CIVIL SERVICE INSTITUTE,

CONSTITUTION ROAD, DUNDEE.

Conducted by Mr TURNER, of Edinburgh University (Highest Honours in Classics and Mathematics), who has had long experience and great success as a Teacher, many of his Pupils occupying distinguished positions in the various Professions, and in the State.

Students are prepared for the Universities, and Candidates for the Civil Service, Pupil Teachers, Law and Accountants' Clerks, Pharmaceutical Assistants, &c., &c., are successfully coached for their different Examinations in Class, Privately and by Correspondence. Special attention is given to those branches which cause the rejection of so many Candidates (otherwise good), viz.: "Orthography" and "Method." Candidates can have a short course which, in many cases, has had more than marvellous success; and, if dissatisfied either with their progress or the system, can have their fee returned.

Spelling should be acquired by Scientific method, based on sound principles, not by endless and fruitless mechanical rehearsal and slavish jabber. The "royal road" is that of commonsense, not that of ignorant "humming and strumming" at long lists of words. A course for this, of say six or eight weeks, should suffice for any earnest and intelligent student.

THE

COMPETITOR'S "VADEMECUM."

A COMPENDIUM OF

ARITHMETIC AND MENSURATION,

Compiled from the Civil Service and other Examinations, &c.

WITH COPIES OF ORIGINAL PAPERS,
AND HINTS AS TO SUBJECTS GIVEN, METHODS, TIME ALLOWED, AND
GENERAL FORMULÆ FOR THE SOLUTION OF PROBLEMS
IN ARITHMETIC, MENSURATION, ETC.

BY

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PREFACE.

LONG experience in preparing pupils for various Examinations, and the consequent necessity of entailing on them the expense of many different books to get a sufficient variety of questions suitable, has alone led the Compiler to get up the present selection, comprising examples in all the rules without the constant and endless repetition of similar questions so common in Arithmetics, and so indispensible in training the very young. The Compiler, while not reflecting on the many valuable Arithmetics extant, indulges the hope that he is presenting to Candidates a kind of *multum in parvo* more than ordinarily adapted to their wants and requirements. In the getting up of this selection, care has been taken to make it a help to all by embracing within it an ample supply of both Lower and Higher Arithmetic, with general Mensuration ; and as a rule, except in the purely elementary part, all the Problems have been selected from past Examinations to present date. Gradually progressive exercises are given so as to initiate and practise Candidates before entering on higher ground. While limiting the number of merely elementary exercises, nearly every possible phase has been given so as to habituate them in varied kinds of solution.

Besides these, a few useful formulæ have been introduced to aid in solving questions of the more difficult kinds, both in Arithmetic and Mensuration. Perfected in the use of these, no one should have any difficulty in passing successfully any Examination in which such are required.

Specimen copies of the most recent Examinations in the various Competitive Departments have been added, so as to afford information as to the number and kind of Problems given, and a few general hints on some of the Situations open for Competition, and as to the method of performing the prescribed Exercises.

Although more especially adapted for Civil Service purposes, it has been arranged to suit other kinds of Examinations, such as those for Pupil Teachers, L.L.A. Candidates, Law Clerks, Accountants, Pharmaceutical Assistants, &c., who will find in it a ready help, to what is often one of the greatest stumbling blocks in their way to success.

GOVERNMENT APPOINTMENTS, SUBJECTS OF EXAMINATION, LIMITS OF AGE, SALARIES, &c., &c.

ALTHOUGH there are many appointments in the Civil Service obtainable by Limited Competition, Open Competition, and Nomination, only the principal of the Open Competitions, which are really worth trying for, are noticed.

FEMALE TELEGRAPH LEARNERS IN POST OFFICE.—Age 15—18. Subjects—Writing, Elementary Arithmetic, Dictation, Geography of the United Kingdom. After 3 months' instruction, salary begins at 10/-, increasing to 34/- per week.

FEMALE SORTERS IN POST OFFICE.—Age 15—18. Subjects—Writing, Orthography, Elementary Arithmetic, Reading and Copying Manuscript, Geography of the United Kingdom. Salary begins at 12/-, increasing to 20/- per week.

FEMALE CLERKS IN POST OFFICE.—Age 18—20. Subjects—Writing, Orthography, Arithmetic, Composition, History, Geography. Salary £65, rising to £170.

BOY CLERKS.—15—17. Writing, Orthography, Arithmetic (up to and including Vulgar and Decimal Fractions), Copying Manuscript, Composition, Geography. 14/- per week, increasing 1/- per week per annum. Not retained after 19, but are then examined for Men Copyists. Eligible for Open Competition for Men Clerkships without preliminary Examination between 17 and 20 years of age, and after a time compete among themselves for a certain number of these appointments. Examinations held quarterly.

CUSTOMS—OUT-DOOR OFFICERS.—Age 19—25 ; Height 5 ft. 4 in. ; Chest Measurement 34 in. ; if Height 5 ft. 10 in. ; Measurement 35 in. Subjects—Writing, Orthography, Dictation, Arithmetic (including Vulgar and Decimal Fractions and Square and Cube Roots), Composition. Salary £55 to £100. Eligible for Examining Officers after 3 years' approved service—Salaries £110 to £300. Examinations generally quarterly.

CUSTOMS—OUTPORTS.—17—20. Examination somewhat similar to that for Men Clerkships. Salary £70 to £400. Examinations at irregular periods.

INLAND REVENUE—ASSISTANTS OF EXCISE.—Age 19—22. Subjects—Writing, Dictation, Orthography, Arithmetic, Mensuration, Composition, Geography (principally of the United Kingdom and British Possessions). Salary £60 to £200. Eligible afterwards to compete for other appointments to £320 and upwards. Examinations generally half-yearly.

MEN CLERKSHIPS AND SECOND-CLASS CLERKS IN INDIA OFFICE.—Age 17—20. Subjects—Writing, Orthography, Dictation, Arithmetic, Mensuration, Copying Manuscript, History, Geography, Composition, Indexing, Digesting, Book-keeping. Salary £80 to £200. Three Examinations annually.

REGISTER HOUSE CLERKS.—Age 18—23. Subjects similar to that for Men Clerkships. Must have been at least two years in Law Office. Salary £90 to £350.

BY NOMINATION.

SCOTTISH PRISONS (CLERKS).—Age 18—40. Writing, Orthography, Dictation, Arithmetic. Initial Salary £80.

ENGLISH PRISONS (CLERKS).—Age 20—30. Subjects—Handwriting, Orthography, Arithmetic (including Vulgar and Decimal Fractions), Copying MS, Composition, Indexing, Docketing, Digesting, Book-keeping. Initial Salary £90.

IRISH PRISONS (CLERKS).—Age 20—30. Handwriting, Orthography, Arithmetic (including Fractions), Copying M.S., Book-keeping by single entry. Initial Salary £80.

FISHERY BOARD (CLERKS).—Age 17—25. Handwriting, Orthography, Arithmetic (including Rule of Three), Book-keeping by single entry, Correspondence. Salary £80.

FRIENDLY SOCIETIES.—Age 25—35. Handwriting, Orthography, Arithmetic (including Fractions), Composition, Laws relating to Friendly Societies. Salary £80.

TIME TABLE.

FEMALE CLERKS, PRELIMINARY.—1 Copying Exercise, ½ hr.; 2 Dictations, ½ hr. each; Additions, 10 Vertical Tots, ½ hr.; Arithmetic, 26 questions, 2 hrs.

FEMALE CLERKS, COMPETITIVE.—Arithmetic, 12 questions, 1½ hrs.; 6 Vertical, and 1 Set Cross Tots, ½ hr.; Composition, 1 hr.; History and Geography, each 1½ hrs.; Maximum No. of Marks 1000; 720 to 750 has secured success.

BOY CLERKS.—1 Copying Exercise, ½ hr.; 2 Dictations, ½ hr. each; Arithmetic, 39 questions, 2½ hrs.; 6 Vertical Tots, and 1 Set Cross Tots, ½ hr.; Copying MS, ½ hr.; Geography, 3 hrs.; Composition, 2½ hrs.; Maximum No. of Marks 1800; 1400 to 1450 will be successful.

CUSTOMS.—1 Copying Exercise, ½ hr.; 1 Dictation, ½ hr.; 1 Orthography Exercise, ½ hr.; Arithmetic, 30 questions, 2¼ hrs.; 6 Vertical, and 1 Set Cross Tots, ½ hr.; Composition; Maximum No. of Marks 900; 720 to 750 has secured success.

EXCISE.—Tabular Statement, Orthography, Dictation, 6 Vertical and 1 Set Cross Tots, each ½ hr.; Composition, 2 hrs.; Arithmetic, 39 questions, 2 hrs.; Geography, 2½ hrs.; Higher Arithmetic, 15 questions, 3 hrs.; Maximum No. of Marks 2400; 1800 to 1850 should be successful.

MEN CLERKSHIPS, PRELIMINARY.—Tabular Statement, 2 Dictations, Additions, 10 Tots, ½ hour each; Arithmetic, 39 questions, 2 hrs.

MEN CLERKSHIPS, COMPETITIVE.—Copying Exercise, 20 minutes; 2 Dictations, 6 Vertical, and 1 Set Cross Tots, ½ hr. each; Arithmetic, 15 questions, 3 hrs.; Geography, History, Indexing, Digesting, Copying MS, each 2½ hrs.; Book-keeping, 3 hrs.; Maximum No. of Marks 2600; 1900 to 1950 will be successful.

HINTS.

TABULAR STATEMENTS.—This requires more than ordinary care, as neatness as well as correctness are particularly looked to. Make, as nearly as possible, a "fac simile" of the copy set, "word for word" and "line for line." Be scrupulously particular as to important words, which should be in enlarged writing, and notice specially how your lines begin, whether "in" or "out." Nothing further would need to be urged in regard to this, were it not a too common error for Candidates to suppose that, if the subject matter be given correctly, it matters but little how it is put down on paper. This is a grievous mistake: form is everything. Practice writing on unruled paper, and keep your marginal line straight. When possible, do not divide your words at the end of a line, rather carry to the next line; but, if absolutely necessary to divide a word, see that it is done syllabically, and above all things, do not cram your words close to the very edge of your paper, as if it was the last scrap of paper in existence. Attend to the proper spacing of your words, keeping them at a uniform distance, and not running two or more words together: every word should be distinctly separate. In Dictation and Orthography exercises you have more scope as to

this last suggestion, as you are not so limited by form and space as in Tabular Statements.

DICTATION.—In order to accomplish this easily, as "Readers" are sometimes, it would almost seem, not in sympathy with Candidates, it is important to practice writing fast. Where you do not catch the word or words at the second reading, leave a blank, so as to be able to fill in when read over the third time.

ORTHOGRAPHICAL EXERCISE.—Should be first read over to get an idea of the subject matter, then read over a short clause, or say from four to six words at a time, so that you may not have to look back too frequently to your paper, lest the mis-spelling in it mislead you, as is more than likely to be the case if you are not well grounded in the general laws of orthography.

Perhaps this might not be an inappropriate place to say a few words to Candidates on this point. It is an undoubted fact that, of the great majority of Candidates who go up for Examination and fail, their failure is specially attributable to a weakness in this branch. In an age of supposed Educational Superiority, it does seem strange that it is so common. Were spelling taught scientifically and not by pure "rote," this stigma of reproach would not long exist; besides, the books in use in Schools as spelling books are very frequently got up without any regard to proper syllabic division. There are certain great general laws which regulate pure and proper pronunciation, and consequently Orthography, which, if attended to, would soon put an end to this reproach. To get at these, and patiently persevere for a little time, will enable any one, however deficient, to become perfect, or nearly perfect, in a very short period. The painful drudgery of conning over long lists of words to commit them to pure memory, without either "rhyme or reason," is specially absurd; you may as well attempt to pulverise Mount Vesuvius with a penny hammer.

ARITHMETIC.—In the papers of 26, 30, or 39 questions, given at the different Examinations, there is generally no special difficulty. The great desideratum is to be able to accomplish all correctly in the given time. With practice this is not a difficult matter, the principal thing to be observed is to do them neatly, shortly, and systematically, each successive part following in proper sequence. Avoid complicated workings in the centre of your paper, rather show your method distinctly, and give results, the odd workings being done on a margin ruled off for the purpose, or on your blank page (for you should use only one side of the paper) leaving your working each opposite its own question. In putting the questions down on paper, study neatness, brevity, perspicuity, and correctness, or the want of these will be sure to end in signal defeat.

COMPOSITION.—Should be easy and simple. Strive to be simple, fluent, and purely grammatical; write naturally, and not in a

strained style. No elaborate essay is or can be expected in the limited time given. A commonsense essay, free from grammatical errors, extending to two folio pages, or say 400 to 500 words, will give quite sufficient evidence of your ability to express your thoughts. Two great obstacles to essay writing are in being either too diffuse, or too curt. In the one case, learn to condense your expressions and prune away the excrescences; in the other, try to acquire the power of extension. Reading authors who are models of thought as well as of style, and thereafter trying to reproduce in your own language what you have read, will aid you effectually.

GEOGRAPHY.—Practice map drawing. After drawing a map on a sufficiently large scale, begin and put in gradually, as you prepare yourself, all the leading Bays, Capes, Mountains, Lakes, Rivers, Estuaries, Deltas, &c., marking down all the principal towns on the course of large or important Rivers, with their tributaries. Take note of all Canals, River Basins, and Routes of leading Railways; group the various localities noted for certain products, seats of different industries, so as to make such information readily available. Get up definitions as to Cyclones, Lagoons, Typhoons, Tornado, Crevasse, Oasis, Watershed, Monsoons, Land and Sea Breezes, Ocean Currents, Isothermal Lines, &c.

HISTORY.—Should be studied very systematically and connectedly. When reading over for the first time, mark on your margin, or take note in any other way of all leading events and prominent leaders in different reigns; changes in Church and State, in rulers or governments, and in bills affecting the well-being and rights of the people. Be able to give a succinct account of the following:—The Plantagenet and Tudor Lines, the Wars of the Roses, the Unions of the different parts of the Kingdom, &c., and seek to understand what is meant by The Lords of Congregation, the Triple Alliance, the Pragmatic Sanction, the Darien Scheme, the Act of Uniformity, Grand Remonstrance, Exclusion Bill, Pilgrim Fathers, Magna Charta, Star Chamber. Commonwealth, The Heptarchy, Domesday Book, Feudal System, The Norman Conquest, Poynings Law, The Armada, American War of Independence, &c., for such are frequently given.

As it is almost impossible to give hints on every subject in a limited space, except in a Complete and Regular Guide Book, which this makes no pretension to be, it may only now be added that Indexing, Digesting, and Book-keeping, although they can in a great measure be got up by Candidates independently of extraneous help from "Coaches," yet it is deemed safer and better as economising their time, reducing their labour, and giving confidence to themselves, to recommend them to put themselves for a short time in the hands of some qualified and conscientious instructor.

ARITHMETICAL TABLES.

I. Money.

4	Farthings	= 1	Penny
12	Pence	= 1	Shilling
2	Shillings	= 1	Florin
5	Shillings	= 1	Crown
20	Shillings	= 1	Pound
21	Shillings	= 1	Guinea

II. Time.

60	Seconds	= 1	Minute
60	Minutes	= 1	Hour
24	Hours	= 1	Day
7	Days	= 1	Week
4	Weeks	= 1	Month
12	Months	= 1	Year
52	Weeks 1 day	= 1	C. Year
365	Days	=	Do.
365¼	Days	= 1	J. Year
365	Dys. 5 hrs. 48 min. 48 sec.	= 1	Solar Year

The Year is divided into Twelve Calendar Months, thus:—

	Days.		Days.
January	31	July	31
February	28	August	31
March	31	September	30
April	30	October	31
May	31	November	30
June	30	December	31

III. Avoirdupois Weight.

16	Drams	= 1	Ounce
16	Ounces	= 1	Pound
28	Pounds	= 1	Quarter
4	Quarters	= 1	Cwt.
112	Lbs.	= 1	Do.
20	Cwts.	= 1	Ton
14	Lbs.	= 1	Stone
8	Stone	= 1	Cwt.

IV. Lineal Measure.

12	Inches	= 1	Foot
3	Feet	= 1	Yard
5½	Yards	= 1	Pole
40	Poles	= 1	Furlong
8	Furlongs	= 1	Mile
3	Miles	= 1	League
220	Yards	= 1	Furlong
1760	Yards	= 1	Mile

V. Measure of Capacity.

4	Gills	= 1	Pint
2	Pints	= 1	Quart
4	Quarts	= 1	Gallon
2	Gallons	= 1	Peck
4	Pecks	= 1	Bushel
8	Bushels	= 1	Quarter
1	Gallon	= 277·274	Cubic inches

VI. Wine & Beer Measure.

1	Hogshead	= 63	Gallons
1	Puncheon	= 84	,,
1	Pipe	= 126	,,
1	Tun	= 252	,,
1	Firkin	= 9	,,
1	Kilderkin	= 18	,,
1	Barrel	= 36	,,
1	Hogshead	= 54	,,

VII. Square Measure.

144	Sq. Inches	= 1	Sq. Foot
9	Sq. Feet	= 1	Sq. Yard
30¼	Sq. Yards	= 1	Sq. Pole
40	Sq. Poles	= 1	Rood
4	Roods	= 1	Acre
4840	Sq. Yards	= 1	Acre
640	Acres	= 1	Sq. Mile
22	Yards	= 1	Chain
10	Sq. Chains	= 1	Acre
100000	Sq. Links	= 1	Acre

VIII. Cubic Measure.

1728 Cubic Ins. = 1 Cubic Foot
27 Cubic Feet = 1 Cubic Yd.
1 Cubic ft. of water = 1000 oz.

IX. Cloth Measure.

2¼ Inches . = 1 Nail
4 Nails . = 1 Quarter
4 Quarters = 1 Yard
5 Quarters = 1 English Ell

X. Troy Weight.

24 Grains = 1 Pennyweight
20 Dwts. = 1 Ounce
12 Ounces = 1 Pound
5760 Grains = 1 lb. Troy
7000 Grains = 1 lb. Avoirdupois

XI. Apothecaries' Weight.

20 Grains . . = 1 Scruple
3 Scruples . = 1 Dram
8 Drams . . = 1 Ounce
12 Ounces . . = 1 Pound

XII. Apothecaries' Fluid Measure.

60 Minims = 1 Fluid ~~Minim~~ Dr.
8 Fluid Drachms = 1 Fluid oz.
20 Fluid Ounces = 1 Pint
8 Pints . . . = 1 Gallon

XIII. Angular Measure.

60 Seconds = 1 Minute
60 Minutes = 1 Degree
90 Degrees = 1 Right Angle
360 Degrees = 1 Circle

EXAMINATION PAPERS.

(Given at previous Examinations.)

DICTATION.

The uninterrupted success that for so many years attended the arms of Napoleon gave him a moral influence doubling his actual force. Exciting at once terror, admiration, and hatred, he absorbed the whole attention of an astonished world, and openly or secretly all men acknowledged the power of his wonderful genius. The Continent bowed before him, and even in England an increasing number of absurd and virulent libels on his person and character indicated the growth of secret fear. His proceedings against the Peninsula were, in truth, viewed at first with anxiety rather than with the hope of arresting their progress; yet, when the full extent of the injustice became manifest, the public mind was vehemently excited, and a sentiment that some extraordinary change was about to take place in the affairs of the word prevailed among all classes of society. Suddenly the Spanish people rose against the man that all feared; and the admiration, which energy and courage exact even from the base and timid, became enthusiastic in a nation conscious of the same virtues. No factious feelings interfered to check this enthusiasm: the party in power, anxious to pursue a warlike system necessary to their own political existence, saw with joy that the stamp of justice and high feeling would, for the first time, be affixed to their policy. The party out of power having always derided the impotence of the ancient dynasties, and asserted that regular armies alone were insufficient means of defence, could not consistently refuse their approbation to a struggle carried on entirely by the Spanish multitude. The people at large exulted that the manifest superiority of plebeian virtue and patriotism was acknowledged; and the arrival of the Spanish deputies was, therefore, universally hailed in England as an auspicious event.

DICTATION.

Of a temper by nature, and by want of restraint, too passionate, though not vindictive, and, though not cruel, certainly deficient in gentleness and humanity, Charles I. was entirely unfit for the very difficult station of royalty, and especially for that of a constitutional king. It is impossible to condone his violations of liberty on the score of ignorance, especially after the Petition of Right; if he was ill-informed, it was only because his impatience of opposition from his council made it unsafe to give him any advice that thwarted his determination. His other great fault was want of sincerity—a fault that appeared in all parts of his life, and from which no one who has paid the subject

any attention will pretend to exculpate him so far as this insincerity was shown in the course of his troubles; it was a failing which untoward circumstances are apt to produce, and which the extreme hypocrisy of many among his adversaries might sometimes palliate. Few personages in history, we should recollect, have had so much of their action revealed and commented upon as Charles; it is perhaps a mortifying truth that those who have stood highest with posterity have seldom been those who have been most accurately known. The turn of his mind was rather peculiar, and laid him open with some justice to very opposite censures, for an extreme obstinacy in retaining his own opinion and an excessive facility in adopting that of others. But the apparent incongruity ceases when we observe that he was tenacious of ends and irresolute as to means, better fitted to reason than to act, never swerving from a few main principles, but diffident of his own judgment in its application to the course of affairs.

ORTHOGRAPHY.

Copy the following passage clearly and legibly, correcting mistakes of spelling, but not otherwise altering either the words or their order.

One impoartent cause of the improovement in human society is the incappasitty of children to act for themsellves, which rendirs the atenshun and protexion of pairents to their ofspring nessessarry for so long a periode. Even where the food which the erth affoardes without culltivashun, such as froots and herbs, is moast plenntiffully suplied, children remain too helples for menny yeers to be caypabbel of gathering it and provyding for their own supoart. For theese reesuns it usually hapens that children feal no dezire to desert their pairents, but remmane inhabbyttants of the same hutts in which they were born, and beginn to layborr for subssistense in their turne, when their fathers and mothers are dissabled bye age. One or two such fammylis gradually unite toggether and avale themselves of each others comepanny for mutuall deffense and asistence. This is the erliest staige of human society; and some savidges have been found in this condyshun so very rood and ignorant that they may be sed to be hardly soopeerior to a heard of animals. Yet, in propoarshun as opurtunities occur, these savadge trybes aquire the arts of sivylized life; they bild huts to shellter them agenst the wether; they invent weppons for distroying wild beests by which they are trubled and for sleyidg those whose flesh is suted for their food. They domesticate others, and use at pleshure their milk, flesh, and furs; they plant frute trees as soon as they diskovver that the produkshuns of nature most nessysarry for

their cumforrt may be increesed by toyle and industrey. Thus the proggress of human societty, unless it is interuppted by some unfortunait sirkumstansses, continews to advans ; and every new gennerashun, without loosing any of the addvantadges alreddy attained, goes on to aquire others which were unknone to the preseeding one.

ORTHOGRAPHY.

His next bizness was to surrvay the sittuation, and the country, and endevvor to find a proper place for his habbittation, and where to stow his posessions, to sekure them from whatever mite happen. He was not yet awair where he was ; whether on the continnent or on an iland—whether inhabbitted or not inhabbitted—whether in danger of savaidge beests or not. There was a hill, not above a mile from him, which rose up very sheer and presippitus above him, and which seemed to overtop some other hills which lay in a ridge from it northward. He took out one of the fouling-pieces, and one of the pistols, and some amewnishon, and, thus armed, he went caushiously on a journie of diskovvery up to the sumit of that hill. After he had with great exershon and dificulty got to the sumit, he perseeved to his great affiixion that he was in an iland, envyroned every way with the oshean—no land to be seen, except two small ilands, which lay about three leegs to the west. He lerned also, that the iland he was in was baren, and, as he saw good reeson to beleeve, uninhabbitted, exept by wild beests, of which, however, he saw none. He deskried abundance of fethered creetures ; but he was not conisant of their speeciees ; neither when he killed them could he tell what was sutable for food, and what was not. At his return he shot at a prodidgeous foul, which he saw roosting upon a tree on the side of a great forrest ; and he had no sooner fired his weppon, but, from all parts of the wood, there rose au inumerable multetude of fouls of many sorts, making a confewzed screeming, and waling every one according to his own peculiar note, but not one of them of any speeciees that he knew. As for the creeture he killed, he immadgined it to be a kind of a faulcon, its colour and beek ressembling it ; but it had no tallons, or clause, larger than common birds ; its flesh was carion, and fit for nothing.

EXERCISE IN ORTHOGRAPHY AND PUNCTUATION.

Long I stud upon the loftay poop of my ship gazeing towards the receeding city with its nobel lines of pallises its crowning temples its fameelyar groavs and plissent gardens As I survaid the fleetes of merchantmen from awl lands gathird about her peers and ankerd in the hayvin I felt my sorroe at parting yield-

ing graddualy to a feeling of pryde that I was the prince of that grate relm to which these argosies caim baring the merchants of all the erth Indeed it was a stiring and nobel site dear mother and kalkulated to divert my thoats to see thees ships as my gally passed throo them lowar their banirs or ellevate theyr rose of shining ores high in the air both in homeage and fairwell to the departing lord of the port Thare were vessels for bringing the merchandiss of gold and silver and preshus stons from unknone sees galleys from Tarsus and the isles of the west bearing perls and koral and preshus stons woods and timewood gayly deckt barjes that carry fine linnen and purple and silk and skarlet down to Egypt and Syria painted ships from the Nile that reseeve by karravans from Ind and the east seenamon and odirs and oyntments and frankinsense and ivory and dymonds the low dark gallys from Afric that bring Etheopian slaves and the broad heavyer vessals from the Delta laiden with wheat and fine flowr Thayre were allso the strong craft from Colchis and the north with iron and brass and marbel and ocken argossies from further Britannia bringing tin tall ships from Greece with horses and charyots while from the south shores of the summery sees were lite graisful vessals laden with daynty and goodly froots and birds of gorjus plooms and of ravisshing songs All thees annualy lay their treshures at thy feet As I moved slowley in my gally threw the rich fleet of ships which filled yon haven I felt my hart beat quicker and I returned the sallutashun of the shipmasters and of the forin merchants on there dekks with smyles of gratefeekashien at the prosperrity still at least of our port of Tyre though the haff of our relm has been lost by invashun and our inteeryor seetays are dekaying.

SUBJECTS FOR ENGLISH COMPOSITION.

(Given at previous Examinations.)

In this Exercise attention should be paid to handwriting, spelling, punctuation, grammar, and style.

1. What, in your opinion, are the qualities that make a noble character?
2. Compare Biography with History.
3. Do animals appreciate kindness.
4. Punctuality.
5. A railway journey.
6. "The child is father of the man."
7. Well begun is half done.
8. Familiarity breeds contempt.
9. The choice of a profession.

10. The events of the past year.
11. The abuse of athletic exercises.
12. Jack of all trades is master of none.
13. The reasons for kindness to animals.
14. Home life and school life.
15. Your favourite author.
16. Any personal adventure.
17. A night on board ship.
18. A long frost in town or country.
19. Like father like son.
20. The use of steam as increasing the national wealth and facilitating human intercourse.
21. The use and abuse of stimulants.
22. He that gives promptly gives two-fold.
23. The advantages and disadvantages of solitude.
24. Love of music—its effect upon the character.
25. Evils of indiscriminate charity.
26. Imperial Federation.
27. An account of a family gathering.
28. The place of Music in education.
29. The decoration of houses.
30. What is a great man.
31. To chose time is to save time.
32. The pleasures and hardships of life in a new colony.
33. Neither a borrower nor a lender be.
34. The choice of a friend.
35. The future of England.
36. Westminster Abbey and its associations.
37. Judicious and injudicious charity.
38. Life boats and their services.
39. Changes produced by railways.
40. Effects of wealth in the character of a nation.
41. Qualities of a good man of business.
42. Second thoughts are best.
43. The effects of popular education on the industries of a nation.
44. The study of Natural History.
45. The advantages of a good memory.
46. Changes in modern life caused by railways and telegraphs.
47. The Channel Tunnel.
48. The Tower of London.
49. The force of example.
50. Review the events of 1883.

The Composition should fill not less than two folio pages.
Only ONE *subject is to be attempted.*

ARITHMETIC.

SIMPLE RULES.

Find the sum of

1. 4827532,771,842508,4647,321,80843,907.
2. 23478.9434,811,6841,1019,2143,786,674102.
3. 641,9863,276,7860245,73600,4827543.
4. 980009,7234,811,1009,114301,264,72,81234.

Find the value of

5. 171407 + 90892 + 78832 + 2600 + 10277.
6. 79213 + 3856 + 7915 + 27384 + 68005 + 729.
7. 709 + 8304725 + 627 + 81 + 471 + 391 + 2740 + 83.
8. 200 + 371209 + 621 + 30 + 8594328 + 3369 + 942.
9. 19236710 − 1912987.
10. 92165432 − 91946719.
11. 987462176 − 712364917.
12. 372196784 − 359468217.
13. 31860075 − 860139.
14. 9276431 − 80076.
15. 5136938 − 4271679.
16. 2768432 − 1926849.

Find the product of

17. 81654321 × 8972,5436.
18. 89476582 × 9277,5430.
19. 91534652 × 807061,20765.
20. 91235761 × 2378,43078.
21. 79382468 × $27\frac{1}{2}$
22. 8467198495 × $36\frac{2}{3}$.
23. 63581637240 × $46\frac{3}{5}$.
24. 28719486152 × $59\frac{7}{8}$.
25. 912614897 × 97680,5207.
26. 413216794 × 84317,1098.
27. 521685937 × 84032,70192.
28. 907601278 × 80127,918260.
29. 459382409 × $78\frac{4}{7}$.
30. 5718926041 × $69\frac{11}{13}$.
31. 479568517 × $18\frac{23}{27}$.
32. 985164538 × $75\frac{13}{18}$.

Find the quotient of

33. 49873220 ÷ 108,85.
34. 20004336 ÷ 132,47.
35. 2463384 ÷ 473,94.
36. 39078975 ÷ 975,75.
37. 35676255 ÷ $34\frac{2}{3}$.
38. 492816370 ÷ $56\frac{4}{11}$.
39. 7271648254 ÷ $69\frac{5}{12}$.
40. 813749218 ÷ $48\frac{4}{9}$.
41. 11666101 ÷ 571,39.
42. 37597068 ÷ 4132,28.
43. 4747743 ÷ 527;91.
44. 62010441 ÷ 7803,197.
45. 58328416 ÷ $57\frac{9}{16}$.
46. 63951748 ÷ $14\frac{12}{25}$.
47. 80575624 ÷ $82\frac{9}{13}$.
48. 94381630 ÷ $47\frac{8}{15}$.

MISCELLANEOUS EXAMPLES.

49. The sum of three numbers is 210754 ; the first is 46152, the second is 28205 more than the first ; what is the third ?

50. By how much does the difference of 196318 and 41100263 exceed the sum of 1420668 and 55968 ?

51. The first of three numbers is 2841105, the second is 526035 less than the first, and the third is 28411 more than the second. Subtract 987654 from the sum of the three numbers.

52. What number added to nine hundred and fifty-four thousand two hundred and six will make up ninety millions fifty-one thousand three hundred and four ?

53. What number subtracted from four millions thirty thousand and fifty-two will leave nine hundred and sixty-nine thousand and eighty ?

54. The sum of three numbers is twelve millions twelve hundred and twelve. The first of the numbers is 2896357, and the second is 8269537 ; what is the third ?

55. What must be added to 27096 to make 7017864 ? and how often can the former of these numbers be subtracted from the latter ?

56. In what number is 759 contained 3609 times with a remainder of 659 ?

57. What number multiplied by 497 will produce 30330419 ?

58. A multiplier is 4875 and product 34164000 ; required the multiplicand ?

59. If the sum of 322, 637, 8589, and 275 be divided by the difference of the first and last of these numbers ; what will the quotient be ?

60. In a division sum the dividend is 1798280 and the quotient is 3068 with a remainder of 432 ; what is the divisor ?

61. Given the divisor 37, the quotient 1578, and the remainder 34, to find the dividend ?

62. How often can 3695 be subtracted from 17 times 1707100, and from 55425 ?

63. What number is contained 216971 times in 123456789 with a remainder of 290 ?

64. What number is 9052 less than 20950 times 290500 ?

65. Add together the numbers 46819, 58072, and 47209, and divide their sum by the difference of the first and last of them.

66. If 58633812 be divided by 7916 and the quotient be then lessened by 99 times 73 ; how many dozen will the remainder make ?

67. What is the highest number less than 2779285 that is exactly divisible by 427 ?

68. What is the smallest number by which 7096379 will be increased so as to make the sum divisible by 365 without remainder ?

69. Find the amount of 171 times that number which, if multiplied by 247, would produce 1456559.

70. What number divided by the sum of $1294\frac{1}{2}$ and $304\frac{1}{2}$ will yield a quotient equal to the difference of these numbers?

71. Add together the numbers 293, 756, and 859, and from half their sum subtract the difference of the greatest and least of them.

72. If you add together the numbers 598, 395, 726, and 863, and from their sum subtract the sum of the second and third numbers; what will the remainder be?

73. A boy having multiplied 5693807 by 3694 makes the product 21023024058; how much is that less or more than the true product?

74. What remainder will be left when 679 has been subtracted as often as possible from 39394001?

75. Add together the half of 1184714, the third part of 62607, and the fourth part of 4796034, and divide the sum by the fifth part of 1795.

76. A number being divided by 758 gave 2468 for the quotient; what was the number?

77. The remainder of a division is 325, the diviser is 467, and the quotient is 43 greater than the sum of the two; what is the dividend?

78. A, B & C take a farm; A contributes £240, B contributes as much as A and $\frac{1}{4}$th part more, and C contributes as much as A & B together; what is their joint stock?

COMPOUND RULES.

Find the values of the following:—

1. £27 6s $4\frac{1}{2}$d + £308 15s 3d + £529 6s 8d + £34 13s 9d + £2000 17s 8d + £476 15s 11d.

2. £506 18s 3d + £27 14s $3\frac{1}{2}$ + £9684 13s $7\frac{1}{4}$d + £12 5s $3\frac{3}{4}$d + £869 14s $2\frac{1}{4}$d.

3. £274 8s $6\frac{1}{2}$d + £1200 17s $9\frac{1}{2}$ + £50 14s $9\frac{3}{4}$ + £783 14s $5\frac{1}{4}$d + £1029 16s $2\frac{1}{2}$d.

4. £574 15s $4\frac{1}{2}$d + £292 18s $1\frac{1}{2}$d + £279 16s $3\frac{1}{4}$d + £27 12s $10\frac{3}{4}$d + £69 17s $6\frac{1}{4}$d + £648 18s $8\frac{3}{4}$d.

5. 127 cwt. 1 qr. 17 lbs. + 24 cwt. 2 qrs. 27 lbs. + 3 tons 17 cwt. 1 qr. 18 lbs. + 5 tons 6 cwt. 3 qrs. 27 lbs.

6. 32 lbs. 5 oz. 8 dwt. 4 grs. + 3 lbs. 5 dwt. 19 grs. + 4 oz. 17 dwt. 18 grs. + 5 lbs. 6 oz. + 3 oz. 14 dwt.

7. 3 cwt. 2 qrs. 9 lbs. + 48 lbs. 13 oz. + 1 cwt. 3 qrs. 8 lbs. 15 oz. 4 drs. + 3 tons 17 cwt. 6 lbs. + 2 qrs. 9 lbs. 11 oz.

8. 17 miles 3 fur. 19 poles + 28 yds. 2 ft. + 4 mls. 3 fur. 8 pls. 10 inches + 7 yds. 2 ft. 9 in.

9. 7 acres 3 ros. 19 per. + 2 ac. 1 ro. 19 per. + 27 ac. 3 ro. 29 per. 18 sq. yds. + 52 ac. 1 ro. 27 per. 12 sq. yds.

10. 21 qrs. 3 bush. 3 pks. + 5 bush. 7 pks. 2 gals. + 2 bush. 3 pks. 3 gals. 3 qts. + 2 pks. 1 gal. 1 qt.

11. 63 yds. 3 qrs. 1 nl. + 74 yds. 2 qrs. 2 nls. + 98 yds. 3 qrs. 1 nl. + 103 yds. 1 qr. 1 nl. + 14 yds. 3 nls. + 27 yds. 2 qrs.

12. 12 hhds. 61 gals. 7 pts. 3 gills + 9 hhds. 58 gals. 4 pts. 1 gill + 14 hhds. 22 gals. 2 pts. 3 gills + 8 hhds. 29 gals. 5 pts. 3 gills + 6 hhds. 55 gals. 3 gills + 14 hhds. 37 gals. 6 pts. 2 gills.

13. £276 13s 3d – £49 17s 8½d ; £4056 10s – £274 16s 3¼d ; £19862 14s 5½d – £7934 15s 6¼d ; £100 – £89 13s 7¾d ; £72385 10s 4½d – £6985 12s 7¾d ; and £703 – £26 14s 11¼d.

14. 27 cwts. 3 qrs. 12 lbs. 7 oz. – 19 cwts. 2 qrs. 18 lbs. 7 drs. ; 28 tons 15 cwt. 2 qrs. 9 lbs. – 11 tons 19 cwt. 3 qrs. 7 oz.

15. 25 ac. 3 ro. 28 po. 2 yd. – 6 ac. 2 ro. 39 po. 5 yds. ; 37 ac. 3 ro. 29 po. 27 yds. – 4 ac. 2 ro. 11 po. 29½ yds.

16. 317 mls. 6 fur. 17 po. 2 yds. – 187 mls. 7 fur. 28 po. 4 yds. ; 26 mls. 4 fur. 6 po. 1 yd. 2 in. – 24 mls. 5 fur. 14 po. 4 yds. 1 ft. 10 in.

17. 741 lbs. 9 oz. 7 dwts. 4 grs. – 423 lbs. 7 oz. 8 dwts. 13 grs. ; 9432 lbs. 9 oz. 7 dwts. 21 grs. – 8409 lbs. 9 oz. 13 dwts. 22 grs.

18. 327 lbs. 11 oz. 7 drs. 0 scr. 9 grs. – 189 lbs. 5 oz. 3 drs. 2 scr. 13 grs. ; 854 lbs. 7 oz. 7 drs. 3 grs. – 718 lbs. 9 oz. 3 drs. 2 scr. 1 gr.

19. 18 yds. 1 qr. 3 nls. 1 in. – 9 yds. 2 qrs. 3 nls. 2 in. ; 16 yds. 2 qrs. 3 nls. 1 in. – 9 yds. 3 qrs. 1 nl. 2 in.

20. 37 qrs. 5 bush. 2 pks. 1 qt. – 18 qrs. 6 bush. 3 pks. 2 qts. ; 18 qrs. 1 bush. 1 pk. 1 pt. – 11 qrs. 2 bush. 2 pks. 1 qt. 1 pt.

21. 183 cub. yds. 11 ft. 179 in. – 17 cub. yds. 17 ft. 921 in.

Find the product of

22. £84 16 9½ × 29, 38.
23. 57 18 4¼ × 67, 76.
24. 72 13 4¾ × 92, 156.
25. 768 14 6¾ × 117, 52.
26. £81 19 11¾ × 118, 53.
27. 685 19 7¼ × 73, 165.
28. 817 16 2½ × 874, 327.
29. 8976 14 3¾ × 897, 3178.
30. 796 tons 16 cwts. 2 qrs. 27 lbs. 12 oz. 13 drs. × 11, 18.
31. 57 tons 19 cwts. 3 qrs. 21 lbs. 5 oz. 12 drs. × 36, 88.
32. 14 lbs. 11 oz. 19 dwts. 17 grs. × 97, 18, 37.
33. 92 lbs. 9 oz. 15 dwts. 23 grs. × 64, 93, 48.
34. 98 lbs. 5 oz. 5 drs. 1 scr. 7 grs. × 11, 23, 16.
35. 13 lbs. 4 oz. 4 drs. 1 scr. 17 grs. × 9, 16, 22.
36. 18 mls. 2 fur. 24 pos. 2 yds. 2 ft. × 16, 17.
37. 17 mls. 3 fur. 8 pos. 1 yd. 2 ft. 2 in. × 264.
38. 76 qrs. 4 bush. 3 pks. × 18, 21, 52.
39. 372 ac. 3 ros. 29 pos. × 26, 38, 63.
40. 28 yds. 2 qrs. 3 nls. 1 in. × 25, 47, 56.
41. 38 yds. 3 qrs. 3 nls. × 46, 75, 84.
42. 1 cub. ft. 1724 cub. in. × 97 × 68.
43. 3 cub. yds. 7 cub. ft. 981 cub. in. × 72, 83.

Find the quotient of

44. £756 11 8½ ÷ 35.
45. 4388 11 9¼ ÷ 87.
46. 1344 13 1½ ÷ 126.
47. 540 7 1¼ ÷ 138.
48. £302657 16 9¼ ÷ 647.
49. 442428 9 0¾ ÷ 785.
50. 681984 18 2¼ ÷ 867.
51. 34203 5 5 ÷ 2687.
52. 6792 tons 13 cwts. 23 lbs. 11 oz. 11 drs. ÷ 35, 416.
53. 3721 tons 7 cwts. 1 qr. 25 lbs. 16 oz. 13 drs. ÷ 86, 279.
54. 967690 lbs. 9 oz. 17 dwts. 19 grs. ÷ 15, 17, 18.
55. 167109 lbs. 7 oz. 15 dwts. 21 grs. ÷ 12, 15, 74.
56. 945 lbs. 9 oz. 1 dr. 1 scr. 17 grs. ÷ 23, 41, 63.
57. 754 lbs. 8 oz. 4 dr. 2 scr. 3 grs. ÷ 17, 19, 67.
58. 2715 mls. 3 fur. 36 po. 3 yds. 1 ft. 11 in. ÷ 679.
59. 2798 mls. 7 fur. 25 po. 2 yds. 1 ft. 8 in. ÷ 942.
60. 186 yds. 1 qr. 2 nls. 1 in. ÷ 26, 84, 96.
61. 86 yds. 2 qrs. 3 nls. ÷ 48, 52, 68.
62. 7642 ac. 36 po. 30 yds. 3 ft. 117 in. ÷ 144, 79.
63. 433 ac. 2 ro. 27 po. 9 yds. 7 ft. 69 in. ÷ 32, 761.
64. 53 qrs. 6 bush. 2 pks. 3 qts. 1 pt. ÷ 217.
65. 28 puncheons 38 gals. 2 qts. 1 pt. ÷ 225.
66. 97 wks. 1 day 16 hrs. 30 min. 45 sec. ÷ 11, 36.
67. 818 wks. 6 days 5 hrs. 11 min. 7 sec. ÷ 94, 273.

Find the value of

68. £78 19 $6\frac{1}{2} \times 6\frac{2}{3}$ and £84 19 $7\frac{1}{4} \div 11\frac{3}{5}$.
69. 83 15 $11\frac{1}{4} \times 18\frac{2}{7}$ and 76 14 $8\frac{3}{4} \div 13\frac{4}{5}$.
70. 65 13 $8\frac{1}{2} \times 23\frac{3}{11}$ and 97 15 $10\frac{1}{2} \div 24\frac{2}{13}$.
71. 183 11 $9\frac{1}{4} \times 71\frac{5}{12}$ and 237 16 $3\frac{3}{4} \div 36\frac{3}{14}$.

REDUCTION.

Reduce

1. To farthings, £177 15s 8½d, £179 14s 6½d, £215 13s 8¼d, £386 13s 8½d, £169 11s 5½d.
2. To halfpence, £18 12s 11½d, £4 19s 2d, £9 9s 9d, £376 0s 3½d, 2179 guineas.
3. To pence, £63 18s 11d, £47 11s 8d, £19 13s 7d, £38 19s 9d, £78 15s 11d, £63 14s 8d.
4. To threepenny pieces, £67 12s 6d, £28 15s 9d, £74 18s 3d, £419 15s 6d, £627 11s 9d.
5. To groats, £7 18s 8d, £71 18s 4d, £713 19s 8d.
6. To sixpences, £719 18s 6d, £4573 17s 6d, £723 11s, 4987 guineas.
7. To shillings, £38 15s, £2968 17s, 875 guineas, 366 guineas 11s, £287 19s.
8. To florins, £97 18s, £46 16s, 576 half crowns, 4978 guineas, £68 14s, 784 crowns.
9. To half crowns, £785 7s 6d, £89 12s 6d, £837 5s, £184 17s 6d, £47 10s.

10. To pounds, 69480 guineas, and 6200 half guineas.
11. To guineas, £78640, 973698 farthings, 37911 crowns, 17943 half sovereigns, 99813 halfpence.
12. To qrs., 8 tons 11 cwt. 1 qr.; 15 tons 17 cwt. 3 qrs.
13. To lbs., 66 tons 3 qrs. 8 lbs.; 715 tons 8 cwts. 17 lbs.
14. To ozs., 386 tons 17 cwts. 3 qrs. 18 lbs. 5 oz.; 5 tons 5 oz.
15. To drams., 276 tons 15 cwts.; 386 tons 17 lbs.
16. To troy oz., 138 lbs. 7 oz.; 1796 lbs. 5 oz.
17. To grains, 19 lbs. 7 dwts. 9 grs.; 25 oz. 11 dwts. 5 grs.
18. To grains, 213 dwts. 17 grs.; 14 dwts. 17 grains.
19. To scruples, 17 oz. 3 drs. 1 scr.; 179 lbs. 7 oz. 2 scr.
20. To poles, 178 mls.; 286 mls.; 136 mls. 6 fur.
21. To yds., 29 per. 6 po.; 713 per. 4 po. 3 yds.
22. To yds., 41 mls. 2 fur. 17 po. 2½ yds.
23. To feet, 76 po. 2 yds. 1 ft.; 166 fur. 33 po. 3 yds.
24. To feet, 476 mls. 3 fur. 19 po. 2½ yds. 2 ft.
25. To inches, 16 yds. 1 ft. 11 in.; 18 yds. 6 in.
26. To pints, 6 qrs. 3 bush. 2 pks. 1 pt.
27. To pints, 5 qrs. 2 bush. 2 pks. 1 qt. 1 pt.
28. To seconds, 7 yrs. 37 days 15 hrs. 17 min. 57 secs.
29. To cubic inches, 37 c. yds. 16 c. ft. 512 c. in.
30. Reduce to pounds, shillings, pence, these farthings :— 583721, 918743, 4180426, 1719235.
31. Reduce 174531 and 389746 halfpence to £, &c.
32. In 187396 pence, how many guineas, &c.
33. In 732848 threepenny pieces, how many £, &c.
34. In 649171 groats, how many guineas.
35. In £48762, how many guineas.
36. In 85235 sixpences, how many half crowns.
37. Reduce to tons, &c., 3947652 oz. and 53777630 drs.
38. Reduce 648385 grains Troy to lbs.
39. Reduce 973376 grains Troy to lbs.
40. Reduce 763042000 grains to Avoirdupois lbs.
41. Reduce 873294 dwts. to lbs., oz., &c.
42. How many lbs. Troy in 98473 dwts.
43. Reduce to lbs. Apoth. 1874381 oz.
44. Bring 1100000 sq. in. to yds ; 8475806 sq. ft. to acres.
45. Bring to cub. yds. 71384216 c. in. and 1728432 c. in.
46. Bring to quarters 9503707 pts. and 21871 pts.
47. ,, 845732 gals. to hhds., and 41784 gals. to qrs.
48. ,, 77483 pts. to pks., and 1000000 pts. to bushels.
49. Reduce to mls. &c. 71384216 in. ; 217421. in.
50. ,, 7865375 cub. in. to cub. yds.
51. ,, 8475806 sq. ft. to ac., ro., &c.
52. ,, 1840360 secs. to degrees, &c.
53. ,, 37281946 secs. to years, days, &c.
54. ,, 4281670 in. to ells, English.
55. ,, 78320 yds. and 54192 to ells, English.

MISCELLANEOUS.

1. A merchant paid the following:—To A, £76 15s 10½d; to B, £856 6s 7d; to C, £18 17s 9¼d; to D, £7064 15s; to E, £936 5s 6d; to F, £178 19s 8d; to G, £630 9s 6½d; to H, £504 15s 7½d; how much did he pay away?

2. Paid carriage for following goods:—Sugar, 12 cwt. 2 qrs. 10 lbs.; tea, 5 cwt. 2 qrs.; currants, 1 cwt. 2 qrs. 14 lbs.; rice, 10 cwt. 1 qr. 10 lbs.; and candles, 3 qrs. 14 lbs.; required the total weight.

3. A man with £1000 pays the following accounts:—The grocer, £37 18s 11¾d; the baker, £24 17s 6½d; the butcher, £62 15s 9¼d; the clothier, £33 12s 9d; the draper, £27 17s 2½d; how much has he left?

4. How much must be added to £250 10s 9½d + £648 12s 3¼d to make ten thousand pounds?

5. Twenty-five men each receive 17s 6½d out of £100, how much was left?

6. What will be the wages of 12 labourers for 34½ days at 3s 6½d a day?

7. If £1468 16s 3d be divided equally amongst 426 persons, how much will each receive?

8. A dealer goes to market with £100, and with this sum buys as many sheep as he can at £1 3s 6d each; how many does he buy, and what money has he left?

9. Three persons purchase a ship for £12000; the first takes 1 share, the second 3 shares, and the third 5 shares; how much do they severally pay?

10. Divide 14 tons 17 cwts. 3 qrs. 9 lbs. 8 oz. 4 drs. of goods among 63 people; if each one gets a penny an oz. for his share, what will he receive?

11. How many farthings in 27 sovereigns, 3 florins, 5 half-crowns, 37 shillings, and 23 sixpences?

12. What sum must be taken from £47 17s 2½d to make it exactly divisible into parts each equal to £1 8s 3½d?

13. A silversmith makes 18 spoons each weighing 2 oz. 7 dwt. 9 grs.; 3½ dozen others weighing 1 oz. 11 dwt. 7 grs.; and 19 silver forks each weighing 1¾ oz., how much silver does he use?

14. 1175 casks contain each 3 gals. 3 qts. 3 pts. and 3 half pints; how much do they hold?

15. How often is £24 11s 6¾d contained in £8061 12s 6d, and find the continued product of 17, × 18, × 19.

16. How many crowns, half crowns, shillings, and fourpenny pieces amount to £99 16s 4d, taking of each an equal number?

17. Divide 53 qrs. 6 bush. 2 pks. 3 qts. 1 pt. by 217.

18. If I buy 1874 yds. of cloth at 4s 6½d per yd. and sell at 4s 3d; how much do I gain?

19. A farm of 329 acres produces 11 bushels of corn per acre ; find the value of the crop at 6s 6d per quarter.

20. In half a year a man spends £114 15s which is exactly 3 times the 7th part of his yearly income. Find his yearly income in guineas.

21. Reckoning 15 francs to be worth 11s 11d, what three equal numbers of guineas, florins, and francs respectively, would be together worth £1088 11s 11d ?

22. Divide £91 17s among 4 men, 13 women, and 7 children, so that each man's share may equal thrice a woman's, and each child's the fifth part of a woman's.

23. Divide £1520 among A B & C, so that B may have £100 more than A, and C £270 more than B.

24. How much short of £1000 is 53 times the 23rd part of £273 4s $10\frac{3}{4}$d ?

25. Add the 79th part of £10981 to the 97th part of £10961, and reduce the sum to guineas.

26. By what number should £27 17s $10\frac{1}{2}$d be multiplied to make it £13500 11s 6d.

27. If a person gives £46 10s for 107 gals. of whisky ; how much must be added to it to reduce its value to 7s 9d per gallon ?

28. A ship is worth £3700, and the cargo is worth 6 times the ship, what is the worth of $\frac{1}{15}$th of the ship and cargo together ?

29. In 9503707 pints ; how many quarters, bush., &c. ?

30. Reduce 41601764336 sq. inches to acres, &c.

31. I bought 7 pieces of cloth, each $53\frac{3}{4}$ yds., and sold $279\frac{3}{4}$ yds. and 3 nails, how many yards remain ?

32. How much coffee at 1s $7\frac{1}{2}$d per lb. would cost the same sum as 1 cwt. 2 qrs. 14 lbs. of sugar, at $7\frac{1}{2}$d per lb.

33. A labourer excavates 1 cub. yd. 7 ft. 70 in. of earth in an hour, what quantity at this rate would he excavate in $3\frac{1}{2}$ days, working $9\frac{1}{2}$ hours per day ?

34. How often is 15 cwt. 1 qr. 27 lbs. contained in 26 times 27 tons 2 cwt. 21 lbs. ?

35. Divide the 4th part of 2431 yds. 2 ft. 8 in. by the 5th part of 17 ft. 11 inches.

36. Reduce 5 ac. 2 ro. 11 po. 7 yds. 5 ft. 29 in. to inches.

37. From a piece of linen containing 27 ells 2 qrs., there were cut off successively 10 yds. 3 qrs. 2 nls. ; 6 yds. 1 qr. 1 nl. ; and 8 yds. 2 qrs. 3 nls. ; how many ells then remained ?

38. If a person buy 693 yds. of cloth at 9s $7\frac{1}{2}$d per yd. ; at what price per yd. should he sell it to gain £17 6s 6d on the whole ?

39. Two fields together contain 87 ac. 2 ro. 11 po. 108 in. ; one is 5 times as large as the other. What is the size of the larger field ?

40. If from a field containing 7 ac. 70 yds. we fence off 28 plots of ground, each measuring 7 sq. po. 11 sq. yds. 76 sq. in. ; how much will remain ?

41. If 71 times a certain length is 224 mls. 5 fur. 21 po. 2 ft. 1 in.; how many times that length amount to 265 mls. 6 fur. 26 po. 2 ft?

42. How many parcels can be made out of 38 tons 15 cwts. 77 lbs., if half the number of parcels contain a stone each, and the remainder half as much?

43. A train travelling from Leicester to London, 96 miles, contained 14 carriages, of which 4 were 1st class, carrying 28 passengers, and 4 were 2nd class, with 36 passengers. The amount paid by the passengers was £84 8s, and the rates were $2\frac{1}{2}$d, $1\frac{3}{4}$d, and 1d per mile respectively; how many 3rd class passengers were there?

44. Reduce 17 qrs. 7 bush. 3 gals. 3 qts. 3 pts. to pints, and find the value of the result at $7\frac{3}{4}$d per pint.

45. If $\frac{1}{13}$ of a certain gold coinage be alloy; what is the quantity of pure gold in 274 pieces, weighing 54 grains each?

46. A tea dealer sold 9 chests of tea, each containing 38 lbs., at 3s $8\frac{1}{2}$d per lb. He received in payment £23 10s 3d in money, and 1824 lbs. of sugar; what was the worth of 19 lbs. of the sugar?

47. Divide £5 among A B C & D, and give B 2s 6d more than A; C 1s 6d less than B; and D 4s less than C.

48. A person bought 374 eggs at 2 a penny, and a second quantity at 3 for 2d. He paid altogether £1 9s 11d. How many did he buy at 3 for twopence?

49. How much water must be mingled with 74 gallons of whisky worth 19s 3d a gallon, to reduce the value to 18s 6d a gallon?

50. A cab horse, together with his harness, is worth £23 16s, the value of the horse being thrice that of the harness; what are the values of horse and harness respectively?

RATIOS AND PROPORTIONS (Simple and Compound).

Ratio is the mutual relationship of 2 magnitudes expressed by the number of times the one is contained in the other. The 2 terms of a ratio are called the "Antecedent" and "Consequent": the ratio of 2 quantities may be defined to be the number of times the "antecedent" contains the "consequent."

Proportion may be defined as the equality of ratios, since if we take 2 pairs of numbers such that the ratio of the 1st pair=the ratio of the 2nd pair, the 4 quantities are said to be proportional. When 2 ratios embrace 2 kinds of magnitudes which increase or decrease together, the proportion is "direct;" but if one magnitude increases as the other decreases, the proportion is "inverse;" hence one of the magnitudes is said to vary "directly" and "inversely" as the other.

Find 4th proportionals to

1.	13	:	24	::	52.	4.	34	:	79	::	136.
2.	72	:	108	::	96.	5.	65	:	84	::	195.
3.	29	:	167	::	116.	6.	4112	:	730	::	45232.

Complete the following proportions :—

7.	13	:		::	14	:	42.	10.	67	:		::	14	:	84.
8.	17	:		::	11	:	88.	11.	683	:	15	::		:	79.
9.	21	:	45	::	35	:		12.	19	:	17	::		:	119.

13. If 8 men can do a piece of work in 39 days ; how long will 24 men take ?

14. If 93 yds. of cloth cost 25s 2¼d ; what will 547 yds. cost ?

15. If 13 cwt. 2 qrs. 16 lbs. of rice cost £15 17s 6½d ; what will be the cost of 3 tons. 1 cwt. 1 qr. 16 lbs. ?

16. If 2 cwt. 3 qrs. 14 lbs. sugar be worth £13 19s 4d ; what quantity is worth £9 7s ?

17. If the rate of interest be £3 10s per £100 ; what is the interest on £1930 ?

18. If a train run 20 miles in 30 min. ; in what time will it run 10½ miles ?

19. If 18 men mow 102 acres in 8 days ; how many acres will 42 men mow in the same time ?

20. What is the height of a tree whose shadow is 273 ft. when a pole 8 ft. long projects a shadow of 12 feet ?

21. If a shopkeeper gains 3¼d in every shilling he receives, and he sells goods to the amount of £9 10s ; what is his total gain ?

22. 22 yds. of carpet 1¼ yds. broad are required to cover a room 30 yds. 2 ft. long ; what is the width of the room ?

23. A bankrupt compounded with his creditors for 9s 6d per £ ; how much was lost on a debt of £112 10s ?

24. The liabilities of a bankrupt are £1096 18s 8d, and his assets are worth £308 10s 3d ; how much can he pay per £ ?

25. If the sixpenny loaf weighs 2 lbs. 3 oz. when wheat is at 64s per qr. ; what should it weigh when wheat is 56s ?

26. The wages of 20 men for 37 weeks amount to £3467 18s 9¾d ; what will their wages for 1 year 4 weeks amount to ?

27. If a merchant sells goods to the amount of £2400 in a year, and his average profit is 2¼d per shilling ; required his annual gain after deducting £50 10s 4d of irrecoverable debts ?

28. If 3 men or 6 women can do a piece of work in 56 days ; in what time will 1 man and 2 women working together do it ?

29. If 5 men can do as much in a day as 8 boys ; how long will it take 32 boys to finish a piece of work 15 men can do in 16 days ?

30. The assets of a bankrupt are £16842 19s 3d, and yield 5s 7d in the £ ; what is the amount of his liabilities ?

31. A gives B 10 yds. & C 15 yds. start in a race of 100 yards; how much should B give C in 150 yards?

32. Two numbers together make 1800, and they are to one another as 2 : 7 ; what are they?

33. Find the difference between the cost of 37 cwts. 2 qrs. 14 lbs. at £7 10s 9d per cwt., and that of 39 cwts. 3 qrs. 26 lbs. at £4 17s 10d per cwt.

34. Two couriers pass through a town at an interval of 4 hours, travelling at the rates of $11\frac{1}{2}$ and $17\frac{1}{2}$ miles an hour ; how far and how long must the first travel before he is overtaken by the second?

35. How long will it take 17 men to earn £50, if 12 men in $6\frac{1}{2}$ days can earn 13 guineas?

36. How many hours will 12 horses take to draw 25 cwt. 40 miles, if one horse draws 20 cwt. 15 miles in 9 hours?

37. If 27 men dig a trench 18 yds. long 3 yds. wide 2 yds. deep in 117 days ; how many cubic yds. will 63 men dig in 351 days?

38. If A can do a piece of work in 6 days, B in 9 days, and C in 10 days ; how long will they take all working together?

39. If the work done by a man, a woman, and a boy respectively, be proportioned as 3 : 2 : 1, and if 9 men, 15 women, and 18 boys, finish a certain work in 208 days ; in what time would 15 men, 12 women, and 9 boys, finish the same?

40. If 10 men do a piece of work in 9 days ; how many men will do another piece 4 times as great in $\frac{2}{3}$ds of the time?

41. If £240 gain £16 in 16 months ; what sum will gain £5 6s 8d in 8 months?

42. If A & B can complete a work in 6 days, B & C in 8 days, and A & C in 10 days ; in what time could they each do it separately?

43. A is to B as 2 : 3, and B to C as 4 : 8, and C to D as 3 : 9; what proportion does A bear to D?

44. A wall 700 yds. long was to be built in 29 days ; at the end of 11 days 18 men had built 220 yds. of it ; how many additional men working at the same rate must be engaged to complete it in the given time?

45. 250 men engaged to form an embankment $1\frac{1}{2}$ miles long in 4 weeks. At the end of 1 week only 520 yds. are finished ; how many more men must be engaged to finish it in the required time?

46. A garrison of 1276 men have 16 tons 4 cwt. 2 qrs. 22 lbs. of provisions to last 19 days, but after 8 days the garrison is reinforced, and then the provisions last only $5\frac{1}{2}$ days longer ; by how many men was the garrison reinforced?

47. If in the same time a boy does half as much work as a woman, and $\frac{1}{3}$rd as much as a man ; and 15 men, 12 women, and 10 boys, complete a piece of work in 300 days ; in what time will 20 men, 14 women, and 15 boys, finish it?

48. If a sovereign contains 112 grains of pure gold, and 25 lbs. of standard gold is minted into 1200 sovereigns ; what proportion of alloy is in standard gold ?

49. If 7 needlewomen can finish a piece of work in $10\frac{5}{8}$ days of $9\frac{3}{4}$ hours each ; how long will it take 3 women to do 2 such pieces of work, if they work 10 hours a day ?

50. If 35 men can do a piece of work in 45 days ; and if 7 men drop off work every 15 days ; find what time will elapse before the work is finished ?

51. On a piece of work 2 men and 5 boys are employed, who do half of it in 6 days. After this 1 man and 1 boy more are put on, and $\frac{1}{3}$rd more is done in 3 days. How many more men must be engaged that the work may be finished in one day more ?

52. Ten men working $10\frac{1}{2}$ hours a day can finish a piece of work in 9 days ; if, however, 3 of them can only work 6 hours a day ; find how many hours a day the other 7 must work to finish it in 10 days ?

CHAIN RULE AND EXCHANGES.

1. If A can make 9 articles while B makes 14, and B can make 7 while C makes 6, and C can make 4 while D makes 5, and D makes 45 while E makes 24 ; how many can E make while A makes 36 ?

2. If 75 Thalers = 9 Francs, 15 Scudi = 81 Francs, 270 Gulden = 124 Scudi, and 10 Gulden = £1 ; find the number of Thalers = £4 15s ?

3. If £3 = 20 Thalers, 25 Thalers = 93 Francs, 27 Francs = 5 Scudi, 62 Scudi = 135 Gulden ; how many Gulden = £1 ?

4. If 16 darics make 17 guineas, 19 guineas = 24 pistoles, 31 pistoles = 38 sequins ; how many sequins = 1581 darics ?

5. If 20 Thalers = 3 sovereigns, 4 sovereigns = 100 francs, 1 franc = 20 sous, and 1 thaler = 24 groschen ; how many groschen = 600 sous ?

6. 100 guineas = 2625 francs, 63 francs = 30 florins, 146 florins = 15 frederick-d'ors ; how many fredericks = 73 guineas ?

7. A person going abroad converts 50 guineas into French money, the exchange then being £1 = 25·35 francs. He spends 1000 francs 25 centimes, and on his return receives for his French money £13, the exchange then being £1 = 25 francs ; how much ought he to have received ?

8. In London a traveller exchanged £45 for Napoleons, at 16s 8d each, and these again at Dresden for florins and kreutzers ; the Napoleons being then worth 9 fl. 25 kr., and the £ worth 11 fl. 45 kr. ; what was the gain or loss ? (60 kr. = 1 fl.)

9. A 5 franc piece is worth 5s, and a Prussian dollar containing 30 groschen = $3\frac{3}{4}$ francs; find the value of £3 11s 9d in Prussian dollars and groschen.

10. A person goes to France with 33 sovereigns, $\frac{1}{2}$ sovereign, and 7 florins. He spends 577 francs 50 centimes; how many florins has he left?

11. If 1 talent = 60 minae, 1 mina = 100 drachmae, and 4 drachmae = 117 kreutzers, and 28·8 kreutzers = 1 franc, 5 francs = 4 shillings; convert 1 talent 2 minae into English money.

SIMPLE INTEREST, INSURANCE, BROKERAGE, &c.

Find the simple interest on

1.	£762	12	6	for	$2\frac{1}{2}$	years	at 4	per cent. per annum.
2.	680	0	0	,,	$2\frac{3}{4}$	,,	,, $3\frac{1}{4}$	,, ,,
3.	1843	10	0	,,	$3\frac{1}{3}$	,,	,, $3\frac{1}{2}$	,, ,,
4.	590	0	0	,,	$8\frac{1}{2}$	,,	,, $3\frac{3}{4}$	,, ,,
5.	4761	0	0	,,	5	,,	,, $4\frac{1}{3}$	,, ,,
6.	812	6	8	,,	7 yrs. 3 mos.		,, 5	,, ,,
7.	892	10	0	,,	4 yrs. 2 mos.		,, $3\frac{1}{2}$	,, ,,
8.	690	10	6	,,	85 days		,, 4	,, ,,
9.	827	17	6	,,	292 days		,, $2\frac{1}{2}$	,, ,,

In what time will

10.	£950	amount to	£1193	16	8	at	$3\frac{1}{2}$	per cent.	per annum.
11.	1986	,,	2416	6	0	,,	$4\frac{1}{3}$	,,	,,
12.	380	,,	435	11	6	,,	$2\frac{1}{4}$	,,	,,
13.	1275	,,	1549	11	0	,,	$3\frac{3}{4}$	,,	,,
14.	3265	,,	3864	18	$10\frac{1}{2}$	,,	$3\frac{1}{2}$	,,	,,

At what rate per cent. per annum will

15.	£1210	13	4	amount to	£1392	5	4	in	5	years.
16.	575	0	0	,,	660	10	$7\frac{1}{2}$	,,	$3\frac{1}{2}$	,,
17.	8022	0	0	,,	9325	11	6	,,	$2\frac{1}{2}$	,,
18.	785	0	0	,,	926	6	0	,,	$4\frac{1}{2}$	,,
19.	725	0	0	,,	867	7	6	,,	12	,,

What principal will amount to

20.	£2306	0	6	in 7	years	at	$5\frac{1}{2}$	per cent. per annum.
21.	5479	12	0	,, 8	,,	,,	$3\frac{1}{3}$	,, ,,
22.	2005	18	9	,, $4\frac{1}{2}$	,,	,,	$3\frac{1}{4}$	,, ,,
23.	3808	2	6	,, 3 yrs. 8 mos.		,,	$3\frac{1}{2}$	,, ,,
24.	962	0	0	,, 4 yrs. 6 mos.		,,	$4\frac{1}{2}$	,, ,,

Find the amount of

25. £2833 6 8 for $4\frac{1}{2}$ years at 3 per cent. per annum.
26. 435 10 0 ,, $4\frac{1}{2}$,, ,, $3\frac{1}{4}$,, ,,
27. 367 12 6 ,, 4 ,, ,, $4\frac{1}{2}$,, ,,
28. 372 10 0 ,, 4 ,, ,, $3\frac{1}{2}$,, ,,
29. 577 6 8 ,, $4\frac{1}{2}$,, ,, $3\frac{1}{2}$,, ,,

What should be paid for insuring goods valued at

30. £2736 at $5\frac{1}{2}$ guineas per cent.
31. 1940 ,, £3 7 6 ,,
32. 6240 ,, $3\frac{1}{2}$ guineas ,,
33. Find the brokerage on £3560 at $\frac{1}{8}$ per cent. per annum.
34. Find the brokerage on £1870 at $\frac{3}{4}$,, ,,

What is the commission on

35. £436 13s, at $2\frac{3}{4}$ and $3\frac{1}{2}$ per cent. per annum.
36. £853, at $1\frac{7}{12}$ and $2\frac{3}{8}$,, ,,
37. What must be insured at $5\frac{3}{4}$ per cent. to recover £1938 12s 6d in case of loss?
38. How much must be insured to cover £540, premium $4\frac{1}{2}$ guineas, policy 5s, and commission $\frac{1}{2}$ per cent.?

DISCOUNT, PRESENT WORTH, AND EQUATION OF PAYMENTS.

Find the discount on

1. £478 5 $3\frac{3}{4}$ due $2\frac{1}{2}$ years hencc at $4\frac{3}{4}$ per cent.
2. 211 11 3 ,, $3\frac{1}{2}$,, ,, $3\frac{2}{3}$,,
3. 487 0 0 ,, $\frac{5}{12}$,, ,, $3\frac{1}{2}$,,
4. 813 9 0 ,, $1\frac{1}{3}$,, ,, $4\frac{3}{4}$,,
5. 324 6 $1\frac{3}{4}$,, $2\frac{3}{4}$,, ,, $3\frac{1}{2}$,,
6. 600 15 0 ,, $2\frac{1}{2}$,, ,, $4\frac{1}{2}$,,
7. 587 18 9 ,, $\frac{1}{2}$,, ,, $4\frac{1}{2}$,,
8. 2741 5 0 ,, $1\frac{2}{3}$,, ,, $4\frac{1}{2}$,,
9. 325 10 0 ,, 146 days hence ,, $3\frac{3}{4}$,,
10. 257 8 $8\frac{1}{4}$,, 210 ,, ,, $4\frac{1}{2}$,,
11. 472 11 9 ,, 75 ,, ,, $4\frac{1}{3}$,,
12. 212 0 0 ,, 150 ,, ,, 4 ,,

Find the present worth on

13. £4220 0 0 due 11 months hence at 6 per cent. per ann.
14. 91 17 6 „ 2 years „ „ 5 „ „
15. 456 15 0 „ 4½ months „ „ 4 „ „
16. 32 15 11 „ 3½ years „ „ 4½ „ „
17. 1708 5 7½ „ 3¾ „ „ „ 4¾ „ „
18. 2330 14 0 „ 3 „ „ „ 4¾ „ „
19. 126 9 7½ „ 1 „ „ „ 3¼ „ „
20. 625 10 0 „ 6 months „ „ 4¼ „ „

21. If £533 6s 8d be the present worth of £560 due 2 years hence ; what is the rate ?

22. If £41 10s 1⅕d be the discount on £387 7s 7⅕d due 3 years hence ; what is the rate ?

23. If £34 14s 3⅜d be the discount on £567 interest at 4½ per cent. ; when is the sum due ?

24. A owes the following sums :—£50 due in 70 days, £60 due in 96 days, and £80 due in 108 days ; when should the whole be paid at once ?

25. A debt of £310 was to be paid as follows :—£60 in 3 months, £70 in 5 months, £80 in 6 months, and the rest in 8 months ; what was the equated time for paying the whole ?

26. A debt was to be paid as follows :—⅕ in ready money, ⅙ in 210 days, ⅕ in 270 days, ⅓ in 360 days, and the rest in 400 days. Find the equated time for payment.

27. £1,000 is to be paid as follows :—£50 on the first day of each month till the whole is paid ; when may the whole be paid ?

PARTNERSHIP.

1. Three persons A, B, and C, enter into company with £400, £600, and £800 respectively. Their profits are £391 10s ; what is each man's share ?

2. Three persons enter into partnership. A has £284 10s, B £96 15s, C £76 5s of capital. Their gain is £220 12s. How is it to be divided ?

3. Three persons join in trade. A puts in £200 for 6 months, B £320 for 8 months, and C £250 for 9 months. Their total gain in one year is £360 ; what is each persons share ?

4. A ship with cargo valued at £5,000 was insured for £3,500. If half of the cargo belonged to A, ⅛ to B, and the rest to C ; what would each lose if the ship were lost ?

5. A & B enter into partnership. A advances £1,200, upon which he is to receive 5% interest. B manages the business at a salary of £220. Their profits are £420 for a year and 4 months. How much should each receive ?

6. A & B engage in trade. A puts in £200, and at the end of 8 months puts in £40 more. B puts in £300, and at 6 month's end takes out £100. At the end of the year their total gain is £240; what is each man's share?

7. Three graziers hire a field for £29 13s 4d. One puts in 14 oxen for $6\frac{1}{2}$ months, another 28 oxen for 3 months, and the third 15 oxen for 18 months; what does each pay?

8. Three graziers rent a field for 8 months for £60. A puts in 30 oxen and is to pay £30, B puts in 20 oxen and is to pay £18, and C puts in 6 oxen and is to pay the remainder. Required the time to be allowed for the oxen of each?

PROFIT AND LOSS, AVERAGES, AND ALLIGATION.

1. Bought cloth at 12s 6d per yd. and sold it at 15s; what was the gain per cent.?

2. Bought cloth at 10s 6d and sold it at 10s; what was the loss per cent.?

3. Bought wine at 15s per gall.; how must I sell it to gain 25 per cent.?

4. Lost 10 per cent. on cloth which cost 5s 5d per yd.; at what did I sell it?

5. If 20°/₀ be lost on a horse sold for £19 4s; what did it cost?

6. Bought tea at 5s 6d and sold it at 4s 9d; what was the loss per cent.?

7. By selling tea at 4s 3d I gained 25°/₀; what would I gain by selling it at 4s 6d?

8. Sold shoes at 8s and lost 4 per cent.; how must they be sold to gain 5 per cent.?

9. By selling sugar at 8d per lb. I gained 24 per cent.; at what must I sell it to gain 4 per cent.?

10. A grocer buys a cwt. of sugar at £1 13s 4d and sells it for £2 2s 6d; what is his gain per cent.?

11. A grocer uses for a pound weight one which only weighs $15\frac{1}{2}$ ozs.; what does he gain per cent. by his dishonesty?

12. Sold 40 hhds. of sugar for £844 and gained as much as 5 hhds. were sold for; what was my net gain, and gain p.c.?

13. At what price must an article be bought that 15°/₀ may be got by selling it for £17 13s $1\frac{3}{4}$d?

14. One sheep weighs 80 lbs., 3 each weigh 84 lbs., 10 each weigh 82 lbs., 15 each weigh 90 lbs.; what is their average weight?

15. In a school containing 73 children, 13 are $7\frac{1}{2}$ years of age, 15 are $8\frac{3}{4}$ years, 24 are 9 years, 11 are $10\frac{1}{2}$ years, and the rest are $11\frac{3}{4}$ years; find the average age?

16. The population of 5 parishes is 1236, 452, 364, 516, and 3430 respectively; find the population of a sixth parish so that the average of the six may be 1256·5.

17. The population of 6 towns is respectively 13,714, 12,395, 8764, 2005, 5320, and 4327; find the population of a seventh town, so that the average population of the 7 towns may be greater by 10 °/₀ than the average of the six?

18. In a regiment of 750 soldiers, 26 °/₀ are in hospital, 32 °/₀ in the trenches, and the rest in camp; how many are in hospital. trenches, and camp respectively?

19. A silversmith melted together 8 lbs. of silver 16 carats fine, 10 lbs. 18 carats fine, 18 lbs. 28 carats fine, and 4 lbs. of Alloy. Required the fineness of the mass.

20. Sugar at 6d, 7d, and 9d per lb. are mixed to make a compound at 8d per lb.; in what proportion were they mixed?

21. How many gallons of whisky at 15s, 16s, and 19s per gal. and of water must be mixed so as to make a compound worth 17s a gallon?

22. Tea at 4s 3d, 4s 6d, 5s 4d, and 5s 6d, are to be mixed so as to be able to sell at 5s; in what proportions was it mixed?

23. I want a mixture of 60 lbs. so as to cost me 5s 6d; how must I mix with goods at 4s 8d, 5s, 5s 4d, and 6s per lb.?

24. A spirit-dealer mixes whisky at 7s, 8s, 10s, 12s, and 13s per gal. so as to cost him not more than 9s; how must he mix to have a quantity of 80 gallons?

PRACTICE.

Find the cost of

1. 339 articles at 3/8, 4/8, 5/10, 6/9, 13/4, 18/6d, 19/8 each.
2. 1232 ,, ,, 6/5½, 9/8½, 6/6¾, 17/11¼, 15/10½, 14/3¾ ,,
3. 954 ,, ,, £1 7s 6½d, £3 19s 4½d, £7 12s 9¾d ,,
4. 343⅗ ,, ,, £2 11s 6d, £3 17s 4½d, £9 18s 4¼d ,,
5. 785¼ yds. at £57 15s 7¼d, and 5694⅓ yds. at £3 11s 9¾d ,,
6. 6452⁶⁄₁₁ ,, £2 4s 4½d, and 217⅜ yds. at £2 17s 7½d ,,
7. 7260 ,, £5 16s 9d per dozen, and per score.
8. 6008 ,, £13 8s 7½d ,, ,,
9. 7 tons 13 cwt. 3 qrs. at £6 7s 6d and at £1 19s 3d per cwt.
10. 1 ton 14 cwt. 3 qrs. 7 lbs. at £11 13s 4d per ton.
11. 3 tons 6 cwt. 2 qrs. 17 lbs. at 7s and at 8s 6d per cwt.
12. 17 cwts. 3 qrs. 9 lbs. 13 ozs. at £3 19s 8d per qr.
13. 3 qrs. 15 lbs. 13 ozs. 8 drs. at 17s 3d per lb.
14. 39 ac. 2 ro. 18 po. at £2 5s and £3 18s 8d per acre.
15. 23 ac. 2 ro. 28 po. at £1 16s 8d and £11 13s 4d ,,
16. 9 lbs. 11 oz. 13 dwts. at 10s, 12s 6d and 15s 6d per lb.
17. 48 lbs. 8 oz. 17 dwts. 12 grs. at £3 10s and £1 4s 6d per lb.
18. 10 lbs. 5 oz. 17 dwts. at £4 13s 7¾d and £3 2s 6½d per oz.

19. 49 ac. 28 po. 10 yds. 8 ft. 112 in. at £51 0s 11¼d per acre.
20. 50 miles 5 fur. 32 po. at £1 18s and £2 17s 6d per fur.
21. 17 miles 7 fur. 23 po. at £2 17s 1d and £6 3s 8½d per mile.
22. 14 fur. 39 po. at £8 10s per ml. and 760 yds. 9 ft. at £10 per ml.
23. 22 yds. 1 foot. 9 in. at 6s 9d, 12s 6d and 13s 4d per yd.
24. 31 cub. yds. 12 ft. 36 in. at £9 7s 6d per cub. yd.
25. 38 cub. yds. 17 ft. 72 in. at £1 12s 4d per cub. foot.
26. 111 yds. 3 qrs. 1 nl. at 17s 7½d and 18s 9¼d per yd.
27. 2 Eng. ells 4 qrs. 1 nl. at £6 3s 6d and 17s 6d per yd.
28. 1 peck 1 gal. 3 qts. 1 pt. at 7s and 8s 6d per peck.
29. 18 galls. 3 qts. 1 pt. at 7s 8d and 9s 6d per gall.
30. 22 qrs. 4 bush. 3 pks. at £1 11s 9d per bushel.
31. 227 qrs. 3 bush. 2 pks. at £1 16s 8d per quarter.
32. 4 hhds. 1 bar. 16 galls. 1 qt. at £4 1s per barrel.
33. 9 galls. 1 qt. 1 pt. at 1s 9d and 7s 6d per quart.
34. 1 month 2 weeks 1 day at £12 1s 8d per week.
35. 4 months 2 weeks 6½ days at £2 5s 6d.

COMPOUND INTEREST.

1. Find the compound interest on £2000 for 3 years at 4 °/₀; 3½ yrs. at 5 °/₀; 4 yrs. at 3½ °/₀; 2¾ yrs. at 4 °/₀; 3 yrs. at 3¼ °/₀; 4½ yrs. at 3 °/₀.
2. Find the amount of £3000 in 2 yrs. at 3⅛ °/₀; 3 yrs. at 4¼ °/₀; 4 yrs. at 4½ °/₀; 5 yrs. at 2 °/₀; 6 yrs. at 3 °/₀; 3 yrs. at 3⅛ °/₀.
3. Find the compound interest on £4000 for 3 yrs. at 4 °/° accruing half yearly; and 2 yrs. at 5 °/₀ accruing quarterly.
4. Find the amount of £4000 in 2 years at 4 °/₀ interest accruing quarterly; 4 years at 2 °/₀ interest accruing half yearly.
5. What sum will amount to £1228 5s in 3 yrs. at 6¼ °/₀ co. int.?
6. What sum will amount to £1000 by compound interest in 4 yrs. at 5 °/₀?
7. What sum will amount to £735 by compound interest in 2 yrs. at 5 °/₀?
8. What sum will amount to £1104 14s 11$\frac{9}{10}$d by compound interest in 3 yrs. at 3⅓ °/₀?
9. What is the difference between the simple and compound interest on £1640 for 3 years at 3½ °/₀ interest taken half yearly?

STOCKS.

1. I purchase £2600 in the 4 per cents. at 93. How much did I invest?
2. I invest £3741 in the 3¾ per cents. at 87, how much stock did I buy?

3. What rate per cent. will I receive by investing in the 3 per cents. at 91, and in the $3\frac{1}{2}$ per cents. at 94?

4. A person invests £4200 in the $3\frac{1}{4}$ per cents. at 90, and a like sum in the 4 per cents. at 108; find the incomes.

5. How much must be invested in the 3 per cents. at $94\frac{1}{4}$ to yield an annual income of £500?

6. Find the income from investing £3500 in the 3 per cents. at $94\frac{1}{8}$ brokerage ($\frac{1}{8}$th per cent.) being payable.

7. Which is the better stock for an investment the 3 per cents. at $90\frac{1}{2}$, or the 4 per cents. at 101; and what would be the difference on an investment of £1000?

8. When the 3 per cents. are at $91\frac{3}{4}$, what amount of stock can I buy for £1835, and what rate of interest would I receive?

9. What amount of stock in the $3\frac{1}{4}$ per cents. will produce the same income as £954 10s in the $4\frac{1}{2}$ per cents.?

10. How much stock must be purchased at 88 per cent. so that if I sell out at 90 I may gain £21?

11. If I buy 10 £20 shares at $£27\frac{1}{2}$ each and receive a dividend of 15%, and then sell out at $£37\frac{1}{2}$, how much is my total gain?

12. I invest £1365 in the 3 per cents. at 91 and sell out £1000 of stock when the shares have risen to $93\frac{1}{2}$, and the remainder on a fall to 85. How much is my gain or loss?

13. What will be the market value of the 3 per cents. so that they may yield 4% after deducting an income tax of 1/4 per £?

14. I invest £1037 10s in the 3 per cents. at 83, and when the funds are at a premium of 1, I transfer my capital to the 4 per cents. at 96; find the alteration in my income.

15. If I lay out £1270 in the 3 per cents. at $92\frac{1}{2}$, and sell out after allowing the interest to accumulate for 2 years, I find myself richer by £147 10s. At what price did I sell out?

16. What is the actual difference in interest between investing in the 3 per cents. at $87\frac{3}{8}$ and the $3\frac{1}{2}$ per cents. at $92\frac{1}{4}$?

17. The £5 shares of the Crystal Palace Company being at 30% premium, how much shall I receive by selling out £350, brokerage $\frac{1}{8}$ per cent. being paid?

18. If I invest £5000 in the 4 per cent. at 96, and sell out when the funds fell 1 per cent., what is my loss? If I then invest in the same funds at 95, and they rise 1 per cent., I again sell out, what is my gain, paying $\frac{1}{8}$ per cent. brokerage?

19. A man invests £1000 in the 3 per cents. at $100\frac{1}{3}$. After receiving a year's interest he sells out, and finds after paying brokerage of 2s 6d per cent. in both cases he has gained nothing. At what price did he sell out?

20. I invest a sum of money in the 3 per cents. at 88, and at the end of $4\frac{1}{2}$ months sell out at $87\frac{7}{8}$ after having received a half-year's dividend. What rate of interest did I receive for my money?

21. What number of £50 shares at a premium of $12\frac{1}{2}$ per cent. should be given for 30 £50 shares which are at a discount of $17\frac{1}{2}$?

22. How much must be invested in the 3 per cents. at 90 to amount at simple interest in $23\frac{1}{2}$ years to £2317, the price of the funds remaining unchanged. If they rose to 96, in how many years sooner could the amount required be realized?

23. What sum must a person invest in the 3 per cents. at 90, so that by selling out £1000 stock when they have risen to $93\frac{1}{2}$, and the remainder have fallen to $84\frac{1}{4}$, he may gain £6 5s by the transaction. If he invest the produce in the 4 per cents. at par, what will be the difference in his income?

24. A person holding a certain amount of India 5% stock sold out $\frac{3}{5}$ of it at $105\frac{1}{8}$, and invested the proceeds in the 3 per cents. at $89\frac{7}{8}$. He thereafter sold out when they had risen $5\frac{1}{4}$ per cent., and repurchased the same amount of India stock as he had sold out at $103\frac{7}{8}$, and then found that after deducting $\frac{1}{8}$ per cent. on every purchase and sale of stock, he had gained £205 by the transaction. How much stock did he hold?

VULGAR FRACTIONS.

1. Find the G.C.M. of 584 and 2308; 10568 and 9247; 1368 and 1953; 4279 and 39678; 2943 and 8829; 11276 and 31628; 112, 3968, and 4640; 729, 1371, and 1695; 396, 693, 558, and 999; 477, 1629, 666, and 3726.

2. Resolve into prime factors 1836; 77616; 19845; 6615; 175175; 2431; 3003; 34034; 4522; 12012; 34650.

3. Find the L.C.M. of 456 and 7125; 235 and 195; 21, 27, 36, and 19; 54, 81, 108, and 162; 54, 81, 42, 153; 9217, 1418, 709, 4963; 728, 2548, 4004, and 4732.

4. Resolve into prime factors, and thence get the G.C.M. and L.C.M. of 2808, 6804, and 6188; 8468, 6351, 19053, and 14819.

5. Find the G.C.M. of $3\frac{2}{3}$, $4\frac{1}{6}$, $5\frac{7}{8}$, $6\frac{3}{5}$, and $7\frac{1}{4}$.

6. Find the L.C.M. of $3\frac{1}{4}$, $5\frac{5}{6}$, $5\frac{1}{4}$, $16\frac{4}{5}$, and $16\frac{1}{3}$.

7. Find G.C.M. and reduce to lowest terms—
$\frac{21}{371}\frac{24}{7}$; $\frac{12}{304}\frac{23}{26}\frac{4}{}$; $\frac{14}{265}\frac{28}{2}$; $\frac{47}{748}\frac{48}{18}\frac{1}{}$; $\frac{29}{38}\frac{06}{28}\frac{1}{9}$; $\frac{12}{65}\frac{43}{56}$.

8. Reduce to a common denominator—
$\frac{11}{24}$, $\frac{5}{18}$, $\frac{7}{12}$, $\frac{3}{8}$, and $\frac{4}{9}$; $\frac{13}{27}$, $\frac{5}{18}$, $\frac{3}{100}$, and $\frac{6}{25}$.
$\frac{9}{35}$, $\frac{3}{20}$, $\frac{5}{7}$, $\frac{8}{27}$, and $\frac{11}{14}$; $\frac{2}{15}$, $\frac{7}{12}$, $\frac{9}{20}$, $\frac{1}{5}$, and $\frac{4}{9}$.

9. Find the sum of the following fractions—
$\frac{9}{10}+\frac{12}{55}+\frac{7}{15}+\frac{4}{11}$; $\frac{6}{13}+\frac{4}{39}+\frac{19}{52}+\frac{17}{28}+\frac{1}{3}$.
$2\frac{1}{7}+3\frac{4}{11}+\frac{2}{3}+\frac{7}{33}+1\frac{7}{9}$; $4\frac{7}{12}+3\frac{13}{24}+\frac{11}{36}+7\frac{3}{4}$.
$6\frac{17}{105}+11\frac{3}{35}+14\frac{7}{12}+\frac{139}{210}$; $27\frac{3}{14}+81\frac{9}{7}+14\frac{18}{84}$.
$3\frac{4}{9}$ of $4\frac{4}{5}+6\frac{7}{15}$; $6\frac{13}{18}+12\frac{5}{72}+\frac{4}{9}$ of $\frac{5}{8}$.
$16\frac{3}{7}$ of $1\frac{1}{3}+\frac{4}{49}$ of $\frac{1}{8}$; $71\frac{4}{15}$ of $\frac{1}{4}+13\frac{1}{9}$ of $\frac{7}{20}$.
$1\frac{13}{68}$ of $\frac{5}{13}+\frac{17}{18}$ of $15\frac{3}{17}$; $470\frac{5}{19}+17\frac{4}{209}+\frac{5}{11}$ of $\frac{1}{2}$.

10. Find the difference of the following:—

$17 - 8\frac{4}{9}$; $23 - \frac{5}{11}$; $71 - 1\frac{6}{17}$; $14 - \frac{3}{13}$
$13\frac{1}{2} - 4\frac{3}{5}$; $19\frac{7}{11} - 13\frac{8}{9}$; $11\frac{2}{17} - 9\frac{2}{3}$; $6\frac{2}{13} - 4\frac{7}{52}$
$12\frac{3}{7}$ of $2\frac{1}{2} - 5\frac{17}{28}$; $125\frac{16}{25} - 9\frac{4}{7}$ of $3\frac{1}{15}$.

11. Find the values of

$4\frac{2}{13} + 7\frac{1}{7} - \frac{11}{12} + 1\frac{3}{4}$; $27\frac{4}{11}$ of $1\frac{1}{3} - 2\frac{13}{33} + 17\frac{1}{11}$
$9\frac{8}{15} - (4\frac{1}{2} + 2\frac{1}{3} + \frac{1}{6})$; $28\frac{2}{3} - (11\frac{5}{9} + 4\frac{2}{27} + 5\frac{1}{3})$
$6\frac{3}{7} + 4\frac{1}{8} - 3\frac{9}{14} + 5\frac{1}{4} - 16\frac{3}{8} + 14\frac{1}{56} - 5\frac{3}{28}$
$\frac{1}{3}$ of $\frac{1}{7} + \frac{3}{5}$ of $1\frac{1}{2} - \frac{4}{5}$ of $\frac{1}{3} + 1\frac{5}{6}$ of $\frac{1}{4} - \frac{11}{12}$ of $\frac{1}{2}$.
$7 + \frac{1}{12} - \frac{9}{13} + 6\frac{3}{4} - 2\frac{1}{3} + 20\frac{5}{24} - 3\frac{5}{6} - 4\frac{5}{8}$
$49\frac{2}{5} - \frac{3}{4}$ of $7 - (\frac{4}{9} - \frac{4}{5}) + 17\frac{2}{3} - (2\frac{17}{20} + 3\frac{7}{10})$
$71\frac{1}{2} + (7\frac{1}{12} - 4\frac{1}{3}) - \frac{5}{6}$ of $\frac{3}{8} - (11\frac{4}{5} - 8\frac{1}{2})$
$249\frac{1}{3} + 15\frac{7}{9} - 82\frac{5}{6} - 16\frac{3}{5} + (3\frac{2}{3}$ of $5\frac{1}{9}.)$

12. Find the products of

$7\frac{1}{3} \times 8\frac{2}{5} \times 2\frac{2}{7} \times 4\frac{3}{8}$; $6\frac{6}{13} \times 1\frac{13}{84} \times 6\frac{1}{2} \times 3\frac{2}{3}$
$14\frac{6}{7} \times 2\frac{9}{13} \times 1\frac{5}{6} \times \frac{7}{33}$; $4\frac{3}{6} \times 3\frac{4}{5} \times 7\frac{3}{7} \times 3\frac{10}{13} \times \frac{5}{49}$
$11\frac{5}{11} \times 3\frac{5}{13} \times 4\frac{2}{9} \times \frac{7}{152} \times \frac{13}{56}$; $17\frac{7}{8} \times 2\frac{8}{15} \times 4\frac{12}{13} \times \frac{3}{304}$.

13. Find the quotients of

$72\frac{4}{5} \div 3\frac{5}{8}$; $16\frac{4}{9} \div 2\frac{20}{27}$; $12\frac{3}{7} \div 2\frac{7}{9}$; $18\frac{5}{12} \div 1\frac{1}{16}$
$26\frac{12}{19} \div 12\frac{17}{38}$; $38\frac{14}{15} \div 15\frac{13}{45}$; $11\frac{11}{19} \div 5\frac{25}{57}$; $15\frac{15}{104} \div 2\frac{1}{7}$
$27\frac{12}{16} \div 5\frac{20}{57}$ of $2\frac{1}{3}$; $38\frac{4}{5} \div 6\frac{7}{15}$ of $2\frac{1}{8}$; $45\frac{3}{4} \div 15\frac{3}{26}$ of $1\frac{20}{41}$.

14. Find the values of

$18\frac{1}{3} \times \frac{2}{3} + 2\frac{1}{2}$; $11\frac{4}{7} + 2\frac{1}{3} \times 1\frac{7}{8}$; $17\frac{2}{3} - \frac{4}{5} \times 1\frac{1}{3}$
$37\frac{1}{2} \div 2\frac{8}{4} + 4\frac{1}{3}$; $18\frac{4}{9} + 2\frac{1}{3} \div \frac{5}{6}$; $7\frac{1}{9} \times 1\frac{1}{3} + \frac{4}{5} \div \frac{5}{8}$
$62\frac{7}{12} \div 4\frac{3}{4} + 2\frac{1}{5} \times 3\frac{8}{11}$; $3\frac{7}{9} \times 2\frac{2}{5} - 7\frac{6}{13} \times 1\frac{4}{9}$.

15. $\dfrac{2\frac{1}{3}}{1\frac{1}{4}} \times 6\frac{2}{5}$; $\dfrac{7\frac{1}{5}}{3\frac{1}{6}} \times 4\frac{4}{7}$; $8\frac{5}{12} \times \dfrac{\frac{4}{7}}{\frac{3}{6}}$; $\dfrac{12\frac{7}{11}}{4\frac{1}{3}\frac{1}{8}} \times \dfrac{16\frac{3}{4}}{5\frac{1}{12}}$

$\dfrac{\frac{1}{2}+\frac{1}{3}}{\frac{1}{2}-\frac{1}{3}} \div \dfrac{\frac{2}{5}+\frac{3}{15}}{\frac{2}{5}-\frac{3}{15}}$; $\dfrac{\frac{1}{3}-\frac{1}{4}}{\frac{1}{3}+\frac{1}{4}} \div \dfrac{\frac{6}{7}-\frac{5}{6}}{\frac{5}{6}+\frac{6}{7}}$;

$\dfrac{\frac{3}{4}+\frac{4}{5}}{\frac{5}{6}-\frac{3}{10}} - \dfrac{\frac{4}{5}+\frac{3}{4}}{\frac{3}{10}+\frac{5}{6}} \div \dfrac{\frac{6}{7}-\frac{5}{6}}{\frac{5}{6}+\frac{6}{7}} + \dfrac{\frac{6}{7}+\frac{5}{8}}{\frac{6}{7}-\frac{5}{6}}$.

16. $\dfrac{1}{1+\dfrac{1}{2+\frac{1}{2}}}$; $\dfrac{1}{1+\dfrac{1}{1+\dfrac{1}{1+\frac{1}{3}}}}$; $\dfrac{1}{1+\dfrac{1}{3+\dfrac{1}{1+\frac{1}{11}}}}$

17. *Simplify the following:—*

$\dfrac{4\frac{1}{2}+5\frac{1}{3}+6\frac{1}{4}}{7\frac{1}{5}+8\frac{1}{6}+9\frac{1}{7}} \times \dfrac{9\frac{1}{2}+10\frac{2}{21}+11\frac{1}{24}}{1\frac{1}{4}+2\frac{1}{10}+3\frac{1}{12}}$; $\dfrac{2\frac{1}{2} \text{ of } 3\frac{1}{4}}{2\frac{2}{3} \text{ of } 1\frac{2}{7}} \text{ of } \dfrac{\frac{7}{8} \text{ of } 1\frac{3}{4}}{4\frac{1}{4}+\frac{1}{17}}$

$\dfrac{3\frac{1}{8}-2\frac{1}{5}}{4\frac{1}{4}-1\frac{1}{2}} - \dfrac{3\frac{1}{5}-3\frac{1}{10}}{4\frac{1}{2}-3\frac{1}{6}}$; $\dfrac{1\frac{1}{8}}{1\frac{3}{14}} \div \left\{ (\frac{3}{17} \times 1\frac{1}{2}) - \dfrac{1}{18\frac{8}{9}} \right\}$;

$\dfrac{1}{3\frac{1}{5}} - \dfrac{2\frac{1}{4}}{9} + \dfrac{3\frac{5}{8}}{12} + \dfrac{\frac{5}{7}}{4\frac{5}{7}} + \dfrac{3-2\frac{1}{3}}{4-3\frac{1}{4}}$; $\dfrac{7}{3+\dfrac{2\frac{1}{4}}{4\frac{3}{4}}} \div \dfrac{1}{2+3\frac{1}{8}}$;

$$\frac{5\frac{1}{2}-3\frac{1}{7}}{3\frac{1}{4}+\frac{1}{9}}\text{ of }\frac{3\frac{1}{2}+7\frac{1}{8}}{3\frac{1}{15}}\div\frac{\frac{1}{2}+\frac{1}{3}}{\frac{15}{16}}\;;\qquad\frac{4\frac{1}{2}}{7\frac{2}{3}}\left(2\tfrac{3}{4}\text{ of }\frac{4\frac{1}{2}\text{ of }9}{\frac{7}{11}+\frac{1}{8}}\right);$$

$$\frac{1\frac{2}{3}\text{ of }1\frac{1}{4}}{3\frac{2}{5}+\frac{5}{1\frac{19}{41}}}+\frac{4}{5+\frac{6}{7+\frac{8}{9}}}\;;\qquad\left(\frac{2\frac{1}{4}-\frac{2}{3}\text{ of }1\frac{5}{6}}{\frac{1}{6}\text{ of }3\frac{1}{3}+\frac{13}{36}}-\frac{1}{2\frac{1}{2}}\right)\div\frac{1}{1\frac{2}{3}}\;;$$

$$1\tfrac{5}{6}\text{ of }\frac{\frac{1}{2}+\frac{1}{3}+\frac{1}{4}}{2\frac{1}{2}-3\frac{1}{3}+4\frac{1}{4}}\times\frac{\frac{2\frac{1}{2}}{3\frac{1}{7}}+\frac{\frac{3}{16}}{1\frac{3}{8}}}{\frac{3}{16}\times\frac{4\frac{1}{2}}{3}}\text{ of a cwt.}$$

18. *Arrange in order of magnitude*

$\frac{11}{16}$, $\frac{17}{45}$, $\frac{7}{15}$, $\frac{43}{96}$, $\frac{17}{36}$; $1\frac{5}{6}$, $\frac{29}{15}$, $\frac{385}{200}$, $\frac{656}{309}$;
$\frac{7}{12}$, $\frac{13}{18}$, $\frac{17}{24}$, $\frac{19}{36}$; $\frac{24}{25}$, $\frac{11}{12}$, $\frac{7}{8}$, $\frac{13}{15}$, $\frac{11}{20}$.

19. *Find the value of*

$\frac{5}{6}$ of £1; $\frac{3}{8}$ of £1; $\frac{4}{5}$ of £1 10/-; $\frac{6}{7}$ of £1 15/-;

$\frac{5}{9}$ of £2 5/-; $\frac{7}{11}$ of £2 4/-; $\frac{7}{12}$ of £3 12/-;

$\frac{5}{7}$ of 1 guinea; $\frac{4}{9}$ of 3 guineas; $\frac{3}{10}$ of 6/8; $\frac{5}{8}$ of 13/4;

$7\frac{1}{5}$ of £1 15/-; $4\frac{2}{3}$ of £3 6s 9d; $\frac{7}{8}$ of £4 16s 8d;

$\frac{4}{7}$ of $3\frac{1}{2}$ cwts.; $\frac{3}{4}$ of $2\frac{1}{2}$ acres; $\frac{5}{6}$ of $12\frac{4}{5}$ oz.;

$1\frac{2}{3}$ of 19 roods; $6\frac{3}{5}$ of 15 tons 10 cwts.; $1\frac{1}{6}$ of 7 bush.;

$\frac{11}{5}$ of $2\frac{1}{3}$ fur.; $3\frac{2}{5}$ of £1 7s $11\frac{1}{3}$d; $\frac{3\frac{1}{2}}{7}$ of 17 lbs. avoir.;

$\frac{3}{5}$ of £2 5/10 $-\frac{4}{9}$ of 2 guineas $+\frac{6}{7}$ of 14 florins;

$\frac{3}{7}$ of £9 $+\frac{2}{3}$ of $\frac{1}{4\frac{2}{3}}$ of $\frac{2}{3}$ of 16/8 $-\frac{5}{8}$ of 17/9$\frac{1}{2}$;

$\frac{2}{3}$ of a sq. yd. $+\frac{8}{9}$ of a perch $+\frac{3}{10}$ of a rood $+\frac{2}{5}$ of an acre;

$\frac{3}{21}$ of a quarter $+\frac{3}{8}$ of a bushel $-\frac{2}{5}$ of 3 pks. $+\frac{4}{5}$ of a qt.

$\frac{7}{8}$ of a mile $+\frac{3}{5}$ of 2 fur. $+\frac{9}{10}$ of a yd. $-\frac{3}{11}$ of a pole.

Reduce

17/6 to the fraction of £1;			4/9 to the fraction of £3.		
18/4	,,	£5 10/-;	5/7$\frac{1}{2}$	,,	4 guin.
£1 3/4	,,	£15;	£3 1/8	,,	£37.
2/0$\frac{1}{4}$	,,	10/9$\frac{1}{2}$;	3/4	,,	10/6.

Express

$\frac{7}{8}$ of £2 13/4 as the fraction of $\frac{4}{5}$ of £5.
$\frac{3}{8}$ lb. and $\frac{5}{9}$ ton each as the fraction of a cwt.
$\frac{14}{17}$ oz. avoir. as the fraction of a lb. avoir.; of a lb. Troy; of an oz. Troy; of a grain.

What fraction is

2 qrs. 12 lbs. of $\frac{1}{4}$ ton ; 15 oz. $4\frac{1}{5}$ drs. of 3 oz.
$\frac{3}{7} + 1/5\frac{1}{2}$ of half a crown ; $2\frac{2}{3}$ acres of a sq. mile.
2 bush. 3 pks. of 3 qrs. 1 bush. ; 3 qts. 1 pt. of $\frac{1}{2}$ gall.
2 cwt. 1 qr. $10\frac{5}{8}$ lbs. of 1 ton 11 cwt. $15\frac{5}{12}$ lbs.
3 ro. $27\frac{1}{2}$ po. of an acre ; 2 ro. 15 per. of a sq. mile.
2 qrs. $2\frac{2}{3}$ nls. of an Eng. ell ; $7/6\frac{2}{5}$ of $11/10\frac{3}{5}$.
$\frac{1}{4}$ of 2 sq. yds. 5. sq. ft. of 2 sq. yds. 7 sq. ft.
$2\frac{1}{2}$ guineas of £$2\frac{1}{2}$; $2\frac{1}{2}$ cwt. of 2 tons 12 lbs.
1 lb. 12 oz. of 1 cwt. 1 qr. ; 1 ft. $\frac{7}{8}$ in. of a sq. yd.
$\frac{3}{5} \times 7\frac{1}{2} \times 16\frac{1}{2}$ yds. of 1 fur. ; $3\frac{7}{8}$ fur. of $2\frac{7}{8}$ miles.
$\frac{7}{9}$ leagues of $\frac{3}{4}$ mile ; $\frac{7}{8}$ lb. avoir. of 2 lbs. Troy.

Express the difference between

$\frac{1}{12}$ of £1 and $\frac{1}{14}$ of a guinea as the fraction of 1 hf. cr.
$\frac{3}{7}$ of cwt. and $3\frac{1}{2}$ qrs. as the fraction of a ton.
$\frac{5}{6}$ of an acre and $37\frac{1}{2}$ po. as the fraction of $2\frac{1}{2}$ acres.
$7\frac{1}{2}$ bush. 2 pks. and $3\frac{1}{4}$ gals. as the fraction of $2\frac{1}{4}$ qrs.

MISCELLANEOUS.

1. Find the product of the sum and difference of $6\frac{1}{3}$ and $4\frac{1}{4}$.
2. To half the sum of $4\frac{3}{5}$ and $2\frac{7}{10}$ add half their difference, and from half their sum subtract half their difference.
3. If $\frac{3}{5}$ of a parcel weighs 12 lbs., what is the total weight?
4. By what must $11\frac{1}{9}$ be divided to make it $= 1\frac{1}{9}$?
5. What must be added to $\frac{3}{7}$ of $\frac{5}{8}$ to make it $= \frac{9}{00}$ of $3\frac{3}{4}$?
6. Find the sum of the greatest and least of the fractions $\frac{7}{11}$, $\frac{11}{26}$, $\frac{10}{23}$, $\frac{2}{5}$, the sum of the other two, and the difference of these sums.
7. After paying away $\frac{1}{2}$ of a sum of money, then $\frac{3}{5}$ of the remainder, 10/6 was left. What was the sum?
8. If I gave away $\frac{2}{3}$ of my money, then $\frac{3}{4}$ of what remains, and again $\frac{4}{5}$ of what still remains, what fraction of the whole shall I have left?
9. The reciprocal of a number is 1 divided by the number. Find the reciprocals of $\frac{1}{2}$, $\frac{3}{8}$, $\frac{5}{7}$, $\frac{4}{5}$, $2\frac{1}{5}$.
10. Out of a cistern $\frac{2}{3}$ full, 20 gallons are drawn, 70 gallons are then added, and it is found to be $\frac{5}{6}$ full; how much does it hold?
11. If $\frac{3}{8}$ of a ship cost £273 2s 6d ; what is $\frac{5}{8\frac{1}{3}}$ of it worth?
12. $\frac{4}{17}$ of a sum of money is equal to a guinea ; find the sum.
13. $1\frac{2}{3}$ of a sum is equal to $\frac{3}{7}$ of 5s 10d ; find the sum.
14. If A be $2\frac{2}{3}$ of B, B $1\frac{3}{8}$ of C, and D $7\frac{1}{3}$ of C ; what fraction is A of D?
15. Two numbers are in the proportion

$$\frac{5\frac{1}{3}}{5\frac{3}{5}} : \frac{6\frac{2}{3}}{4\frac{3}{8}}$$

and their sum is 143 ; find the sum.

16. If £120$\frac{4}{5}$ in $\frac{3}{5}$ year gain £2$\frac{2}{5}$; how much will £376$\frac{1}{5}$ gain in 4$\frac{1}{2}$ years?

17. If 8 men perform a piece of work in 12$\frac{1}{3}$ days; in what time will 9 men and 5 boys do the same, if a boy can perform $\frac{5}{8}$ of a man's work?

18. A possessed $\frac{3}{4}$ of a ship, and sold $\frac{5}{8}$ of his share to B, who again sold $\frac{3}{10}$ of his share to C. What part of the ship did C possess?

19. How much will $\frac{3}{4}$ yd. of cloth which is $\frac{7}{8}$ yd. wide cost when 17$\frac{1}{2}$ yds. of cloth of the same quality $\frac{3}{8}$ yd. wide cost £3$\frac{1}{5}$?

20. Divide 20s among A, B, & C, and give B $\frac{1}{3}$ more than A, and C 10d less than A.

21. If A can do a piece of work in 4 days, B in 6, and C in 8; in how many days can they do it all working together?

22. If A and B can do a piece of work in 6 days, but with the help of C could do it in 4 days; in what time could C do it himself?

23. A can do a piece of work in 9$\frac{1}{6}$ days, B in 11 days, and A, B, C, together in 3$\frac{1}{8}$ days; in what time could C do it?

24. If when the duty on sugar is £$\frac{5}{12}$ per cwt. $\frac{5}{12}$ of a cwt. cost $\frac{3}{4}$ of $\frac{7}{8}$ of £3; what will be the price of $\frac{3}{8}$ of a cwt. when the duty is £$\frac{7}{12}$ per cwt.?

25. A and B together can do a piece of work in 4 days, A and C together in 3$\frac{3}{5}$ days, and B and C together in 5$\frac{1}{7}$ days; in what time will each alone do the work?

26. A, B, & C, are appointed to do a piece of work. A can do it in 36 hours, B in 45 hours, and C in 40 hours. If B begins 3 hours later than A, and C an hour later than B; in what time will the work be done?

27. If A can perform a certain amount of work in 39 hours, B in 48 hours, and C in 52 hours, and if A leaves off 10 hours and C 3 hours before completion; in what time could the work be finished?

28. A and B together can do a piece of work in 6$\frac{6}{13}$ days, B and C in 6$\frac{6}{7}$ days, and A and C in 7$\frac{7}{15}$ days; how long will each singly take to do it?

29. A cistern has 2 supply pipes, one of which alone could fill it in 3$\frac{4}{7}$ hours, the other in 3$\frac{3}{4}$ hours. It has also a discharge pipe which can empty it in 1$\frac{1}{2}$ hours. The cistern being full, all 3 pipes are turned on; when will it be empty?

30. A, B, & C, are appointed to finish a piece of work in 2$\frac{1}{12}$ hours. B alone would take $\frac{1}{4}$th as long again as A, and C $\frac{1}{3}$rd as long again as B; when could each finish it by himself?

31. A, B, & C, who can respectively do a piece of work in 15, 16, and 18 days, work together at it for 1$\frac{1}{2}$ days, after which C leaves off, and in 3 days more agrees to increase his rate of working so as to complete it in 3$\frac{17}{48}$ days. What proportion does C's second rate of working bear to his first rate?

DECIMAL FRACTIONS.

Reduce to Vulgar Fractions in their lowest terms

1. ·6 ; ·06 ; ·006 ; 1·06 ; 16·06 ; 16·006 ; 6·0006 ; ·375.
2. 45·23 ; 17·054 ; 23·904 ; 5·75 ; 4.675 ; 18·0725.
3. $\dot{.}\dot{8}$; ·08̇ ; ·0$\dot{1}\dot{8}$; 3·08̇ ; 3·0$\dot{8}$; 3·008̇ ; 3.00$\dot{8}$; 3·$\dot{1}\dot{8}$.
4. 413·7̇ ; 426·7$\dot{4}$; 63·6$\dot{1}\dot{8}$; 61·03$\dot{7}$; 1·60$\dot{3}\dot{7}$.
5. ·428571̇ ; ·85714$\dot{2}$; 6·28571$\dot{4}$; 6·3571428.
6. ·692307̇ ; ·923076̇ ; ·307692̇ ; ·076923̇.
7. ·461538̇ ; ·1538$\dot{4}\dot{6}$; ·8461$\dot{5}\dot{3}$; ·0391$\dot{8}$.
8. 37·923076̇ ; 3·7923076̇ ; 5·71230769̇ ; ·0$\dot{2}\dot{7}$.
9. $2{\cdot}0\frac{3}{7}$; $5{\cdot}1\frac{4}{9}$; $7{\cdot}3\frac{4}{6}$; $12{\cdot}71\frac{4}{9}$; $63{\cdot}05\frac{1}{3}$; $8.1\frac{4}{13}$.

Reduce to Decimals the following :—

10. $\frac{3}{4}$; $\frac{3}{10}$; $\frac{2}{6}$; $\frac{7}{8}$; $\frac{13}{15}$; $\frac{4}{9}$; $\frac{5}{6}$; $\frac{3}{13}$; $\frac{3}{7}$; $\frac{2}{39}$; $\frac{9}{11}$.
11. $1\frac{2}{3}$; $3\frac{5}{6}$; $4\frac{1}{2}$; $7\frac{3}{4}$; $8\frac{7}{9}$; $11\frac{4}{7}$; $6\frac{2}{13}$; $14\frac{5}{11}$.
12. $17\frac{11}{14}$; $25\frac{14}{25}$; $61\frac{3}{14}$; $70\frac{7}{24}$; $86\frac{9}{20}$; $74\frac{17}{36}$.

Find the values of the following :—

13. 12·738 + 4·6254 + 793284 + ·00375 + 619·7.
14. 284·7 + ·032086 + 1·486 + 58·37 + ·00036.
15. 318·48 + 637·16 + 4·54 + ·318 + 56·375.
16. 13·18 + 2·037 + 5·6314 + 27 + 6·2381.
17. 592·0137 + 61·28 + 231·6 + 518·23148.
18. 697·38416 − 428·596784 ; 14·7283 − 4·95964.
19. 23·4752 − 15·68759 ; 74·130706 − 18·372839.
20. 11·3784 − 4·56 ; 759·32816 − 145·4746.
21. 48·137 − 19·4763 ; 471·0367 − 184·7613.
22. 78·54 × 15·8 ; 69·03 × ·058 ; 8·736 × ·0904.
23. ·00709 × ·0046 ; 7·0348 × 57·860003.
24. ·63 × 4·8 ; 4·74 × 7·6 ; 87·316 × 4·83.
25. 6·734 × 4·18 ; 62·46 × 8·37 ; 4·83 × ·148.
26. £8 7s 11d × 1·9 and £487 2s $11\frac{1}{2}$d × 4·4.
27. £41 3s $11\frac{1}{2}$d × 1·25 and £63 8s $4\frac{1}{4}$d × 7·75.
28. £17·025 × $4\frac{3}{4}$ and £182·734 × 1·545.
29. 4·0203 ÷ 2.7 ; 35 ÷ ·05 ; 86·38 ÷ ·007.
30. 18·9225 ÷ 4·35 ; ·002 ÷ 200 ; 7 ÷ ·0035.
31. 31·5 ÷ ·126 ; ·006318 ÷ ·00045 ; ·002 ÷ 34·2.
32. ·37 ÷ ·148 ; 53·46 ÷ 7·3 ; 13·7 ÷ 3·04.

33. $5{\cdot}06\dot{8} \div {\cdot}\dot{1}42857\dot{1}$; ${\cdot}\dot{1} \div {\cdot}5384\dot{6}\dot{1}$; $1{\cdot}18 \div {\cdot}29\dot{5}\dot{4}$.
34. $17{\cdot}\dot{2} \div 5{\cdot}2\dot{7}$; $18{\cdot}\dot{2}\dot{3} \div 427{\cdot}\dot{4}$; $81{\cdot}7\dot{3}\dot{2} \div 2{\cdot}8\dot{3}$.

Find the value of

35. £·78125; £·24375; £·390625; £2·94375.
36. 2·1386 guis.; 617·254 crs.; ·635 s.; ·1825 of £5.
37. 1·2125 of £2; 8·5 of 2s 6d; 3·0625 of 6s 8d.
38. £·04583; £·79$\dot{1}\dot{6}$; £.073$\dot{1}\dot{8}$; £1·49$\dot{1}\dot{4}\dot{6}$.
39. £·3$\dot{7}\dot{6}$; £7·3$\dot{6}$; £19·73$\dot{4}\dot{8}$; £6·47$\dot{3}\dot{6}$.
40. ·03125 of £20; ·$\dot{7}2\dot{9}$ of 6s 2d; ·$0\dot{1}\dot{3}$ of 25s.
41. 1·$\dot{7}14285\dot{7}$ cwts.; 3·7687 tons; 2·73856 acres.
42. 2·375 qrs.; 1·015625 lbs. troy; ·000715 roods; 26875 mls.
43. ·2845 gal.; ·00614 cub. yd.; 13·38 sq. yds.; 4·07 qts.
44. ·6385 lbs. avoir.; ·0375 bush.; ·625 pks.; 4·75 fur.

Reduce to the Decimal of

45. £1 – 12s 6d; 10s 9d; 18s 1½d; 15s 6¾d; 6s 4¼d; 14s 3¾d.
46. £1 – £1 11s 7½d; £13 13s 7¼d; £1 18s 5½d; £3 11s 4½d.
47. £4 – £2 6s 4½d; £5 11s 9d; £11 3s 4¾d; £1 10s 6¾d.
48. 1 guinea – £4 15s 2d; £2 9s 5d; £1 5s 3d; £3 12s 6d.
49. £1 10s – 18s 3d; 17s 6d; 12s 9d; 15s 3d; 14s 7½d.
50. £50 – £2 11s 6d; £3 17s 9d; £4 1s 6d; £3 5s 3d.
51. 1 ton – 1 ton 18 cwt. 12 lbs.; 17 cwts. 2 qrs. 14 oz.
52. 1 cwt. – 3 qrs. 14 lbs.; 3 lbs. 8 oz.; 3 qrs. 11 lbs. 7 oz.
53. 1 lb. troy – 1 lb. 7 oz. 20 grs.; 7 oz. 5 dwts. 8 grs.
54. 1 acre – 1 ro. 19 po. 5 ft.; 28 po. 21 yds. 4 ft. 36 ins.
55. 1 lb. avoir. – 17 lbs. 6 oz.; 13 oz. 4 drs.; 2 qrs. 7 lbs. 4 oz.
56. Reduce £9 16 3 to the decimal of £15 15 6
57. ,, 4 17 4½ ,, 60 3 4½
58. ,, 12 15 7¾ ,, 16 8 8¼
59. ,, 0 14 7½ to the decimal of ·04 of £2 10s.
60. ,, ⅔ of a florin to the dec. of ⅘ of £1 5s.
61. ,, £16·75 + 1·3125s + 11·25d to dec. of £25.

Find the value of

62. ·375 of 1 gui. + ·$\dot{5}\dot{4}$ of 8s 3d + ·$0\dot{2}\dot{7}$ of £3 14s.
63. ·045 of £4 10s + £·725 + 1·05 of £3 5s.
64. ·35 of 3⅓ cwts. + 1·25 of 2 qrs. – ·45 of 20 lbs.
65. 1·075 of 1 qr. 8 lbs. + ·8 of 3 qrs. + 7·5 of 4½ lbs.
66. 5·03 lbs. + ·063 cwts. + 1 qr. 1 lb. 8·75 oz.

MISCELLANEOUS EXERCISES.

1. If ·625 of an article cost £13 6s $1\frac{3}{4}$d ; what will ·125 cost?

2. Bought $98\frac{5}{8}$ yds. of cloth at £1 $16\dot{}$ per yd. and sold it at £$1\frac{3}{8}$ per yd. ; what was the gain on the whole?

3. The circumference of a circle is 3·1416 of the diameter. What is the circumference of circles whose diameters are 13·7 ft., 1·96 yds., and 28·342 miles respectively?

4. If 2 persons do a piece of work in 10·5 days, which one of them alone could do it in 17·75 days ; in what time would the other finish it?

5. If an ounce of gold be worth £4·18953$\dot{}$; what is the value of ·3753$\dot{}$ lbs. ?

6. If A can do ·$6\dot{}$ of a work in 4 hours, B ·75 of the remainder in 1 hour, and C can finish it in $\frac{1}{3}$ of an hour ; in what time can A, B, and C, do it?

7. Subtract $\frac{3}{7}$ from 1·1 and divide the remainder by ·1.

8. Reduce and add together £$6\frac{3}{8}$, £$19\frac{5}{6}$, £$21\frac{1}{3}$, £5,75, and £14·125.

9. Add together ·21 of a ton, ·32 of 2 cwt. and ·27 of 3 lbs., and give the answer in lbs. and dec. of a lb.

10. Subtract ·041 of a week from ·48 of 37 hours, and give the answer in hours and dec. of an hour.

11. Add together ·037 of an acre and ·613 of 5 sq. yds., and give the answer in feet and dec. of a foot.

12. Subtract ·793 of 16s $4\frac{1}{2}$d from ·0345 of 25 guineas, and give the answer in pence and dec. of a penny.

13. Add together 1·325 of 1 hour 16 min. and ·297 of 1 day 16 hours, and give the answer in minutes and the decimal of a minute.

14. Subtract ·0049 of a rood from ·8654 of a perch, and give answer in yards and the decimal of a yard.

15. Reduce ·073 of 4 lbs. 3 oz. 6·9 dwts. to grains and the decimal of a grain.

16. Add together ·0025 of an oz., ·0371 of a dwt., and ·73 of a grain, and give the answer in grains and the decimal of a grain.

17. Add together ·0273 of a lb. and 5·2 of a dwt., and give the answer in grains and decimal of a grain.

18. Subtract ·0075 of a mile from 13·73 of a yd., and give answer in inches and decimal of an inch.

19. What decimal of an acre is ·176 of 5·5 sq. yds. ?

20. Reduce ·0739 of 13 bush. 2 gallons to pints and the dec. of a pint.

21. Subtract ·0043 of 1 week 3 days from 3·89 of 4 hrs. 53 min., and give answer in minutes and the decimal of a minute.

22. Add together ·75 of 10s 6d, ·375 of 5s, and ·6 of 7s 6d.

23. Subtract ·0205 of 1 lb. from ·125 of 3 ozs. 2 drs.

24. Add $1\cdot025$ of $3\frac{1}{4}$ oz. to $\cdot2758$ of $16\frac{1}{2}$ dwts., and give answer in grains and the decimal of a grain.

25. Subtract $\cdot0851$ of 2 weeks $3\frac{1}{2}$ days from 1 day $21\cdot064$ hours, and give answer in minutes and the decimal of a minute.

26. Multiply $5\cdot\dot{8}\dot{1}$ by $\cdot00260416$ and divide $2\cdot\dot{3}07692$ by $2\cdot\dot{1}42857$, and give both answers in decimals.

SQUARE AND CUBE ROOTS, SURDS, AND DUODECIMALS.

1. *Find the square root of*

$16\cdot5649$; $103471\cdot5889$; 231496225 ; $49\cdot182169$

$2660\frac{3196}{44889}$; $1339\frac{686}{12225}$; $3\frac{118}{169}$; $346\frac{1761}{2500}$; $20\frac{341}{841}$

$8\cdot\dot{0}2\dot{7}$; $6\cdot2\dot{4}\dot{9}$; $\cdot4$; $\cdot000005$; $3\cdot6\dot{8}\dot{7}$; $1\cdot\dot{1}7361\dot{}$

$83\cdot012345679$; $21-8\sqrt{5}$; $\frac{2\cdot05}{2\cdot25}$; $\frac{3\cdot79}{19016}$ $\frac{7\cdot98}{62\cdot4}$

2. *Find the cube root of*

$77854\cdot483$; $2\cdot628072$; $24642\cdot171$; $8452\cdot264653$

$13997\cdot521$; $3241\cdot792$; $\cdot210644875$; $\cdot004096$

$\cdot002048383$; $\cdot008365427$; $4173\cdot281$; $\cdot\dot{4}$

$1876\cdot0\dot{3}\dot{7}$; $\cdot01$; $17\cdot\dot{4}$; $18\cdot0\dot{3}\dot{6}$; $509\cdot\dot{7}$; $62\cdot8\dot{7}\dot{5}$

$35\frac{162}{343}$; $151\frac{19}{27}$; $\frac{343}{2197}$; $1\frac{1557}{1728}$; $1\frac{250081}{29791}$; $\frac{216}{729}$

1. Add $4\sqrt{2}+5\sqrt{8}-\sqrt{18}$ and $3\sqrt{3}+12\sqrt{12}+\sqrt{27}-2\sqrt{48}$
2. Add $2\sqrt{6}-2\sqrt{24}+5\sqrt{54}$ and $5\sqrt{5}+\sqrt{20}-2\sqrt{45}$
3. Subtract $\sqrt{243}$ from $6\sqrt{12}$ and $\sqrt{175}$ from $18\sqrt{7}$
4. Add $3\sqrt[3]{16}+7\sqrt[3]{54}+9\sqrt[3]{2}$ and $4\sqrt[3]{128}+\sqrt[3]{16}-\sqrt[3]{250}$
5. From $16\sqrt[3]{4}$ take $3\sqrt[3]{32}$ and from $13\sqrt[3]{9}$ take $2\sqrt[3]{72}$
6. Multiply $\sqrt{3}+\sqrt{4}$ by $\sqrt{3}+\sqrt{4}$ and $\sqrt{3}+\sqrt{4}$ by $\sqrt{3}-\sqrt{4}$
7. Multiply $\sqrt{5}-\sqrt{6}$ by $\sqrt{5}-\sqrt{6}$ and $\sqrt{6}+\sqrt{7}$ by $\sqrt{6}-\sqrt{7}$
8. Divide $6+2\sqrt{42}+7$ by $\sqrt{6}+\sqrt{7}$
9. Find value of $\sqrt{\frac{13}{42}}\times\sqrt{\frac{126}{117}}\times\sqrt{\frac{250}{720}}\times\sqrt{\frac{81}{150}}\times\sqrt{\frac{10}{9}}$
10. ,, ,, $\sqrt[3]{\frac{91}{48}}\times\sqrt[3]{\frac{72}{124}}\times\sqrt[3]{\frac{1575}{504}}\times\sqrt[3]{\frac{54}{98}}\times\sqrt[3]{\frac{1176}{144}}$
11. ,, ,, $\dfrac{\sqrt{4}-\sqrt{5}}{\sqrt{4}+\sqrt{5}}+\dfrac{\sqrt{4}\times\sqrt{5}}{\sqrt{4}-\sqrt{5}}$

$\dfrac{\sqrt{6}+\sqrt{8}}{\sqrt{6}-\sqrt{8}}-\dfrac{\sqrt{6}-\sqrt{8}}{\sqrt{6}+\sqrt{8}}$ and $\dfrac{3\sqrt{2+1}+4\sqrt{3}}{2\sqrt{7+5}+3\sqrt{2+1}}$

12. $\frac{\sqrt{2}}{\sqrt{10}} + \frac{3}{\sqrt{20}} + \frac{1}{\sqrt{5}}$ and $\frac{1}{4-\sqrt{12}} + \frac{1}{4+\sqrt{12}}$

1. Multiply together and give answer in square ft. and inches. 6 ft. 3 in. 4 pts. × 5 ft. 6 in. 8 pts. ; 14 ft. 5 in. 7 pts. × 3 ft. 1 in. 5 pts. ; 19 ft. 0 in. 3 pts. × 11 ft. 1 in. 6 pts. ; 7 ft. 8 in. 10 pts. × 2 ft. 9 in. 4 pts. ; 12 ft. 3 in. 4 pts. × 10 in. $7\frac{1}{2}$ pts. ; 6 ft. 8 in. $10\frac{1}{4}$ pts. × 6 in. 8 pts.

2. Multiply together and give answer in cubic ft. and inches. 13 ft. 3 in. × 10 ft. 5 in. × 6 ft. 9 in. ; 3 ft. 8 in. × 8 ft. 4 in. × 11 ft. 5 in. ; 20 ft. 4 in. × 3 ft. 8 in. × 7 ft. 4 in. ; 11 ft. 7 in. × 4 ft. 3 in. × 5 ft. 7 in. ; 10 ft. $6\frac{1}{2}$ in. × 2 ft. $1\frac{1}{4}$ in. × 5 ft. 8 in. ; 7 ft. $6\frac{3}{4}$ in. × 8 ft. $4\frac{1}{2}$ in. × 9 ft. 4 in.

3. Find the areas of 2 rooms, one of which is 36 ft. 7′ 11″ by 19 ft. 8′, the other 20 ft. 8′ by 12 ft. $3\frac{1}{2}$′.

4. A room is 20 ft. $10\frac{1}{2}$ in. long, 13 ft. 6 in. wide, and 10 ft. 9 in. high ; how many square feet are there in the floor and in the walls ?

5. How many square feet of paper are required for the walls of a room 20 ft. 10 in. long, 16 ft. broad, 10 ft. 8 in. high, and for another 18 ft. 10 in. long, 16 ft. 9 in. broad, 9 ft. 6 in. high ?

6. What length of carpet $\frac{3}{4}$ of a yard wide will cover a floor $6\frac{1}{2}$ yards long by $5\frac{1}{4}$ yards wide ?

7. If a floor is $250\frac{5}{6}$ sq. ft. in area, and length is $17\frac{1}{2}$ feet ; what is the breadth ?

8. A floor is 392 sq. ft. 68 ins. in area, its width is 17 ft. 8 ins. ; what is the length ?

9. An area is 156 ft. 8′; its length is 17 ft. 9′ 4″. What is the width ?

10. A sitting room is 15 ft. 6 in. long, 12 ft. 4 ins. wide, and height 12 ft. 6 in. ; how much paper will it take to cover the walls ?

11. The cost of papering a room 19·5 feet long, 17·25 ft. wide, and 10 ft. high, with paper 1·6 feet wide is £1 7s $6\frac{3}{4}$d ; what is the price of the paper per yard ?

12. It costs £7 5s 10d to carpet a room at 6s 3d per sq. yd. If the room is 13 ft. 4 in. wide ; what is its length ?

SCALES OF NOTATION.

Change the following :—

1. 2195 denary to binary, ternary, and quaternary.
2. 3716 denary to quinary, senary, and septenary.
3. 3542 denary to octonary, nonary, and undenary.
4. 475 octonary to binary, senary, and duodenary.
5. 20114 quinary to septenary and undenary.
6. 23545 senary to octonary and nonary.

7. 2139e duodenary to senary and ternary.
8. 2586 nonary to undenary and duodenary.
9. 6564 septenary to denary and nonary.
10. Add the senary numbers 51432 and 34153.
11. Add the nonary numbers 73628 and 47154.
12. Find the difference in the octonary numbers of 634152 and 356257 ; 51273 and 22346.
13. Multiply 87416×238 nonary and 58 t $3 \times$ t 97 undenary.
14. Divide 65462 by 45 septenary and 3320086 by 374 nonary.
15. Change 325·43 senary to denary and octonary.
16. Change ·214 senary to denary, and 3·02101 quaternary to denary.
17. Find the L.C.M. nonary of 245, 351, 426, and 436.
,, G.C.M. octonary of 25366 and 231311.
,, square of 7384 and of 3526 nonary.
,, square root of 420652 septenary.
,, cube root of 151044070 octonary.

Find what weights of a series, 1, 2, 4, 8, 16 lbs., etc., would be used to weigh 233 lbs., each weight being used only once.

RIGHT ANGLED TRIANGLE.

P = Perpendicular. B = Base. S = Hypothenuse or Slant height.

Formulæ, $P = \sqrt{S^2 - B^2}$ or $\sqrt{(S+B)(S-B)}$; $S = \sqrt{P^2 + B^2}$;

$B = \sqrt{S^2 - P^2}$ or $\sqrt{(S+P)(S-P)}$.

Find the Slant Height from the two given sides.

1. 42 ft., 56 ft.; 260 yds., 342 yds.; 7584 in., 3937 in.
2. 3 ft. 6 in., 2 ft. 10 in.; 63 ft. 4 in., 48 ft. 7 in.; 1400 links, 2020 links.
3. 11 chains 20 links, 3 chains 30 links ; 48 poles, 36 poles.

Find the Base when Hypothenuse and Perpendicular given.

4. 647 chains, 431 chains ; 20·08 fur., 13·45 fur.
5. $8\frac{1}{2}$ fur., $6\frac{3}{4}$ fur.; 3 chains 13 links, 100 links.

Find the Perpendicular when Hypothenuse and Base given.

6. 16417 ft., 14208 ft.; 6 ft., 9 in., 3 ft. 8 in.
7. 694 links, 548 links ; 36 yds. 2 ft., 24 yds. 2 ft.
8. At a distance of 15 ft. from a house I placed a ladder 18 ft. long, how high would it reach ?
9. A ladder 20 ft. long stands upright against a wall, how far must the bottom be pulled out to lower the top 1 foot ?
10. The top of a pole being broken off, struck the ground at a distance of 15 feet from the foot of the pole ; find the height of the whole pole, the length of the broken piece being 39 ft.

11. A precipice on the bank of a river is 74 ft. high, and a string reaching to the opposite side is 132 ft., find the breadth of the river.

12. A ladder 50 ft. long is so placed that it will reach a window on one side 28 ft. high, or by turning it over it will reach another on the other side 36 ft. high ; how wide is the street?

SQUARE AND RECTANGLE.

Square, S = Side. A = Area. D = Diagonal.

Formula, $S^2 = A$. $S = \sqrt{A}$. $D = \sqrt{2A}$.

Rectangle, L = Length. B = Breadth. $L \times B = A$; $L = \frac{A}{B}$; $B = \frac{A}{L}$

13. Find the areas of the squares whose sides are 39 ft.; 486 yds; 694 links; 145 chains; 48 ft. 3 in.; 462 yds. 2 ft.; 74 chains 25 links.

14. Find the areas of the rectangles whose sides are 47 ft. × 82 ft.; 16 ft. 4 in. × 4 ft. 3 in.; 87 ft. 9 in. × 12 ft. 6 in.; 894 links × 437 links; 625 chains × 441 chains.

15. From the following areas of squares find the side, 1296 sq. yds.; 2304 sq. ft.; 625 sq. links; 441 sq. chains.

16. In the following rectangles find the breadth, area 441 ft., length 49 ft.; area 1728 yds., length 64 yds.; area 1 acre, length 44 yds.; area 6750 yds., length 270 ft.

17. In the following rectangles find the length, area 432 sq. ft., breadth 12 ft.; area 273 sq. yds., width 39 ft.

18. In a rectangular field, length 426 links, breadth 271 links, find the diagonal.

19. A field in the form of a square is in area 11250 sq. yds., find the diagonal.

20. In a field the shape of a rectangle the area is 38352 sq. yds., and breadth 47 yds., find the length.

21. A garden 86 yds. long has an area of 1232 sq. yds. 6 sq. ft., find its breadth.

TRIANGLES.

To find area or surface.

Right angled $\frac{B \times H}{2} = A$; $B = \frac{2A}{H}$ and $H = \frac{2A}{B}$

Isosceles and Equilateral do. do. do.

or Equilateral, Area = $Side^2 \times \cdot 433$; Side = $\sqrt{\frac{A}{\cdot 433}}$

Scalene, or when all the sides are unequal.

a. b. c. represent the 3 sides, and S their sum.

$$\text{Area} = \sqrt{\frac{S}{2} \times \left(\frac{S}{2} - a\right) \times \left(\frac{S}{2} - b\right) \times \left(\frac{S}{2} - c\right)}$$

or $\frac{1}{4} \sqrt{S \times (S - 2a) \times (S - 2b) \times (S - 2c)}$.

22. Find the area of the right angled triangle whose base is 32 ft., and perpendicular height 63 ft.

23. Find the perpendicular when the area is 672 sq. yds., and base 24 yds.

24. The area of a triangle is 84 sq. yds., the perpendicular 42 ft., find the base.

25. An isosceles triangle has each of its two equal sides 10 yds., and base 12 yds., find the area.

26. A field in the form of an isosceles triangle has an area of half an acre, and its base 44 yds., find its direct length.

27. An equilateral triangle has each of its sides equal to 23 ft., find the area.

28. The area of an equilateral triangle is 73·177 sq. ft., find its side.

29. Find the areas of the triangles whose sides are 13 ft., 14 ft., 15 ft. ; 28 ft., 36 ft., 42 ft. ; 45 ft., 62 ft., 66 ft. ; 263 yds., 143 yds., 374 yds. ; 874 links, 942 links, 473 links ; 3 chains, 4 chains, 5 chains.

30. Find in links the side of an equilateral triangle which shall contain an acre.

31. Find the height of a triangle similar to another 12 ft. in height, but which shall contain only $\frac{1}{3}$ of the area.

PARALLELOGRAMS—RHOMBUS AND RHOMBOID.

Area = Length × Height. $A = L \times H$. $H = \frac{A}{L}$. $L = \frac{A}{H}$.

32. A rhombus has for its length 153 ft., and perpendicular breadth or height 126 ft.; find its area.

33. A rhombus is 4625 links in length, and perpendicular breadth 3500 ; find its arca in sq. poles.

34. A garden in the shape of a rhombus has for its area 2465$\frac{1}{3}$ sq. yds., and length 86 yds. ; find its perpendicular breadth.

35. A piece of ground of rhomboidal shape is 13$\frac{1}{2}$ yds. long, and 4$\frac{1}{2}$ yds. broad ; find its area in sq. yds.

36. A rhomboidal play ground is 1717 sq. yds. in area, and is 34 yds. in perpendicular breadth ; find length in yds.

37. A parallelogram whose length or base is 14 chains, 16 links, and height 9 chains, 48 links ; find its area.

38. If a parallelogram has for its area 1125 sq. ft., and base 15 yds. ; find its height.

TRAPEZOID AND TRAPEZIUM.

Area of Trapezoid = Sum of the 2 sides × Height ÷ 2 or $\frac{(S+S)\times H.}{2}$

Area of Trapezium = Sum of perpendiculars × Diagonal ÷ 2 or $\frac{(P+P)\times H.}{2}$

39. The diagonal of a trapezium is 80 yds., the two perpendiculars are 36 yds. and 42 yds.; find its area.

40. In a trapezium whose area is 60500 sq. poles, and diagonal 1000 poles, one of the perpendiculars is 90 poles longer than the other; find them.

41. A trapezoid whose parallel sides are 168 and 212 links respectively, and perpendicular distance 121 links; what is the area.

42. In a trapezoid whose perpendicular distance is 14 yds., and area is 322 sq. yds., has one of its parallel sides 10 yds. longer than the other; find the sides.

CIRCLE.

R = Radius, D = Diameter, C = Circumference, A = Area.

$R=\frac{1}{2}D$, $D=2R$, $C=D\times 3{\cdot}1416$; $D=\frac{C}{3{\cdot}1416}$; $R=\frac{C}{2(3{\cdot}1416)}$;

$C=2R\times 3{\cdot}1416$; $A=D^2\times{\cdot}7854$, or $R^2\times 3{\cdot}1416$, or $\frac{C^2}{4(3{\cdot}1416)}$, or $\frac{1}{2}C\times\frac{1}{2}D$.

$D=\sqrt{\frac{A}{{\cdot}7854}}$; $R=\sqrt{\frac{A}{3{\cdot}1416}}$; $C=\sqrt{A\times 4\times 3{\cdot}1416}$.

43. The diameter of a circle is 304 ft.; find circumference.
44. ,, circumference ,, 160 ft.; ,, diameter.
45. ,, radius ,, 800 links ,, circumference.
46. ,, circumference ,, 165 yds.; ,, radius.
47. The diameter of a field is 640 yds.; find its area.
48. The radius of a circular green is 20 poles; find the area.
49. The circumference of do. is 700 ft.; find the area.
50. A circular field is $3\frac{1}{2}$ acres in extent; find its diameter.
51. Find the circumference of a field whose area is 2420 sq. yds.
52. The difference between the circumference and the diameter of a circle is 12 ft.; find the diameter.
53. The area of a semicircle is 14 sq. yds.; find its radius; also its perimeter.
54. The diameter of a circle is 12 ft.; find the area of a square inscribed in it.

55. The radius of a circle is 6 ft.; find the side of a square inscribed in it.

56. What will be the side of a square equal in area to a circle whose circumference is 200 ft.

57. If the side of a square be 300 links, what will be the circumference of the circumscribed circle.

58. A square field has an area of $5\frac{1}{2}$ acres; find the area of the circle having the diagonal for its diameter.

59. A man wishing to find the number of acres covered by a circular pond, walked round it at the rate of $3\frac{1}{2}$ miles an hour, and found that it took him $2\frac{1}{2}$ hours to complete the journey; what was the area of the pond.

60. Three equal circles, each 10 in. in diameter, touch one another externally; find the area of the space included between them.

61. A field in the form of an equilateral triangle contains half an acre, a horse is tethered by a peg at one corner; what must be the length of his rope to enable him to graze exactly half the field?

AREA OF RING.

Area of larger circle—Area of smaller circle.

$(D^2 - d^2) \times \cdot7854$ or $(R^2 - r^2) \times 3\cdot1416$.

$(D+d)(D-d) \times \cdot7854$ or $(R+r)(R-r) \times 3\cdot1416$.

Volume of a cylindric ring.

Area of section × mean circumference.

62. What is the area of the ring formed by two circles having 25 ft. and 35 ft. for diameters?

63. Find the area of a ring of which the radii are 24 and 36 ft.

64. The diameter of the larger circle is 60 ft., the width of the ring is $2\frac{1}{2}$ ft., find area of ring.

65. The radius of the outer boundary of a ring is 18 ft., the area of the ring is 300 sq. ft.; what is the radius of the inner boundary?

66. A circular bowling green has a diameter of 60 yds., a walk round its outer edge is $4\frac{1}{2}$ ft. wide; how many sq. yds. does the walk cover?

67. The outer circumference of a circular walk is 360 yards, the walk contains 700 sq. yds., find its breadth.

68. A gentleman has a circular bowling green 220 ft. in diameter, the walk round it is as large as one fourth of the green; what is the breadth of the walk?

69. The section of a flat ring is 2 inches square, and the outer circumference is 3 ft., find the volume of the ring.

SQUARE AND TRIANGULAR PRISM.

Solidity = area of end × length.
Surface = area of the sides + area of the 2 ends.

70. The base of a triangular Prism is 36 sq. ft. 9 in., and length 12 ft. 6 in., find the volume in cubic feet.

71. A triangular Prism has the sides of its base respectively 3, 4, and 5 feet, and length 20 ft., find its volume and total surface.

72. A Prism whose base is an equilateral triangle each side 4 ft., has a length of 9 ft., find volume and surface.

73. Required the surface of a triangular Prism of which the length is 13 ft., and the sides of base are respectively 19, 23, and 34 inches.

74. Find volume and upright surface of a square Prism whose length is 41 ft., and one side of its base 15 in.

CYLINDER.

Volume = Area of Base × Height = B × H.
Surface (upright) = Circumference × Height = C × H.
For total surface add area of both ends.

75. The height of a cylinder is $16\frac{1}{2}$ ft., and radius of base is 3 ft., find volume and surface.

76. The length of a cylindrical roller is 4 ft., the exterior diameter 2 ft., and the thickness of the metal $\frac{3}{4}$ of an inch, find its solidity.

77. The perimeter of a cylinder is $2\frac{1}{2}$ feet, the length $5\frac{1}{4}$ feet. How many sq. feet in the upright surface.

78. The solid content of a cylinder is 86·63398 cubic ft., and the diameter of its base 38 inches, find its height.

79. The curved surface of a cylinder is 129·591 sq. ft., and its length 15 ft., find the diameter of base.

80. A circular well 40 feet in depth and 5 feet in diameter. How many gallons will it hold (277·274 cubic inches = a gallon).

81. The volume of a cylinder is 100 cubic feet, with height 4 ft. 3 in. Find the radius of the base.

82. What is the volume and upright surface of a cylinder 48 feet long and 6 ft. in circumference?

83. The diameter of a well is 3 ft. 6 in., and its depth 40 ft. How many cubic yds. of earth were dug out?

84. Find the volume of a cylindrical shell, the radii of inner and outer surface being 5 in. and 6 in., and the height 7 feet.

85. The length of a pipe is 13 ft., the bore $1\frac{3}{4}$ in., and the thickness $1\frac{1}{8}$ in., find solid content.

86. The area of the curved surface of a right circular cylinder is 8 square feet, the circumference of the base is 4 ft. 6 in.; what is the height?

87. The area of the curved surface of a cylinder is 10 sq. feet, and the radius of the base $2\frac{1}{2}$ ft., find the height.

88. The area of the upright surface of a cylinder is 4 sq. ft., and the volume of the cylinder is 5 cubic feet, find area of the end.

CONE AND PYRAMID.

Solidity = Area of Base × Perpendicular Height ÷ 3.

$$\text{Sol.} := \frac{A \times P}{3}\ ;\ P = \frac{3\ S}{A}\ ;\ A = \frac{3\ S}{P}.$$

Surface (upright) = Circumference of Base × Slant Height ÷ 2.

$$\text{Surf.} := \frac{C \times \text{Sl. H}}{2}\ ;\ C = \frac{2\ \text{Surf.}}{\text{Sl. H}}\ ;\ \text{Sl. H} = \frac{2\ \text{Surf.}}{C}.$$

Total Surface = Upright Surface + Area of Base.

89. Find the solid content and upright surface of a cone whose diameter of base is 3 ft., and perpendicular height 9 ft.

90. Find solid content and total surface of a cone whose radius of base is 5 ft., and slant height 13 feet.

91. A pyramid on a square base whose side is 6 ft., and perpendicular height 12 ft., find solidity.

92. Find solidity and upright surface of a square pyramid, side of base being $18\frac{1}{2}$ feet, and perpendicular height 30 feet.

93. Find the total surface of a cone whose diameter of base is 25 ft., and perpendicular height 40 ft.

94. Find the volume and surface of a cone, circumference of base being 22 ft., and height 12 ft.

95. Find volume and total surface of a cone with diameter of base 12 ft., and slant height 10 ft.

96. Find the volume and upright surface of a pyramid on a square base, side of base being 6 ft., and height 12 ft.

97. Find the volume and upright surface of a pyramid on a rectangular base, sides being 6 ft. and 4 ft., and height 18 ft.

98. The volume of a cone is 600 cubic inches, and area of base is 100 sq. inches, find the height.

99. The volume of a square pyramid is 3422·5 cubic ft., perpendicular height, 30 ft., find side of base.

100. The solid content of a cone is 76·8 cubic ft., and the diameter of base 5 ft., find perpendicular height.

101. The volume of a cone is 1000 cubic ft., the perpendicular height is 60 ft., find the area of the base.

102. In a pyramid on a square base the volume is 500 cubic feet, perpendicular height 15 ft., find the side of the base.

103. Find the upright and total surface of a cone whose circumference is 24 ft., and slant height 12 ft.

104. Find the upright and total surface of a pyramid on a square base, whose slant height is 16 ft., and side of base 4 ft.

105. The upright surface of a cone is 400 ft., and the slant height 20 ft., find the radius.

106. The total surface of a pyramid is 15 sq. ft., the side of base is 2·5 ft., find the slant height.

107. A sugar loaf in the form of a cone weighs 16 lbs., and is 12 in. high. If I want exactly 2 lbs. ; how much must I cut off the top ?

SPHERE.

Solidity = Diameter^3 × ·5236 = $\frac{2}{3}$ of Circumscribing Cylinder.

Solidity = $D^3 \times \cdot 5236$ or = $\frac{2}{3} D^3 \times \cdot 7854$. $\therefore$ $D = \sqrt[3]{\frac{\text{Solidity}}{\cdot 5236.}}$

Surface = $C \times D = D^2 \times 3 \cdot 1416$. $\therefore D = \sqrt{\frac{\text{Surface}}{3 \cdot 1416}}$ or

Surface = $\frac{C^2}{3 \cdot 1416}$ $\therefore$ $C = \sqrt{\text{Surface} \times 3 \cdot 1416.}$

108. A globe has a diameter of 6 ft., find solidity and surface.

109. Find solid content and surface of a sphere, radius 2·5 ft.

110. Find the solidity and surface of a globular mound whose circumference is 22 yds.

111. What is the volume of a spherical shell whose internal and external diameters are 12 and 16 inches respectively ?

112. The diameter of a sphere is 5 ft., find the volume of its circumscribing cylinder.

113. A sphere 6 inches in diameter is cut out of a cube of wood, the edge of which is 6 inches, find the quantity of wood cut away.

114. A solid in the form of a right circular cylinder has hemispherical ends, the extreme length is 24 ft., and diameter 3 ft., find the volume.

115. The solidity of a sphere is 447·975 cubic inches ; what is its diameter ?

116. A sphere contains 5946 cubic inches, find the radius.

117. The circumference of a sphere is 36 in.; what is the area of its surface ?

118. The diameter of the sun is 112 times greater than that of the earth ; how many times greater is its volume ?

SEGMENT AND ZONE OF SPHERE.

R = Radius of Base ; C = Circumference ; H = Height ; R and r = Radii of Ends of Zone.

Volume of Segment $= (3R^2 + H^2) \times H \times \cdot5236.$

,, of Zone $= \left\{ 3(R^2 + r^2) + H^2 \right\} \times H \times \cdot5236$

or $= \left\{ R^2 + r^2 + \frac{H^2}{3} \right\} \times 2H \times \cdot7854$

Surface = Circumference × Height = C × H.

119. Find volume and surface of a segment 3 ft. high, and diameter of base 9 ft.

120. Find volume and surface of a segment when radius of base is 24 in., and height 6 in.

121. Find volume of a zone of a sphere whose height is 4 in., and radii of the ends 7 and 8 inches.

122. Find volume of a zone of a sphere, height 2 inches, and diameter of sphere is 10 inches.

123. Find surface of a zone of a sphere, heights 6 in. and 9 in., and radius of sphere 15 inches.

124. Find surface of a zone on same side of centre, distances of ends of zone from the centre 4 in. and 8 in., and radius of sphere 14 inches.

125. Find surface of a zone on opposite sides of centre, distances of ends from centre being 3 in. and 5 in., and circumference of sphere is 60 in.

FRUSTUMS OF A CONE OR PYRAMID.

Ee = Ends ; Volume of Pyramid $= (E^2 + e^2 + Ee) \times \frac{H}{3}$

Volume of Cone $= (D^2 + d^2 + Dd) \times \cdot7854 \times \frac{H}{3}$

or $= (R^2 + r^2 + Rr) \times 3\cdot1416 \times \frac{H}{3}$

Volume of Rectangular Pyramid. A = Area of End.

$$\text{Vol.} = (A + a + \sqrt{Aa}) \times \frac{H}{3}$$

Surface = Sum of Perimeters of Ends × $\frac{1}{2}$ Slant Height.

126. Find the volume of the frustums of following Cones :—

Diameter of ends	12 ft. and 4 ft.,	Perpendic. height	16 ft.
Do.	8 ft. and 3 ft.,	Do.	12 ft.
Radii of ends	6 ft. and 4 ft.,	Do.	15 ft.
Circumfe. of ends	12 ft. and 10 ft.,	Do.	8 ft.

127. Find the volume of the frustum of a square pyramid whose sides of bases, or ends, are 15 ft. and 6 ft., and height 12 feet.

128. Find the volume of the frustum of a rectangular pyramid whose ends are 12 ft. by 8 ft. at one end, and 9 ft. by 6 ft. at the other, and height 12 ft.

129. Find the volume of the frustum of a pyramid whose ends are equilateral triangles, the lengths of the sides respectively being 6 ft. and 8 ft., and height 4 ft.

130. Find the upright surfaces of the frustums of the cones whose dimensions are—

Diameters	4 ft. and	3 ft., and slant height		6 ft.
Radii	3 ft. and	2 ft., and	do.	8 ft.
Circumfce.	12 ft. and	10 ft., and	do.	9 ft.

131. Find the whole surface of the frustum of a cone whose radii of ends are 9 ft. and 5 ft., and slant height 12 ft.

132. Find the whole surface of the frustum of a cone with perpendicular height 8 ft., and radii of ends 20 ft and 8 ft.

133. Find the upright surface of the frustum of a square pyramid whose ends are 8 ft. and 5 ft., the straight line which joins the middle point of a side of one end with the middle point of the corresponding side of the other, is 12 ft.

GAUGING.

V = Volume of a Cask; B = Bung Diamr.; H = Head Diamr.
L = Length of Cask; W = Wet inches; D = Dry inches.

$V = (39\ B^2 + 25\ H^2 + 26\ B \times H) \times L \times \cdot000031473.$

Wet ullage of a standing cask less than half full.

$B - \frac{D^2(B-H)}{L^2}$ = mean diameter (mD).

$mD^2 \times W \times \cdot0028326$ = Wet ullage.

Wet ullage of a standing cask more than $\frac{1}{2}$ full.

$B - \frac{W^2(B-H)}{L^2}$ = mean diameter (mD).

$mD^2 \times D \times \cdot0028336$ = Dry ullage.

$V - (mD^2 \times D \times \cdot0028326)$ = Wet ullage.

or subtract dry ullage from volume for wet ullage.

134. Find in gallons the volumes of casks having the following dimensions :—

(1) Length, 48; Bung diameter, 36; Head diameter, 22·7.
(2) Do., 30·5; do., 26·5; do. 23.
(3) Do., 46·9; do., 31·2; do. 26·1.

Find in gallons the wet ullage of the following :—

Length, 50; Bung dr., 32; Head dr., 27; Wet inches, 10.
Do., 40; do., 32; do., 36; do., 12.
Do., 48; do., 40; do., 34; do., 18.

MISCELLANEOUS EXERCISES.

1. Find in links the side of a square field which will contain as much land as one of 6 acres, and another of 3 acres, 2 roods, 16 poles.

2. Find the diagonal of a rectangular field in length 426 links, and breadth 240 links.

3. A cord 20 yards in length reaches from one side of a street to the top of a house 40 feet high on the other side ; how wide is the street ?

4. Find the diagonal of a square that shall be equal in area to a rectangle whose two sides are 40 and 30 ft. respectively.

5. The diagonal of a square field is 1800 links, find its area in acres, roods, poles, &c.

6. A field in the form of a triangle has its 3 sides 450, 360, and 270 yds. respectively, find the area.

7. What will be the cost of carpeting a room 30 ft. 6 inches by 18 ft. 4 in. with carpet 28 inches wide at 4s 9d per yard.

8. A rectangular field is 2000 links long and 350 broad. It is required to cut off a part to contain 1 ac. 3 ro. 20 po. by a line parallel to one of its ends, find the length of the part cut off.

9. B undertakes to run round a rectangular play ground whose sides are 576 and 432 feet, whilst A runs from one corner to the opposite and back. A has 54 feet to run when B has completed his circuit, find A's speed.

10. A field is in the form of a trapezoid of which the parallel sides are 250 and 150 yds., and the perpendicular distance between them is 80 yds., find the area.

11. One diagonal of a trapezium is 20 chains 25 links, and the perpendiculars on it from the opposite angles are 8 chains 24 links and 7 chains 36 links, find the area in acres, roods, poles.

12. Find the diameter of a circle whose area is 3 acres.

13. A circular field is equal in area to 43560 sq. yds., find the radius.

14. There are three fields, the diameters of the two smaller fields are 800 links and 600 links, the third field is equal in area to both ; what is its diameter ?

15. The carpeting of a room twice as long as it is broad at 5s per sq. yd. would cost £6 2s 6d, and the painting of the walls at 9d per sq. yd. cost £2 12s 6d. Required length, breadth, and height of room.

16. The diameter of a circle is 16 ft., find the area of a square inscribed in it.

17. A circle 12 ft. diameter is inscribed in a square ; what is the area of the space intercepted between the circle and the square ?

18. If a church 50 ft. long and 30 ft. wide accommodate 400 people ; what will be the dimensions of a similar church that would accommodate 1024 people ?

19. What is the diameter of a circular room which shall be twice as large as another 20 ft. in diameter?

20. The outer circumference of a circular walk measured 360 yards, and the walk contained 700 sq. yards; what was the breadth of the walk?

21. A box is 4 ft. long, 2 ft. wide, and $1\frac{1}{2}$ ft. deep, required the dimensions of one similar, but containing 8 times as much.

22. Find the area of a circular ring whose internal and external diameters are 8 ft. and 15 ft. respectively.

23. What will be the cost of turfing a circular plot of ground whose diameter is 180 ft., a circular fountain standing in the centre of 18 ft. diameter?

24. A right-angled triangle has its base 16 ft., and perpendicular 12 ft. A triangle is cut off from it by a line parallel to the base of which the area is 24 sq. ft.; what are the lengths of the sides of that triangle?

25. What is the length of the side of an equilateral triangle which cost as much for paving the area of it at 8d per sq. foot as for palisading its 3 sides at a guinea per lineal yard?

26. A cylinder is made of metal one inch thick, its inner diameter is 3 ft. 9 in., find its outer circumference and the area of the piston which works in it.

27. A closed vessel formed of metal one inch thick, external dimensions 8 ft. 3 in., 7 ft. 5 in., and 4 ft. 3 in., and weighing 3 cwts. 1 qr. 8 lbs.; what would be the weight of a solid mass of metal of the same dimensions?

28. Find the height of a cone similar to another 20 ft. high, and containing one half of its solidity, or the distance from the top at which the cone may be cut into two equal portions by a section parallel to the base.

29. The wheels of a chaise, each 4 ft. high, in turning within a ring moved so that the outer wheel made two turns while the inner made one, and their distance from one another was 5 ft.; what were the circumferences of the tracks described by them?

30. The slant height of a cone is $5\frac{1}{2}$ yds., and the diameter of the base $2\frac{1}{2}$ yds., find the cost of renewing the upright surface at 1s 3d per sq. foot.

31. A sphere and a cube have the same surface; how much greater is the volume of the sphere than that of the cube?

32. Two men have a grinding stone 30 inches in diameter, they agree that the one should grind down $\frac{2}{5}$ths of it, and the other the remainder; how much of the radius should the first grind down?

33. A pyramidal roof 16 ft. high standing on a square base which is 24 ft. on each side is covered with sheet lead $\frac{1}{16}$ of an inch thick, find the weight of the lead, supposing a cubic inch to weigh 7 ounces.

34. A piece of iron containing 11 cubic feet is drawn out into a cylindrical rod, 14 yards long; what is the thickness of the rod?

35. A top of a circular table is 7 ft. in diameter and an inch thick; how many cubic feet does it contain, and what will be the cost of polishing its upper surface at 6d per sq. ft.?

36. The diameter of a vessel is 20 in. at the bottom, 18 in. at the top, and depth 10 in., find the content.

37. A tent made in the form of a conic frustum of a right circular cone is surmounted by a cone lying at a different angle, find the number of sq. yds. of canvas required for the tent, supposing the diameters of the ends of the frustum to be 28 ft. and 16 ft. respectively, the height of the frustum being 8 ft., and the height of the conical part 6 ft.

38. What is the solid content of a grinding stone 36 in. diameter, 6 inches thick at the circumference, and 9 in. thick in the centre?

39. A cylinder 24 ft. long, diameter 4 ft., is closed at each end by a hemisphere, find the cost of painting it at one halfpenny per. sq. foot?

40. A frustum of a cone has its slant side 8 ft., and the diameters of its bases 4 ft. and 1·5 ft.; what is its value at 12s. per solid foot?

41. A globe 19 in. in diameter weighs 73 lbs.; what will be the weight of a globe made of the same material, and whose diameter is 38 in.?

42. A gentleman has a circular bowling green 220 ft. in diameter, and a walk round it which occupies as much as $\frac{1}{4}$th of the bowling green; what is the breadth of the walk?

43. A person wants a cylindrical vessel 3 ft. deep which shall hold twice as much as another 28 inches deep and 46 inches in diameter; required the diameter of said vessel.

44. A bowling green 300 ft. long and 200 ft. broad is to be raised a foot higher by means of the earth dug out of a ditch which surrounds it; to what depth must it be dug, supposing its breadth to be 8 ft.?

45. How many wine glasses, 2 in. in diameter at top, 1 in. at bottom, and 1·7 in. deep, will be contained in a tumbler 3·2 in. in diameter at top, 2·5 in. at bottom, and 3·6 in. deep?

46. Find the depth of a box 1 ft. 6 in. long, 1 ft. 2 in. wide, that will contain as much as a cylinder 1 ft. 6 in. in diameter, and 20 in. long.

47. A square hole 2 inches wide is cut through a solid cylinder whose radius is $\sqrt{2}$, so that the axis of the hole cuts the axis of the cylinder at right angles; how much of the material will be cut away?

48. An acre of ground was laid off with a chain, which was afterwards found to be 3·6 in. too long; how much more than an acre was laid off?

49. The height of a zone of a sphere is $2\frac{1}{2}$ ft., the diameter of the sphere is $6\frac{1}{2}$ ft.; what is the area of the curved surface?

50. Find in gallons the volume of a cask 47·5 inches long, bung diameter 28·6, and head diameter 26·5.

FORMULÆ FOR SIMPLE INTEREST, COMPOUND INTEREST, DISCOUNT, PRESENT WORTH, AND INSURANCE.

To find Interest. $\text{Interest} = \dfrac{\text{Cap.} \times \text{Rate} \times \text{Time}}{100}$

,, Rate. $\text{Rate} = \dfrac{100 \times \text{Interest}}{\text{Cap.} \times \text{Time}}$

,, Time. $\text{Time} = \dfrac{100 \times \text{Interest}}{\text{Cap.} \times \text{Rate}}$

,, Capital. $\text{Capital} = \dfrac{100 \times \text{Interest}}{\text{Rate} \times \text{Time}}$

To find the Capital which will amount to a certain amount at a given rate and time.

$$\text{Capital} = \frac{100 \times \text{Amount}}{100 + (\text{R} \times \text{T})}$$

Compound Interest; A = Amount; R. rate; T. time.

$$\text{Interest} = \left(1 + \frac{\text{R}}{100}\right)^{\text{T}} \times \text{Capital} - \text{Capital}$$

$$\text{Amount} = \left(1 + \frac{\text{R}}{100}\right)^{\text{T}} \times \text{Capital}$$

$$\text{Capital} = \frac{\text{Amount}}{\left(1 + \frac{\text{R}}{100}\right)^{\text{T}}}$$

$$\text{Present Worth} = \frac{\text{Amount} \times 100}{100 + \text{RT}}$$

$$\text{Discount} = \frac{\text{Amount} \times \text{RT}}{100 + \text{RT}}$$

To Insure so as to recover both Insurance and Premium.

P. = Annual Premium. V. Value of Insurance.

$$\text{Insurance} = \frac{\text{V.} \times 100}{100 - \text{P.}}$$

EXAMINATION PROBLEMS.

First Series. Suitable for all Examinations.

1. Find the value of $\dot{3}\dot{7}$ of $\frac{\frac{17}{240}}{3\frac{17}{25} + 2\frac{1}{10}}$ of $\dot{4}2857\dot{1}$ of £4 4s.

2. Find the square root of 16·5649, and the cube root of 24642·171.

3. A merchant sells a third of a cargo of goods for £228, thereby losing 5 per cent. on the cost of that portion. For what must he sell the remainder in order to realize 5 per cent. on the cost of the whole cargo?

4. A man invests £40,600 in the 3 per cents. when they are at $101\frac{1}{2}$. Find (1) the amount of his stock; (2) his yearly income; (3) the actual rate of interest at which his money is invested.

5. Extract the square root of $3\dot{6}\dot{8}\dot{7}$ and of $21 - 8\sqrt{5}$; each to four places of decimals; also, cube root of $151\frac{19}{27}$.

6. Find in factors the least common multiple of 67,925; 51,870; 46,585; 27,225.

7. The first of 5 clerks can copy 3 lines as soon as the second can copy 4, the second can copy 5 as soon as the third can copy 3, the third can copy 7 as soon as the fourth can copy 8, and the fourth can copy 14 as soon as the fifth can copy 17. How many lines will the fifth copy while the first is copying 490?

8. A grocer buys one kind of tea at £7 14s a cwt., and another kind at 2s a lb. In what proportion must he mix the two to gain 50 per cent. by selling the mixture at 2s 6d a lb.?

9. Find the value in pounds, shillings, and pence, of $3\frac{5}{17}$ of £49 4s $11\frac{1}{4}$d $- 1\frac{1}{6}$ of $\frac{22}{35}$ of £91 1s 3d. Reduce the result to the decimal of £1000.

10. Find (by Practice) the value of 129 acres at £34 13s 4d per acre. If a plot measuring 3 roods 31 poles $15\frac{1}{8}$ yards were taken off, by how much would the value be reduced?

11. The rent of an orchard is paid by selling the apples at 12s for a bushel and a half when the number of apples produced is 8442; at what price per quart must the apples be sold to pay the rent when the number produced is 7236?

12. At what rate per cent. per annum will the simple interest on £920 2s 1d amount to £71 9s $3\frac{3}{4}$d in 2 years 3 weeks 5 days? (1 year = 365 days).

13. A sum of money was divided among 5 people; 4 of them received respectively ·15, $\frac{3}{40}$, ·1, and $\frac{3}{8}$ of the whole, while the 5th received £105 3s 6d. What was the sum divided?

14. A person has a sum in $3\frac{1}{2}$ per cent. stock which yields an income of £66 10s a year. If he sell out at $72\frac{1}{4}$, and buy stock yielding $6\frac{3}{4}$ per cent. at $106\frac{3}{4}$; what will be the change in his income, allowing $\frac{1}{8}$ per cent. brokerage on each transaction?

15. From $\frac{5}{8}$ of $\frac{3\frac{8}{9}}{2\frac{4}{5}}$ of ·192 subtract $\frac{35}{121}$ of $\dot{3}\dot{4}9206\dot{}$.

16. A person entitled to £2877 10s 1½d in 2½ years time, discounts his expectation at 7½ per cent. compound interest; what is the estimated present value?

17. A wall is 15 ft. 8 in. long, 11 ft. 6 in. high, and 11 inches thick, and has in it a doorway 6 ft. 3 in. high, by 2 ft. 4 in. broad; find the number of bricks contained in it, each brick containing $165\frac{7}{12}$ cubic inches.

18. The first, second, and third class fares on a railway are 3d, 2d, 1d, per mile respectively; find the distance travelled by two men, one of whom travels first class one quarter of the distance, and the remainder second class, and pays 8s 9d more than the other man, who travels third class all the way.

19. If A can mow $\frac{2}{5}$ of a field of grass in 7½ days, and B can mow $\frac{3}{5}$ of the same field in 9½ days, in what time can A and B together mow the whole field?

20. A man bought 63 sheep, and sold $\frac{4}{9}$ of them at a profit of 15 per cent., $\frac{1}{7}$ at a profit of 50 per cent., and the remainder at a loss of 25 per cent. What did he pay for the sheep if his gain was £3 17s on the whole transaction?

21. If a person owe a certain amount payable in 2½ years hence, in what time ought he to pay $\frac{3}{8}$ of the debt so that he may retain the remainder for 3½ years?

22. Multiply duodecimally 19 ft. 8 in. 3 pts. by 17 ft. 2 in. 6 pts., and the product by 12 ft. 6 in. What does the product become when expressed in cubic feet and the fraction of a cubic foot?

23. Simplify $\dfrac{(583\frac{1}{5} \text{ of } \cdot 078125)^{\frac{1}{2}}}{30\,(\dot{\cdot}0\dot{4}8\dot{3} \div \frac{43\frac{1}{2}}{90})} \times (3\frac{7}{8} + 4 \times \frac{2}{3}1\frac{1}{2})$.

24. A man owes a debt to be paid in three equal instalments at the end of 3, 9, and 12 months respectively, discount being allowed at 5 per cent. true method: £1274 paid at present will discharge the entire debt. How much did he owe?

25. A person can row 8 miles an hour on still water, and he finds it just takes him twice as long to row up as to row down the river; find the rate of the stream.

26. A and B start at the same time from two points, 27 miles apart. A going at the rate of 3 miles every 55 minutes, and B 2½ miles in 38 minutes; when and where will they meet?

27. The cash price of goods differs from the credit price, which is 8 per cent. more than the former; find the cash price when the credit price is £1 7s.

28. A cistern can be filled by one cock in 40 min., by a second in 30 min., by a third in 35 min., and can be emptied by a fourth

in 20 min. ; in what time would the cistern be filled if the four cocks are all opened together ?

29. If I borrow money at 3 per cent. interest, payable yearly, and lend it immediately at 5 %, payable half-yearly (receiving compound interest for the 2nd half year), and gain thereby at the end of the year £660 ; what was the sum of money which I borrowed ?

30. At a game of billiards A can give B 15 points in 50, and he can give C 20 in 50 ; how many can B give C in a game of 70 ?

31. A pays B a debt a year before it is due, mercantile discount being allowed. If B had waited for payment till the end of the year, he would then, money being supposed to produce 5 per cent. interest, have been £5 richer than by the actual arrangement ; what was A's debt ?

32. A dealer buys 80 tons of coals, and after selling them again at 1s 6d per sack, finds that he has gained £4. Had he sold them at 1s 4d per sack he would have lost £6. Find the cost price per ton, and the weight of a sack of coals.

33. In how many years will £250 double itself at $2\frac{1}{2}$ per cent. simple interest, and at 4 % compound interest ?

34. A who travels $3\frac{1}{4}$ miles an hour, starts $2\frac{1}{2}$ hours before B, who travels the same road at the rate of $4\frac{1}{2}$ miles an hour ; when will B overtake A ?

35. If silver be worth 5s 6d an oz., and pure gold be worth £4 5s an oz. ; what would be the weight of a 15s piece containing 92·5 per cent. of pure gold, and the rest silver ?

36. The population of a country would increase annually 3 per cent. if it were not for emigration, which annually carries off ·5 per cent. ; what will be the increase per cent. in the population after 5 years ?

37. A person rows a distance of $1\frac{1}{2}$ miles down a stream in 20 minutes, but without the aid of the stream it would have taken him half an hour ; what is the rate of the stream per hour ? and how long would it take him to return against it ?

38. A bag contains a certain number of sovereigns, twice as many shillings, and three times as many pence ; the value of the whole sum in the bag is £267 ; find how many sovereigns, shillings, and pence, it contains respectively.

39. A field of 50 acres is to be drained, 10 men in 6 days of 9 hours each drain 30 acres. How many men additional must be employed to complete it in 3 days of 10 hours each ?

40. To the difference between ·5 of a mile and ·375 of a furlong add ·163 of $2\frac{1}{2}$ miles, and express the result as the fraction and decimal of a geographical mile.

41. A tradesman buys 4 cwt. of goods for £15, intending to gain $\frac{3}{5}$ of his outlay by the sale ; but a guinea's worth at this calculation being damaged, at what price shall he sell the remainder per cent. to gain as much upon the whole outlay as he intended ?

42. Add $2\cdot8\dot{7}\dot{6}\dot{3}$, $\cdot5\dot{6}$, $\cdot7\dot{8}\dot{1}$, $3\cdot\dot{1}7\dot{6}4\dot{8}$ and $\cdot1\dot{8}$.

43. Subtract $\cdot5\dot{3}7\dot{6}$ from $\cdot\dot{8}10\dot{2}$ and $\cdot05\dot{1}\dot{6}$ from $\cdot\dot{3}1\dot{8}$.

44. Multiply $4\cdot10\dot{8}$ by $\cdot3\dot{8}\dot{7}$ and $8\cdot4\dot{9}\dot{7}$ by $1\cdot0\dot{6}$.

45. Divide $53\cdot62\dot{7}1\dot{4}$ by $3\cdot4\dot{3}7\dot{6}$ and $68\cdot9\dot{3}\dot{1}$ by $3\cdot7\dot{6}\dot{2}$

46. A bill for £550 is discounted on 15th November; it was drawn 25th June, at 8 months; find the present value at $4\frac{1}{2}$ p.c.

47. A person possessing £10,000 of 3 per cent. consols, sells out when they are at $93\frac{5}{8}$, and invests the proceeds in 4 per cent. stock at $101\frac{7}{8}$; find the change in income, allowing $\frac{1}{8}$ per cent. brokerage on each transaction.

48. What sum of money will amount to £699 13s $2\frac{2}{5}$d in 2 years, reckoning compound interest for one year at 4 °/₀, and the other at $3\frac{1}{2}$ per cent. per annum?

49. If I buy a map at 6s 9d with 3 month's credit; for what should I sell it to gain 5 per cent., and give 9 month's credit?

50. A man bought a horse and carriage for £100, and sold the horse at a gain of 50 °/₀ on its prime cost, and the carriage at a loss of 25 °/₀, thus gaining 5 °/₀ on his whole outlay; what were the buying and selling prices of the horse and carriage respectively?

51. A person sells 20 lbs. of tea at a profit of 5 p.c., and 30 lbs. at a profit of 8 p.c.: if he had sold it all at a profit of 6 p.c. he would have received one shilling less; what was the prime cost?

52. It is half-past 3 o'clock. At what time will the two hands of a watch overlap each other first?

53. Divide £1766 17s 10d among A, B, C, so that 5 times A's share, 6 times B's share, and 7 times C's share, may be equal.

54. A sum of £948 12s is so divided among A, B, C, and D; as often as A takes £2, B takes £3; when A takes £3, C takes £6; and when B takes £4, D takes £5; apportion the money.

55. What must the sum assured on goods worth £1880, premium 5 guineas, policy duty 5/-, and commission $\frac{1}{2}$ per cent., so that in the event of loss, the value of the goods and the premium may be recovered.

56. A, B, and C, are sent to empty a cistern by means of 2 pumps of the same bore, A and B go to work first, making 37 and 40 strokes respectively per minute, but after five minutes, they make each 5 strokes less a minute, and after 10 minutes more, A gives way to C, who works at the rate of 30 strokes per minute. the cistern is emptied in 22 minutes altogether, and the men are paid 12/7 for their labour; how shall the money be divided?

57. Goods are purchased at £28 10/6 per cwt., the trade profits are 15 p.c. on invested capital, the income tax due thereon at 9d in the £ is £24 3/6; how many cwts. were purchased?

58. If sugar be bought at £3 14/- per cwt.; how must it be sold per cwt. to gain $12\frac{1}{2}$ p.c. after allowing a discount of $7\frac{1}{2}$ p.c.

59. I borrow £130 on the 5th March, and pay back £132 10/6 on the 18th October; what rate per cent. per annum have I paid?

60. A merchant's profits annually amounted to 20 p.c. on his stock, out of which he paid bills at the year's end to the amount of £200. At the end of 3 years his stock had increased to £4456; what had he at first?

61. If the square of a certain number be multiplied by $\frac{2}{7}$ of 5, the product will be $2\frac{4}{5}$; find the number.

62. I bought £128 5/- worth of goods and kept them on hand for six months when money was worth 8 °/₀, I then sold them at a nett gain of 6 °/₀; for how much were they sold?

63. What sum will be left out of the amount realised by £1000 stock standing at $91\frac{1}{10}$ if enough be set aside to clear £43 12/- in $1\frac{3}{8}$ years, at $3\frac{1}{2}$ per cent. per annum?

64. In a mile race between a bicycle and a tricycle their rates were proportional to 11 : 8. The tricycle had 320 yds. start, but was beaten by half-a-minute; find the rates of each.

65. If 14 men, 15 women, and 20 boys (the men working for 15, the women 10, and the boys for 18 days, of 9 hours long) can finish $\frac{7}{10}$ of a certain work; what part of the work could 18 men, 12 women, and 24 boys do, the men working 16, the women 9, and the boys 20 days of 8 hours each; supposing in the former case, 2 men equals 3 women or 4 boys; and in the latter case, 1 man=2 women or 3 boys?

66. A, B, and C, will trench a field in 12 days; B, C, and D, in 14 days; C, D, and A, in 15 days; and D, A, and B, in 18 days; in what time will it be done (1) by all together, (2) by each separately?

67. A beats B 3 yds. in a race of 300 yds., C can beat B $9\frac{3}{4}$ yds. in same distance; by how much should C beat A in a mile race?

68. Going a journey of 27 miles into a town, I met the coach, which left town at the same moment that I started from home (7 o'clock), at the 18th milestone from town; supposing that it travels 10 miles an hour, determine the hour when we meet, and the time when, proceeding at the same rate as before, I shall reach London.

69. If a snail, on the average, creep 2 ft. 7 in. up a pole during 12 hours of the night, and slip down 16 inches during the 12 hours in the day; how many hours will he be in getting to the top of a pole 35 feet high?

70. A shopkeeper buys $\frac{1}{2}$ cwt. of tea at 4s 2d per lb., and mixes it with tea which cost him 2s 11d per lb.; how much of the latter must be added to the former that he may sell the mixture at 3s 8d per lb. and gain 20 °/₀ on his outlay?

71. The interest on a sum at simple interest is £7, and the discount for the same time is £5 9s $4\frac{1}{2}$d; what is the sum?

72. A cistern has 3 pipes, A, B, and C; A and B can fill it in 3 and 4 hours respectively, and C can empty it in 1 hour. If these pipes be opened in order at 3, 4, and 5 o'clock, when will the cistern be empty?

73. A man skates 6 miles an hour with the wind at the rate of 10 miles an hour, and returns in 50 minutes; how much does the wind accelerate or retard his speed?

74. The distance between Newcastle and Carlisle is 60 miles, 15 miles uphill, 20 downhill, and the rest level. If a bicyclist goes at the rate of 12 miles an hour on level ground, 15 miles downhill, and 5 miles uphill; what will be the difference in time between going to Carlisle and returning?

75. A certain sum of money was divided among 3 persons, A, B, and C. Suppose A's share was £264 12s, and C's share £2 8s, and that A's share contained the value of B's as often as B's contained C's; what must the whole amount have been?

76. The sum of the incomes of A and B is £1073 7s 6d, and the difference is £78 2s 6d; what is the income of each?

77. A gentleman, after paying income tax at 9d per £ on his whole income, and other taxes at 10d per £ on the remainder, has left £5180 3s 6d; what was his whole income?

78. Find the cubic roots of 1030331603303001, and of $\frac{31944}{41472}\frac{0}{0}$.

79. Three regiments start for the same place at the rate of 8, 9, and 10 miles an hour, the second starts 3 hours after the first; how long after the second should the third start that they may both overtake the first at the same time?

80. A merchant buys tea at 3s 6d per lb., and $1\frac{1}{4}$ times as many lbs. of coffee at 1s 4d per lb.; he sold the tea at 4s 3d per lb., and the coffee at 1s 2d per lb., and gained £3 0s 8d in all; how many lbs. of each did he buy?

81. Bought goods for £600, and 8 months' credit, and am offered £40 discount for present payment; at what rate per cent. is this offer made?

82. Divide £954 9s between A, B, and C, so that A's share may be to B's share as 3 : 5, and B's to C's share as 10 : 11.

83. What fraction is that from which, if $\frac{2}{3}$ of $\frac{3-1\frac{1}{4}}{2\frac{2}{5}}$ be subtracted and the remainder be divided by $\frac{5\frac{1}{8}}{16\frac{2}{5}}$ the result will be $\frac{1}{3}$?

84. A man spends every year one tenth of his income, and invests the rest in annuities at the rate of £90 for every annuity of £3. Supposing his income £1000 a year to begin with, what will it be at the end of 4 years?

85. A ship at sea is known to sail at the rate of 10 miles per hour when the tide is with her; on the tide returning, her rate of sailing is reduced $\frac{1}{3}$ the former rate. After sailing for some time at this rate, the wind increasing, her speed is increased $\frac{1}{5}$ the last rate. Required the distance travelled over in 12 hours, supposing her to sail $\frac{1}{5}$ of the time as in the first case, $\frac{2}{3}$ of the time as in the second case, and the remainder as in the third case.

86. £19200 is divided between A, B, C, and D, so that A gets £2880 and $\frac{2}{5}$ of B's share, B gets £1920 and $\frac{3}{5}$ of C's share, and C £1200 and $\frac{3}{4}$ of D's share; what are their respective shares?

87. A person can walk a certain distance in $4\frac{1}{2}$ hours, taking three steps of 32 in. each in 2 seconds; how many steps of a yard each must he take in a minute to walk half that distance in 2 hours?

88. Invested £5760 in the 4 per cents. at $94\frac{1}{2}$, and sold out so as to gain £288; at what price was it sold?

89. 6 oz. of gold 22 carats fine are melted with 9 oz. 21 carats fine, 12 oz. 18 carats fine, and 3 oz. 20 carats fine; what is the fineness of the mixture per oz.?

90. In 110908116 sq. inches how many acres, &c., and in 96842429 inches how many miles, &c.?

91. Find (by practice) the value of 168 cwt. 3 qrs. 25 lbs. at £4 8s 6d per cwt.

92. A bought goods for £5750, and sold them to B for £6900, who disposed of them to C at a profit of $12\frac{1}{2}$ p.c., and C again sold them to D at an advance of £776·25; how much per cent. above prime cost did D pay for them?

93. Lost 10 p.c. by selling an article for £11 5s, and recovered the loss by selling another for £18 15s; what was the gain p.c. on the second article?

94. Two trains start from opposite directions; the faster from A would reach B in 2 hours. Had the slow one kept time they would have met at $\frac{3}{8}$ the whole distance from B, but owing to an accident to it they met at $\frac{1}{4}$ the whole distance from B; how much was the slow train late on reaching A?

95. A vessel whose speed was $9\frac{1}{4}$ miles per hour started at 8 o'clock to go a distance of 74 miles. A second vessel whose speed was to that of the first as 8·:·5 starting from the same place arrived 5 minutes before the first; when did the second vessel start?

96. The weights of pure gold and of alloy in a sovereign are in the ratio of 113 : 10, and the price of pure gold is £3 17s $10\frac{1}{2}$d per oz.; find the weight of a sovereign, supposing its value to be that of the pure gold it contains.

97. If an oz. of standard gold, of which the weight of the alloy is represented by two parts out of 12, be worth £3 17s 6d; find the value of 10 lbs. of jewellers' gold in which the weight of alloy is represented by ·416, the value of the alloy being neglected.

98. A passenger and a goods train start from the ends of a line 120 miles long and meet in the middle of it; the goods train started an hour earlier than the other and goes at $\frac{3}{4}$ speed; find the rate of each.

99. A and B set out for London and Brighton at the same time, a distance of 50 miles; A walks 5 miles an hour, but after 10 miles, rests 40 minutes; B walks constantly 4 miles an hour; when will they meet?

100. The price of gold is £3 17s 10½d per oz.; what ought 539 sovereigns to weigh, supposing $\frac{1}{12}$ of each to be pure gold, and that the value of a sovereign is equal to the gold it contains?

Second Series, for all Examinations.

1. Find the value of $\left(\frac{5\frac{1}{2}-3\frac{1}{7}}{3\frac{1}{4}+\frac{1}{9}} \text{ of } \frac{3\frac{1}{2}+7\frac{1}{8}}{3\frac{1}{15}}\right)+\frac{\frac{1}{2}+\frac{1}{3}}{\frac{15}{16}}$

2. Find to six places of decimals the value of $\sqrt{\cdot 4}-\sqrt{\cdot 000005}$; also the cubic root of 967·068262369.

3. Find the value of 6·45 tons − 18·09375 cwt. + 3·60714285 of 168 lbs.

4. Find by duodecimals the volume of a cubical tank whose edge is 3 yds. 2 ft. 6⅔ ins.; express the result in cubic feet.

5. The diagonal of a cube is $21\sqrt{3}$; find the cost of painting its surface at 4d a square yard.

6. If 174 lbs. 6 oz. be bought for £52 11s 5d, and 12 p.c. of the whole be allowed for waste; at how much per lb. must the remainder be sold to gain 12½ p.c.?

7. A grocer sells 56 lbs. of tea at 4s 6d per lb., 112 lbs. at 3s 4d per lb., and 166 lbs. at 2s per lb.; by the first he gains 40% of the cost, by the second 25 p.c., and by the third 50 p.c.; find his whole outlay and his gain per cent.

9. A person possessed of £1500 three per cent. consols sells out at 93; he invests half of the proceeds in 6 p.c. foreign securities at 116¼, £200 in a mortgage at 4½ p.c., and loses the rest; compare his first and final incomes.

10. A merchant bought 2688 yds. of cloth at 8s 8d per yd., and sold one fourth at 10s 2d, one third at 10s 11½d, and the remainder at 11s 4½d per yd.; what was the whole gain, and also the gain p.c.?

11. The sum of £6500 was divided between A, B, and C, so that A's share was half as great again as B's share, and twice as great as that of C; how much did each receive?

12. If a ship can sail 12 miles per hour, but a current is going in the opposite direction at the rate of $\cdot\dot{1}42857\dot{1}$ miles per hour; how long will she take to go a distance of 747 miles?

13. If two trains meet, the one 150 yds. long moving at the rate of 50 miles an hour, and the other 240 yds. long moving at the rate of 40 miles an hour; how long will they be in passing each other?

14. A watch set accurately at 1 p.m. indicates 10 minutes to 7 at 7 o'clock; what will be the true time when the hands point to 7?

15. How much will remain of $\frac{7}{9}$ of £25 10s after the following articles have been paid for, viz.; $1\frac{4}{5}$ yds. of cloth at £$\frac{4}{5}$ per yd., $17\frac{7}{8}$ yds. of calico at $\frac{8}{9}$ of 1s per yd., and $12\frac{1}{3}$ yds. linen at $\frac{1}{8}$ of £1 per yd.?

16. A tradesman sells goods either for cash, at a discount of $2\frac{1}{2}$ p.c., or at 4 months' credit. If I buy goods worth £31 10s, and pay half of the sum in ready money, taking credit for the rest; what will the goods cost me?

17. A gentleman left $\frac{3}{7}$ of his property to his eldest son, $\frac{3}{8}$ to another, and the remainder to a third, which turned out £2125 less than the sum of the shares of the other two; required their shares?

18. Divide 20 shillings among A, B, and C, and give B $\frac{1}{3}$ more than A, and C 10d less than A.

19. A and B jointly purchase a certain quantity of rum, of the price of which A advanced £180 more than B; by retailing it at 18s 9d per gallon, A cleared £105, and B £60; find the quantity of the rum, and the gain per gallon.

20. A merchant bought 40 yds. of cloth for £28 2s 6d, he gave 12s 6d a yard for part of it, and 15s a yard for the rest; how many yards of each did he buy?

21. Two men on opposite sides of a wood 500 yds. in circumference start at the same instant to walk round it in the same direction, the one walks 60 yds., the other 65 yds. in a minute; when will they come together, and how many circuits will each have made?

22. Two men row $24\frac{1}{2}$ miles down a river in $3\frac{1}{2}$ hours; how long will they take to return, the velocity of the water being $2\frac{1}{4}$ miles an hour?

23. A person after spending £54 17s 6d less than $\frac{3}{5}$ of his annual income has £93 6s 8d, more than $\frac{1}{3}$ of it remaining; what is his income?

24. What is the smallest number which, when divided by 72, leaves 52 of a remainder, and divided by 100, leaves 72 of a remainder?

25. A purse and its contents are worth £20 3s $6\frac{1}{2}$d, and 7 times the contents added to 4 times the value of the purse is £117 0s $6\frac{1}{2}$d; find their respective values.

26. If 9 men and 12 boys do as much work in a week as 12 men can do, how many boys must assist 4 men so that they may, in a certain time, do the work which 17 men and 16 boys can do in the same time?

27. A clock marks the true time on Monday at noon, but when it is 12 o'clock on Thursday by the clock, the true time is 11.40; what is the time by the clock at 4 p.m. on Saturday?

28. A sold a horse to B at a gain of 5 p.c.; B sold it to C at a gain of 4 p.c.; C to D at a gain of 3 p.c.; D to E at a gain of 2 %, receiving £1195·0575; what did A give for it?

29. How long hence is £238 18s 4d due if its present worth be £203 6s 8d, interest being reckoned at 5 p.c. per annum?

30. Divide £91 7s among A, B, C, D, so that B's share may equal $\frac{2}{5}$ of A's, C's $\frac{2}{5}$ of B's, and D's $\frac{2}{5}$ of C's.

31. At what time between 8 and 9 o'clock do the hour and minute hands of a watch form an angle of 60°?

32. A cubical cistern contains 9 times as much as another; if the depth of the former be 25, what is the depth of the latter?

33. How much brandy at 22s 6d a gallon mixed with three fourths as much at 19s, and with 28 gallons at 25s 6d will make a mixture worth 23s a gallon?

34. By selling wheat at a certain price per quarter I lost 4 per cent. Had I obtained 4s 6d a quarter more for it I should have gained 4 per cent.; at what price did I sell it?

35. Divide 9·614 by ·0000019 and $\frac{2\frac{1}{5}}{5\frac{1}{2}}$ by $\cdot 00\dot{3}$ and multiply the sum of the quotients by ·005.

36. Four bells begin to toll simultaneously, and they toll at intervals of 4, 6, 8, and 10 seconds. After what time will they again toll simultaneously?

37. Find the greatest number which will divide 17260 and 16039, and leave remainders 5 and 2 respectively.

38. Find the value of $\frac{5}{6}$ of $\frac{1}{7\frac{1}{2}}$ of 3 sq. yds. 6 sq. ft. at $\frac{9}{25}$ of $\frac{1}{5\frac{1}{2}}$ of 4s 2d per sq. foot.

39. A can do a piece of work in 20 days, B in 12 days. A and B work at it together for 6 days, and C finishes it in 2 days. In how many days could C have done it alone?

40. A can walk 5 miles while B is walking 4. Suppose A walks 6 hours a day, and B 7 hours a day; how many days will B take in walking a distance which A can accomplish in 14 days?

41. If 7 men working $10\frac{3}{5}$ hours a day can earn £4 15s 3d in $5\frac{1}{4}$ days; what sum will 28 men earn in $15\frac{3}{4}$ days if they work only $5\frac{3}{16}$ hours a day?

42. If A can make 9 articles while B makes 14, and B makes 7 while C makes 6, and C makes 4 while D makes 5, and D makes 45 while E makes 24; how many can E make in the time that A makes 36?

43. The net rental of an Estate after deducting 7d in the £ for income tax, and 5 per cent. on the remainder for the expense of collecting, is £479 11s 10d; what is the gross rental?

44. One farmer asserts that his and his neighbours farms are in the proportion of 5 : 2, his neighbour says they are in the proportion of 3 : 1; by how much do these ratios differ in the 1400 acres of land of which the two farms consist?

45. Two engines 40 miles apart are approaching each other at the rates of 25 and 35 miles an hour. Determine the time and place of their meeting.

46. The circumference of a circle is 30 miles. A, B, and C, start from the same point to go round it, A goes 5 miles an hour, B 4, and C $3\frac{1}{2}$; after how many hours will they be at the starting point? During this time how often will A have overtaken B and C respectively?

47. A barrel is $\frac{2}{3}$ full, and after 14 gallons are drawn off, it is found that $\frac{4}{5}$ of the whole remain; what is the size of the barrel?

48. Find the sum and difference of $5\dot{9}2\dot{5}$ and $\cdot4\dot{2}\dot{7}$. (1) Multiply; (2) Divide the former result by the latter, and give answers in vulgar and decimal fractions.

49. Find the value of $\dfrac{\sqrt{7}+\sqrt{5}}{\sqrt{7}-\sqrt{5}} + \dfrac{\sqrt{7}-\sqrt{5}}{\sqrt{7}+\sqrt{5}}$.

50. Simplify $\sqrt{128} + 2\sqrt{32} - \sqrt{18} + \sqrt{50} - 3\sqrt{2} + 3\sqrt{8}$ and $\sqrt[3]{24} + 2\sqrt[3]{81} - \sqrt[3]{192} + 5\sqrt[3]{3} - 3\sqrt[3]{375} + \sqrt[3]{648}$.

51. A quantity of goods weighed $4\frac{1}{2}$ lbs. when suspended at one end of a balance, and $5\frac{1}{4}$ when suspended at the other; find the correct weight.

52. Bought cloth at 19s 6d a yard; at what price per yard may I sell it to allow a discount of 5 per cent., and still gain 20 %?

53. By selling tea at 5s 4d per lb. a grocer gained $\frac{5}{27}$ of the prime cost; what was gained per cent. by selling a quantity at $4\frac{1}{2}$d per oz.?

54. A merchant owes a manufacturer £240, payable in 4 months, but, being pressed to pay £100 ready money, he requires to know the equated time for paying the remainder.

55. Two chests of tea of same size and quality are consigned to A, B, and C. A at first was to have $\frac{4}{5}$ of a chest, B $\frac{5}{6}$, and C the rest. But A and B purchase $\frac{3}{11}$ and $\frac{2}{11}$ of C's share respectively. How much will each have?

56. Divide £195 5s between A, B, and C, so that A's share : B's share :: 6 : 5 and A's share : C's share :: 15 : 8.

57. Simplify $\dfrac{2\cdot375}{3\cdot1\dot{6}}$ of $\dfrac{4\frac{4}{8}}{\cdot0625} \div \dfrac{8\cdot\dot{8}}{5\frac{5}{8}}$ of $\dot{5}7142\dot{8} - \left\{ \dfrac{2\cdot8 \text{ of } 2\frac{3}{11}}{1\cdot1\dot{3}\dot{6}} - 4\frac{8}{15} \text{ of } \dfrac{4\cdot\dot{4} - \cdot28\dot{3}}{1\frac{2}{3} + 2\cdot6\dot{2}\dot{9}} \right\}$

58. In a company of 6270 persons the number of women : number of men :: 1 : 8; boys : women :: 2 : 9; and girls : boys :: 3 : 10; how many were there of each?

59. Extract square root of 5186·160225 ; $\frac{5\cdot29}{7\cdot29}$; $20\frac{341}{841}$

60. A farmer engages 24 men and 40 women to cut down his crop in 15 days of 12 hours each, but after 10 days' reaping he wishes the remainder cut down in 2 days of 10 hours each ; how many extra men must be employed to do it, 3 men being equal to 5 women ?

61. If 5 men and 7 women earn £7 13s in 6 days, and 2 men and 3 women earn 3 guineas in the same time ; in what time will 6 men and 12 women earn £60 ?

62. If 20 Thalers = 3 sovereigns, 4 sovereigns = 100 francs, 1 franc = 20 sous, and each Thaler = 24 groschen ; how many groschen are there in 600 sous ?

63. A and B travel 120 miles together by rail. B intending to come back again takes a return ticket, for which he pays one half as much again as A. They find that B travels cheaper than A by 4s 2d for every 100 miles ; find the price of A's ticket.

64. A workman is engaged for 28 days at 2s 6d per day ; but instead of receiving any thing, is to pay 1s per day for every day he is idle. He receives altogether £2 12s 6d ; for how many idle days did he pay ?

65. What sum invested at 5 % compound interest will amount in 3 years to £9781 18s 7½d ?

66. The walls of a room 35 ft. long, 17 ft. 6 in. wide, and 18 ft. high, are to be panelled to the height of 4 ft., at 5s 6d per sq. ft., and papered above the panelling, at 1s 6d per sq. yd.; the doors and windows reduce the area to be panelled by 25 sq. ft., and that to be papered by 60 sq. ft. ; what will be the cost of the whole work ?

67. There are 3 partners in a business where shares are in the proportion of 9 : 7 : 3, and an additional profit of 3 per cent. raises the income of the smallest share by £202 10s ; what capital has each partner in the business ?

68. A, B, and C, have an estate divided among them in the proportion of 3 : 5 : 7. If B's share exceeds A's by 202 acres 18 poles 20 yds. 1 ft. 72 in., what is the whole area of the estate ?

69. Find the price of 6 per cent. debentures when £1200 invested in them will produce the same income as £1955 invested in the 3 per cents. at 97¾.

70. Find the amount of £191·761$\dot{3}\dot{6}$ in 3 years at 6·$\dot{3}$ per cent. per annum, compound interest.

71. If 107 lbs. of tea, which cost 2s 6d per lb., be mixed with 122 lbs., which cost 1s 3d per lb. ; how much refuse tea, regarded as worthless, must be added in order that 12½ per cent. profit may be added by selling the whole at 1s 6d per lb. ?

72. By using false weights a grocer charges 17d when he should charge 16d ; find the number of ounces in his false lb., and his gain p.c.

73. A person possesses stock in the 3 per cents. which are at $73\frac{1}{8}$. If he were to transfer it to the $3\frac{1}{2}$ per cents. at $81\frac{1}{4}$, his income would be increased by £4 10s. How much stock has he in the 3 per cents.?

74. Four dozen of wine cost £9, one half being bought at one rate, and the other half at another. By selling the cheaper kind at a gain of 15 p.c., and the dearer at a loss of 8 p.c., the same price is charged for both; what did each kind cost per dozen.?

75. A watch, which gains 15 seconds per hour, indicates the right time at 8.30 p.m.; what will be the right time between 2 and 3 in the morning of the next day, when the hour and minute hands of the watch point in exactly opposite directions?

76. Two numbers are to one another as $\frac{1}{12} : 1\frac{1}{12}$, and the first is 2816; find the other.

77. Of 5625 persons convicted of crimes, $23{\cdot}5\dot{1}$ per cent. were unable to read or write, $49{\cdot}1\dot{5}$ per cent. could do both fairly, and the rest had received a decent education; what were the numbers in each class?

78. A merchant buys 250 bushels of wheat at 8s per bushel; 4 °/₀ of it is wasted; he sells $13\frac{1}{3}$ per cent. of the remainder at 7s a bushel, $26\frac{2}{3}$ per cent. at 8s a bushel, and the rest at 9s a bushel; what does he gain or lose by the transaction.

79. Calculate the true discount on a bill for £246, drawn on 15th July for 3 months, discounted 3d September, at 4 °/₀.

80. Divide £648 16s $11\frac{3}{4}$d amongst 3 persons, A, B, and C, so that $\frac{1}{17}$ of A's $= \frac{1}{22}$ of B's $= \frac{1}{26}$ of C's portion.

81. The product of two numbers, one of which is $\frac{3}{5}$ of 1015, is added to 38378, and it is found that the sum subtracted from a million leaves half-a-million; what are the numbers?

82. In a crowd $\frac{1}{3}$ of my money is stolen, $\frac{1}{5}$ of this I recover, and lose $\frac{3}{8}$ of what remains. Having received £10, which increased by $\frac{3}{11}$ of the money I then had, I paid away $\frac{2}{3}$, and received back $\frac{1}{7}$ of the bill as discount; what sum then remained?

83. A clock marks the true time on Monday at noon, but when it is 12 on Thursday by the clock, the true time is 11.40; what is the time by the clock at 4 p.m. on Saturday?

84. A stream flows at the rate of $2\frac{1}{4}$ miles an hour. A man rows 18 miles against the stream in 6 hours; how long will he be in returning?

85. What decimal is equivalent to $8{\cdot}5\dot{7}1428\dot{} + 2{\cdot}36\dot{3}6\dot{} - 7{\cdot}3\dot{1}8\dot{} - {\cdot}\dot{3}$

86. Simplify $\dfrac{4{\cdot}2857\dot{1}4\dot{} \text{ of } 3{\cdot}4}{1\frac{3}{10} \text{ of } 2{\cdot}42857\dot{1}} \times \dfrac{{\cdot}4\dot{3} \text{ of } {\cdot}625}{{\cdot}24}$

87. Divide 32547631, by successive division, by the prime factors of 1155, and show how to obtain the complete remainder.

88. How much must I invest in the 3 per cents. at 85 in order to have an income of £780 per annum after paying an income tax of 6d in the £?

89. The population of a country increases 3 per cent. annually, by emigration, to the extent of one half per cent. on the whole; what will be the increase per cent. in 3 years?

90. A, B, C, and D, undertake to do a piece of work; A's rate of working is to B's as 3 to 4; B's to C's as 5 to 4; C's to D's as 5 : 6. A would do it alone in 60 hours; find in what time all four would do it working together.

91. Reduce $\cdot\dot{4}5$ of $2\cdot\dot{1}\dot{6}$ of 2/6 to the fraction of $\cdot0\dot{2}\dot{7}$ of $1\cdot\dot{1}\dot{8}$ of £5

92. Which is the better investment, the 3 per cents. at 91, or the 4 per cents. at 112, and what is the difference per cent. between them?

93. The mean temperature from the 9th to the 15th February, 1877, both included, was 36°.6 a.m.; from the 10th to the 16th, it was 39°.9; the mean temperature on the 9th was 30°.5; what was it on the 16th?

94. A train starts with its full complement of passengers. At the first station it drops one third of these, and takes in 96 more; at the next it drops one half of the new total, and takes in 12 more; on reaching the third station there are found to be 248 left; what number started?

95. In what proportion must a grocer mix black tea at 2s 4d per lb., with green tea at 3s 8d, so as to sell the mixture at 2s 8d per lb.?

96. A shilling weighs 3 dwts. 15 grains, of which three parts out of every forty are alloy, and the rest pure silver. If the value of silver rises 8 per cent., what must be the reduction of pure silver in a shilling?

97. A clerk's salary is regularly progressive, and his average yearly income from 1858 to 1868, both included, is £80. In 1858 his salary was £5 less, and in 1869 £17 more than the average; find his average income from 1859 to 1869, both included.

98. If hats are retailed at 17s each, and that 24 are sold for 17 guineas; what discount per cent. has been allowed?

99. A man sells a horse for £27 6s, and thereby loses 9 °/₀ on the cost price: find the rate per cent. profit on the price of a second, bought for £97 4s, so as to yield a gain nine times the former loss.

100. A gentleman, wishing to allow his son £300 annually, lets him have the yearly dividend arising from the investment of £1803 15s, in a stock bearing 8 per cent. at 188; how much will it be necessary to invest in funds bearing 5 p.c. at 117½ so as to complete the allowance?

EXAMINATION PAPERS.

(No. 1.)

(Principally for Lower Division and Excise Examinations.)

1. Reduce to a single Decimal fraction

$$\frac{2\cdot\dot{7}}{1\cdot5318} \div \frac{\cdot\dot{3}4\dot{2}}{4\cdot2\dot{1}\dot{6}} \times \frac{\cdot04275}{3\cdot0\dot{5}}$$

2. A sum of money was divided among 5 people; 4 of them received respectively ·15, $\frac{3}{40}$, ·1, and $\frac{2}{5}$ of the whole, while the 5th received £105 3s 6d. What was the sum divided?

3. Find the square root of 6246·057024, and the cube root of 8452·264653.

4. A rectangular tank is 37 ft. 5 in. 6 pts. long and 22 ft. 7 in. 8 pts. wide, and has a volume of 329 cub. yds. 21 ft. 273 in. Find (1) by duo-decimals the area of the bottom; (2) the depth of the tank; and (3) the cost of lining the four sides at one shilling per square foot.

5. Reduce the denary numbers 7384 and 51·27 to the duodenary scale, and divide the former by the latter in that scale.

6. Three persons, A, B, C, jointly own an estate, their shares being as $8 : 2\frac{1}{2} : 1\frac{1}{2}$. A sells half his share to C, and C sells 100 acres to B, and their shares are then equal. How many acres was each entitled to at first?

7. When the compound interest on £500 for 3 years is £62 8s 7·68d, what is the rate per cent. per annum?

8. At what rate per cent. per annum, and for how many years will the simple interest on £2700 be £220 10s, if the number expressing the rate be half as much again as that expressing the number of years?

9. If a train 90 yards long, going 40 miles an hour, meets another train going 35 miles an hour, and they pass one another in 4·8 secs., what is the length of the other train? and how long would the faster train have taken to pass the other if they had been going in the same direction?

10. A starts to walk from one town to another at the average rate of 3 miles an hour; 40 minutes later a bicyclist B starts on the same journey at the rate of 12 miles an hour. On reaching the second town B rests half an hour, and after riding 40 minutes on his return journey meets A still on his way. Find the distance between the two towns.

11. Simplify $\dfrac{\sqrt{4+\sqrt[3]{1728}+\sqrt{81}}}{\sqrt[3]{6+\sqrt[3]{512}+\sqrt[3]{2197}}}$ & $\sqrt{3}+\sqrt{27}+2\sqrt{48}-\sqrt[3]{192}$

12. A train starts to go from A to B, a distance of 72 miles. Its proper rate of travelling is 20 miles an hour, but after having

gone 24 miles it meets with an accident which delays it 10 minutes, and diminishes its speed to 15 miles an hour; how much will the train be behind time?

13. A gunter's chain consists of 100 links, and an acre equals 10 square chains. Find the area in acres, roods, and poles of a field which is 26 chains 25 links long and 16 chains 5 links wide?

14. A gentleman bequeaths half of his estate to his son, and one-third of it to three friends, A, B, C, in shares in the ratio of 3 : 2 : 1; he afterwards disposes of £500, and then divides the residue between B and C in shares in the ratio of 4 : 1. If C's portion comes to £6500, how much does each of the others receive?

15. The half-yearly dividends on £18,600 three per cent. stock are invested as they become due in the same fund in augmentation of the stock at 96, 94½, and 93 respectively, By how much will the dividend for the fourth half-year exceed that for the first?

(No. 2.)

1. Reduce to a single fraction

$$\frac{919\frac{2}{17}}{7\cdot\dot{9}5\dot{4}} \times \frac{4\cdot\dot{1}0\dot{0}}{442\frac{3}{37}} \times \frac{7}{11} \text{ of } \cdot07344$$

2. Find the square root of 930·677049 and the cube root of $14586401\frac{19}{27}$, and of $\cdot\dot{2}9\dot{6}$.

3. If a person spends £50 more than $\frac{19}{20}$ of a fixed income in a certain year, £35 less than $\frac{14}{15}$ of it in the next year, and $\frac{11}{12}$ of it in the year after that, and his savings in the three years amount to £705; what is his income?

4. Divide 418·9666 by 6·289 in the duodenary scale; reduce 296·7 from the duodenary to the denary scale; and find the value in decimals of $\cdot\dot{1}\dot{5}$ in the scale of 7.

5. The accounts of a company show that when 54 per cent. of the receipts have been used for working expenses, 10 per cent. set aside for a reserve fund, and a preference dividend paid on £250,000 of the capital at 6 per cent., there will remain £30,000, and this will be just sufficient for a dividend of 2½ per cent. on the rest of the capital. Find the capital and receipts.

6. Two persons set out to walk from A to B; the first walks 4 miles an hour, and in 45 minutes he is $\frac{3}{8}$ of a mile before the other; he then stops half-an-hour, afterwards proceeds at the same rate as before, and in the end arrives half-an-hour before the other, who has walked at a uniform pace all the way without stopping. What is the distance from A to B?

7. A cubic foot of water weighs 1000 oz., and the weight of a given volume of air = weight of same volume of water × ·00125. What weight of air is contained in a room measuring 36 ft. in length, 16 ft. in breadth, and 7½ ft. in height?

8. Two clocks, one gaining 3 min. and the other losing 2 min. per day, are set right at noon. What is the time by the first clock when the second indicates noon a week afterwards?

9. A yard rule made of metal expands in hot weather so as to be ·05 of an inch too long and contracts in cold weather so as to be ·02 of an inch too short. What is the true length of a line the measures of which taken in hot and cold weather by this rule differ by $3\frac{1}{2}$ inches.

10. A person possessed of £1500 three per cent. consols sells out at 93; he invests half of the proceeds in 6 per cent. foreign securities at $116\frac{1}{4}$, £200 in a mortgage at $4\frac{1}{2}$ per cent., and loses the rest. Compare his first and final incomes.

11. The cost of levelling a square exercise ground is £70, and if each side were 3 feet longer, the cost would be increased by £7 3s 6d. What is the length of the side of the square, and the cost per square yard?

12. What principal and at what rate per cent. per annum, simple interest, would amount to £56 13s $10\frac{1}{4}$d in $2\frac{1}{2}$ years, and to £58 6s 3d in $3\frac{1}{3}$ years.

13. A trench 920 feet long, 17 feet wide, and 10 feet deep has been dug by 7 men and 2 boys; the work could have been done in the same time by 6 men and 5 boys. What length of a trench, 15 ft. wide and 12 ft. deep, could be dug by 5 men and 3 boys in half the time?

14. At the beginning of the year a person lent £310 in two separate sums—one at $3\frac{1}{8}$ and the other at $4\frac{3}{4}$ per cent. per annum, and he thus obtained at the end of the year $4\frac{1}{2}$ per cent. interest on the whole? What were the several sums lent?

15. A boatman finds that to row $10\frac{1}{2}$ miles down a tidal stream from A and back again takes him 5 hours $3\frac{1}{3}$ min.; and that to come 4 miles up takes him as long as to go 9 miles down. What is his power of rowing in still water?

(No. 3.)

1. If an English sovereign is equal to 25·25 francs or to $6\frac{2}{3}$ thalers, find how many thalers there are in 16,000 francs, and reduce the remainder into English money.

2. If the duty on two kinds of foreign wine be changed from 3/6 and 2/- per gallon respectively to an uniform rate of 2/6, and in consequence the consumption of the former, which was at the rate of 200,000 gallons per annum, is increased 15 per cent., and that of the latter, which was 700,000 gallons, is diminished 25 per cent., while the cost of collecting the duty is reduced from 2d to $1\frac{1}{2}$d per gallon. Find the gain or loss to the revenue.

3. If a bushel of oats measures 2169·6428571 cubic inches, find the depth of a cubical corn bin which will just contain 42 bushels; and also the smallest whole number of inches in the

diameter of a cylindrical bin of the same depth which will hold as much.

4. If the three per cent. consols are at 81⅞, what must be the price of the 5 per cents. that there may be no loss of income in selling one of the former and re-investing in the latter, allowing for the usual brokerage of ⅛ p.c. of stock on each transaction?

5. For what sum must goods worth £28,800 be insured, at a 3 per cent. insurance premium, in order that in case of loss the owner may recover the value both of the goods and of the premium paid?

6. A fishmonger buys a certain quantity of fish; 21 per cent. of it becomes worthless before it can be sold, and 14 per cent. has to be sold at one-half of its cost price; at what rate per cent. profit must the rest be sold so that upon the whole 50 per cent. may be gained on the original purchase?

7. Any one of a number of men can dig 20 ft. in length of trench for the foundation of a wall, or build 9 ft. (in length) of the wall, or fill up 85 ft. of the trench after the wall is built in a day of 10 hours. Find how many out of 1058 men must be employed day by day in building the wall, so that the remaining men may be just sufficient each day to dig for the next day's building, and to fill up, after the preceding day's building, the same length of trench.

8. A person sets out to walk from A to B at the rate of 4 miles an hour. After he has walked 1⅔ mls., he is overtaken by the coach, which started a quarter of an hour after him. At a distance of 13 miles from A, he meets the coach returning from B, where he has stayed for half an hour; find the distance from A to B.

9. The interest on a certain sum in 4 years is £70 6s 3d, and the true discount for the same time, at the same rate per cent., is £56 5s; find the sum and the rate per cent.

10. A cylindrical reservoir whose diameter is 10 ft., and height 10½ ft., is supplied by two pipes. One of them alone could fill it in 20 minutes; and water flows in through the other at the rate of 200 gallons a minute. If both pipes are opened simultaneously, how long will they take to fill the reservoir, supposing the volume of a gallon of water to be 277·25 cubic in.?

N.B.—The area of a circle is 3·1416 times the square of its radius.

11. Extract the square root of 105404·440241 in the scale of 6, and express the result in the duodenary scale.

12. Simplify $3\frac{1}{3}$ of $\dot{6} + \frac{1\cdot75}{2\cdot625}$ of $17 + 5\cdot75$ of $4 - \frac{1\cdot\dot{7}14285}{2\cdot095238}$.

13. The principal £260 produces a certain sum at simple interest, in a certain time, at a certain rate per cent. per annum; what principal would yield a sum of interest twice as large in ⅔ of the time, at ⅘ of the rate per cent.?

14. Two towns A and B are 30 miles apart. The road goes over a hill, the summit of which is 6 miles from A. Two men set out at the same time from A to B, the former walks 4 miles an hour uphill, and $5\frac{1}{4}$ down; the latter $3\frac{1}{2}$ miles an hour uphill, and $4\frac{1}{2}$ down. How far from A will they meet?

15. How much 3 per cent. stock must be sold out at $89\frac{1}{8}$ in order that the owner's income may be increased £12 by investing the proceeds in 4 per cent. stock at $91\frac{7}{8}$? The brokerage on each sale is $\frac{1}{8}$ per cent.

(No. 4.)

1. Resolve 2145, 1170, and 1287 into their prime factors. Find the value of $\frac{3}{13}\frac{2}{87} + \frac{3}{21}\frac{7}{45} - \frac{4}{11}\frac{7}{70}$ and multiply the result by $514\frac{4}{5}$.

2. Find the number which, being multiplied by $\frac{2}{13}$ of 3, will be equal to $\frac{1}{13}$ of 8 divided by $\frac{2}{67}$.

3. A man adds to his capital annually £50 more than the eighth of the original amount, and at the end of 6 years, finds the whole amounts to £11675; what was the original capital?

4. A ship worth £10520 is so insured that, if lost, the owners may recover both the value of the vessel and the premium of $1\frac{3}{8}$%; on what sum is insurance effected, and what is the amount of premium?

5. Two sums of money, one of them £4 1s 3d more than the other, are lent for a year, the greater at $7\frac{1}{2}$%, the less at 12%, and at the year's end the two loans are jointly repaid with £20 12s $0\frac{1}{4}$d; what were the sums lent?

6. Find the number in the scale of 12 which is equal to 22161 in the scale of 10; divide 55974 by 67 in the scale of 11; and square 123 in the scale of 4.

7. A tradesman marks his goods at a price which will give him 25% profit, and he takes off $12\frac{1}{2}$ per cent. from the marked price for ready money. If an article marked 5 guineas is sold at the reduced price, find (1) what he gets for it, (2) what he gave for it, and (3) what rate per cent. profit on his outlay he still makes.

8. The area of the floors of two rooms is the same, but the volume of one of them exceeds that of the other by 1080 cubic feet. If the length and height of the larger room are 24 ft. and 15 ft. respectively, and the width and height of the smaller room are 18 ft. and 12 ft.; what is the width of the larger, and the length of the smaller room?

9. Two larger circles are concentrie with one which encloses 3927 sq. ft.; find their radii (to 4 placcs of decimals) so that the areas lying between the given circle and the second, and between the second and the outermost, may each equal the area of the given circle.

10. Eight bells begin tolling simultaneously, and they toll at intervals of 1, 2, 3, 4, 5, 6, 7, 8 seconds respectively; how many times will they toll simultaneously in the course of an hour?

11. A wall is to be built to the height of 27 ft., and it is known that each successive 9 ft. in height takes twice as long to build as the preceding 9 ft. In 6 days 12 men raise it to 9 ft.; how many men must be employed to finish it in 4 days more?

12. The mercantile discount on a certain sum due 2 years 8 months hence is £93 2s, but the true discount is £81 13s 4d; find the rate $\%$ and the sum.

13. A person leaves Redhill for London at the rate of 3 miles an hour, and one hour later another person leaves London for Redhill at the rate of $3\frac{1}{2}$ miles an hour. Supposing the whole distance to be $22\frac{1}{2}$ miles, and that the White Hart Inn, Croydon, lies half way; find their distance from the inn when they meet.

14. What number is that which, if multiplied by $\frac{3}{5}$ of $1\frac{3}{7}$ of $8\frac{3}{4}$, will equal 35, and find the value of $4\cdot\dot{0}\dot{9}$ of $2\cdot\dot{0}428571\dot{}$ of $3\frac{1}{2}$ tons at £1 3s 4d per cwt.

15. Three persons invest sums of £575, £450, and £300 respectfully in a venture, on the agreement that the profits shall be divided in such a manner that the rate of interest made by each of them shall be proportional to the sum which he subscribed. In 8 months the profits amount to £124 12s 6d; how much of this will each receive, and what rate of interest does each make?

(No. 5.

1. Express as a vulgar fraction, and also as a decimal, the difference between $25\cdot\dot{1}3\dot{5} \times 13\frac{7}{31}$ and $61\cdot375 \times 5\frac{15}{37}$.

2. From a building site, three plots of ground are let, measuring 2 ros. 17 po. 25 yds., 1 ro. 23 po. 27 yds., and 1 ro. 0 po. 16 yds. 6 ft. 108 in. respectfully; and these together make up $\frac{1}{27}$ of the whole. What is the area of the site in acres, ros. pos. &c.?

3. A dealer imports equal weights of tea, coffee, and cocoa; the value per lb. of the tea is half as much again as that of the coffee, and $1\frac{1}{8}$ as much as that of the cocoa, the whole weighs 54 cwts., and costs £672; at what price per lb. is each article imported?

4. The present worth of a sum of money due 2 years 9 months hence is £56 13s 4d, but if payment were due 2 years 5 months later, the present worth would be £5 less; find the rate per cent. and the sum.

5. The rent of an orchard is paid by selling the apples at 12s for a bushel and a half, when the number of apples produced is 8442; at what price per quart must the apples be sold to pay the rent, when the number produced is 7236?

6. Find the compound interest on £5333 6s 8d for $3\frac{1}{2}$ years at $2\frac{1}{2}\%$, and show that it is equivalent for that time to about £2 11s $7\frac{1}{2}$d per £100 per annum simple interest.

7. Transform 275·9375 from the decimal to the duodenary scale; multiply 432 by 234 in the scale of 5; and extract the square root of 148915 in the scale of 11.

8. Water is rising in a cellar whose level floor has an area of 2000 sq. feet at the rate of 6 inches per hour, and is $1\frac{1}{2}$ feet deep when a pump which discharges at the rate of 1800 cubic feet in an hour is set to work. If the pump is alternately worked for 10 minutes and stopped for 3 minutes, how soon will the cellar be dry?

9. If it costs £7 3s 9d to carpet a room which is twice as long as it is broad with carpet $\frac{3}{4}$ yard wide at 3s 10d a yard, and £2 1s $6\frac{3}{4}$d to paper the walls with paper $\frac{1}{2}$ yard wide at $3\frac{1}{2}$d per yd., find (1) the breadth, (2) the height of the room.

10. If silver be worth 4s 10d per oz., and gold £4·250675 per oz., express as a vulgar fraction of an oz. the weight of a 15s piece containing 92·5 per cent. of pure gold and 7·5 per cent. of silver.

11. 100 acres are planted with barley one year, and 75 the next year. Each year $\frac{1}{4}$ of the produce is of the best quality, and $\frac{3}{4}$ of the remainder of medium quality, which sells at $\frac{3}{5}$ the price of the best; the rest is inferior, and sells for $\frac{2}{3}$ of the price of the medium quality. The second year the yield per acre is $\frac{1}{2}$ as much again as before; and the malt tax having been abolished, the price of the best barley falls 9s 4d per quarter, while that of the medium quality only falls 2s, and the inferior is unaltered in value. If the whole of the barley sells each year for the same total sum, find the prices of the different qualities.

12. On the Eastern Counties Railway an ordinary train takes 50 minutes from Ely to Cambridge; an express train a quarter of an hour less. Supposing an express to leave London at 10.57 A.M., and arrive in Cambridge just as an ordinary train is leaving which arrives in London at 4.20 P.M., find the times respectively taken by these trains.

13. A watch is 1 min. 8·4 sec. too fast on July 28, 1860, at 9 o'clock in the morning, and its daily rate of gain is 7·4 sec. What will be the correct time in the afternoon of August 8th, 1860, when the time by my watch is 20 min. 10 sec. past 3 o'clock.

14. A person sold a certain quantity of 3 per cent. stock at 95; he invested half the proceeds in 5 per cent. railway bonds at 106, and the other half on a mortgage at $4\frac{1}{2}\%$; the brokerage for transfer of the stock amounted to £2 9s $8\frac{1}{4}$d, and the cost of drafting and executing the mortgage deed was £15. After these charges had been paid out of the first year's income there remained 15s 6d more than the previous income from the 3 per cent. stock. How much of this stock was sold?

15. Simplify the fractions

$$\frac{\sqrt{2}\times\frac{1}{7}\sqrt{50}}{3\frac{1}{3}-\sqrt{\frac{11}{175}\frac{2}{6}}} \text{ and } \frac{\sqrt{13}+\sqrt{7}}{\sqrt{13}-\sqrt{7}}+\frac{\sqrt{13}-\sqrt{7}}{\sqrt{13}+\sqrt{7}}$$

and divide the former by the latter.

(No. 6.)

1. Find the sum, difference, and product of $\cdot 96\dot{3}4\dot{5}$ and $\cdot\dot{3}$, and give each result (1) as a vulgar fraction, (2) as a decimal.

2. Two clocks point simultaneously to noon; one of them loses 6 secs. in 9 hrs. and the other gains 9 secs. in 12 hrs. After what interval will they shew a difference of 51 minutes; and what will then be the time by each?

3. Two pieces of silver plate are melted down together; the first weighs 3 lbs. 4 oz. and contains 9 per cent. of alloy, the other weighs 5 lbs. 5 oz. and contains 6 oz. of alloy. What will be the percentage of pure silver in the whole mass?

4. Shew that for a bicycle with a wheel of 56 inches diameter the number of revolutions in 10 seconds is almost exactly the rate in miles per hour. (Circumference $= 3\cdot1416 \times$ Diameter.) If the diagonal of a cube is $21\sqrt{3}$, find the cost of painting its surface at 4d per sq. yd.

5. Find the square root of $11\frac{1}{11}\frac{9}{4}\frac{5}{9}\frac{1}{2}\frac{0}{1}$ and of $\cdot 007$ to 4 places of decimals; also the cube root of $2\cdot 628072$, and show that the result added to the square root of $346\frac{1}{2}\frac{7}{5}\frac{6}{0}\frac{1}{0}$ is equal to 20.

6. A sum of money having been lent at $3\frac{3}{4}$ per cent. per an. for 3 years, the time is afterwards extended for 6 months at 5% per an., and the amount to be paid in the end in consequence of the advanced rate of interest is increased by £1 12s. Find the sum lent, and the whole amount of the interest paid.

7. The product of 3 numbers is $3057\frac{1}{2}\frac{8}{5}\frac{3}{6}$; the greatest of them is $17\frac{3}{4}$; and of the others the greater is not more than $3\frac{1}{16}$ of the other nor less than $2\frac{1}{4}$ of it. Find the limits within which the least must lie.

8. Find by duodecimals the area of a floor whose dimensions are 8 yds. $2\frac{1}{2}$ ft. by 6 yds. $1\frac{1}{4}$ ft. Find the cost of staining a border of 1 foot all round it at 6d per sq. yd., and of laying the interior area with carpet at 4/6 per sq. yd.

9. In a journey of 9 hours a train travels $45\frac{1}{2}$ miles an hour, and stops 30 min. on the road. How long will a train take which travels 39·6 miles an hour, and makes stoppages amounting to $\frac{3}{4}$ of an hour?

10. If a manufacturer makes a profit of 20%, the wholesale dealer a profit of 25%, and the shopkeeper a profit of 40%, what was the cost of manufacturing an article which was sold at the shop for 17/6.

11. Two casks of 48 and 42 gallons are filled with mixtures of wine and water, the proportions being 13 : 7 and 18 : 17 in the two casks repectively. If the contents of the two casks be mixed, and 20 gallons of water be added to the whole, what will be the proportion of wine to water in the result?

12. A man embarks his whole property in 4 successive speculations. In the first he clears 100°/₀, and in each of the others loses 20°/₀. What percentage will he have lost or gained ultimately on his original capital?

13. A crown weighing 64½ oz. was made of gold adulterated with silver. It was found by the water which it displaced to contain 8·5 cube inches of metal, and a cube inch of gold was found to weigh 10·25 oz. and of silver 5·75 oz. Find the weight of gold and silver in the crown.

14. A piece of metal weighing 12 cwt. 60 lbs. has been formed by compounding 3 metals in quantities which by measure are as 5 : 3 : 2; but the weights of equal volumes of them would be as 7 : 11 : 13. What weight of each of the component metals has been used?

15. A merchant having bought 400 tons of coal reckons that by selling them at 17/6½ per ton he will make 5¼°/₀ on his outlay. After selling 300 tons at that rate he disposes of the remainder at a price which reduces his profit on the whole to 5°/₀. Find (1) what he gave for the 400 tons of coal, and (2) at what price per ton the second lot was sold.

(No. 7.)

1. Find the square root of $14\frac{21}{44} \times 2\frac{7}{55} \times \frac{9}{20}$ and of 901·140361, and divide $2\frac{2}{15}$ of 2·0625 by $4\frac{2}{3}$ of $3\cdot\dot{1}4285\dot{7}$.

2. Express $\cdot\dot{7}$ of 3/9 + $\cdot\dot{1}3\dot{5}$ of 6/2 + $\cdot 26\dot{3}$ of £3 15/- as the decimal of £9 8/-, and state which of the three ratios is the greatest 11 : 17, $1\frac{3}{4} : 2\frac{5}{8}$, or ·75 : ·96.

3. Find the cost of £9462 10/- stock in the 3 per cents. at $93\frac{3}{4}$ (inclusive of all charges), and the income it produces. A sells some stock to B, each paying the broker ⅛ per cent. If the broker makes £8 8s 3d by the transaction, what is the amount of stock dealt with?

4. Multiply 43620 by 265 in the scale of 7, and reduce 16325130 from the scale of 7 to the scale of 12, and extract the square root of 553416204 in the scale of 12.

5. The death rate in a town is 16·25 per 1000 of population for a half year of 26 weeks, and 803 persons die in a year of 365 days. What is the population?

6. A vessel making for a harbour fires a signal gun; the flash is seen from the harbour, and the sound follows in 22½ seconds. A tug puts off immediately, and steams in a straight course

towards the vessel at the rate of 12 miles an hour, and from the tug 5 minutes afterwards the flash of a second gun is seen, the sound of which follows in 15 seconds. If sound travels 13 miles per minute, at what rate is the vessel approaching the harbour, and how soon after starting will the tug meet her?

7. A person has 2 casks with wine in each; in order to have an equal quantity of wine in each he pours out of the first, which contains the larger quantity, into the second as much as the second already contains; he next pours from the second into the first as much as the first then contains; and again pours from the first into the second as much as the second contains; each cask then contains 16 gallons. How much did each contain at first?

8. A cubical box, the interior of which measures 2 ft. 9 in. each way, contains 15625000 small cubes; find the length of a side of each of the small cubes in decimals of an inch; and find (1) by duodecimals the area of a rectangle 42 ft. $10\frac{1}{3}$ in. long and 21 ft. $10\frac{1}{4}$ in. wide; and (2) the length of a side of a square equal in area to the rectangle.

9. A mass of lead ore weighed 7 tons; one portion of it yielded 78% and silver 8 oz. per ton, the remaining portion yielded 75% and silver $7\frac{1}{2}$ oz. per ton. The tolal yield of silver was 55 oz. What average per cent. of lead did the whole mass contain?

10. A contractor undertook to build a house in 21 days, and engaged 15 men to do the work; but after 10 days he found it necessary to engage 10 men more, and then he accomplished the work 1 day too soon. How many days behind hand would he have been if he had not engaged the 10 additional men?

11. Simplify $\frac{7}{15}\left(\frac{\sqrt{2-\frac{3}{5}}\times\sqrt{3+\frac{4}{7}}}{3\sqrt{2-\frac{3}{5}}\div\sqrt{3+\frac{4}{7}}}\right)$ and $\frac{2\times\sqrt{1+\frac{1}{8}}\div\sqrt{1-\frac{1}{8}}}{5\times\sqrt{1+\frac{1}{8}}\times\sqrt{1-\frac{1}{8}}}$

12. A person purchases 150 shares in a company for £100 per share. He sells out at £64 per share when they are paying $2\frac{1}{2}$%, and buys with the proceeds $3\frac{1}{2}$ p.c. consols at 96. What change is there in his income?

13. Two partners A and B started a business, B finding half as much again of the capital as A. At the end of 8 months B withdrew $\frac{1}{2}$ of his capital, and 2 months later on A withdrew $\frac{1}{4}$ of his capital. At the end of the year the profits were found to be £530. To how much of this profit was each man entitled?

14. A can do $\frac{1}{2}$ a piece of work in 24 days, and B can do as much work in 3 days as A can do in 4 days; they work together for 4 days; A then leaves, and C joins B, and they work together for 6 days; then A returns, and the three finish the work in 11 days. How long would it have taken C to do the whole piece of work?

15. An up train 88 yards long, travelling at the rate of 35 miles an hour, meets a down train 88 yards long at 12 o'clock, and passes it in 6 secs. At 15 min. and 3 secs. past 12, the up train meets a second down train 132 yds. long, and passes it also in 6 secs. At what time will the second down train run into the first?

(No. 8.)

1. Find the value of

$$1.\dot{5}7142\dot{8} \text{ of } 18\cdot2 \times \frac{1\frac{1}{12}\frac{3}{6} \times 2\frac{3}{14}}{1\frac{2}{63} - \frac{13}{42}} \text{ of } \cdot\dot{8}57142\dot{8} \text{ of } 12\tfrac{1}{2} \text{ guineas.}$$

2. A certain sum of money placed out at simple interest for 3 years at $5\frac{1}{2}$ per cent. per annum brings in £18 8s 9d more in the three years than if it were placed out at compound interest for the same time at 5 per cent. per annum. Find the sum.

3. The difference between the simple and compound interest on a certain sum of money at 4 per cent. interest would be £3 4s in two years. What is the sum?

4. Obtain the square root of $\sqrt{\cdot 0277}$, and the cube roots of ·008365427 and $1876\cdot0\dot{3}\dot{7}$.

5. If a dollar is worth either 4s $3\frac{3}{5}$d or 5·42 francs, express a franc accurately as a decimal of £1, and find as a vulgar fraction of £1 the difference between 252 francs and £10.

6. Multiply $5\cdot\dot{8}\dot{1}$ by $\cdot4583\dot{}$, and divide $1\cdot1\dot{3}$ by $\cdot000\dot{1}0\dot{2}$. Find the repeating decimal equal to the sum of $\cdot00\dot{3}1\dot{2}$; $\cdot\dot{1}\dot{2}$; $\cdot00\dot{2}4\dot{1}$; $\cdot\dot{0}12343\dot{}$.

7. Five horses start together and continue running round a circular course which is 2 miles in circumference. If they respectively run at 18, 16, 15, 12, and 10 miles per hour, how soon will they all be again together at the starting point?

8. If gold be beaten out into leaves so thin that 275,625 of them placed upon one another will form an inch in thickness, find the weight of a piece of gold leaf 7 inches by 8 inches in size; assuming that a cubic foot of gold weighs 10 cwt. 95 lbs., and that 7000 grains troy equal 1 lb. avoirdupois.

9. The sides and bottom of a cylindrical vessel are made of metal 1 inch thick. Its external depth and diameter are respectively $96\frac{5}{11}$ inches and 162 inches. Within it is concentrically placed a solid cylinder of metal $95\frac{5}{11}$ inches long and 104 inches in diameter. How many gallons of fluid can be poured into the remaining space, if $3\frac{1}{7}$ be taken as the ratio of the circumference of a circle to its diameter, and a gallon be supposed to contain $277\frac{1}{3}$ cubic inches?

10. In what time will the compound interest on £3125, at 4 per cent., amount to £390 4s? If the true discount on a certain

sum, due in a year's time, is £17 13s 4d, money being worth 5 per cent. interest, what would it be if interest were at 6 p.c. ?

11. A watch which loses 5 secs. per hour is set to the correct time at 8.30 A.M., what will be the correct time when the hour and minute hands of the watch are at right angles next after 8 o'clock p.m.?

12. 180 men were employed for 10 hours a day digging a piece of land. At the end of 45 days it was found that only $\frac{4}{9}$ of the task was done. Boys were then taken on in order to complete the work in 30 days more. Find the number of boys required, a boy's work being equal to $\frac{2}{3}$ of that of a man, and the men and boys working only $7\frac{1}{2}$ hours a day for the rest of the time.

13. One workman can do a piece of work in 6 days of $9\frac{1}{4}$ hrs. each, while a second takes 5 days of the same length. A third workman joining them, the three together complete the job in 15 hrs. How many days would the third man have taken by himself to complete the whole ?

14. A stone pillar, in shape a cylinder of 3 feet diameter, with the top rounded into a hemisphere, is found to weigh exactly twice as much as a sphere made of the same sort of stone and of 6 feet diameter. What is the height of the pillar ? (Volume of a sphere $= \frac{2}{3} \times$ the circumscribing cylinder.)

15. Find the compound interest on £2150 for 3 years at 5 p.c. A company obtain a loan from their bankers of £2150 at 5 p.c.; they do the same a year afterwards, and again a year after that; what will their whole debt be at the end of the third year, allowing compound interest on the first two loans ?

(No. 9.)

1. Reduce the following expressions to their simplest forms

(1.) $\left\{ (\frac{9}{10}+2\frac{1}{2}) - (2\frac{1}{5}-1\frac{3}{4}) \right\} \times \left\{ (5\frac{1}{4}+7\frac{2}{3}) \div 16\frac{1}{10} \right\}$

(2.) $3\cdot175 \times 3\cdot\dot{3} \div 57\cdot\dot{7}\dot{2}$.

2. The numbers 1184323 and 589 are expressed in the duodenary scale: divide the former by the latter in that scale. Supposing you had weights of 1, 3, 3^2, 3^3, 3^4, 3^5, &c., lbs., shew which of them you would use in order to weigh 334 pounds.

3. The simple interest on a certain sum of money at $4\frac{1}{4}$ per cent. amounts in 2 years and 11 months to £89 5s; what is the sum ?

4. A person buys 3 per cent. stock at $89\frac{3}{8}$, and after receiving half a year's dividend sells out at $94\frac{5}{8}$, and thus gains £54. What sum did he originally invest ?

5. The area of a side of a cubical cistern is $12\frac{1}{4}$ feet; it is furnished with three taps, one of which could fill the cistern in ten minutes, the second could fill it in twelve minutes, and the

third could empty it in fifteen minutes. If all three be opened, the cistern being empty, find the weight of the water in the cistern at the end of five minutes. (A cubic foot = 1000 oz.)

6. Show that for a bicycle with a wheel of 50 inches diameter the number of revolutions in nine seconds is approximately the rate in miles per hour. Give the ratio of circumference to diameter :: 22 : 7.

7. If 5 per cent. per annum be the current rate of simple interest, what will be the value on the 19th May of two bills of £246 13s 4d and £267 15s, due on March 7th and October 12th of the same year respectively?

8. Two clocks are set right at the beginning of the year, but each day one loses 2 minutes and the other gains 2 min. 12 sec. How many times in the course of the year will the two minute hands be pointing simultaneously at the same hour?

9. A courtyard 15 yds. by 12 yds. is to be paved with pebbles at 3s per square yard, except two footpaths at right angles to the sides, each 4 feet broad, which meet in the centre, forming a cross; these are to be laid in paving stone at 3s 3d per sq. yard. Find the cost of the whole.

10. A man possessing money in the 3 per cent. consols, from which he derives an income of £864, sells out at 90, and invests in railway shares that pay 5 per cent. interest. If his income is increased by £336, at what price does he buy in?

11. Six men are set to a certain piece of work which they could finish alone, working 6 days in the week, in 126 days. At the end of each week 6 more men are added. In what time will the work be done?

12. A fraudulent tradesman removed from a cask a certain quantity of whisky that contained 64 per cent. of alcohol, replacing it by diluted spirit containing 8 per cent. only of alcohol. The cask was then of 50 per cent. strength. What portion of the whole quantity did he take out?

13. A railway company spends £1,616,220 on working expenses during the year; half that sum in laying down new lines, and a third of it in buying rolling stock. The daily receipts are £9238; and at the end of the year a dividend is paid of $6\frac{1}{2}$ on $109\frac{1}{2}$. Find the capital of the company.

14. Extract to five figures the square root of 30, and the cube root of ·03. What is the side of a square field whose area is one acre?

15. What is the greatest common measure of 47495, 138355, and 684740? Three men walk round a circular path 2640 yards in circumference, at rates 132, 120, and 110 yards per minute respectively. If they start together, in how long will it be till they will all be together again?

(No. 10.)

1. Add together $3\cdot5 + 2\cdot8\dot{3} + \cdot\dot{6} + 1\cdot175$,

and simplify $\left\{ \frac{\cdot0019}{3\cdot\dot{1}6} \text{ of } \frac{4\cdot\dot{4}}{\cdot0005} \right\} \div \left\{ \frac{8\cdot\dot{8}}{7} \text{ of } \frac{4}{5\cdot625} \right\}$

expressing the results as decimals.

2. A railway cutting is 35 feet wide at the bottom, and 53 ft. wide at the top, both top and bottom being horizontal, and the slope of each side the same. Its length is 1350 yards, and its perpendicular depth 11 feet. Find the cost of digging it at $3\frac{1}{8}$d per cubic yard. Also, if in each cubic yard of earth dug out of it there is clay enough to make 256 bricks, 384 of which will build a cubic yard of brickwork, find the length of wall, 9 inches thick and 10 ft. 8 ins. high, which may be made from the whole of the earth dug out.

3. A starts at mid-day to walk from London to Reading, a distance of 39 miles, at the rate of 4 miles an hour. B starts at 6 P.M. from Reading for London on a bicycle, going 16 miles an hour. At what hour will they meet? and how far will A be from Reading when B gets to London?

4. Find by duodecimals the capacity of a rectangular tank which is 32 feet long, 18 ft. 8 ins. wide, and 8 ft. 4 ins. deep. What will be the depth of water in the tank when the weight of the water is 56 tons 5 cwts., supposing a cubic foot of water to weigh 1000 oz.?

5. If a sum of £2320 10s, due a year hence, is to be paid off at once, and 5 per cent. discount is to be allowed, what difference will it make in the present payment if 5 per cent. of the whole amount is deducted, instead of the true discount?

6. A rough block of stone, 72 feet long, and having an average transverse section of $56\frac{1}{2}$ square feet, loses one-third of its volume by being shaped, and then weighs 226 tons. Find the weight in lbs. of a cubic foot of it.

7. Find the cube root of 15 to three places of decimals. If 15 cubic inches of metal be made into 8 equal cubes, find the length of the edge of each cube, correct to the thousandth part of an inch.

8. What is the price of $3\frac{1}{2}$ per cent. stock when a sum of £8567 16s 3d, invested without charge for brokerage, produces an income of £324 3s 9d per annum? If brokerage were charged $\frac{1}{8}$ per cent., how much less would the income be from the same investment?

9. Transform 17,400 from the denary to the duodenary scale of notation; and find the square of it in the duodenary scale.

10. Supposing a cubic inch of iron to weigh $6\frac{1}{4}$ oz., what will be the length of a round iron rod $\frac{1}{4}$-inch in diameter, which weighs 5 lbs. 1 oz. 13 drs.? (Circumference of a circle $= 3\cdot1416 \times$ diameter.)

11. Find $\sqrt{71\frac{15}{22}\frac{4}{5}}$; $\sqrt[3]{\cdot 000079507}$; $\left\{\sqrt{\dot{\cdot}\dot{6}^{-1}} + \sqrt{1\cdot 5}\right\}\sqrt{\cdot 24}$.

12. A watch set accurately at noon indicates 10 mins. to 7 at 7 o'clock P.M. What is the true time when the watch indicates 7 P.M., and when will the watch first indicate the true time again?

13. Find to 3 places of decimals the number of metres in length of English silk, $\frac{3}{4}$ yd. wide, worth 2/6 per square foot, which must be given for 10 metres in length of French velvet, $\frac{1}{3}$ metre wide, worth £1 per square metre, if 37 English feet be equal to 36 Rhenish feet, 3·192 of which latter are equal in length to one metre.

14. The cubical contents of a certain cask are equal to twice that of a frustum of a right cone $2\frac{1}{2}$ ft. high, the end diameters of which respectively measure 3 ft. and 3 ft. 6 in. How many such casks will hold as much as 508 cylindrical casks, each measuring internally 5 ft. in height and 3 ft. 3 in. in diameter?

15. An income tax levied at 3d in the £ on the whole incomes of 400,000 householders produces £2,500,000. If the tax be altered so as to produce the same amount when it is only levied on the excess of each income over £200, what is the largest income the possessor of which would benefit by the change?

(No. 11.)

1. Find the sum and also the difference of $\cdot 02\dot{2}\dot{7}$ and $\cdot 1\dot{2}$. Divide the 1st result by the 2nd, and give each of the three results (1) as a vulgar fraction (2) as a decimal.

2. In a race A takes 23 strides to B's 22, but B's stride is 31 inches, while A's is only 30; find the length of the course, so that the quicker may give the slower a start of 19 yds., and yet win exactly by a yard.

3. A sum of money was left A, B, and C in the proportions 7, 9, and 5 respectively. A's share invested at 5 p.c. brought in less than B's invested at 4 p.c. by 12s a year; find the total sum left, and the share each received.

4. If 12 men, 10 women, and 22 children working together earn £16 13s in a week, and a woman earns as much as 3 children, and a man and a child as much as 3 women; what are the daily wages of each man, woman, and child?

5. The distance from Exeter to Penzance is 132 miles. An express train starting 40 min. after a parliamentary train from Exeter, reaches Penzance 13 miles in advance. If the two trains had started at the same time, the express would have reached Penzance 33 miles in advance; how long does each train take to do the journey?

6. My income is derived from 10,000 stock in the $2\frac{1}{2}$ per cents. which are at 80. How must I sell out in order that, after

reinvestment of the proceeds in 4 per cents. at 120, my income may be £12 10s greater than formerly?

7. A man purchases two estates, for the larger one he pays twice as much as for the other; he presently sells them, and gains in doing so 15 per cent. on the cost of the smaller, and $22\frac{1}{2}$ per cent. on that of the larger estate. If he receives £6498, find what he paid.

8. A closed rectangular vessel, made of metal one inch thick, weighs 3 cwt. $22\frac{1}{2}$ lbs.; what would its weight be if made of metal 3 inches thick, its external measurements in each case being 8 ft. 3 in., 7 ft. 5 in., 4 ft. 3 in.?

9. A does $\frac{2}{3}$ of a piece of work in 4 hours, after which B does $\frac{3}{4}$ of what is left in one hour; how long will it take C to finish the remainder if A, B, and C working together can do the whole in 1 hour 20 minutes?

10. The owner of some $3\frac{1}{4}$ per cent. stock spends in a certain year 75 % of his net income, after an income tax of 6d in the £ has been deducted from the interest due to him. The next year the income tax is reduced to 3d in the £, but the rate of interest being also reduced to 3 per cent., he only spends $68\frac{3}{4}$ p.c. of his net income. He then finds his surplus to be £8 11s more than in the previous year; how much stock does he possess?

11. An iron beam whose vertical section is 8 inches square is passed horizontally through a wooden cylinder whose axis is vertical, and whose diameter measures $8\sqrt{2}$ inches, so that equal portions of the width of the beam are on each side of the axis of the cylinder. What volume of wood must be cut away so as just to let the beam pass through?

12. What principal put out at compound interest for 3 years at $4\frac{1}{2}$ p.c. will amount to £7874 0s 11·103d? Find the discount on £170 18 5d due 52 days hence, reckoning $2\frac{1}{2}$d per cent. per day, simple interest.

13. A vessel is full of a mixture of spirit and water in which there is found to be 17 p.c. by measure of spirit; 10 gallons are drawn off, and the vessel is filled up with water. The proportion of spirit is now found to be $15\frac{1}{5}$ p.c. How much does the vessel hold?

14. A and B embark in partnership for 7 years. B is to have $\frac{5}{16}$ of the net profits during the first half of the time, and $\frac{1}{2}$ of them afterwards. After $4\frac{1}{2}$ years, owing to a duty being lowered, the annual profits, which had so far remained stationary, are suddenly increased in the proportion of 6 : 5; but at the same time they are reduced by the creation of an income tax of 7d in the £. By the end of the 7 years B's share of the net profits has altogether amounted to £976. What were the annual profits before the duty was lowered?

15. A prairie fire spreading from a centre at the rate of 80 ft. in a minute has lasted for an hour, when, meeting with drier

grass, its rate is accelerated to the extent of 5%. How much more surface will it cover in the 5 minutes following than it did in the 5 minutes preceding the completion of the hour? (Area of a circle is proportional to the square of the radius.)

(No. 12.)

1. Extract the square root of $4\cdot34027$, and find the number whose square is equal to the difference between the squares of 6467 and 4683, and find value of $\sqrt{2\cdot370}$.

2. A piece of metal measuring 1 ft. 4 in. by $10\frac{1}{2}$ in. by $3\frac{3}{10}$ in. being melted down, how many cubes $2\frac{1}{2}$ inches each way can be cast out of it, and how many $\frac{1}{10}$ inch each way can be made of what is left?

3. If I invest £5075 in 3 per cent. stock at $90\frac{1}{2}$ and $\frac{1}{8}$ p.c. brokerage, what income shall I obtain? and if, after holding the stock for a year, I sell it at $91\frac{3}{8}$, again paying brokerage at the same rate as before, by how much will my capital be increased, and what rate of interest shall I have made on my investment?

4. If 5 p.c. is gained by selling sugar at $5\frac{1}{4}$d per lb., what is the cost price per cwt., and what would the gain p.c. be if 3 cwt. 2 qrs. 26 lbs. 4 oz. were sold for £10 9s $1\frac{1}{2}$d?

5. A gunter's chain consists of 100 links, and an acre equals 10 square chains. Find the area in acres, ros., pos., of a field which is 26 chains 25 links long and 16 chains 5 links wide.

6. The diameters of 4 spheres are to one another as $3\cdot75 : 5 : 6\cdot25 : 7\cdot5$; and the volumes of spheres vary as the cubes of their diameters: prove that the greatest of these 4 spheres is equal to the other 3 together.

7. Reduce the denary number 16784 to the duodenary scale: divide 42404 by 871 in the scale of 11, and find the number in the scale of 4 which when divided by 3 gives the quotient 133.

8. A poor rate of £1178 2s 6d is voted by the Guardians in a Union consisting of three parishes, in which the number of ratepayers is 150, 100, and 75 respectively: find the portion of the rate which must be contributed by each parish (1) if the average sum to be paid by each ratepayer is the same in each parish; (2) if the average varies as 2 : 3 : 4 respectively.

9. A speculator gains 15 p.c. on half his capital and loses $7\frac{1}{2}$ p.c. on the other half in the first 6 months of the year; he then invests the whole, with the balance of profit already made, and in 2 months has lost 10 p.c. of it; after that he makes $13\frac{1}{3}$ p.c. on the residue by the end of the year; find his whole gain or loss p.c. by these transactions.

10. The weight of a gold 10 franc piece is $49\cdot78$ grains; the weight of a silver 5 franc piece is $385\cdot8$ grains, of which the equivalent in pure silver is $\cdot782$ oz. Troy. If the relative value

of coined gold and silver be 19·29 : 1, find the intrinsic value of a gold 10 franc piece, the intrinsic value of pure silver being 4/2 per oz. Troy.

11. A and B undertake to do each one half of a piece of work. A begins at 9 A.M., B at half-past 10, and both stop at 12, having then done $\frac{1}{3}$ of the work between them. They resume work at 1 P.M., and A finishes his share at 4 o'clock. When will B have finished?

12. A person holding £4205 $2\frac{1}{2}$ per cent. stock calculates that by selling at 84 and investing the proceeds in 5 per cent. debentures at the current price, he will improve his income by £63 1s 6d. What is the price of the debentures?

13. Find the present value of a bill for £6433 3s 4d due 3 months hence, the rate of interest being $3\frac{1}{3}$ p.c. per annum. A person holding such a bill disposes of it through an agent at the reduced rate of £100 for £$106\frac{1}{3}$ of the nominal value, and the agent charges a commission of $\frac{1}{6}$ p.c. on the purchase money. What does the person receive?

14. Add together $5\cdot\dot{7}14285$ of 12 cwts. 3 qrs. 14 lbs. and $4\cdot230\dot{7}69$ of 11 cwts. 2 qrs. 12 lbs., and reduce the result to the decimal of 140 tons 11 cwts. 1 qr. 15 lbs.

15. Find to the nearest minute the length of time that a man walking at 4 miles an hour will take to walk round a circular field 10 acres in area; and to the nearest sq. yd. the area of the largest square that could be cut out of the above field?

(No. 13.)

1. A gives B 5 yards start in 100 yards, and is beaten by $\frac{1}{4}$ of a yard. In how many more yards would A have caught np B?

2. If the price of goods be £171 2s $4\frac{1}{2}$d, credit for one year being allowed, what is the true cash price, reckoning $4\frac{1}{2}$ p.c. simple interest per annum.

3. If the interest of £40 for $4\frac{1}{2}$ years be 6 guineas, in what time at the same rate will £240 7s 6d amount to £307 13s $7\frac{1}{2}$d?

4. A vessel in the form of a conic frustum is required to hold $3\frac{1}{2}$ gallons of water: if the diameters of its circular ends be 10 and 6 inches, what must be its length? (1 gal. = 277·274 cub.in.)

5. A man has stock in the $3\frac{1}{2}$ per cents. which brings him in £43 15s a year. He sells out $\frac{1}{5}$ of the whole at $112\frac{1}{2}$, and invests the proceeds in railway debentures at $128\frac{3}{4}$. How much per cent. must the dividend of the debentures be in order that his annual income may be diminished by 10/$11\frac{1}{4}$; no brokerage being charged for the sale of the stock, but $\frac{1}{4}$ per cent. being charged for the purchase of the debentures.

6. Simplify $\dfrac{2\frac{1}{2}-(1\frac{1}{3}\text{ of }2\frac{1}{4})+1\frac{7}{9}}{(2\frac{1}{2}-1\frac{1}{3})\text{ of }(2\frac{1}{4}+1\frac{7}{9})}$ of $\dfrac{\frac{2}{11}+\frac{1}{9}}{\frac{4}{7}-\frac{3}{11}}$ of $3\frac{3}{4}$

and reduce to simplest form $\sqrt[3]{\frac{51}{119}}$ of $\sqrt[3]{\frac{360}{441}}$ of $\sqrt[3]{\frac{225}{343}}$.

7. A watch which goes uniformly is 5 minutes slow at 9 a.m. on May 23rd, and $13\cdot29\dot{6}$ minutes fast at 20 minutes past 2 a.m. on June 6th; find at what instant it was exactly right, and the true time when on May 27th it indicated 45 min. $32\frac{1}{2}$ sec. past noon.

8. Find the number of bricks, each 9 ins. long, $4\frac{1}{2}$ ins. broad, and $2\frac{1}{2}$ ins. thick, required for $96\frac{1}{2}$ rods of brickwork, each rod consisting of $272\frac{1}{4}$ sq. yds. of wall 14 in. thick, allowing for $\frac{1}{16}$th of the whole work being occupied by mortar. If the bricks, together with 7983 spare ones, be piled up in a solid cubical heap before being used; what is the length of its side?

9. The diameter of a sphere being 2 feet, segments, whose heights are 8 and 6 inches respectively, are cut off from the top and bottom by parallel sections; find the volume of the remaining solid Zone.

10. A farmer buys 750 sheep for £1134 on condition that he is not to pay until after the lapse of six months, and the same day he sells them for cash at 29s 8d each; by how much is he a gainer (at the time when he receives the cash) if 10% be the rate of interest?

11. Find in gallons, by Hutton's General Rule, the volume of a cask, length 46·9 ins., bung diameter 30·6 ins., head diameter 26·1 ins.; also find in gallons the wet ullage of a standing cask, length $30\frac{1}{2}$ ins., bung diameter $27\frac{1}{4}$ ins., head diameter 23 ins., wet ullage 10 ins.

12. The 1st class fare on a certain railway is $1\frac{3}{10}$ times the 2d class fare, and it is found that 140 first class, 250 second class, and 520 third class passengers can travel 24 miles for a total sum of £124. But because of the imposition of a government duty, all the fares are raised 5%, and it is then found that 240 first class, 120 second class, and 1080 third class passengers can travel 120 miles for a total sum of £945; what was the original 3d class fare per mile?

13. At what price per quarter must I buy 2400 qrs. of grain so that, if I sell one third of the whole at $2\frac{1}{2}$ p.c., one sixth at $3\frac{1}{4}$ p.c., one eighth at $4\frac{1}{3}$ p.c., and the rest at $5\frac{1}{3}$ p.c. profit, I may gain upon the whole £5 3s 4d less than if I sold it all at 4 p.c. profit?

14. Two equal sums of money are invested in the 3 per cents. at 99, and in the $3\frac{1}{2}$ per cents. at $115\frac{3}{8}$, and the difference of the respective incomes is £1 6s 8d; find the sums invested.

15. When an income is less than £400, income tax is not chargeable upon the first £120. A man having £13,300 in the 3 per cents. sells out £300 at par, and invests it in a mortgage returning 4 p.c. His net income is now 1s 6d less than formerly; what is the amount of the income tax in the pound?

(No. 14.)

1. Simplify $\frac{3\frac{1}{4} \div 2\frac{1}{2}}{2\frac{1}{2} \div 3\frac{1}{8}} \div \frac{7\frac{1}{11} \div 5\frac{4}{7}}{2\frac{1}{6} \div 2\frac{1}{3}}$;

2. Find the square root of 5345344 and 534·5344; and the cube root of ·210644875.

3. A is twice and B just one and a half times as good a workman as C. The three work together for two days, and then A works on alone for half a day; how long would it have taken A and C together to complete as much as the three will have thus performed?

4. A and B at the opposite extremities of the diameter of a circular area 135 miles in circumference start to go round it at the same time in the same direction, A at the rate of 11 miles in 2 hours, and B at the rate of 17 miles in 3 hours. How many rounds will each take before the one will overtake the other, and how long will the chase continue?

5. After having purchased a cask of brandy for a certain sum, I paid a duty of 50 per cent. on the prime cost. A loss of 12 per cent. on the whole outlay is sustained by its sale. In order to make 4 per cent. by the transaction, I should have charged £2 more for the cask. What was its prime cost?

6. A field of 7 acres is sown with turnips, beet, and cabbages; the areas of the crops being respectively as $1\frac{1}{3} : 1\frac{1}{2} : 1\frac{1}{4}$. If the values of an acre of each be also respectively in the same ratios, and an acre of turnips be worth £7, what is the worth of the whole crop?

7. The income tax being 4d in the £, a gentleman has to pay £42 less than when the tax was 7d, although his income has increased by £250. What was his income at first?

8. A cubic foot of water weighs 1000 oz. and of brandy 795 oz.; find the weight of a cubic foot of a mixture in which the proportion of water to brandy is 3 : 2.

9. What sum lent at compound interest for 3 years at $7\frac{1}{2}$ per cent. will amount to £4969 3s 9d?

10. If a man can walk $\dot{5}71428\dot{}$ of 2 furlongs 22 poles 1 ft. $4\frac{1}{2}$ ins. in $2\frac{3}{7}$ minutes, how long will he occupy in walking 149 miles 2 furlongs 15 poles?

11. Find, by Practice, the cost of 59 lbs. Troy 11 oz. 17 dwts. 12 grs. at £4 15s 4d per lb. If the whole be sold at 5 grains for 1d, how much will the profit amount to?

12. A gutter is formed by joining two equal planks so as to have two of their longest edges in contact; the planks are 5 inches wide, and they are fastened together so that the extreme breadth of the gutter is 8 inches. If the gutter is 4 yards long, find how many cubic inches of water it will hold.

13. A trench 920 ft. long, 17 ft. wide, and 10 ft. deep has been dug by 7 men and 2 boys: the work could have been done

in the same time by 6 men and 5 boys. What length of a trench 15 ft. wide and 12 ft. deep could be dug by 5 men and 3 boys in half the time?

14. A running course, one-third of a mile long, is made round a field. There are three boys who can run three laps in five minutes, four laps in six minutes, and five laps in eight minutes respectively. If they start all in the same direction from the same post, how far will each have gone when they all meet again?

15. If the three per cents. are at 95, and Government offer to receive tenders for a loan of £5,000,000, the lender to receive five millions in the 3 per cents., together with a certain sum in the $3\frac{1}{4}$ per cents., what sum in the $3\frac{1}{4}$ per cents. ought the lender to accept?

(No. 15.)

1. Simplify $\dfrac{4\frac{1}{3} \text{ of } 3 - 3\frac{1}{4} \text{ of } 3\frac{1}{2}}{4\frac{1}{4} - 3\frac{1}{3}} \div \left\{ 6\frac{1}{2} \text{ of } \dfrac{\frac{1}{3\frac{1}{3}} + \frac{1}{2\frac{1}{4}}}{3\frac{1}{3} - 2\frac{1}{4}} \right\}$

2. Find the value of $\dfrac{7\cdot\dot{7}\dot{2}}{\cdot\dot{2}\dot{9}\dot{7}}$ of 2 lbs. 11 oz. 8 dwts.; and divide 6 galls. 7 pints by $1\frac{1}{2} + \dfrac{3\frac{1}{2} - \frac{1}{4}}{3\frac{1}{2} + \frac{1}{4}} - 2\frac{3}{5}$ of $\frac{1}{1\frac{3}{8}} - \frac{6}{7}$.

3. A person estimates that four-sevenths of his income will be required for housekeeping, four-sevenths of the remainder for education of his children, and four-sevenths of what still remains for rent and taxes; and he finds that he will then have £135 left for general expenses. What is his income?

4. Find, by duodecimals, the area of a rectangle which measures 27 ft. 9 ins. 4 pts., by 6 ft. 2 ins. 3 pts. If these figures represent the length and height of a nine-inch wall, and the dimensions of a brick are 9 inches by $4\frac{1}{2}$ inches by $2\frac{1}{2}$ inches; how many bricks will be required to build the wall?

5. If a piece of silk costs £15 15s $2\frac{1}{4}$d, and the number of yards in its length is the same as the number of pence in the cost of one yard; what is the length of the silk, and its price per yard?

6. Given that a cubic metre is equal to 35·316581 cubic feet; find the length in feet of a linear metre, correct to four places of decimals.

7. A question being proposed in an examination to find the simple interest on a certain sum of money for $2\frac{1}{2}$ years at $3\frac{1}{4}$ per cent., a candidate by mistake reckoned it for $2\frac{1}{4}$ years at $3\frac{1}{4}$ per cent., and so obtained a result too little by £26 4s 8d. What ought the answer to have been?

8. A person has a sum in $3\frac{1}{2}$ per cent. stock which yields an income of £66 10s a year. If he sell out at $72\frac{1}{4}$, and buy stock

yielding $6\frac{3}{4}$ per cent. at $106\frac{3}{4}$; what will be the change in his income, allowing $\frac{1}{8}$ per cent. brokerage on each transaction?

9. The number 113140331 is in the scale of 7. Conduct the operation of finding its cube root in that scale.

10. Add together $5\cdot\dot{7}14285$ of 12 cwts. 3 qrs. 14 lbs., and $4\cdot\dot{2}30769$ of 11 cwts. 2 qrs. 12 lbs.; and reduce the result to the decimal of 140 tons 11 cwts. 1 qr. 15 lbs.

11. There are two upright pillars on the same horizontal plane, whose heights are respectively 44 ft. and 28 ft., a certain point is taken in that plane between the two pillars, and it is found that the distance of this point from the top of the higher pillar is 125 ft., and from the top of the shorter pillar is 53 ft.; find the distance between the tops of these pillars.

12. A square of very thin gold, whose side is 196 ins., is divided into squares (like a chess board), each of whose sides is 14 inches, and circles inscribed in these squares are punched out of them. If the price of gold leaf is £2 14s per sq. yard, find the value of the remainder of the large square after the circles have been removed.

13. A cistern has two pipes, A and B, which singly could fill it in 9 hours and 10 hours respectively. It has also 2 taps, C and D, which singly could empty it in 12 hours and 8 hours respectively. Suppose that, when the cistern stands half full of water, A and D are turned on for 3 hours, that then B is also turned on for the next 2 hours, that then A and D are turned off, and C is turned on for the next 8 hours, after which all are shut, and the cistern is found to contain 95 gallons more than half its capacity; (1) find the contents of the cistern; (2) find also how much per hour the cistern would lose or gain if all the pipes were set open at once.

14. Divide £13 10s into two parts, so that if one part be divided equally among 20 boys, and the other part equally among 35 men, each man will have twice as much as each boy. How much does each boy get?

15. The population of four cities is in the proportion of the reciprocals of $\frac{2}{3}$; $\frac{4}{5}$; $\frac{5}{6}$; $\frac{6}{7}$; suppose the last to have had 3,600 inhabitants; what were the populations of the others respectively?

(No. 16.)

1. Find the value of $\dfrac{1\frac{1}{8} \div 1\frac{1}{5}}{\frac{2}{3} \text{ of } \frac{5}{9} \div 10\frac{1}{3}} \times \dfrac{1\frac{1}{2} \text{ of } 4\frac{1}{5}}{6\frac{1}{16}\frac{5}{6} \text{ of } 5\frac{1}{3}}$ of £1.

2. A house cost 4 times as much for materials as for labour. If the materials had cost $12\frac{1}{2}$ p.c. more, and the labour $9\frac{3}{8}$ p.c. less, the house would have cost £810 18s 9d; what was it worth?

3. Divide £2850 between A, B, C, giving $\frac{6}{11}$ of B's share to A, and to C, £300 more than what is given to A and B together.

4. A hemispherical bowl whose internal radius is 1 foot is filled with water and placed on a horizontal table. In the water there is placed with its vertex touching the centre of the bottom of the bowl, and its axis verical, a cone whose angle is 90°; find the amount of water left in the bowl after the intrusion of the cone.

5. I took money out of a bank giving $2\frac{1}{2}$ p.c., and bought five £20 shares bearing interest at $8\frac{1}{2}$%, the shares to be paid in 6 equal instalments. I at once paid up 5 instalments, and at the end of a year and a half, the property having increased $17\frac{1}{2}$ p.c. in value, I sold my shares; what did I gain by the whole transaction?

6. Bought £128 5s worth of goods and kept them on hand for 6 months when money was worth 8%. I then sold at a net gain of 6 p.c.; for how much were they sold?

7. What sum will be left out of the amount realised by £1000 stock standing at $91\frac{1}{10}$ if enough be set aside to clear £43 12s in $1\frac{3}{8}$ years at $3\frac{1}{2}$ p.c. per annum?

8. There are 4 vessels of equal capacity, the first is filled with spirit to the extent of $\frac{1}{8}$, the second to $\frac{1}{6}$, the third to $\frac{1}{4}$, and the last to $\frac{1}{3}$; the first is then filled up with water, and from this mixture the second is filled up; again from the second mixture the third is filled up, and in like manner the fourth from the third; what proportion of water to spirit is there in the fourth vessel?

9. A quantity of wine is sold to A at a certain loss p.c., then A sells it to B losing at the same rate, but B sells it to C for the original cost price and gains thereby 44% on his outlay; what was the loss p.c. at which A and B sold the wine?

10. A bicyclist ran $4\frac{1}{4}$ miles in 17 minutes. The distance made in the last minute was $\frac{3}{5}$ of that made in the 1st minute, and the distance made in each successive minute was less than that made in the preceding minute by the same quantity. Find the average rate and decrease per minute.

11. An agent has to receive a rent paid in corn from a tenant and deliver it to the landlord. At each payment he uses, so as to benefit himself, a false balance, such that 9 lbs. in one scale balances 10 lbs. in the other. Corn being worth 49/- a quarter, the value of his plunder is £46 11s; what is the corn rent?

12. A person holding a certain amount of India 5 per cent. stock, sold out $\frac{3}{5}$ths of it at $105\frac{1}{8}$, and invested the proceeds in the 3 per cent. consols at $89\frac{7}{8}$; he sold out from consols when they had risen $5\frac{1}{4}$ per cent., and repurchased the same amount of India stock as he had sold out at $103\frac{7}{8}$, and he found that after deducting brokerage of $\frac{1}{8}$ per cent. on every purchase and sale of stock, he had gained by the transaction £205; what amount of stock did he hold?

13. A person bought a quantity of goods for £47 9s 8d, payable in 12 months; sold them again for £57 8s 2d, payable in 9

months; what is the gain in ready money, allowing true discount at $4\frac{1}{2}$ per cent.?

14. A watch which is 4 min. $8\frac{9}{3\frac{1}{2}}$ secs. fast at 9.30 a.m. on Tuesday, loses $2\frac{3}{4}$ min. daily; what time will the watch show at 5.15 p.m. on the following Friday?

15. There are two sorts of gold, in one of which the alloy is 5, and the other $12\frac{1}{2}$ p.c., the rest being pure. How much of each sort should be taken to obtain a mixture of one ounce in weight, and having one grain of alloy to every nine of gold?

(No. 17.)

1. Divide £1 3s between a man and a boy so that the man shall have 2s 6d less than double the share of the boy.

2. Find the exact value both in vulgar and decimal forms of the error made in estimating to only 3 decimal places the result of $\frac{7}{1\frac{1}{5}} - 4{\cdot}5 + 6{\cdot}0\dot{2}7\dot{7} - \frac{6\frac{5}{9}}{1}$.

3. An apothecary bought a cwt. of tea at 4/- per lb., and sold it at 3d the oz. apothecary. Find his loss per cent.? What would he have gained °/₀ by selling at 3/9 per lb. apothecary?

4. The Browns, Smiths, and Robinsons fell heirs to £10,000, and the shares of the respective families were 5 : 3 : 2. Again, there were 2 Browns, 3 Smiths, and 5 Robinsons. Mr Brown married Miss Smith, and they had 2 children. The parents dying, what did each child get?

5. If £1200 is lent at 5°/₀ per annum, simple interest, find the difference in 3 years between the results according as the interest is paid yearly or half-yearly.

6. A train 88 yards long overtakes a man going at the rate of 4 miles an hour, and passes him in 10 seconds; it passes another man going the same way as the former in 9 seconds; at what rate is the man going?

7. To $\frac{7}{1\frac{1}{2}}$ of $5{\cdot}8$ add $2\frac{4}{5}$ of $\cdot\dot{9}0476\dot{1}$; and from their sum subtract $4\frac{1}{3}$ of $\cdot5692307$.

8. Find three numbers which are to one another as 1 : 2 : 3, and such that the sum of their cubes is 4500.

9. If I invest £5355 in 3 per cent. consols at $95\frac{1}{2}$, and sell out when the price has risen to 97, paying $\frac{1}{8}$ per cent. brokerage on each transaction, by how much do I thereby increase my capital? If the interval between buying and selling be exactly a year, so that one year's dividends are received, putting the dividends and increase of capital together, what rate per cent. have I made on the sum invested?

10. The profits on a capital of £10,000 used in trade for four years are equivalent to compound interest at 25 p.c. per annum for that time; how much do the profits amount to? A sum of

money is placed out at compound interest at a rate which causes it to be doubled in four years; how many fold will it be increased in 16 years?

11. The nominal weight of a truck of coals is 8 tons 10 cwts., the actual weight is 8 tons 18 cwts.; if 10 per cent. profit be made by selling the coal by the truck at 22s per ton nominal weight, what rate of profit will be made by retailing it at 22s 8d per ton actual weight?

12. There are two rectangular wells, one of them 5 feet by 4 feet in section, the other 6 feet by $3\frac{1}{2}$ feet; a hose which fills the first in 4 minutes would take 7 minutes to fill the other, and the water which would fill the smaller well, if poured into the larger one, would stand 15 feet below the top. What is the depth of each well?

13. The amount of a certain sum put out at compound interest (payable yearly) exceeds the amount that would have been obtained from the same sum at the same rate per cent. simple interest by £2 12s 1d at the end of the second year, and by £5 6s 3d at the end of the third year. Find the original sum.

14. A and B engage to walk a match of 10 miles round a course of 5 furlongs; A during his first eight rounds gains 110 yards each round upon B; and then, their rates being reversed, B gains similarly on A at the rate of 110 yards on each round for the rest of the race; which comes in first, and by how many yards does he win?

15. An ornament is made of gold and silver; the weight of the gold used is $\frac{2}{25}$ that of the silver, and the cost is £14 13s; assuming the volume of gold to be $\frac{1}{3\frac{1}{2}}$ that of an equal weight of silver, and the value of gold to be 17·5 that of an equal volume of silver, find the value of the gold and silver respectively used in making the ornament.

PAPERS GIVEN AT EXAMINATIONS.

ARITHMETIC.

LOWER DIVISION, BOY CLERKS.—FEBRUARY 1886.

(To Vulgar and Decimal Fractions.)

1. Add together $2\frac{3}{7}$, $\frac{13}{45}$, $\frac{5}{14}$, and $3\frac{8}{35}$.
2. Subtract $16\frac{25}{32}$ from $27\frac{5}{24}$.
3. Multiply $3\frac{5}{11}$ by $3\frac{5}{57}$.
4. Divide $8\frac{41}{56}$ by $2\frac{13}{25}$.
5. Add together ·896, 17·96, ·70909, and 307·564317.
6. Subtract 46·486315 from 61·0719.
7. Multiply 58·096 by ·7395.
8. Divide 8·5255 by ·7225.

9. Reduce ·69 of 3 tons 17 lbs. to lbs. and the decimal of a lb.
10. In 176432 inches how many miles, furs., poles, yards, etc.?
11. If £36 4s 7½d is paid as a bonus for a loan of £851 10s, how much could be borrowed for £362 6s 3d at the same rate for the same time?
12. Find (by Practice) the cost of 7 ozs. 15 dwts. 18 grs. at £8 per lb.
13. What is the simple interest on £1344 for $2\frac{1}{2}$ years at $3\frac{1}{4}$ per cent. per annum?
14. Add together $2\frac{1}{10}$, $\frac{14}{39}$, $5\frac{5}{57}$, and $\frac{11}{13}$.
15. Subtract $22\frac{48}{65}$ from $30\frac{15}{91}$.
16. Multiply together $1\frac{23}{42}$, $2\frac{2}{55}$, $\frac{11}{13}$, and $12\frac{3}{4}$.
17. Divide $7\frac{169}{188}$ by $1\frac{41}{94}$.
18. Add together 8·4076347, ·601, 623·8065, 117·004, and 28·421.
19. Subtract 4·85635 from 16·1476387.
20. Multiply ·003652 by 5·0604.
21. Divide ·05782 by ·20763, giving the result to three places of decimals.
22. Reduce ·437 of £1 3s 7d to pence and the decimal of a penny.
23. Reduce 7 lbs. 3 ozs. 11 dwts. to grains (Troy).
24. At what price per ton will 25 bags, each containing 175 lbs. of potatoes, cost £7 5s 10d.
25. Find (by Practice) the value of 37452 articles at 17s 3d per dozen.
26. What will £5000 amount to in 3 years at $3\frac{3}{4}$ per cent. per annum, compound interest, neglecting fractions of a penny?
27. Add together $\frac{11}{15}$, $\frac{16}{55}$, $12\frac{7}{30}$, and $4\frac{5}{168}$.
28. Subtract $11\frac{23}{91}$ from $15\frac{5}{78}$.
29. Multiply together $1\frac{38}{43}$, $\frac{7}{8}$, $5\frac{4}{25}$, and $3\frac{19}{27}$.
30. Divide $2\frac{101}{224}$ by $3\frac{167}{168}$.
31. Add together ·847 of 3 cwt., $\frac{5}{168}$ of 3 qrs., and 3·15 of 7 lbs., and give the answer in lbs. and the decimal of a lb.
32. Subtract ·0243 of a bushel from ·478 of a gallon, and express the answer in pints and the decimal of a pint.
33. Multiply $\cdot 5\dot{1}\dot{3}$ by $\cdot 3\dot{1}\dot{8}$, and express the answer in a decimal form.
34. Divide $5\cdot\dot{2}\dot{9}$ by $4\cdot\dot{2}\dot{8}$, and express the answer in a decimal form.
35. Express 6 poles 3 yards 2 feet as the decimal of a mile.
36. Reduce 1 acre 1 rood 3 perches 4 yards to square inches.
37. What number bears the same ratio to $\frac{15}{16}$ that $\frac{8}{15}$ does to $\frac{3}{7}$ of ·875?
38. Find (by Practice) the dividend on £1472 5s at 14s 9d in the £.
39. In what time will £4725 amount to £5569 11s 10½d at $3\frac{1}{4}$ per cent. per annum, simple interest?

FEMALE CLERKS, PRELIMINARY.—OCTOBER, 1885.

ARITHMETIC.

1. Add together $5\frac{2}{11}$, $3\frac{1}{2}$, $\frac{14}{33}$, and $\frac{7}{12}$.
2. Subtract $19\frac{26}{27}$ from $32\frac{13}{90}$.
3. Multiply $2\frac{22}{23}$ by $1\frac{41}{51}$.
4. Divide $5\frac{7}{16}$ by $\frac{63}{64}$.
5. Add together ·820945, 34·825, 6·009371, and ·0976.
6. Subtract 296·810735 from 321·01976.
7. Multiply ·0820173 by 5·6092.
8. Divide 12·6836 by 2960.
9. In 471653 ins., how many miles, furlongs, poles, yds., &c.?
10. Reduce ·0987 of 15 tons 7 cwts. 1 qr. 12 lbs. to ozs. and the decimal of an ounce.
11. A man works 10 hours a day for 6 days a week, and at the end of 5 weeks has earned £9 7s 6d. How much does he earn per hour?
12. Find the simple interest on £375 at $2\frac{1}{2}$ per cent. per annum in $8\frac{1}{2}$ years.
13. Add together $2\frac{5}{28}$, $\frac{11}{36}$, $1\frac{8}{35}$, and $\frac{14}{27}$.
14. Subtract $8\frac{27}{72}$ from $11\frac{3}{54}$.
15. Multiply together $3\frac{5}{33}$, $4\frac{13}{35}$, $12\frac{3}{26}$, and $\frac{11}{102}$.
16. Divide $2\frac{71}{77}$ by $\frac{135}{308}$.
17. Add together ·0075 of a ton, ·463 of a cwt., and 5·643 of a qr., and express the answer in pounds and the decimal of a pound.
18. Subtract 3·607 of 13 dwts. from ·095 of 3 lbs. 6 ozs. and express the answer in grains and the decimal of a grain.
19. Multiply 4·6073 by ·07606.
20. Divide 57·6407 by ·6483 to 3 places of decimals.
21. Multiply ·00792 by 5·60, and express the answer as a decimal.
22. Divide $1\cdot10\dot{2}$ by $\cdot7\dot{3}\dot{5}$, and express the answer correct to 5 places of decimals.
23. In 34796 pints how many quarters, bushels, pecks, &c.?
24. Find the cost of a piece of floorcloth 21 feet long and 8 feet wide, if a square yard costs 2s 9d.
25. In what time will the simple interest on £850 at $3\frac{1}{4}$ per cent. per annum amount to £124 6s 3d?
26. In what time will the simple interest on £725 at 4 per cent. per annum amount to £16 6s 3d more than the interest on the same amount for the same time at $3\frac{1}{2}$ per cent. per annum?

CUSTOMS.—MAY, 1885.

ARITHMETIC.

(To Vulgar and Decimal Fractions.)

1. Add together $2\frac{3}{4}$, $5\frac{11}{24}$, $\frac{23}{45}$, and $\frac{101}{180}$.
2. Subtract $15\frac{32}{33}$ from $18\frac{9}{55}$.
3. Multiply together $6\frac{1}{31}$, $\frac{25}{36}$, $11\frac{17}{33}$, and $\frac{62}{85}$.
4. Divide $6\frac{28}{53}$ by $\frac{173}{318}$.
5. Add together 68·39076, 209·0756, 3·856, and ·0976549.
6. Subtract 182·765039 from 213·37105.
7. Multiply 5·860259 by ·002765.
8. Divide 48·601 by ·1484.
9. Reduce ·0329 of 1 day 11 hours to minutes and the decimal of a minute.
10. Add together $\frac{46}{111}$, $4\frac{7}{18}$, $2\frac{1}{37}$, and $1\frac{5}{9}$.
11. Subtract $22\frac{22}{35}$, from $29\frac{13}{63}$.
12. Multiply together $2\frac{29}{72}$, $\frac{54}{225}$, $2\frac{2}{39}$, and $\frac{445}{615}$.
13. Divide $14\frac{11}{20}$ by $31\frac{22}{65}$.
14. Add together ·0031 of a mile, ·065 of a furlong, and ·73 of a pole, and give the answer in yards and the decimal of a yard.
15. Subtract ·321 of 1 peck 1 gallon from ·097 of 3 bushels, and give the answer in pints and the decimal of a pint.
16. Multiply $\cdot\dot{1}53846\dot{}$ by $\cdot0\dot{3}2\dot{8}$, and express the answer as a decimal.
17. Divide ·0517 by $\cdot0\dot{4}2\dot{3}$, and express the answer in a decimal form.
18. Express £1 3s $2\frac{1}{4}$d as the decimal of £92 15s.
19. Reduce 1 lb. 3 ozs. 2 dwts. to grains.
20. If a bankrupt pays £2204 4s $8\frac{1}{2}$d upon a debt of £3245 10s, what is the dividend in the £.
21. Find (by Practice) the dividend on £1350 15s at 13s 9d in the £.
22. If £370 amount in $6\frac{1}{4}$ years to £450 18s 9d at simple interest, what is the rate per cent.?
23. In 381297631 square inches how many acres, roods, perches, &c.?
24. The cost of maintaining a ship's crew of 310 men on a voyage which lasts 17 days is £1317 10s. What will be the cost in a ship containing 115 men when the voyage lasts three weeks, and the allowance to each man is increased by one-fourth?
25. Find (by Practice) the value of 3257 articles at £1 3s 6d per dozen.
26. What will £5000 amount to in three years at $3\frac{1}{4}$ per cent. per annum compound interest (neglecting fractions of a penny)?

MISCELLANEOUS.

You had better not attempt any of the following questions till you have done as many as you can of the previous ones.

27. Resolve 1980, 5250, 7350, and 16170 into their prime factors, and thence obtain their greatest common measure and least common multiple.

28. A's rate of working is to B's as $\frac{1}{2}$ to $\frac{1}{3}$, B's is to C's as $\frac{1}{4}$ to $\frac{1}{5}$, and C's is to D's as $\frac{1}{6}$ to $\frac{1}{7}$. If A could do a piece of work alone in 420 hours, how long would it take A, B, C and D to do it working together?

29. A man buys certain goods and sells $\frac{1}{3}$ of them at a profit of 17 per cent., $\frac{2}{5}$ at a profit of 20 per cent., and the remainder at a profit of 15 per cent. What profit per cent. did he gain on the whole?

30. If I find I can make £3 a year more by investing £3645 in the 3 per cents. at $91\frac{1}{8}$ than in the $3\frac{1}{4}$ per cents., what is the price of the latter stock?

CUSTOMS.—JANUARY, 1886.

ARITHMETIC.

(To Vulgar and Decimal Fractions.)

1. Add together $3\frac{2}{17}$, $\frac{16}{33}$, $2\frac{5}{34}$, and $\frac{13}{44}$.
2. Subtract $18\frac{15}{32}$ from $22\frac{3}{40}$.
3. Multiply together $2\frac{7}{10}$, $\frac{4}{11}$, $1\frac{19}{81}$, and $\frac{33}{40}$.
4. Divide $18\frac{21}{52}$ by $4\frac{59}{65}$.
5. Add together 23·8459, 1·765, ·998763, and ·0215.
6. Subtract 87·265439 from 103·12913.
7. Multiply 3·092608 by ·018095.
8. Divide 328·383 by 4815.
9. Reduce ·372 of 1 qr. 11 lbs. to ounces and the decimal of an ounce.
10. Add together $6\frac{5}{16}$, $\frac{22}{25}$, $7\frac{11}{40}$, and $20\frac{2}{3}$.
11. Subtract $17\frac{45}{64}$ from $25\frac{11}{56}$.
12. Multiply together $8\frac{1}{55}$, $2\frac{87}{119}$, $1\frac{67}{154}$, and $1\frac{12}{81}\frac{3}{45}$.
13. Divide $\frac{520}{13099}$ by $\frac{416}{39227}$.
14. Add together ·307 of an acre, 2·046 of a rood, and ·25 of 3 perches, and give the answer in square feet and the decimal of a square foot.
15. Subtract ·643 of 1 lb. 7 ozs. 3 dwts. from 10·045 of 2 ozs. 11 dwts. 14 grains, and express the answer in grains and the decimal of a grain.
16. Multiply $2\cdot26\dot{1}$ by $\cdot\dot{4}6437\dot{3}$, and express the answer as a decimal.
17. Divide $\cdot25\dot{3}$ by $9\cdot2\dot{8}$, and express the answer in a decimal form.

18. Express 1 cwt. 1 qr. 17 lbs. 8 ozs. as the decimal of 5 cwts.
19. Reduce 2 miles 3 furlongs 9 poles 2 yards to feet.
20. After paying the working expenses of a business at the rate of 16s 9½d in the £ on the gross receipts, a balance of £405 1s 0½d remained. What were the gross receipts?
21. Find (by Practice) the value of 342,654 articles at 7s 4½d per dozen.
22. In how many years will £475 amount to £572 19s 4½d at 3¾ per cent. per annum, simple interest?
23. In 4373 pints how many quarters, bushels, pecks, etc.?
24. If a day's work of a man, woman, and boy are respectively as 3, 2, and 1, and if 30 men, 24 women, and 18 boys can complete a certain piece of work in 25 days, how many days will it take 18 men, 30 women, and 42 boys to do twice as much?
25. Find (by Practice) the value of 3 lbs. 7 ozs. 12 dwts., if 9 lbs. cost £10 2s 6d.
26. Find the compound interest on £4725 in 3 years at 3½ per cent. per annum (neglecting fractions of a penny).

MISCELLANEOUS.

27. Find the value of

$$1\tfrac{1}{3}\,(3\tfrac{5}{6}-2\tfrac{1}{8})\times\left(\frac{1\frac{5}{16}}{3\frac{7}{2}}-\frac{\frac{6}{7}}{1\frac{3}{4}}\right)\div 13\tfrac{4}{9}\left(\frac{4\frac{6}{11}}{6\frac{2}{3}\frac{2}{3}}+\frac{1\frac{3}{5}}{1\frac{4}{15}}\right).$$

28. Distribute £1000 between A, B, C, and D, so that B has $\frac{7}{8}$ as much as A; D $\frac{1}{4}$ as much as C; and C $\frac{4}{15}$ as much as A and B have together.
29. If a coach travels at the rate of 9½ miles per hour and a railway train runs 25 miles while the coach is accomplishing 8 miles, how much time would a traveller save on a journey of 152 miles by adopting the train as his mode of conveyance?
30. A grocer bought 500 lbs. of tea and sold 100 lbs. at 2s 3d per lb., making a profit of 12½ per cent.; at what rate per lb. must he sell the remainder so that he may gain 20 per cent. on the whole purchase?

EXCISE.—NOVEMBER, 1885.

ARITHMETIC.

(To Vulgar and Decimal Fractions.)

1. Add together $3\frac{5}{12}$, $2\frac{1}{7}$, $\frac{3}{16}$, and $\frac{13}{56}$.
2. Subtract $12\frac{14}{15}$ from $21\frac{7}{40}$.
3. Multiply $8\frac{8}{11}$ by $9\frac{35}{144}$.
4. Divide $4\frac{6}{25}$ by $\frac{53}{185}$.
5. Add together 56·814, 11·0917, 8·0931, and 683·25496.
6. Subtract 84·7356 from 98·107.
7. Multiply 25·6073 by ·00857.
8. Divide 41·16 by 1680.

9. Reduce ·0563 of 1 furlong 3 poles to yards and the decimal of a yard.
10. Reduce 2 acres 1 rood 3 perches 5 square yds. to square ins.
11. If 1 cwt. 1 qr. 7 lbs. of tea cost £80 17s, what is the price per lb.?
12. Find (by Practice) the dividend on £375 15s at 14s 9d in the £.
13. What is the simple interest on £960 for $3\frac{1}{4}$ years at $2\frac{1}{2}$ per cent. per annum?
14. Add together $4\frac{5}{21}$, $\frac{13}{14}$, $1\frac{9}{10}$, and $\frac{4}{55}$.
15. Subtract $19\frac{16}{17}$ from $28\frac{5}{68}$.
16. Multiply together $1\frac{7}{26}$, $8\frac{13}{14}$, $\frac{7}{198}$, and $1\frac{14}{25}$.
17. Divide $\frac{23}{24}$ by $12\frac{15}{16}$.
18. Add together 94·63, ·07985, 9·8112, 16·97, and ·84945.
19. Subtract 8·09726 from 9·007321.
20. Multiply ·097653 by 50·863.
21. Divide 43·8071 by 8·37 to three places of decimals.
22. Express 1 qr. 7 lbs. as the decimal of half a ton.
23. In 240731 pints how many bushels, pecks, gallons, &c.?
24. If 3 acres 1 rood 17 perches of land can be bought for £134 5s what must be paid for 11 acres 3 roods 9 perches of the same land?
25. Find (by Practice) the value of 3 cwt. 2 qrs. 15 lbs. 8 ozs. at £9 6s 8d per cwt.
26. Find the amount of £3000 in 3 years at $3\frac{1}{2}$ per cent. per annum compound interest (neglecting fractions of a penny).
27. Add together $8\frac{5}{17}$, $1\frac{5}{9}$, $\frac{11}{45}$, and $\frac{16}{85}$.
28. Subtract $43\frac{38}{39}$ from $51\frac{17}{65}$.
29. Multiply together $4\frac{3}{7}$, $\frac{16}{35}$, $1\frac{28}{341}$, and $1\frac{5}{72}$.
30. Divide $16\frac{12}{13}$ by $\frac{55}{104}$.
31. Add ·0765 of 3 ounces to ·683 of a pennyweight, and give the answer in grains and the decimal of a grain.
32. Subtract ·034 of £1 10s from ·621 of half-a-crown, and express the answer in pence and the decimal of a penny.
33. Multiply $\cdot\dot{2}\dot{4}\dot{7}$ by $2\cdot\dot{5}71428\dot{}$, and express the answer as a decimal.
34. Divide $5\cdot\dot{6}\dot{3}$ by $18\cdot\dot{7}$, and express the answer as a decimal.
35. Reduce $\frac{3}{5}$ of ·69 of 1 day 3 hours to minutes and the decimal of a minute.
36. Reduce 3 lbs. 2 ozs. 5 dwts. to grains (Troy).
37. If A can walk 33 miles in 8 hours, and his rate is half as fast again as B's, how long would it take B to walk 27 miles?
38. Find the cost of 13424 articles at 5s $4\frac{1}{2}$d per doz.
39. At what rate per cent. per annum simple interest will £158 amount to £185 13s in 5 years?

MEN CLERKS, PRELIMINARY.—MAY, 1885.

ARITHMETIC.

(To Vulgar and Decimal Fractions.)

1. Add together $3\frac{5}{16}$, $2\frac{1}{7}$, $\frac{11}{48}$, and $3\frac{2}{3}$.
2. Subtract $7\frac{16}{33}$ from $11\frac{5}{22}$.
3. Multiply $5\frac{15}{22}$ by $1\frac{56}{65}$.
4. Divide $4\frac{37}{40}$ by $2\frac{191}{200}$.
5. Add together 2·364, ·0089732, 43·8097, and 122·369872.
6. Subtract 549·8973 from 1210·375.
7. Multiply 48·63207 by ·09058.
8. Divide 2496·96 by ·0765.
9. Reduce ·1357 of 1 cwt. 2 qrs. 11 lbs. to ounces and the decimal of an ounce.
10. Reduce 3 lbs. 5 ozs. 2 dwts. 3 grs. to grains (Troy).
11. If 13 acres 1 rood 15 perches of land are valued at £1547 17s 6d, what is the value per acre?
12. Find (by Practice) the value of 3 cwt. 2 qrs. 10 lbs. 8 ozs. at £30 per ton.
13. What is the simple interest on £975 for 2 years 4 months at 4 per cent. per annum?
14. Add together $4\frac{5}{13}$, $1\frac{1}{4}$, $\frac{3}{28}$, and $10\frac{17}{65}$.
15. Subtract $21\frac{23}{24}$ from $25\frac{8}{29}$.
16. Multiply together $4\frac{23}{26}$, $7\frac{5}{16}$, $\frac{19}{41}$, and $2\frac{22}{39}$.
17. Divide $25\frac{26}{27}$ by $\frac{11}{90}$.
18. Add together ·06621, 492, 53·8172, and 19·68739.
19. Subtract 265·5973 from 320·071325.
20. Multiply ·0928765 by 253·092.
21. Divide 5·63209 by 22·37 correctly to 4 places of decimals.
22. Express 1 hour 20 minutes as the decimal of a day.
23. In 47715853 inches how many miles, furlongs, poles, etc.?
24. If 78 tons 10 cwts. 3 qrs. 10 lbs. 1 oz. cost £722 4s $4\frac{1}{4}$d, find the cost of 123 tons 8 cwts. 1 qr. 23 lbs. 13 ozs.
25. Find (by Practice) the cost of 3725 articles at 7/9 per score.
26. Find the amount of £1650 for 2 years at $2\frac{3}{4}$ per cent. per annum, compound interest (neglecting fractions of a penny).
27. Add together $6\frac{11}{20}$, $5\frac{23}{25}$, $\frac{16}{45}$, and $2\frac{183}{270}$.
28. Subtract $39\frac{45}{56}$ from $42\frac{121}{343}$.
29. Multiply together $3\frac{19}{37}$, $\frac{12}{64}$, $2\frac{19}{65}$, and $\frac{74}{1469}$.
30. Divide $7\frac{5}{16}$ by $62\frac{1}{48}$.
31. Add together ·073 of a ton, ·695 of a cwt., ·83 of a lb., and express the answer in lbs. and the decimal of a lb.
32. Subtract ·02053 of £1 7s 6d from ·37 of 18s $4\frac{1}{2}$d, and express the answer in pence and the decimal of a penny.
33. Multiply $11\cdot91\dot{3}\dot{2}\dot{8}$ by ·00396, and express the answer as a decimal.
34. Divide $\cdot0\dot{7}\dot{9}$ by $7\cdot3\dot{9}$, and express the answer as a decimal.

35. Express $\frac{1}{99}$ of £62 1s 7½d as a decimal of £2 10s.

36. In 253721 pints how many bushels, pecks, gals., etc.?

37. Five men are employed 7 hours a day on a certain work. After they have been engaged 4 days it is found they have done one-twelfth of the whole. Six additional men are then employed, and all are to work 7½ hours per day. When will the work be completed, supposing that they all work equally fast?

38. Find (by Practice) the dividend on £6285 15s at 13s 9d in the £.

39. At what rate per cent., simple interest, will £825 amount to £972 9s 4½d in 5½ years?

FEMALE CLERKS.—JANUARY, 1885.

II. COMPETITION.

ARITHMETIC.

1. Define a "prime factor." Divide 2359481 by successive division by the prime factors of 19404, and show how to obtain the complete remainder.

2. Simplify $2\frac{1}{2} \times \frac{\frac{5}{9} + 3\frac{1}{4}}{2\frac{5}{16} - \frac{11}{27}} \div \frac{11\frac{5}{12}}{1\frac{103}{720}}$.

3. One clock gains 4 minutes in 24 hours and another loses 9 minutes in 36 hours. Both are set right at noon. When one is 15 minutes before the other, what will be the correct time?

4. How many yards of matting 2·625 feet wide will cover a floor 26 ft. 3 in. long and 15 ft. 9 in. wide.

5. Find the value of $(\dot{4}2857\dot{1} + \dot{0}619047 + \dot{0}\dot{3})$ of 1s 9d.

6. Write down the square root of ·0001, and extract the cube root of $41\frac{301}{1331}$.

7. The difference between the simple interest and the true discount on a certain sum in one year at 4 per cent. is £2. Find the sum.

8. Compare the values of $\frac{7}{24}$ of a crown, $\frac{1}{15}$ of a sovereign, and $\frac{1}{18}$ of a guinea.

9. A man's net income after paying an income tax of 6d in the pound is £536 5s. What is his gross income?

10. The average daily number of persons passing a certain point on Sunday, Monday, Friday, and Saturday is 1765. The average daily number passing on Tuesday, Wednesday, and Thursday is 1541. What is the daily average for the whole week?

11. A man buys two horses for £65 and £85 respectively. He sells the first at a gain of 15 per cent., but the second, which falls lame, he is obliged to sell at a loss of 20 per cent. He then buys a third for £70. At what price must he sell it in order that he may neither lose nor gain on the three?

12. If I sell £5000 out of the 3 per cents when they are at 84, and invest the proceeds in the 4 per cents at 96, how is my yearly income affected?

FEMALE CLERKS.—OCTOBER, 1885.

II. COMPETITION.

ARITHMETIC.

1. Find the value of $\frac{5}{8}$ of $\frac{2\frac{5}{9}-\frac{3}{4}}{2\frac{4}{9}+\frac{1}{4}}$ of $3\cdot4\dot{9}$ of $.5\dot{7}1428\dot{5}$ of 8s 1d.

2. Find the greatest period of time which is a measurse of 22 days 11 hours 15 min. 3 sec. and 35 days 7 hours 23 min. 39 sec.

3. Divide £448 10s among A, B, C, and D in the proportion of the numbers 3, 5, 7, 11.

4. Define Ratio. Express in its simplest form the ratio of 1 ton 12 cwt. 3 qrs. 13 lbs. to 2 tons 19 lbs.

5. Find a number the square root of which exceeds the fifth power of ·4 by ·015696.

6. Extract the cube root of 912·673.

7. A can do a piece of work alone in 40 hours, B in 50 hours, and C in 60 hours. A and B work together for 5 hours, when C begins. Find how much longer it will take all three working together to finish it.

8. Find a fraction the third part of which shall bear the same ratio to $\frac{7}{2\frac{1}{6}}$ that $1\frac{4}{15}$ does to the third part of $\frac{1\frac{3}{10}}{2}$.

9. By selling cloth at 8s 9d a yard I gain 12 per cent. What shall I gain per cent. by selling it at 12s 6d a yard?

10. If 69120 sovereigns are coined out of 1473 lbs. troy of gold, find the weight of a sovereign, and the mint price of gold per ounce.

11. A sum of £5 8s is made up of half-crowns, shillings, and sixpences. There are twice as many shillings as half-crowns, and as many sixpences as shillings and half-crowns together. How many are there of each?

12. A man has an income of £1710 from the $3\frac{1}{2}$ per cents after an income tax of 1s in the £ is deducted. He sells out at 95 and invests in the 3 per cents at $85\frac{1}{2}$. What is his new income?

INLAND REVENUE: EXCISE.—NOVEMBER, 1883.

HIGHER ARITHMETIC.

(Including Mensuration, Square and Cube Root, &c.)

1. Simplify—

$$\left(\tfrac{1}{2} \text{ of } 3\tfrac{4}{17} \text{ of } 6\tfrac{2}{11} - \frac{3\frac{4}{9}}{1\frac{2}{3}}\right) \div \frac{6\frac{7}{8}+5\frac{2}{3}}{9\frac{5}{12}-5\frac{5}{6}};$$

and find the circulating decimal which multiplied by $2\frac{3}{5} \div 4\frac{1}{2}$ will give 2 for the product.

2. What is the general form of vulgar fractions in their lowest terms which are reducible to terminating decimals? Explain the reason. Find the value of $\cdot\dot{3}\dot{6}$ of $\cdot\dot{2}\dot{7}$ of 2s $6\frac{1}{4}$d, and reduce the result to the decimal of £1 5s.

3. Extract the square root of $6.24\dot{9}$, and find within an inch the length of a side of a square field the area of which is 30 acres.

5. What sum lent at 4 per cent. per annum compound interest will amount to £2050 10s 8d in three years?

5. A imports goods, and pays for freight and duty 4 per cent. on the cost price; he sells his goods to B at a profit of 15 per cent. on his whole outlay; B sells these goods to C at a profit to himself of 25 per cent. Find the cost to A of goods sold to C for £2302 6s.

6. The perimeter of an equilateral triangle is 200 feet; find its area.

7. If the earth be a globe of 7920 miles diameter, and the ocean having a mean depth of four miles cover five-eighths of the surface of the globe, what is the approximate ratio of the volume of the ocean to that of the earth?

8. Find the value of—

$$\frac{7+\sqrt{5}}{6-\sqrt{5}}-\frac{7-\sqrt{5}}{6+\sqrt{5}}$$

to three places of decimals; and find the side of a cube which contains 411,166,897,856 cubic inches.

9. If 1 lb. Troy of standard silver, of which 222 parts in 240 are pure silver, be worth 62s, find the value of a Bombay rupee which weighs 7 dwt. 11 gr. and has a fineness of 926 parts in 1000.

10. Find the present worth of £150 due nine months hence, supposing the 3 per cent. Consols to be at 99.

11. A contractor engaged to complete a work of 4725 cubic yards in 75 days; he employed at once 60 men upon it, but at the end of $52\frac{1}{2}$ days he finds only 2700 cubic yards completed; how many extra men must he put on to complete the work in the given time?

12. A bill falls due in 6 months. The creditor agrees to accept immediate payment of one half, and to defer payment of the other half for one year. He finds that by this arrangement, reckoning interest at 6 per cent. per ann., he gains 9 shillings. What is the amount of the bill?

13. Find the weight of a 13-inch iron shell, the thickness of which is two inches; the weight of a cubic foot of iron being 441 lbs.

$$\left(\pi=\frac{22}{7}.\right)$$

14. A tent is made in the form of a conic frustrum, surmounted by a cone of different angle. The diameters of the base and top of the frustrum are 14 and 7 feet, its height 8 feet, and the height of the tent 12 feet; find the quantity of canvas required for it.

ASSISTANTS OF EXCISE.—NOVEMBER, 1885.

ARITHMETIC.

(Including Mensuration, Square and Cube Root, &c.)

1. Find the square root of $\frac{\cdot00125}{\cdot18}$ Find the value of $\frac{5\frac{1}{8}+\frac{3}{4}}{3\frac{1}{5}-\frac{2}{3}}$ of £5+2⅔ of 1⅓ of ⅐ of 5s 3d; also of ·428571̇ of £2 9s 10½d, and reduce it to the decimal of £1 3s 6d (correctly to six places of decimals).

2. A room 27·7 feet long, 19·55 feet wide, and 12·4 feet high is hung with paper. If the paper is 2·7 feet wide, what will be the cost at 1s 3d per yard?

3. To pay off a debt in a certain number of years £63 12s 6d has to be raised for every £1000 of debt. An assessment of one penny per pound of rental brings in £130. Find to the nearest penny the assessment required to pay off a debt of £18000 in the given time.

4. In Paris a sovereign is worth 25 francs 10 centimes, and in London a 20 franc piece is worth 15s 3d. What is gained or lost by changing £100 in Paris, and changing their French equivalent back into English money in London?

5. Simplify $\frac{3872}{92807}$; $\frac{15}{16}-\frac{14}{15}+\frac{13}{14}-\frac{11}{12}$ and $\frac{5\frac{5}{8}\div\frac{3}{5}}{(1\frac{1}{3}\text{ of }\frac{5}{9})\div 10\frac{1}{3}}\times\frac{2}{5}$ of $\frac{1\frac{1}{2}\text{ of }4\frac{1}{9}}{13\frac{7}{8}\text{ of }5\frac{1}{3}}$.

6. Find, approximately, the length of the side of a square which is equal in area to a rectangle 660 yards long and 376 yards broad.

7. Roman silver coin is $\frac{2\,9}{3\,0}$ of pure silver, and standard silver is $\frac{37\frac{1}{2}}{40}$ ditto; what will be the value of the silver in 250 denarii (Roman coin) of 60 grains each at the rate of 5s 3d per oz. standard?

8. The earth's diameter is 7912 miles, and the volume of the sun is 1250000 times that of the earth; find, approximately, the sun's radius.

9. A block of wood is 7 feet long, 2 broad, and 1½ wide. Find the length of its diagonal; and also the area of a superficies made by a plane going through two opposite edges of 2 feet.

10. Find the present worth of £2065 at 4½ per cent. per annum due in two years and one month. Also find, approximately, the discount, at the same rate of interest, on £504 17s 4½d paid 105 days before the amount is due.

11. A tradesman sells his goods at 22½ per cent. above cost price, but allows for ready money a discount of 5 per cent. on the price charged. What profit does he make on a ready-money customer's payment of £285 17s 8d?

12. A cistern can be emptied by three taps A, B, and C; A and B discharge water at the rate of 37 and 40 gallons per hour respectively, and are allowed to run for five minutes, when they are partially turned off and discharge 7 gallons per hour less than before; they run thus for ten minutes, when A is turned off completely, and C, which discharges 30 gallons per hour, is turned on, with the result that the cistern is emptied of its contents in 33 minutes from the commencement of operations. Find its contents.

13. A cannon consists of a frustum of a cone 10 feet long formed of steel with a cylindrical bore of 6 inches diameter, the external diameter of one end being 12 inches, and of the other 24 inches—the larger end being closed with a solid hemisphere of steel, whose base coincides with the larger end of the frustum. The density of steel being eight times that of water, and 1000 oz. of water measuring a cubic foot, find the weight of the gun.

14. Two men, A and B, begin at the same time to run opposite ways once round a circular course, starting from the same point. From the moment at which they first meet A takes 63 seconds to finish the round, B 84 seconds. But whereas A ran at a uniform rate the whole way, B mended his pace in the ratio 4 : 3 from the moment at which they first met. Find the time each takes to run the whole course.

MEN CLERKS.—SEPTEMBER, 1884

ARITHMETIC.

1. What numbers, of four digits each, can have 119 as their Greatest Common Measure and 13923 as their Least Common Multiple?

2. Find the value of $\cdot 006510416\dot{}$ of £8 + $\cdot 0015625$ of £40 + $\cdot 013802083\dot{}$ of £16.

3. Two fields are bought, one containing 2 acres 15 poles at 16s per sq. yard, and the other 3 acres 1 rood 28 po. 24 sq. yds. 1 sq. foot at 18s per square yard. If the whole be divided into 40 equal plots, and sold at $16\frac{16}{17}$s per square yard, find the loss on each plot.

4. In 11 days 250 men working 9 hours a day complete 528 yards of an embankment which is to be $1\frac{1}{2}$ miles long. How many additional men must be put on in order that, if all now work 10 hours a day, the embankment may be finished in 33 days more?

5. Find, by duodecimals, the contents of rectangular tank measuring 12 ft. 6 in. by 5 ft. 3 in. by 3 ft. 9 in. Also (by duodecimals) how much more it will hold than a cubical one whose side is 6 ft. 3 in.

6. Change the numbers 180 and 150 from the scale of 10 to that of 7, and in the latter scale find their product and its cube root.

7. If a foot-rule by which the sides of a rectangle are measured is too long by ·06 of an inch, find by what decimal of the calculated area the true area will exceed the calculated. If one side only be measured with the above rule, find by what vulgar fraction of an inch another foot-rule must be too short if, the other side being measured with it, the calculated area is correct.

8. If the true discount upon a sum of money (due after a certain time) at 5 per cent. simple interest is $\frac{5}{8}$ of the interest for the same time, find the time.

9. A cistern can be filled by one of two pipes in 30 minutes, and by the other in 36 minutes. They are both opened together for a certain time, but, being partially clogged, only $\frac{5}{6}$ of the full quantity of water flows through the former and only $\frac{9}{10}$ through the latter. The obstructions, however, being suddenly removed, the cistern is filled in $15\frac{1}{2}$ minutes from that moment. How long was it before the full flow of water began?

10. At what moment between 9 and 10 o'clock is the hour hand of a clock exactly $15\frac{2}{3}$ minute divisions in advance of the minute hand?

11. Divide £1050 into 4 parts such that the respective interests on the 1st at $2\frac{1}{2}$ per cent. for 4 months, on the 2nd at 3 per cent. for 4 months, on the 3rd at 4 per cent. for 5 months, and on the 4th at 5 per cent. for 6 months, may all be the same.

12. Two boats start in a race, the one rowing 36 strokes per minute and advancing 33 feet in each stroke, while the other rows 39 strokes per minute, advancing 27 feet in each. When the first has rowed one-half of the course both crews suddenly reduce their strokes to 33 per minute. If the first boat thenceforth clears 39 feet per stroke, what must the second clear in order that the race may be a dead heat?

13. Find the principal which will amount, at compound interest, in 2 years to £739 7s 6d, and in 3 years to £768 19s.

14. Two passengers travel first class and 3 travel second class for every 45 that travel third class, when the respective fares are $2\frac{1}{2}$d, $1\frac{3}{4}$, and 1d per mile. If the fares are changed to $1\frac{1}{2}$d, $1\frac{1}{4}$d, and 1d per mile, while the ratio of the number of first to second class passengers and the whole number travelling remain unchanged, what must be the ratio of the number of first class to that of third class under the new fares in order that the total receipts may be the same as before?

15. I possess 12,000 of 3 per cent Consols bought when they were at $99\frac{1}{4}$. They are now at $100\frac{1}{8}$. The Chancellor of the Exchequer offers me 108 of $2\frac{1}{2}$ per Cents for each 100 of the 3 per Cents, and I agree so to exchange five-eighths of my stock. The remainder I sell out and invest in $3\frac{1}{2}$ per cent. debentures.

What must be their price in order that my income may be unaltered; and to what price must the $2\frac{1}{2}$ per Cents attain in order that, if I presently sell them and the debentures, when the latter have fallen to $94\frac{1}{8}$, I may exactly recover my original capital? (N.B.—One-eighth per cent. brokerage is to be charged for all sales and purchases, but not for the exchange.)

MEN CLERKS.—JANUARY, 1885.

ARITHMETIC.

1. What is the greatest number which, when used as the divisor of 68130 and 107275, will leave remainders 27 and 49 respectively?

2. Find the value in pounds; shillings, and pence of $\cdot\dot{0}61728395\dot{}$ of £617 2s $4\frac{1}{2}$d + $\cdot 2916\dot{}$ of £182 17s; and reduce the result to the decimal of £53000.

3. The area of a rectangular field is 8 acres 2 roods 16 poles 30 yards 108 inches; and the length of each of the longer sides is 1 furlong 2 poles 4 yards 2 feet; find the length (1) of the other sides, (2) of the diagonal.

4. When the price of wheat was 45s 2d per quarter, and the yield 4 quarters per acre, the produce of a certain piece of land was worth £153 11s 4d; what must the yield be per acre if the produce of the same land is worth £157 5s when the price of wheat is 30s 10d per quarter?

5. The length of a building is 123 ft. 8 in. 6 pts., and the breadth 97 ft. 10 in. 9 pts.; find, by duodecimals, the area of the basement. If the average height is 48 ft., find the volume in cubic feet and inches.

6. A dealer sells 25 tons of coal at 19s 2d per ton, and allows 5 per cent. discount for cash payment; if he had not allowed the discount his profit would have been 15 per cent. of his outlay; find what his profit per cent. is at the reduced price, and his whole gain on the quantity sold.

7. Reduce 67·75 from the scale of 10 to the scale of 5; divide 142772 by 482 in the scale of 12; and find the square root of 373444 in the scale of 9.

8. If the true discount on £2696 13s 4d, due three months hence, is £30; what is the rate per cent., simple interest? At what rate per cent. would the banker's discount on the same sum for the same time be £30 6s 9d?

9. Find the cube root of 426957777. A spherical ball of lead, 3 inches in diameter, is melted and recast into three spherical balls; the diameters of two of these are $1\frac{1}{2}$ in. and 2 in. respectively: what is the diameter of the other ball? [The volumes of spheres are proportional to the cubes of their diameters.]

10. A and B together could do a piece of work in 40 days; after working 10 days they are assisted by C, and the work is then finished in 20 days more; C does as much work in 2 days as B does in 3 days: in how many days could each of them do the work alone?

11. If 13 men working 6 days, 8 women working 5 days, and 5 boys working 4 days, earn between them £13 15s; and the wages per day of a man, a woman, and a boy are as 5: 3: 2; what sum is each of them entitled to?

12. A sum of £5000 is lent on the condition that, if it is not repaid within a year, compound interest will be charged; the option is given of 5 per cent. interest throughout, or $2\frac{1}{2}$ per cent. for the first year, 5 per cent. for the second year, $7\frac{1}{2}$ per cent. for the third year, and so on, the interest increasing by $2\frac{1}{2}$ per cent. every year: shew that, if the loan is repaid within 3 years, the latter system will be in favour of the borrower; and find the difference on the two systems if it be not paid off till the end of the fourth year.

13. A person possessed of £2500 invested £348 13s 9d in 3 per cent. stock at $99\frac{1}{2}$, £1651 17s 6d in foreign 6 per cent. securities at 110, and the remainder on loan at 5 per cent.; at the end of a year he sold the stock at 97, the securities at $102\frac{1}{4}$, and recovered only 75 per cent. of the loan; he paid $\frac{1}{8}$ per cent. on both purchase and sale of the stock and securites, and received the year's dividend on them as well as the interest on the loan; how much was he possessed of at the end of the year?

14. A merchant imports 1335 chests of tea; he sells $\frac{1}{3}$ of them at a profit of 25 per cent., $\frac{1}{5}$ at a profit of 15 per cent., and the remainder at a profit of 5 per cent.; his whole gain is £1064 5s 10d; how much per chest did the tea cost him?

15. Find the fraction with denominator less than 1000 which approximates most closely to 3·14159.

MEN CLERKS.—MAY, 1885.

ARITHMETIC.

1. Reduce $\dfrac{2\frac{1}{7} \text{ of } (3 - 1\frac{1}{5})}{2 + \dfrac{1}{1 + \dfrac{1}{2 + \frac{1}{3}}}}$ of 3/6 to the decimal of $\frac{27}{35}\frac{44}{87}$ of £100.

2. A fraction which, when reduced to a decimal, consists of two non-repeating figures followed by $\dot{7}8\dot{3}$, has 148 for its denominator, and the numerator is $\frac{3}{2}$ of the number expressed by the non-repeating figures; find the numerator of the fraction.

3. A room, 25 feet 7 inches long and 16 feet 9 inches broad, has three windows each 5 feet by 3 feet 6 inches, a door 7 feet by

4 feet, and a fireplace 5 feet by 6 feet; the cost of papering the walls with paper $\frac{5}{8}$ yard wide at $4\frac{1}{2}$d per yard is £3 8s 10d; find the height of the room.

4. If 3 ozs. 2 dwts. of precious metal worth 5s 5d per oz., 1 oz. 1 dwt. 6 grs. worth 1s 8d per oz., be melted up together; how much alloy, worth 1d per oz., must be combined with $2\frac{3}{4}$ oz. of the mixed metal to make a compound worth 3s 9d per oz.?

5. The internal dimensions of an open rectangular vessel are —length 13 feet 6 inches, width 8 feet 4 inches, height 6 feet: find by duodecimals its content in cubic feet and inches. If the sides and bottom of the vessel are each 2 inches thick, and it is made of a metal worth 13s 6d per cubic foot; what is the value of the metal used?

6. Coal bought at £4 6s per truck, each truck containing 5 tons 7 cwts. 2 qrs., is sold at 19s per ton; what is the profit per cent.? In what proportion must this coal be mixed with coal bought at 13s per ton, so as to gain 25 per cent. by selling at 18s per ton?

7. Simplify $\frac{13}{1t} \times \frac{104}{47} \div \frac{31}{t1}$ in the scale of 12; multiply 4·302 by 2·104 in the scale of 5; and reduce $37\cdot\dot{2}2916\dot{}$ from the scale of 10 to the scale of 12.

8. A person holding a bill due 30 days hence, discounts it without the usual 3 days of grace at $4\frac{1}{2}$ per cent. per annum (true discount), and invests the proceeds at 5 per cent. interest per annum; he thereby gains 11s 3d in the 30 days; find the amount for which the bill was drawn.

9. The volume of a sphere being ·5236 of the cube of its diameter, find the diameter of a sphere of which the volume is 8·18125 cubic feet. Extract the cube root of 7 to three places of decimals.

10. A train going 30 miles an hour passes a man walking in the same direction at the rate of 3 miles an hour, and goes by him in 10 seconds; what is the length of the train? If another train, 88 yards long, going in the opposite direction, meets the man and goes by him in 8 seconds, at what rate is this train going?

11. An annuity of £3675 per annum for 5 years is agreed to be discharged by a single payment at the end of the third year; interest at 5 per cent. per annum is to be paid on the first two instalments overdue; and discount at the same rate is to be deducted from the instalments paid in advance; the amount of the first instalment, and the present value of the last are to be reckoned by compound interest; what will the whole payment amount to?

12. A person invested money in 3 per cent. stock at $95\frac{7}{8}$, and derived a net income, after paying income tax at 5d in the pound, of £146 17s 6d; he afterwards sold the stock at $102\frac{1}{8}$, and in-

vested the proceeds in $2\frac{1}{2}$ per cent. stock; and the income tax having meanwhile been raised to 6d in the pound, found that his net income was 12s 6d less than before; how much money did he invest, and at what price did he buy the $2\frac{1}{2}$ per cent. stock? N.B.—One-eighth per cent. brokerage is to be allowed for in each sale or purchase.

13. A corn merchant purchased 180 qrs. of wheat, and sold 84 qrs. at a profit of 5 per cent., 56 qrs. at a profit of $7\frac{1}{2}$ per cent., and the remainder at a profit of 10 per cent.; the whole profit amounted to £34 2s; at what price per quarter did he buy the wheat?

14. The number of passengers in the 2nd class carriages of a train was three times the number in the 1st class; and the number in the 3rd class exceeded the other two together by 36; the fares for the several classes were at the rate of 3d, 2d, and 1d per mile; the average distance travelled by each of the 1st class passengers was 120 miles, by each of the 2nd class 50 miles, and by each of the third class 25 miles; and the whole of the fares amounted to £390 1s 8d; how many passengers were there of each class?

15. The diameter of the second of three pipes is to that of the 1st in the ratio of 4 to 3; find the ratio of the diameter of the 3rd to that of the 2nd, if the water which will flow through all the three in 9 minutes is 50 times as much as will flow through the first alone in one minute, it being assumed that the quantity of water flowing through any pipe varies as the square of its diameter.

MEN CLERKS.—OCTOBER, 1885.

ARITHMETIC.

1. Find to four places of decimals the value of $2\sqrt{3}-\frac{1}{2}\sqrt{12}+\sqrt{27}$.

2. A square field contains 3 acres 1 rood 38 perches $20\frac{1}{2}$ sq. yds.; find in acres, roods, &c., the area of a rectangular field whose sides are respectively 75 and 65 yds. longer than those of the square field.

3. If ·12775 of ·21917808 of 1 cwt. 13 lbs. of coal cost ·39375d, what is the price per ton?

4. Three clocks A, B, C go at uniform speed. At noon on Monday A is 1 minute slow, B is 2 minutes slow, and C is 1 minute fast. At 8 p.m. Tuesday B is 1 minute fast and C is 3 minutes slow. At 8 a.m. Wednesday A is $2\frac{3}{8}$ minutes before B. When do A and C both indicate the same time?

5. The inside of a rectangular water cart measures 4 ft. 7 in. long, 3 ft. 8 in. wide, 3 ft. deep. Find by duodecimals the

volume of water which it will hold ; and, if 4 such cartloads be evenly spread over one acre of ground, find as a duodecimal of a foot the depth of water deposited.

6. Express in the scale of 10 the greatest and least numbers that can be written with 4 digits in the scale of 6 ; and extract the square root of 32*e*75721 in the scale of 12.

7. A, B, and C can build a certain wall respectively in 16, 20, and 24 days. In how long a time would A and B together build a similar wall of double the length, if C helped them for one-half of each day?

8. A tank 9 yards long, $3\cdot0\dot{3}$ yds. wide, and $2\cdot05\dot{3}$ ft. deep, holds water enough for 27 men for 308 days : find the depth of a tank $6\cdot2$ yds. long and $2\cdot0\dot{2}$ yds. wide which will hold enough for 158 men, 48 women, and 81 children for 45 days, if a woman use $\frac{3}{4}$, and a child $\frac{2}{3}$, as much as a man.

9. If the compound interest on a certain sum of money for 2 years at 4 per cent. is £45 18s ; what is the true discount on the same sum of money due two years hence at simple interest at 4 per cent.?

10. The 3 per cents. are at $96\frac{7}{8}$, and $3\frac{1}{4}$ per cents. are at 105. What amount invested in the former would produce an annual income of £1 more than if invested in the latter, one-eighth per cent. brokerage being charged on each investment?

11. A room is $\frac{1}{3}$ as wide and $\frac{1}{2}$ as high as it is long, and $\frac{1}{12}$ of the wall-space is occupied by windows and fireplace. The rest of the walls and the ceiling are painted at a cost per sq. foot which is $\frac{1}{4}$ of the cost of per sq. foot of carpeting the floor with carpet 2 ft. 3 in. wide, costing 3s $4\frac{1}{2}$d per yd. The whole cost of carpeting and painting is £52 13s. Find the length of the room.

12. Two men walk with uniform speed along a railway in the same direction. A train travelling uniformly overtakes one of them who walks at 4 miles per hour, and the whole train, which is 132 yards long, passes him in $7\frac{1}{2}$ seconds. $6\frac{3}{4}$ minutes after it began to pass the above-named man, the train begins to pass the other, and occupies $7\frac{1}{3}$ seconds in passing him. When will one man overtake the other?

13. A mixture of 16 parts of gin costing 10s $1\frac{1}{2}$d a gallon with 5 parts of water (costing nothing) is sold at 10s 8d a gallon ; while one of 4 parts of rum costing 15s a gallon with 1 part of water is sold at 16s a gallon. What proportion of water must be mixed with brandy costing 30s a gallon, so that, if the mixture be sold at 33s 6d a gallon, the whole profit gained may be 40 per cent., supposing the quantity of diluted gin sold to be thrice, and that of the diluted rum twice, that of the diluted brandy?

14. A holder of railway stocks receives for one year at 4 per cent. dividend, and spends $\frac{7}{8}$ of his net income after paying an income tax of 6d in the £. The next year, the dividend being

$4\frac{3}{8}$ per cent., and the income tax being raised to 8d, he only spends $\frac{4}{5}$ of his net income, and finds that he has a surplus income £22 7s 11d greater than in the previous year. How much stock did he possess?

15. A has a capital of £666 13s 4d in a business for 12 months. B has £500 in the same business for 7 months, which he raises to £766 13s 4d for the remaining 5 months. C has £800 in the same business for the first 3 months, and only £300 for the last 9 months. If B's share of the profits is £53 0s 10d more than C's, what should A's share be?

MEN CLERKS.—JANUARY, 1886.

ARITHMETIC.

1. Simplify $\dfrac{5\frac{5}{8}+5\frac{1}{6}}{5\frac{5}{8}-5\frac{1}{6}}$ of $\dfrac{2112}{7104}$ of $\dfrac{2778}{25928} \div \dfrac{(4\frac{2}{3}-4_{1}\frac{7}{2}) \text{ of } \frac{2}{3}\frac{4}{3}}{4\frac{2}{3}+(4_{1}\frac{7}{2} \text{ of } \frac{2}{3}\frac{4}{3})}$.

2. A rectangular tank, 9 ft. $7\frac{1}{2}$ in. long, 2 ft. 8 in. deep, and 4 ft. $1\frac{1}{11}$ in. broad, has two pipes connected with it, one of which can supply 1080 cubic inches of water per minute, while the other can discharge the whole contents of the tank in $3\frac{1}{2}$ hours. If the tank be empty, and both pipes be simultaneously opened, how long will it take to fill it?

3. Reduce $\dot{9}\dot{6}\dot{2}$ of $\dot{2}\dot{5}\dot{9}$ of $\dot{1}6\dot{3}\dot{6}$ of $\dot{0}32967\dot{}$ of ·6875 of 27 miles to yards.

4. A clerk's salary is each year increased by $\dot{1}42857\dot{}$ of that which he has received for the previous year, and for his fourth year of service amounts to £120 1s. Find what it is for his seventh year, and express his first year's salary as a fraction of his seventh year's salary.

5. *(a)*, Transfer 1885 from the scale of 9 to the ordinary scale of 10; *(b)*, divide 65502 by 45, both being in the scale of 7; and *(c)*, find which of a series of weights of 1 lb., 2 lbs., 4 lbs., 8 lbs., 16 lbs., &c., must be used in order to weigh 233 lbs., if only one weight of each kind be used.

6. If the volume of a right cylinder is obtained by multiplying its height by $3\frac{1}{7}$ times the square of the radius of its circular end, find (using duodecimal notation) how many cylinders of copper, each $6_{1}\frac{5}{2}$ inches long and $2\frac{1}{2}$ inches in diameter, are equal in value to five cubes of iron, each of whose sides is 2 ft. 9 in. long; one cubic foot of copper being worth $9\frac{3}{5}$ cubic feet of iron.

7. Express $\sqrt[3]{44{\cdot}6}$ as a decimal of $\sqrt{167{\cdot}9619}$, obtaining the nearest value to two places of decimals.

8. If 124 men in $5\frac{1}{2}$ days of 11 hours each dig a trench $232\frac{1}{2}$ yards long, 3 ft. 8 in. wide, and 2 ft. 4 in. deep, in how many days of 9 hours each will 36 men dig a trench $337\frac{1}{2}$ yards long,

5 ft. $7\frac{1}{5}$ in. wide, and 3 ft. 6 in. deep; supposing that in the same time each of the second set of men does one-sixth more work than each of the first set?

9. How many English sovereigns must I have in order that, if I take them to France, and change them into francs, &c., at an exchange of 25 francs 45 centimes for each sovereign, I can spend as much of them as is equal to £16 while there, and by changing the rest into sovereigns on leaving, at an exchange of 25 francs 25 centimes, have as many sovereigns as I began with?

10. By selling out of the 3 per cents. when they are at $91\frac{1}{8}$, and then buying $3\frac{1}{4}$ per cent. stock, I find that I obtain £1 0s $1\frac{3}{7}$d of income for every £1 which I previously received. Find the price of the $3\frac{1}{4}$ per cent. stock, one-eighth per cent. brokerage being charged in each transaction.

11. Four men and 10 boys together do one-half of a piece of work in 6 days. Two more men and 2 more boys having joined them, another one-third of the work is done in the next 3 days; how many more boys must then be put on if the rest of the work is to be finished in one day more?

12. A sells some iron to B at a gain of 5 per cent.; B sells it to C at a gain of 4 per cent.; C to D at a gain of 3 per cent.; and D to E at a gain of 2 per cent. E receives £1434 1s 4·56d; What did A give for it?

13. A's capital exceeds B's by $\frac{41}{400}$ of B's capital. B puts his out at compound interest for three years at 5 per cent. At what rate per cent. of simple interest must A put his out in order that, at the end of the three years, the two amounts may be the same?

14. I pay £212 10s for a carriage and a pair of horses, one of the horses costing half as much again as the other. If, however, each horse had cost 15 per cent. more, and the carriage 19 per cent. less, the whole amount to be paid would have been unaltered. Find the respective prices of each horse and of the carriage.

15. Two vessels holding 40 gallons each are both full, the one of two parts of wine mixed with three parts of water, the other of wine and water mixed in a different ratio. One-fourth of the liquid in each vessel is then transferred to the other. The contents of each vessel having been well mixed, one-third of each is again transferred to the other, after which it is found that there are $1\frac{1}{3}$ more gallons of water than of wine in the first vessel. What was the original mixture in the second vessel?

ADDITION.

N.B.—*You had better occupy the whole time allowed.*
No additional marks will be given for rapidity.
Do not copy out the sums.
Add these up, placing the answers in the spaces indicated.

£	s.	d.	£	s.	d.	£	s.	d.
32410	3	5	361211	6	7	541263	9	5
95016	18	2	787639	7	7	347786	11	10
23276	5	9	887142	7	9	267873	13	2
3976	15	8	98290	2	10	89768	12	11
209674	19	11	465983	17	11	566984	5	4
302475	11	6	786178	2	4	99374	5	7
7624	6	2	314197	6	5	891174	2	10
373041	2	7	538097	1	2	984917	10	8
358756	3	7	23297	12	5	318019	3	8
859276	3	8	748639	7	5	232087	9	7
93257	13	11	189603	2	5	769873	13	7
18759	13	11	1983	19	10	41877	19	3
69840	3	7	631902	8	6	298772	2	6
815975	16	11	22896	10	10	36197	11	7
90574	2	11	147732	6	2	24761	18	4
744032	8	6	642935	8	1	31847	1	2
34232	1	11	658	16	11	74573	2	4
476239	15	7	17296	13	7	621140	15	6
381397	7	1	828	17	5	29200	7	9

£	s.	d.	£	s.	d.	£	s.	d.
16391	1	4	106747	18	3	639875	12	3
6679	14	5	29215	9	5	432799	11	8
23109	19	10	76899	13	7	11835	0	3
376514	10	5	528636	4	11	313257	8	11
74321	18	9	403750	5	8	16391	1	4
47983	19	3	827516	3	9	897	15	3
810732	17	1	42361	8	9	74321	18	9
274032	12	1	166197	11	7	23109	19	10
94636	1	1	17218	9	6	112935	8	1
291414	12	4	326408	13	10	675940	18	2
97243	17	11	734321	18	9	810327	4	4
714961	13	11	129374	5	7	39642	5	2
93198	10	8	239763	2	1	310397	8	7
153748	2	9	228416	9	10	6910	0	3
34728	12	6	95483	17	10	20242	0	7
765491	9	5	141263	9	5	708416	19	7
673159	0	1	310397	8	7	7187	7	7
31140	15	6	310397	8	7	612356	1	2
299653	1	8	649603	2	5	32752	15	3

ADDITION—*continued.*

Add these *across*, placing the Totals in the spaces indicated.

										Totals.
8963	9572	7485	5417	3985	7501	5212	19077	488	2657	
43958	10195	36567	6105	2897	12120	8345	2543	3285	2502	
80631	21555	22279	18919	1350	15670	6259	1488	12424	3535	
58392	16228	9735	2779	9665	21944	504	205	6771	8520	
9505	10075	3657	31932	4718	9026	40914	12980	2957	2469	
19425	18090	13218	8577	36095	862	6304	4425	4525	2187	
6653	17282	247	4275	3891	4725	5725	8890	23473	4869	
9135	7639	6495	12815	9687	284	19842	7280	17449	1689	
14955	18215	31457	7000	9800	3503	461	913	615	1314	
2472	17633	34209	17568	3001	11909	2165	3038	323	7400	
16760	13668	969	3620	22916	8270	9720	6252	394	2074	
27770	9298	14175	4323	4073	1070	15587	6291	7527	329	
2152	6590	220	1033	16075	3710	2604	4145	290	3640	
487	1096	5018	2499	7790	386	769	1940	491	535	
876	3205	2076	830	13276	74	602	2072	6225	457	
14245	2356	7803	930	6537	925	673	856	486	1405	
13721	819	9195	2573	24293	12190	7495	197	210	845	
8756	17945	12788	43986	2406	1275	7079	320	770	892	

COPYING.

Copy, on the form supplied, as much of the following, including the table of figures, as you can in half an hour, taking care to write as well as you can.

EXTRACT from the ARMY MEDICAL DEPARTMENT REPORT for 1880.

The following Table shows the number of recruits inspected for each arm of the Service, and the number rejected. It will be seen that the proportion of recruits is higher than in the previous year for the Royal Artillery, Foot Guards, Departmental Corps, and Royal Engineers. It is lower for Infantry Regiments, Cavalry of the Line, and Household Cavalry.

Arms of the Service.	By Army Medical Examination		By Civil Medical Examination		Total Number Inspected.		Rejected at Second Inspections.	Total Rejected at First and Second Inspections.
	Inspected.	Rejected.	Inspected.	Rejected.	Inspected.	Rejected.		
Household Cavalry ..	250	76	—	—	250	76	2	78
Cavalry of the Line ..	3,701	1,579	129	14	3,830	1,593	46	1,639
Royal Artillery ..	5,645	2,024	696	125	6,342	2,149	137	2,286
Royal Engineers ..	845	324	40	7	885	331	11	342
Foot Guards	1,408	403	121	19	1,529	422	66	488
Infantry Regiments ..	26,516	10,651	5,173	1,153	31,689	11,894	1,282	13,086
Departmental Corps ..	1,577	868	7	2	1,584	870	3	873
Not stated	2	2	—	—	2	2	—	2
Total ..	39,944	15,927	6,166	1,320	46,110	17,247	1,547	18,794

As compared with the results for the previous year, the proportion of recruits rejected for Departmental Corps is higher by 156·5, for the Royal Engineers by 104·6, for the Cavalry by 86·3, and for Infantry Regiments by 54·7 per 1000. A decrease in the proportion of rejections is observed among recruits for the Foot Guards of 418·6, among those for the Household Cavalry of 43·3, and of those for the Royal Artillety of 2·8 per 1000.

COPYING.

On the form supplied, copy in your best handwriting, as much as you can of the following, including the Table of Figures, in the prescribed time.

SAN FRANCISCO—IMPORTS.

The value of the principal articles from Great Britain during the past five years has been—

Articles.	1883.	1882.	1881.	1880.	1879.
	Dollars.	Dollars.	Dollars.	Dollars.	Dollars.
Manufactured Steel ...	355,600	1,960,800	726,800	—	—
Tin Plates	683,300	935,000	679,400	704,000	443,000
Coals	400;000	402,700	593,300	98,500	71,800
Cement	202,000	161,200	—	—	—
Earthenware	166,000	217,000	178,500	159,300	166,008
Pig Iron	281,100	218,000	63,300	133,000	26,100
Manufactured Iron ...	186,000	472,000	301,100	424,800	135,000
Steel Ingots	210,000	224,000	83,100	180,000	51,200
Cotton Goods	110,200	142,000	116,000	65,000	108,300
Flax Goods	78,200	178,500	245,000	175,000	184,642

Iron.—J. W. Harrison's circular, dated 31st December, states that the past year has not proved advantageous to importers of pig iron, as it was only during the earlier portion of the year that the price obtained here showed any advance over the cost of importation, and during the later months prices showed a decided loss.

Scotch pig iron can now be bought at 1 dol. 50 c. to 2 dol. per ton less than it can be contracted to be loaded for next January or February, this being attributable to the large stock on hand, the supply being almost an exact counterpart of the annual average of the last five years' consumption; hence the outlook forbodes a continuance of low prices, at least until consumption materially increases.

To illustrate how a staple like pig iron fluctuates, he shows that in January, 1883, it sold here at 27 dol. 50 c. per ton when inward freights from Glasgow were less than they are now, whilst 24 dol. 50 c. per ton would be the utmost now obtainable for it. From January to August the prices ranged from 27 dol. to 27 dol. 50 c.; from August to the end of the year from 24 dol. 50 c. to 27 dol. Only the Glengarnock brand is quoted, as it forms 75 per cent. of the entire pig iron melted here.

BOY CLERKS.—MAY, 1885.

GEOGRAPHY.

Extra marks will be given for neatness in drawn maps, but only so far as they are accurate.

1. In the accompanying outline map of Scotland mark the boundaries of the counties north of the Grampians. Insert the names of the principal lakes and mountains, and of the lochs or firths, round the coast. Trace the courses of the Tay and the Spey. Insert Stirling, Inverness, Wick, Perth, Greenock, Peterhead, and name the islands of Staffa and Arran.

2. Name in order the rivers whose mouths are in the *European* portion of the coast of the Black Sea. Describe the course of any *one* of these rivers, and name the principal towns upon it.

3. Draw an outline map of India, and insert the mountains, rivers, and ten of the chief towns. Mention *one* fact of interest or importance in connection with each of these towns.

4. Where are the following mountains and lakes:—Atlas, Ararat, Vosges, Carpathians, Alleghanies, Teneriffe, Athabasca, Nicaragua, Baikal, Onega? To what is the cold on high mountains due?

5. State the positions of Cronstadt, Toulon, Cardiff, Londonderry, Aden, Goulburn, Buenos Ayres, Lima, Dresden, Muscat. Mention any interesting facts relating to them.

6. Excluding the United Kingdom, enumerate as fully as you can the islands possessed by the British Crown in the North Temperate Zone. Name the most Northerly, the most Westerly, and the most Southerly of the British Isles.

7. Describe the principal ocean currents and prevailing winds which are encountered on the Atlantic Ocean.

8. Name the most extensive deserts, and the chief volcanic districts, upon the earth's surface.

9. Describe shortly *two* of the following counties:—Westmoreland, Kerry, Midlothian. Draw a map of *one* of the two you select.

10. Give some account of the commerce and industrial pursuits of Austria.

BOY CLERKS.—FEBRUARY, 1886.

GEOGRAPHY. (Optional.)

Extra marks will be given for neatly drawn maps, but only so far as they are accurate.

1. Define what is meant by the *Zones* on the Earth's surface; and explain as fully as you can, with a diagram, why the Tropics are *hot* and the Poles *cold*.

2. On the accompanying outline map of England and Wales mark the boundaries of the six northern Counties of England, and any six Counties in South Wales, with the names of each of them. Insert also the names of the Seas bordering the coasts, and the Bays and chief inlets.

3. Describe the geographical position of *six* of the following Lakes:—Baikal, Tchad, Nyassa, Winnipeg, Ladoga, Nicaragua, Titicaca, Van, Geneva, Como, Lomond, Windermere; and give some particulars about each of them.

4. Draw a sketch-map of the River Rhine, showing its source and tributaries, the Countries these rivers drain, and the principal Towns situated on their banks.

5. What Countries supply—*tea, spices, gold, palm-oil, olive-oil, silk, wool, cotton, raisins, currants, mahogany, tobacco?* Mention the Ports from which these commodities are more especially sent.

6. Enumerate the Mountain-ranges of Europe; describe, or show by sketch-map, their direction and extent; state the names and heights of their chief summits.

7. Mention six of the chief Towns of Ireland, and six of Scotland; indicate their geographical position, and state for what they are remarkable in history or commerce.

8. What are the differences between Tides and Ocean-currents? Mention some of the latter. Where do the Tides sometimes rise very high? What Sea has the least Tide?

9. Enumerate in order the chief Islands, Coasts, and Ports passed in a voyage from London, round the Cape, to Bombay, and thence to Singapore and Canton, mentioning which are British possessions.

10. What and where are the West Indies? What do they produce? To what European Governments do most of them belong?

EXCISE EXAMINATIONS.—NOVEMBER, 1883.

GEOGRAPHY (especially of the British Isles).

Extra marks will be given for neatness in map-drawing, but only so far as it is accompanied by accuracy.

1. Write an account of the Pennine Range of mountains, describing its geographical position and its chief physical features. Mention the principal towns on its eastern and western slopes, and the industries that have sprung up in them. Illustrate your account with a map.

2. What principal lines of railway connect London with Scotland? Describe a journey by one of them from London to Glasgow, mentioning the counties which would be traversed, the chief rivers which would be crossed, and the principal towns which would be passed in the course of the journey.

3. Draw a sketch map of the Province of Munster, showing its counties, with the positions of their chief towns, and the principal mountains and rivers of the Province.

4. Enumerate the principal sea-ports on the South Coast of England. Select six of them, and mention any facts with which you may be acquainted regarding their geographical position, their trade, and the causes of their prosperity.

5. Define as accurately as you can the position of the following, and mention the trades with which they are connected:—Cardiff, Dowlais, Dudley, Dumfries, Dundee, Greenock, Middlesbrough, Paisley, Barrow, and Wrexham.

6. On the accompanying outline map of Africa mark the states bordering upon the North Coast, the South African Colonies, the chief lakes and mountain ranges, the courses, as far as they are known, of the following rivers:—the Senegal, the Niger, the Congo, the Orange River, the Zambesi, and the Nile; and the more important towns on the banks, or at the mouths, of these rivers. (Show up your map with the green book.)

7. Describe a coasting voyage from Bombay to Hong Kong, mentioning the states, the principal islands, and the mouths of the more important rivers which would be passed. You can illustrate your account with a map.

8. Where are the following, and what do you know about them:— Chicago, Hainan, Hamburg, Lubeck, Mobile, New Britain, New Caledonia, Mount Athos, Reunion, and Trieste?

9. Write a geographical description of either Staffordshire or Lanarkshire, or the County of Antrim.

ASSISTANTS OF EXCISE.—NOVEMBER, 1885.

GEOGRAPHY.

Extra marks will be given for neatness in map-drawing, but only so far as it is accompanied by accuracy.

1. Describe the physical characteristics of Northumberland, Derbyshire, Cornwall, and the Channel Islands. Mention their chief products.

2. Draw a map of Wales; on it show, by their names, the positions of the counties into which it is divided, and of those English counties by which it is bounded; also name the chief bays on the coast.

3. Name eight of the principal canals in England and Scotland, and the rivers or places which they unite.

4. In what consist the trade and the importance generally of Glasgow, Waterford, Dundee, Hull, Cork, Halifax, Manchester, Plymouth, and Barrow-in-Furness?

5. Name in order, from north to south, the inlets on the east coast of Ireland, the rivers flowing into them, and the towns of note situated in or near them.

6. Give reasons for the commercial prosperity of Archangel, Nantes, Sydney, Cadiz, Bombay, Batavia, Alexandria, Trebizond, and Winnipeg.

7. Explain, by reference to the contiguous districts, or in any other way, the situation of Silesia, Liberia, Bulgaria, Yemen, Bhootan, Ohio, and Nicaragua.

8. Enumerate the Asiatic and African possessions of Continental European powers.

9. On the accompanying outline map mark the chief political divisions of Italy. Show the following capes: Passaro, Bon, Corso, and Leuca. Name the principal islands and place the following towns and mountains: Rome, Leghorn, Naples, Ravenna, Milan, Trieste, Tunis, Fiume, Cagliari, Valetta, Etna, Vesuvius.

LOWER DIVISION, MEN CLERKS.—SEPTEMBER, 1885.

GEOGRAPHY.

1. State concisely the usual proofs of the rotundity of the Earth, and explain the *annual* and *diurnal* motions respectively.

2. Enumerate, in three separate colums, (*a*) the mining districts and manufacturing towns of Great Britian, (*b*) the counties in which they are situated, and (*c*) the articles produced.

3. Name the political divisions of North (including Central) America, enumerate and state the positions of the chief lakes and estuaries; and name (*in order*) the States of the Eastern seaboard, with their capital towns.

4. Give the names, and briefly describe the situation, of the capital towns of Bavaria, Queensland, Tasmania, Jamaica, Jersey, Burma, British Burma, Siam, Persia, Cuba, French Guiana, Isle of Man, West Australia, Madagascar, Sierra Leone, Malta, Beloochistan, Java, Hungary, Bohemia, Roumania, Servia, and Bulgaria.

5. Give a descriptive account of any *one* of the following countries, in reference to *(a)* their situation and extent, *(b)* their physical features, *(c)* their industries, and *(d)* the character of the population:—Sweden and Norway—India—South Africa—the United States of America.

6. Define, with the aid of a diagram, the zones of the Globe, showing how the lines of equal temperature traverse it in winter and summer. Trace also the general directions of the ocean currents.

7. Mention in order of their size the various Oceans; describe their boundaries and peculiar characteristics, and state any ascertained facts concerning their depth.

8. On the accompanying outline map of Asia, sketch the chief mountain ranges and rivers; trace the boundaries of the various countries, naming their capital towns; insert the names of the prominent headlands and larger islands, and show the position of Tobolsk, Pondicherry, Mecca, Mocha, Lahore, Candahar, Foochow, Saigon, Yarkand, Macao, Poona, Shanghai, Martaban, Hydera bad, Sarawak, Agra, Benares.

MEN CLERKS.—MAY, 1885.

GEOGRAPHY.

1. What are the principal subjects treated of under the heads of Physical, Historical, Political, and Descriptive Geography? Explain the following terms, "Boxing the Compass," "Variations of the Compass," "Compression of the Earth," and "Meridian."

2. Describe the chief physical differences between Ireland and England. Mention the four provinces into which the former is divided. Select one of them for a more detailed description of its counties, rivers, towns, population, and trade.

3. Describe carefully the river systems of Russia, and the geographical situation of all its seaports.

4. Mention the principal mountain passes on the North-West Frontier of Hindustan, and draw a map of that part of Asia which lies between the Indus and the Caspian Sea, marking on it the position Khiva, Bokhara, Pamir, Merv, Ghuznee, Cabul, Candahar, Herat, Quetta, Kelat, Teheran, Ispahan, and Peshawur.

5. Mention, *in order*, the States which lie along the south shores of the Mediterranean, and the Governments to which they belong; and enumerate the British Possessions in Africa.

6. Describe the geographical situation of Heligoland, the Corea, Bosnia, Luxembourg, Manitoba, Alaska, Venezuela, and Queensland, and state the principal characteristics of their population, productions, and government.

7. Write down the names of (1) the towns on the St. Lawrence; (2) the tributaries of the Mississippi; (3) the rivers of France; (4) six lakes in England; (5) six straits in any part of the world; (6) the capes of Europe in the Mediterranean.

8. Fill up the accompanying map of India, marking on it the names of the chief provinces, rivers, mountain ranges, and at least twelve principal towns.

FEMALE CLERKS IN POST OFFICE.—OCTOBER, 1885.

GEOGRAPHY.

1. Give the position of the different lake-systems of Great Britain, naming the principal lakes in each system and explaining how they are supplied and drained. Which is the largest lake in the British Isles?

2. Name in order the different independent European countries that border on the Coast line from the Gulf of Bothnia to the Dardanelles. Name also the capital, with its situation, the chief river, and the most important commercial port of each State. What seas wash the shores of these states?

3. On the accompanying map of Africa draw the principal rivers and mountain chains. Add also the names of the most important capes and the chief seaports.

4. Write a short geographical description of Canada.

5. What islands border the Eastern coast of Asia from Kamchatka to Singapore? State to whom they severally belong, their capitals, and for what they are commercially important.

6. Give, as accurately as you can, the position of the following places, mentioning anything noteworthy concerning them:—Tirnova, Salonica, Strasburg, Durban, Belgrade, Peshawur, San Francisco, Chicago, Monte Video, and Demerara.

FEMALE CLERKS.—OCTOBER, 1885.

ENGLISH HISTORY.

1. Mention the different occasions on which the Romans visited Britain. What traces remain of their occupation?

2. Describe briefly *in narrative form* the principal events of Henry I.'s reign.

3. What do you know of the Lollards, the Crusades, the Covenanters, the Trial of the Seven Bishops, the First Reform Bill?

4. Mention the English possessions in France at the accession of Henry VI. Compare them with (1), those of Henry II.; (2), those of Edward III. at the peace of Bretigny.

5. Give in tabular form the *hereditary* title of William III. and George I. to the throne of England.

6. Mention the principal wars and military operations of the present reign to the year 1870, with the approximate date and the cause of each.

MEN CLEKKS, LOWER DIVISION.—MAY, 1885.

ENGLISH HISTORY.

1. In the political and judicial institutions of modern England, what traces of Anglo-Saxon customs and laws are discoverable?

2. Explain the nature of the quarrel between Archbishop Anselm and the Anglo-Norman Kings, William II. and Henry I.

3. Give some account of the most important events of the reign of John.

4. Describe the attempt of Charles I. (January, 1642) to arrest the "Five Members," and the circumstances which led up to it.

5. Give an account of the measures taken after the Restoration for reviving and strengthening the Episcopalian system in England and Scotland.

7. Write a short account of the Battle of Pinkie, Wyatt's Rebellion, the Spanish Armada, the Death of Raleigh, the Siege of Drogheda, and the Battle of Sedgmoor.

7. What stipulations in the Treaty of Utrecht regarded: 1. The safety of the succession to the throne; 2. British colonial interests; 3. The extension of British trade?

8. Give a brief account of the domestic and foreign policy of Mr Pitt, after the breaking out of the French Revolution.

9. With what views was the "Crimean War" undertaken by the allied powers, and how far were those views realised at the Peace of Paris?

MEN CLERKS, LOWER DIVISION.—JANUARY, 1886.

ENGLISH HISTORY.

1. Narrate, briefly, the circumstances under which the West-Saxon kingdom annexed to itself the other kingdoms of the Heptarchy.

2. By what measures did Henry II. endeavour to extend the reign of justice and law in every part of his realm?

3. How was Calais acquired, and how was it lost?

4. What were the nature and value of the hereditary claim to the throne possessed by each of the following persons—Edward Plantagenet, Arabella Stuart, and Prince Charles Edward?

5. Name six of the leading men in the Long Parliament, and describe their careers.

6. Of whom did the "Cabal" ministry consist? State what you know of the later history of any of its members.

7. What advantages were secured for England by the Peace of Utrecht?

8. In what manner did Ceylon, the Mauritius, St. Lucia, and Tasmania, become portions of the British Empire?

9. Describe, briefly, the share taken by England in the establishment of Greek independence.

MEN CLERKS, LOWER DIVISION.—MAY, 1885.

BOOK-KEEPING BY DOUBLE ENTRY.

1885.

Jan. 1. Cash at Bank £326 5s 10d; Cash at office £18 16s 3d; Bills receivable, £289 18s 4d; Bills payable, £100 16s; Goods on stock, £1008 11s 8d.

The Personal Accounts stand as follows:—Due to T. Herbin, £53 18s 6; C. Boyd, £82 1s 3d. Due from E. Hendry, £84 18s 8d; A. Wolland, £28 10s.

			£	s.	d.
Jan.	2.	Advanced to clerk for petty expenses -	10	0	0
,,	3.	Received from E. Warburton consignment of goods to be sold on his account at 2½ per cent. commission, iuvoiced at - -	350	0	0
,,	3.	Paid dock charges on this consignment -	4	2	1
,,	4.	Sold E. Hendry, goods - - -	84	18	0
,,	4.	Sold T. Philips, goods - - -	132	11	8
,,	5.	Drew cheque for office cash - -	25	0	0
,,	6.	Paid T. Herbin, by cheque - -	53	6	0
,,	6.	Discount allowed by T. Herbin - -	0	12	6
,,	8.	Bought of C. Boyd, goods - -	184	6	0
,,	9.	Bought of T. Herbin, goods - -	72	3	4
,,	9.	Received of E. Hendry his acceptance at one month - - - -	150	0	0
,,	9.	Received of E. Hendry his cheque for -	19	6	4
,,	9.	Allowed E. Hendry for discount - -	0	10	4
,,	10.	Purchased at broker's sale, goods £300, and gave up my bargain to T. Wardrop for £320; received cash - - -	20	0	0
,,	10.	Discounted with Graham & Co., E. Tuke's acceptance for £207 10s, and received their cheque for - - - -	205	5	0
,,	10.	Discount charged thereon - - -	2	5	0
,,	12.	Received cash of A. Wolland - -	28	2	6
,,	12.	Discount allowed A. Wolland - -	0	7	6
,,	15.	Sold E. Browel, goods - - -	250	0	0
,,	16.	Received of E. Browel, A. Westrop's acceptance for £200, his cheque for £49, and allowed him for discount £1 -	250	0	0
,,	18.	Paid at bank my acceptance of D. Roberts' draft due this day - - -	100	16	0
,,	22.	Lent cash to A. Wolland - - -	20	0	0
,,	23.	E. Browel's acceptance paid this day by cheque - - - - -	82	8	4
,,	24.	Paid half a year's rates on office - -	12	11	3
,,	24.	Sold to E. Browel, part of E. Warburton's consignment - - - -	200	0	0
,	24.	My commission on the sale - -	4	10	0
,,	25.	Accepted C. Boyd's draft at 21 days -	266	7	3
,,	25.	Sold T. Herbin, goods - - -	42	0	0
,,	26.	Received cash, being 10s in the pound on T. Philip's debt to me, he having compounded with his creditors - -	66	5	10
,,	31.	Allowed clerk's account for petty payments - - - - -	9	13	6
,,	31.	Clerk's salary for the month - -	10	0	0

1. In the form of "Cash Book" enter all the cash transactions, and, if you are able to do so, all the Bank transactions also. You may employ one or both sets of money columns.

2. Carry all the transactions through the Journal, using one of the two forms provided.—"Narrations" are not required.

3. Post all the transactions into the Ledger, inserting the proper folio references.

4. Balance and close the Ledger, showing the Trial Balance and opening a Balance Account. The goods on hand may be valued at £900.

5. Has the firm gained or lost in the month? By how much?

6. Was the firm solvent or insolvent on Jan. 31? By how much?

[*The following should not be attempted until you have done all you can of the above.*]

7. W. Soper, a partner in the firm of Watson, Soper, & Co., retires and leaves with the new firm, on their bond, his share of the stock, valued and agreed at £3000, which is to be paid to him in annual instalments of £1000, and is to bear interest at 5 per cent.

What entry would the new firm make in their books—

(1.) On entering into this agreement;

(2.) On paying to W. Soper the first instalment of £1000 and £150 for interest?

8. What Journal entries would Johnson & Co. and J. Walker respectively make for the following transactions recorded in the Waste Book of the former?

"Received of Turner & Co., J. Walker's acceptance to us "for £100, endorsed by us, which had been returned to "them dishonoured."

"Paid notarial charges on J. Walker's acceptance, 7s 6d."

9. The following entry was subsequently made in the Waste Book of Johnson & Co.

"Renewed J. Walker's bill for one month, with interest "£1 14s, and charges 7s 6d, £102 1s 6d."

Would J. Walker make any Journal entry for the transaction? If so, give it.

INDEXING

Instructions—

1. Continue the index to the letters or enclosures printed below,* on the forms supplied to you, in a style similar to that of the subjoined specimen.

2. The subject-matter of each letter should be stated in as *brief* a compass as possible.

3. Write the index from page 2 to page 8 *inclusive* in one book, and from page 9 to the end in another.

SPECIMEN.

No. of Letter.	Date.	Correspondents.	Subject-matter.
1	Sept. 11, 1877.	Mr Graham to The Earl of Derby	Reporting that he had urged, on the Peruvian Minister, the claims of the bond-holders to nitrate of soda in case guano should prove insufficient to pay their bonds.
2	Oct. 18, 1877.	Mr Graham to The Earl of Derby	Enclosing memorandum from Peruvian Minister on the claim of the bond-holders to the nitrate of soda.
Inclos. in No. 2.	N. D.	From Señor Rospigliosi.	Stating that the deposits of guano are ample to meet the claims of the bond-holders, and that the nitrate of soda is to be applied otherwise.

* These were letters and enclosures extracted from a Paper presented to Parliament, entitled Peru, No. 1, 1882, and occupied about 14 pages.

DIGESTING RETURNS INTO SUMMARIES.

LOWER DIVISION, MEN CLERKS.—JANUARY, 1885.

N. B.—(a.) In assigning marks, great importance will be attached to accuracy and neatness. No additional credit will be given for completing the paper in less than the time allowed.

(b.) The paper put before you must not be mutilated in any way. Mistakes should be corrected, but no erasure is to be made. Calculations may be made on waste paper, which will be provided for that purpose, but no rough copy of any part of the Form is to be made.

Rule a Form (which may be as *wide* as your paper will admit) like the subjoined specimen,* and fill up the several columns from the particulars given on page 22, observing carefully the following instructions :—

1. That the names of the Railways are to be entered into the Form in strict alphabetical order.
2. That all stops and *initial* capitals given in the Specimen of Form are to be exactly reproduced.
3. That all the figures which cannot be directly copied from page 22 are to be supplied by calculation.
4. That the cost of Maintenance is to be calculated to pounds sterling, neglecting fractions of a £.
5. That percentages are to be calculated and entered correctly to two places of decimals.

RETURN No. 1.—EXPENDITURE on the INDIAN STATE RAILWAYS in 1881.

Railway.	Maintenance	Working, &c.	Railway.	Maintenance	Working, &c.
	£	£		£	£
Nalhati	1,447	3,860	Muttra-Hathras	1,383	7,981
Holkar and Sindhia-Nimach	39,400	94,868	Rajputana	93,495	344,026
Punjab Northern	48,457	262,539	Tirhut	6,696	21,220
Sindhia	3,768	9,455	Rangoon and Irawadi Valley	21,886	67,968
Calcutta and South-Eastern	4,473	5,658	Nagpur and Chhatisgarh	3,681	17,866
Patna-Gaya	3,792	29,636	Wardha Coal	2,465	47,206
Indus Valley and Kandahar	80,903	337,725	Northern Bengal	21,029	62,755
Cawnpore and Farrukhabad	3,918	15,516			

RETURN No. 2.—RECEIPTS from the INDIAN STATE RAILWAYS in 1881.

Railway.	Passengers.	Goods.	Railway.	Passengers.	Goods.
	£	£		£	£
Northern Bengal -	53,692	102,852	Tirhut - - -	22,971	23,918
Muttra-Hathras -	8,978	4,247	Punjab Northern -	135,430	199,022
Cawnpore and Farrukhabad -	15,417	12,211	Sindhia - - -	15,089	9,769
Nalhati - - -	4,599	1,940	Rangoon and Irawadi Valley -	81,090	71,555
Wardha Coal - -	3,606	13,009	Calcutta and South-Eastern -	8,328	3,709
Rajputanta - -	223,570	490,991	Nagpur and Chhatisgarh -	8,750	18,931
Holkar and Sindhia-Nimach - -	74,112	119,323	Patna-Gaya - -	34,684	15,944
Indus Valley and Kandahar -	149,870	354,139			

RETURN No. 3.—RECEIPTS (MISCELLANEOUS) from the INDIAN STATE RAILWAYS in 1881.

Northern Bengal, £3,385. Wardha Coal, £30,984. Nagpur and Chhatisgarh, £472. Rangoon and Irawadi Valley, £1,717. Tirhut, £1,810. Rajputana, £9,664. Muttra-Hathras, £309. Calcutta and South-Eastern, £3,214. Patna-Gaya, £715. Indus Valley and Kandahar, £28,860. Cawnpore and Farrukhabad, £230. Nalhati, £167. Holkar and Sindhia-Nimach, £1,183. Punjab, Northern, £12,841. Sindhia, 182.

RETURN No. 4.—LENGTH of RAILWAY in MILES.

Cawnpore and Farrukhabad, 86. Nalhati, 27¼. Holkar and Sindia-Nimach, 254½. Punjab Northern, 354¾. Sindhia, 74¾. Calcutta and South-Eastern, 28. Patna-Gaya, 57. Indus Valley and Kandahar, 653. Northern Bengal, 252½. Wardha Coal, 46½. Nagpur and Chhatisgarh, 98. Rangoon and Irawadi Valley, 161. Tirhut, 85. Rajputana, 1,115¾. Muttra-Hathras, 53.

(SPECIMEN OF FORM.)

STATEMENT showing the REVENUE from the INDIAN STATE RAILWAYS in 1881.

RAILWAY.	Length in Miles.	RECEIPTS.				EXPENDITURE.			Cost of Maintenance per Mile.	Amount of Expenditure for every £100 of receipts.
		Passengers.	Goods.	Miscellaneous	Total.	Maintenance	Working, &c.	Total.		
		£	£	£	£	£	£	£	£	
Total for all Railways,										

DIGESTING RETURNS INTO SUMMARIES.

LOWER DIVISION, MEN CLERKS.—SEPTEMBER, 1884.

No. 1.—RETURN showing the NUMBER of PAUPER LUNATICS in ENGLAND and WALES on the 1st January in each of the Years 1871 to 1882 inclusive.

	Females.	Males.		Females.	Males.
1874	30,634	24,101	1880	35,473	28,098
1881	36,486	28,886	1872	28,862	23,136
1879	34,611	27,496	1878	33,994	26,852
1875	31,455	24,948	1876	32,127	25,280
1882	37,432	29,657	1873	29,696	23,577
1871	27,867	22,434	1877	32,961	26,078

No. 2.—RETURN showing the NUMBER of PRIVATE LUNATICS in ENGLAND and WALES on the 1st January in each of the Years 1871 to 1882 inclusive.

	Females.	Males.		Females.	Males.
1877	3,510	4,087	1871	2,879	3,575
1873	3,128	3,895	1882	3,663	4,090
1876	3,447	4,062	1875	3,447	4,062
1878	3,520	4,172	1879	3,591	4,187
1872	2,960	3,682	1881	3,654	4,087
1880	3,554	4,066	1874	3,269	4,023

No. 3.—RETURN showing the POPULATION in ENGLAND and WALES on the 1st January in each of the Years 1871 to 1882 inclusive.

	Females.	Males.		Females.	Males.
1874	11,541,540	12,181,477	1875	11,697,203	12,512,771
1880	12,507,582	13,201,084	1876	11,854,966	12,345,281
1881	12,676,276	13,379,130	1882	12,837,952	13,568,868
1872	11,236,400	11,859,419	1873	11,387,948	12,019,369
1879	12,341,136	13,025,408	1871	11,086,869	11,701,597
1878	12,176,903	12,852,070	1877	12,014,856	12,681,038

(SPECIMEN OF FORM.)

TABLE showing the RATIO of LUNATICS to the POPULATION in ENGLAND and WALES on the 1st January in each of the Years 1871 to 1882 inclusive.

YEAR.	POPULATION.			NUMBER OF LUNATICS.									Total Number of Lunatics in *every* 10,000 of the Population.
				Private.			Pauper.			Total.			
	Males.	Fem.	Total.	Males.	Fem.	Total.	Males.	Fem.	Total.	Males.	Fem.	Total.	

ADDITION.

N.B.—*You had better occupy the whole time allowed.*
No additional marks will be given for rapidity.
Do not copy out the Sums.
Add these up, placing the answers in the spaces indicated.

£	s.	d.	£	s.	d.	£	s.	d.
465983	17	11	347786	11	10	32410	3	5
95016	18	2	23276	5	9	98290	2	10
314197	6	5	787639	7	7	267873	13	2
541263	9	5	209674	19	11	89768	12	11
302475	11	6	566984	5	4	3976	15	8
891174	2	10	887142	7	9	99374	5	7
7624	6	2	373041	2	7	189603	2	5
786178	2	4	538097	1	2	984917	10	8
93257	13	11	859276	3	8	1983	19	10
358756	3	7	769873	13	7	232087	9	7
361211	6	7	69840	3	7	318019	3	8
18759	13	11	748639	7	5	41877	19	3
23297	12	5	815975	16	11	29200	7	9
631902	8	6	828	17	5	36197	11	7
90574	2	1	22896	10	10	24761	18	4
744032	8	6	642935	8	1	31847	1	2
34232	1	11	298772	2	6	658	16	11
476239	15	7	381397	7	1	621140	15	6
17296	13	7	74573	2	4	147732	6	2

£	s.	d.	£	s.	d.	£	s.	d.
827516	3	9	897	15	3	326408	13	10
6679	14	5	76899	13	7	17218	9	6
23109	19	10	74321	18	9	16391	1	4
106747	18	3	639875	12	3	313257	8	11
29215	9	5	47983	19	3	734321	18	9
376514	10	5	810732	17	1	166197	11	7
361	8	9	94636	1	1	74321	18	9
274032	12	1	11835	0	3	23109	19	10
403750	5	8	675940	18	2	112935	8	1
291414	12	4	528636	4	11	432799	11	8
97243	17	11	30642	5	2	714961	13	11
810327	4	4	239763	2	1	16391	1	4
93198	10	8	129374	5	7	95483	17	10
228416	9	10	691040	3	7	153748	2	9
10397	8	7	310397	8	7	32752	15	3
765491	9	5	141263	9	5	708416	19	7
673159	0	1	20242	0	7	7187	7	7
31140	15	6	299653	1	8	649603	2	5
310397	8	7	612456	1	2	34728	12	6

Add these *across*, placing the Totals in the spaces indicated.

										Totals.
8963	38756	9572	12190	24393	12120	8345	12424	488	2657	
18919	43958	10195	12788	43986	15670	7501	19077	6771	2502	
7485	17945	36567	6105	5417	205	40914	8520	2187	3285	
80631	58392	36095	3657	9665	22279	5212	3985	2543	1488	
21555	2779	9735	2897	6259	4718	6304	12980	8890	2469	
16228	19425	247	31932	21944	1350	7280	504	3535	2957	
10075	18090	9505	8577	9026	4425	3503	4525	5725	4869	
6653	9135	7639	3891	6495	862	4725	23473	3038	1689	
17282	13218	4275	7000	9687	19842	284	913	615	1314	
2152	18215	17632	13668	8270	461	6252	323	2165	2074	
2472	31457	17568	14175	22916	1033	9720	17449	4145	7527	
16760	12815	34209	3710	7079	9800	15587	394	290	329	
27770	14955	3205	3001	11909	4323	7790	6291	7400	3640	
969	9298	5018	16075	3620	2604	1070	1940	491	535	
487	6590	1096	4073	830	386	930	845	1275	486	
876	220	602	2573	13276	925	673	2072	457	1405	
14245	13921	7803	2499	2406	2076	197	769	210	856	
2356	819	9195	7495	74	74	6225	320	770	892	
10195	9572	7485	5417	12120	8345	5212	19077	488	2657	
43958	8963	18919	6150	2897	3985	7501	2543	3285	2502	
80631	21555	22279	36567	1350	15670	6259	6771	12424	3285	
58392	16228	9735	2779	9665	21944	504	205	1488	1488	
9505	10075	3657	31932	4718	9026	40914	12980	2187	2469	
19425	18090	13218	8577	36095	862	6304	4425	4525	2957	
6653	17282	247	4275	3891	4725	5725	8890	8890	4869	
9135	7639	6495	12815	9687	284	19482	7280	7280	1689	

ANSWERS.

SIMPLE RULES.

(1) 5757529. (2) 718614. (3) 12772168. (4) 1184934. (5) 354008. (6) 187102. (7) 8309827. (8) 8970699. (9) 17323723. (10) 218713. (11) 275097259. (12) 12728567. (13) 30999936. (14) 9196355. (15) 865259. (16) 841583. (17) 732602568012; 443872888956. (18) 830074251214; 485857840260. (19) 73874047777772; 1900717048780. (20) 216958639658; 3930254112358. (21) 2183017870. (22) $310463944816\frac{2}{3}$. (23) 2962904295384. (24) 1719579233351. (25) 89144223138960; 4751985768679. (26) 34841200419698; 453712039832. (27) 43838312657984; 36618179289904. (28) 72723367602306; 833413949536280. (29) $360943321355\frac{5}{7}$. (30) $399444988094\frac{6}{13}$. (31) $9040754635\frac{18}{27}$. (32) $74598848071\frac{16}{18}$. (33) $461789\frac{8}{108}$; $586743\frac{65}{85}$. (34) 151548; $434134\frac{3}{4}\frac{8}{7}$. (35) 5208; $26206\frac{20}{64}$. (36) 40081; 521053. (37) $1029122\frac{78}{104}$. (38) $8743516\frac{150}{620}$. (39) $104753636\frac{240}{833}$. (40) $16797575\frac{262}{436}$. (41) 20431; $299133\frac{14}{39}$. (42) 9099; $1342752\frac{12}{28}$. (43) 9009; 52173. (44) 7947; $322997\frac{32}{197}$. (45) $1013305\frac{751}{921}$. (46) $4416557\frac{66}{366}$. (47) $974402\frac{962}{10075}$. (48) $1985588\frac{296}{713}$. (49) 90245. (50) 39427309. (51) 6512002. (52) 89097098. (53) 3066972. (54) 835318. (55) 6990768; 259 times. (56) 2739890. (57) 61027. (58) 7008. (59) 209. (60) 586. (61) 58420. (62) 785; 15 times. (63) 569. (64) 6085965948. (65) 390. (66) 7407. (67) 2779343. (68) 316. (69) 1008387. (70) 1583000. (71) 388. (72) 1324. (73) 9899000. (74) 458. (75) $5048\frac{5}{718}$. (76) 1870744. (77) 390270. (78) £1080.

COMPOUND RULES.

(1) £3377 15s $7\frac{1}{2}$d. (2) £11101 5s $7\frac{3}{4}$d. (3) £3339 11s $9\frac{1}{2}$d. (4) £1893 18s $11\frac{1}{2}$d. (5) 16 tons 16 cwts. 2 qrs. 5 lbs. (6) 41 lbs. 8 oz. 5 dwts. 17 grs. (7) 4 tons 3 cwts. 1 qr. 16 lbs. 7 oz. 4 drs. (8) 21 mls. 6 fur. 33 po. 3 yds. 2 ft. 7 ins. (9) 90 ac. 2 ro. 14 po. 30 yds. (10) 22 qrs. 6 bush. 2 pks. 1 gall. (11) 382 yds. 1 qr. (12) 67 hhds. 63 galls. 3 pts. 3 gills. (13) £226 15s $6\frac{1}{2}$d; £3781 13s $8\frac{3}{4}$d; £11927 18s $11\frac{1}{4}$d; £10 6s $4\frac{1}{4}$d; £65399 17s $8\frac{3}{4}$d; £676 5s $0\frac{3}{4}$d. (14) 8 cwts. 22 lbs. 6 oz. 9 drs.; 16 tons 15 cwts. 3 qrs. 8 lbs. 9 oz. (15) 19 ac. 28 po. 27 yds. 2 ft. 3 ins.; 33 ac. 1 rood 17 po. 27 yds. 6 ft. 108 ins. (16) 129 miles 6 fur. 28 po. 3 yds. 1 ft. 6 ins.; 1 mile 6 fur. 31 po. 1 yd. 2 ft. 10 ins. (17) 318 lbs. 1 oz. 18 dwts. 15 grs.; 1022 lbs. 11 oz. 13 dwts. 23 grs. (18) 138 lbs. 6 oz. 3 drs. 0 scr. 16 grs.; 135 lbs. 10 oz. 3 drs. 1 scr. 2 grs. (19) 8 yds. 2 qrs. 3 nls. $1\frac{1}{4}$ ins.; 6 yds. 3 qrs. 1 nl. $1\frac{1}{4}$ ins. (20) 18 qrs. 6 bush. 2 pks. 1 gall. 3 qts.; 6 qrs. 6 bush.

2 pks. 1 gall. 3 qts. (21) 165 cubic yds. 20 ft. 986 ins. (22) £2460 6s 11½d; £3223 18s 1d. (23) £3880 9s 8¾d; £4401 14s 11d. (24) £6685 12s 5d; £11336 9s 9d. (25) £89941 3s 9¾d; £39973 17s 3d. (26) £9675 17s 6½d; £4345 18s 10¾d. (27) £50076 11s 1¼d; £113186 14s 8¼d. (28) £714765 7s 10½d; £267423 13s 3¾d. (29) £8052113 18s 3¾d; £28528002 5s 1½d. (30) 8765 tons 4 cwts. 25 lbs. 12 oz. 15 drs.; 14343 tons 1 cwt. 1 qr. 24 lbs. 6 oz. 10 drs. (31) 2087 tons 17 cwts. 3 qrs. 12 lbs. 15 oz.; 5103 tons 14 cwts. 3 qrs. 3 lbs. 10 oz. (32) 1454 lbs. 10 oz. 11 dwts. 17 grs.; 269 lbs. 11 oz. 14 dwts. 18 grs.; 554 lbs. 11 oz. 9 dwts. 5 grs. (33) 5940 lbs. 3 oz. 1 dwt. 8 grs.; 8631 lbs. 11 oz. 4 dwts. 3 grs.; 4455 lbs. 2 oz. 6 dwts. (34) 1083 lbs. 2 oz. 3 drs. 2 scr. 17 grs.; 2264 lbs. 10 oz. 5 drs. 1 scr. 1 gr.; 1575 lbs. 6 oz. 7 drs. 12 grs. (35) 120 lbs. 5 oz. 1 dr. 1 scr. 13 grs.; 214 lbs. 1 oz. 1 dr. 2 scr. 12 grs.; 294 lbs. 4 oz. 5 drs. 1 scr. 14 grs. (36) 293 mls. 1 fur. 31 po. 4 yds. 6 ins.; 311 mls. 4 fur. 16 po. 1 yd. 1 ft. (37) 4593 mls. 6 fur. 34 po. 3 yds. 2 ft. (38) 1378 qrs. 5 bush. 2 pks.; 1608 qrs. 3 bush. 3 pks.; 3982 qrs. 7 bush. (39) 9696 ac. 34 po.; 14171 ac. 1 ro. 22 po.; 23494 ac. 2 ro. 27 po. (40) 717 yds. 3 qrs. 2 nls. 0¼ in.; 1349 yds. 2 qrs. 1 nl. 2 in.; 1603 yds. 2 qrs. 2 ins. (41) 1791 yds. 2 nls.; 2920 yds. 1 qr. 1 nl.; 3270 yds. 3 qrs. (42) 193 cub. ft. 1340 in.; 135 cub. ft. 1458 ins. (43) 236 cub. yards 4 ft. 1512 ins.; 272 cub. yards 7 ft. 207 ins. (44) £21 12s $4\frac{1}{70}$d. (45) £50 8s $10\frac{15}{48}$d. (46) £10 13s $1\frac{65}{84}$d. (47) £3 18s $3\frac{413}{552}$d. (48) £467 15s $8\frac{19}{25}\frac{41}{88}$d. (49) £563 12s $0\frac{3}{4}$d. (50) £787 3s $7\frac{183}{1156}$d. (51) £12 14s 7d. (52) 194 tons 1 cwt. 2 qrs. 2 lbs. 4 oz. $7\frac{6}{35}$ drs.; 16 tons 6 cwt. 2 qrs. 7 lbs. 13 oz. $13\frac{55}{176}$ drs. (53) 43 tons 5 cwts. 1 qr. 20 lbs. 10 oz. $15\frac{35}{86}$ drs; 13 tons 6 cwt. 3 qrs. 1 lb. 11 oz. $2\frac{175}{279}$ drs. (54) 64512 lbs. 8 oz. 13 dwts. $4\frac{7}{16}$ grs.; 56922 lbs. 11 oz. 17 dwts. $12\frac{7}{17}$ grs.; 53760 lbs. 7 oz. 4 dwts. $7\frac{13}{18}$ grs. (55) 13925 lbs. 9 oz. 12 dwts. $23\frac{3}{4}$ grs.; 11140 lbs. 7 oz. 14 dwts. $9\frac{2}{5}$ grs.; 2258 lbs. 2 oz. 17 dwts. $5\frac{59}{74}$ grs. (56) 41 lbs. 1 oz. 3 drs. 1 scr. $12\frac{21}{23}$ grs.; 23 lbs. 6 drs. 1 scr. $8\frac{29}{41}$ grs.; 15 lbs. 1 dr. $10\frac{1}{9}$ grs. (57) 44 lbs. 4 oz. 5 drs. 2 scr. $15\frac{8}{17}$ grs.; 39 lbs. 8 oz. 5 drs. $18\frac{1}{19}$ grs.; 11 lbs. 3 oz. 1 dr. 1 scr. $3\frac{2}{67}$ grs. (58) 3 mls. 7 fur. 39 po. 4 yds. $6\frac{239}{679}$ in. (59) 2 mls. 7 fur. 30 po. 4 yds. 1 ft. $4\frac{421}{71}$ ins. (60) 7 yds. 2 nls. $1\frac{31}{62}$ in.; 2 yards 3 nls. $1\frac{23}{168}$ in.; 1 yard 3 qrs. 3 nls. $0\frac{29}{192}$ ins. (61) 1 yd. 3 qrs. $2\frac{1}{64}$ ins.; 1 yd. 2 qrs. 2 nls. $1\frac{107}{208}$ in.; 1 yd. 1 qr. $0\frac{243}{272}$ in. (62) 53 acres 11 po. 11 yds. 1 ft. $30\frac{13}{16}$ ins.; 96 ac. 2 ro. 37 po. 28 yds. 3 ft. $5\frac{46}{79}$ ins. (63) 13 ac. 2 ro. 8 po. 10 yds. 6 ft. $50\frac{17}{32}$ ins.; 2 ro. 11 po. 5 yds. 3 ft. $110\frac{743}{761}$ ins. (64) 1 bush. 3 pks. 7 qts. 1 pt. (65) 10 galls. 2 qts. 1 pt. (66) 8 wks. 5 days 21 hrs. 8 mins. 15 secs.; 2 wks. 4 days 21 hours 47 mins. 31¼ secs. (67) 8 wks. 4 days 23 hrs. 32 mins. $40\frac{27}{54}$ secs.; 2 wks. 6 days 23 hrs. 55 min. $51\frac{244}{273}$ secs. (68) £526 10s $3\frac{1}{3}$d; £7 6s $6\frac{49}{2352}$d. (69) £1532 5s $8\frac{4}{7}$d; £5 14s $1\frac{37}{44}$d. (70) £1528 13s $6\frac{10}{11}$d; £4 0s $11\frac{45}{628}$. (71) £13111 5s $7\frac{29}{48}$; £6 11s $4\frac{19}{3338}$d.

REDUCTION.

(1) 170674; 172538; 207057; 371218; 162790. (2) 8951; 2380; 4554; 180487; 1098216. (3) 15347; 11420; 4723; 9357; 18911; 15296. (4) 5410; 2303; 5993; 33582; 50207. (5) 476; 4315; 42839. (6) 28797; 182955; 28942; 209454. (7) 775; 59377; 18375; 7697; 5759. (8) 979; 468; 720; 52269; 687; 1960. (9) 6283; 717; 6698; 1479; 380. (10) 72954; 3255. (11) 74895 guin. 5s; 965 guin. 20s 4½d; 9026 guin. 9s; 8544 guin. 6s; 198 guin. 10½d. (12) 6851271. (13) 147932; 1602513. (14) 13866341; 179205. (15) 158699520; 221352192. (16) 1663; 21557. (17) 109617; 12269. (18) 5129; 353. (19) 418; 51722. (20) 56960; 91520; 43760. (21) 140541½; 3451044. (22) 72696. (23) 1261; 36704½. (24) 2515583. (25) 599; 654. (26) 3297. (27) 2723. (28) 224003877. (29) 1754432. (30) £608 0s 10¼d; £957 0s 5¾d; £4354 12s 2½d; £1790 17s 4¾d. (31) £363 12s 1½d; £811 19s 5d. (32) 743 guin. 13s 4d. (33) £9160 12s. (34) 10304 guin. 6s 4d. (35) 46440 guin. (36) 17047 half-crs. (37) 110 tons 2 cwts. 3 qrs. 20 lbs. 4 ozs.; 93 tons 15 cwts. 2 qrs. 12 lbs. 13 ozs. 14 drs. (38) 112 lbs. 6 ozs. 16 dwts. 1 gr. (39) 168 lbs. 11 ozs. 17 dwts. 8 grs. (40) 109006 lbs. (41) 3638 lbs. 8 ozs. 14 dwts. (42) 410 lbs. 3 ozs. 13 dwts. (43) 156198 lbs. 5 ozs. (44) 848 sq. yds. 6 ft. 128 ins.; 194 acs. 2 ros. 12 pos. 13 yds. 2 ft. (45) 1530 c. yds. 536 ins.; 37 c. yds. 1 ft. 432 ins. (46) 18561 qrs. 7 bush. 1 pk. 1 gall. 1 qt. 1 pt.; 42 qrs. 5 bush. 2 pks. 1 gall. 3 qts. 1 pt. (47) 13424 hhds 20 galls.; 652 qrs. 7 bush. (48) 4842 pks. 1 gall. 1 qt. 1 pt.; 15625 bush. (49) 1126 mls. 5 fur. 6 po. 1 yd. 2 ft. 8 in.; 3 mls. 3 fur. 18 po. 1 ft. 5 ins. (50) 168 cub. yds. 15 ft. 1247 ins. (51) 194 ac. 2 ro. 12 po. 13 yds. 2 ft. (52) 511° 12′ 40″. (53) 1 yr. 66 days 12 hrs. 5 mins. 46 secs. (54) 95148 ells 1 qr. 1 in. (55) 62656 ells; 43353 ells 3 qrs.

MISCELLANEOUS.

(1) £10267 5s 6¾d. (2) 30 cwts. 3 qrs. 20 lbs. (3) £812 17s 9d. (4) £9100 16s 11¼d. (5) £78 1s 5½d. (6) £73 6s 3d. (7) £3 8s 11½d. (8) 85 and 2/6 left. (9) £1333 6s 8d; £4000; £6666 13s 4d. (10) £35 5s 11¾d. (11) 29136. (12) £1 3s 7d. (13) 141 ozs. 12 dwts. (14) 5067 galls. 1½ pts. (15) 328; 5814. (16) 226. (17) 1 bush. 3 pks. 7 qts. 1 pt. (18) £27 6s 7d loss. (19) £147 0s 5¼. (20) £267 15s. (21) 915. (22) Men £10 8s 9d; W. £3 9s 7d; C. 13s 11d. (23) A £350; B £450; C £720. (24) £370 6s 11¾d. (25) 240 guin. (26) 484. (27) 13 galls. (28) £1726 13s 4d. (29) 18561 qrs. 7 bush. 1 pk. 1 gall. 1 qt. 1 pt. (30) 6626 acres 1 po. 6 yds. 4 ft. 140 in. (31) 96 yds. 1 qr. 1 nl. (32) 2 qrs. 14 lbs. (33) 41 cub. yds. 24 ft. 1463½ ins. (34) 910 times. (35) 509. (36) 34940585. (37) 1 yd. 2 qrs. 2 nls. (38) 10s 1½d. (39) 72 ac. 3 ro. 35 po. 25 yds. 1 ft. 72 in.

(40) 5 ac. 2 ro. 35 po. 2 yds. 2 ft. 32 in. (41) 81 times fully. (42) 8274. (43) 80. (44) £296 1s $11\frac{3}{4}$d. (45) 2 lbs. 4 oz. 9 dwts. $1\frac{1}{13}$ grs. (46) 8s $3\frac{3}{4}$d. (47) A £1 4s $10\frac{1}{2}$d; B £1 7s $4\frac{1}{2}$d; C £1 5s $10\frac{1}{2}$d; D £1 1s $10\frac{1}{2}$d. (48) 258. (49) 3. (50) £17 17s; £5 19s.

RATIOS AND PROPORTIONS.

(1) 96. (2) 144. (3) 668. (4) 316. (5) 252. (6) 8030. (7) 39. (8) 136. (9) 75. (10) 402. (11) $3597\frac{2}{7}$. (12) 133. (13) 13 days. (14) £7 8s $1\frac{3}{4}$d. (15) £71 8s $11\frac{1}{4}$d. (16) 1 cwt. 3 qrs. $19\frac{2}{41}\frac{3}{9}\frac{6}{}$ lbs. (17) £67 11s. (18) $15\frac{3}{4}$ mins. (19) 238 acres. (20) 182 ft. (21) £2 11s $5\frac{1}{2}$d. (22) 8 ft. $2\frac{8}{1}\frac{2}{8}\frac{}{1}$ ins. (23) £59 1s 3d. (24) 5s $7\frac{1}{2}$d. (25) $2\frac{1}{2}$ lbs. (26) £5248 15s 6d. (27) 399 9s 8d. (28) 84 days. (29) 12 days. (30) £60333. (31) ~~$71\frac{1}{2}$~~ yds. (32) 400 and 1400. (33) £88 0s $4\frac{3}{5}\frac{3}{6}$d. (34) $134\frac{1}{6}$ mls.; $11\frac{2}{3}$ hrs. (35) $16\frac{9}{11}\frac{6}{9}$ days. (36) $2\frac{1}{2}$ hrs. (37) 756 c. yds. (38) $2\frac{11}{17}$ days. (39) 200 days. (40) 60 men. (41) £160. (42) A $14\frac{2}{17}$ days; B $10\frac{1}{2}\frac{9}{3}$ days; C $34\frac{2}{7}$ days. (43) 1 : 9. (44) 6 men. (45) $89\frac{2}{3}\frac{9}{9}$ men. (46) 1276 men. (47) $230\frac{1}{10}\frac{0}{3}$ days. (48) 1 : 15. (49) $47\frac{3}{5}$ days. (50) 75 days. (51) 3. (52) $10\frac{1}{14}\frac{3}{}$ hrs.

CHAIN RULE.

(1) 32. (2) $981\frac{2}{3}$. (3) 10. (4) 2601. (5) 192. (6) $93\frac{3}{4}$. (7) £13 4s 6d. (8) £1 14s $5\frac{2}{4}\frac{9}{7}$d. (9) 19 dol. 4 gr. (10) 722 ft. (11) £250 17s 6d. £251.17.6

SIMPLE INTEREST, &c.

(1) £76 5s 3d. (2) £60 15s 6d. (3) £215 1s 6d. (4) £188 1s 3d. (5) £1031 11s. (6) £294 9s 5d. (7) £130 3s $1\frac{1}{2}$d. (8) £6 5s $10\frac{1}{1}\frac{5}{8}\frac{9}{2}\frac{2}{5}$d. (9) £16 11s $1\frac{4}{5}$d. (10) $7\frac{1}{3}$ yrs. (11) 5 yrs. (12) $6\frac{1}{2}$. (13) $5\frac{1}{2}\frac{6}{5}\frac{7}{}$. (14) $5\frac{1}{4}$. (15) 3%. (16) $4\frac{1}{4}$%. (17) $6\frac{1}{2}$%. (18) 4%. (19) $1\frac{4}{6}\frac{4}{9}\frac{3}{6}$. (20) £1665 ~~10s~~ $7\frac{1}{2}\frac{8}{7}\frac{5}{7}$. (21) £4326. (22) £1750. (23) £3375. (24) £800. (25) £2496 6s $6\frac{6}{8}\frac{4}{3}\frac{2}{1}$d. (26) £379 18s $8\frac{2}{9}\frac{7}{1}\frac{2}{7}$d. (27) £311 10 $11\frac{1}{5}\frac{1}{9}$d. (28) £326 15s $1\frac{1}{19}$d. (29) £498 15s $6\frac{1}{4}\frac{2}{6}\frac{2}{3}$d. (30) £158 0s $9\frac{3}{5}$d. (31) £65 13s 6d. (32) £229 6s $4\frac{4}{5}$d. (33) £4 9s. (34) £14 0s 6d. (35) £12 0s $1\frac{8}{1}\frac{9}{0}\frac{}{0}$d; £15 5s $7\frac{4}{5}\frac{3}{0}$d. (36) £13 10s $1\frac{2}{5}$d; £20 5s $2\frac{1}{10}$d. (37) £2056 17s $11\frac{5}{20}$d. (38) £571 5s $6\frac{2}{3}\frac{2}{7}\frac{1}{8}\frac{4}{1}$d.

DISCOUNT, &c.

(1) £50 15s $3\frac{3}{4}$d. (2) £24 1s 3d. (3) £7. (4) £48 9s. (5) £28 9s $5\frac{3}{4}$d. (6) £60 15s. (7) £12 18s 9d. (8) £191 5s. (9) £4 16 s $2\frac{9}{2}\frac{8}{0}\frac{}{3}$d. (10) £6 9s $11\frac{1}{4}$d. (11) £4 3s 5d. (12) £3 8s $6\frac{6}{7}$d. (13) £4000. (14) £83 6s 8d. (15) £450. (16) £28 6s 8d. (17) £1450. (18) £2040. (19) £122 10s. (20) £612 9s $8\frac{2}{8}\frac{6}{1}\frac{8}{7}$d. (21) $2\frac{1}{2}$ p.c. (22) 4 p.c. (23) 1 yr. $163\frac{6}{6}\frac{8}{9}$ days. (24) $94\frac{4}{19}$ days. (25) $5\frac{2}{3}\frac{6}{1}$ months. (26) 249 days. (27) $10\frac{1}{2}$ months.

PARTNERSHIP.

(1) £87; £130 10s; £174. (2) £113 16s $11\frac{9}{71}\frac{1}{5}$d; £59 14s $0\frac{14}{71}\frac{4}{5}$d; £47 1s $0\frac{36}{143}$d. (3) £71 17s $7\frac{0}{4}\frac{52}{601}$; £153 6s $10\frac{1}{2}\frac{36}{601}$d; £134 15s $6\frac{0}{4}\frac{216}{601}$d. (4) £750; £250; £500; (5) £90; £330; (6) 110 10s $0\frac{3}{4}\frac{63}{139}$d; £129 9s $11\frac{0}{4}\frac{76}{139}$d. (7) £6 1s 4d; £5 12s; £18; (8) A $2\frac{2}{39}$; B $1\frac{11}{13}$; C $4\frac{4}{39}$ months.

PROFIT AND LOSS, &c.

(1) 20. (2) $4\frac{10}{11}$. (3) 18s 9d. (4) 4s $10\frac{1}{2}$d. (5) £24. (6) $13\frac{7}{11}$. (7) $32\frac{6}{17}$. (8) 8s 9d. (9) $6\frac{2}{31}$d. (10) $27\frac{1}{2}$. (11) $3\frac{1}{8}$. (12) £105 10s; $14\frac{2}{7}$. (13) £15 7s 1d. (14) $86\frac{8}{29}$ lbs. (15) $9\frac{7}{25}$ years. (16) 1541. (17) 13182. (18) 195; 240; 315. (19) 16·7 carats. (20) 1 at 6d, 1 at 7d, 3 at 9d. (21) 1 at 15s, 1 at 16s, 10 at 19s, 1 of water. (22) 2 at 4s 3d, 2 at 4s 6d, 3 at 5s 4d, 3 at 5/6. (23) 10 at 4s 8d, 5s, and 5s 4d, and 30 at 6s. (24) $25\frac{3}{5}$ at 7s and 8s; $9\frac{3}{5}$ at 10s, 12s, and 13s.

PRACTICE.

(1) £62 3s; £79 2s; £98 17s 6d; £114 8s 3d; £226; £313 11s 6d; £333 7s. (2) £397 16s 8d; £598 0s 8d; £404 5s; £1104 19s; £977 18s; £881 13s. (3) £1313 14s 9d; £3786 3s 9d; £7289 3s $1\frac{1}{2}$d. (4) £884 15s $4\frac{4}{5}$d; £1329 6s $0\frac{3}{5}$d; £3407 14s $5\frac{9}{10}$d. (5) £45371 18s $2\frac{1}{16}$d; £20446 4s $3\frac{3}{4}$d. (6) £14316 11s $8\frac{6}{11}$d; £626 6s $2\frac{13}{16}$d. (7) £3531 13s 9d; £2119 0s 3d. (8) £6724 11s 7d; £4034 14s $11\frac{2}{5}$d. (9) £980 3s $1\frac{1}{2}$d; £301 14s $8\frac{1}{4}$d. (10) £20 6s $1\frac{3}{4}$d. (11) £23 6s $6\frac{8}{4}$d; £28 6s $6\frac{27}{56}$d. (12) £284 4s $3\frac{3}{11}\frac{3}{12}$d. (13) £86 2s $3\frac{21}{22}$d. (14) £89 2s $6\frac{3}{4}$d; £155 16s $2\frac{1}{5}$d. (15) £43 8s 1d; £276 4s 2d. (16) £4 19s $2\frac{1}{2}$d; £6 4s $0\frac{1}{8}$d; £7 13s $9\frac{1}{40}$d. (17) £170 11s $9\frac{1}{4}$d; £59 14s $1\frac{7}{16}$d. (18) £589 5s $3\frac{15}{16}$d; £393 10s $10\frac{17}{40}$. (19) £2510 6s $11\frac{1}{2592}$d. (20) £771 0s $4\frac{4}{5}$; £1166 13s 6d. (21) £51 3s $3\frac{65}{192}$d; £110 17s $7\frac{401}{1920}$d. (22) £15 18s $2\frac{5}{8}$d; £4 6s $8\frac{5}{11}$d. (23) £7 12s $5\frac{1}{4}$d; £14 2s $3\frac{1}{2}$d; £15 1s $1\frac{1}{8}$d. (24) £294 15s $11\frac{53}{72}$d. (25) £1686 5s $0\frac{1}{6}$d. (26) £98 10s $8\frac{11}{32}$d; £104 13s $3\frac{831}{3008}$d. (27) £21 19s $11\frac{5}{8}$d; £3 2s $4\frac{1}{8}$d. (28) 13s $6\frac{3}{4}$d; 16s $5\frac{9}{28}$d. (29) £7 4s $8\frac{1}{2}$d; £8 0s $5\frac{1}{4}$d. (30) £286 18s $9\frac{3}{4}$d. (31) £416 19s $4\frac{1}{2}$d. (32) £30 3s $6\frac{3}{4}$d. (33) £3 5s $7\frac{1}{2}$d; £14 1s 3d. (34) £74 4s $6\frac{2}{7}$d. (35) £43 1s 3d.

COMPOUND INTEREST (Neglecting fractions of a penny).

(1) £249 14s 6d; £373 2s 7d; £295 0s 11d; £228 1s 11d; £201 8s 1d; £284 15s 7d. (2) £3190 8s 7d; £3398 19s 8d; £3577 11s 1d; £3312 4s 10d; £3582 3s 1d; £3310 2s 2d. (3) £4504 12s 11d; £4417 18s 11d. (4) £4331 8s 2d in each case. (5) £1024. (6) £822 14s 1d. (7) £666 13s 4d. (8) £1001 5s. (9) £7 14s 3d.

STOCKS.

(1) £2418. (2) £4300. (3) £3 5s $11\frac{19}{91}$; £3 14s $5\frac{29}{47}$d. (4) £151 13s 4d; £155 11s $1\frac{1}{3}$d. (5) £15708 6/8. (6) £111 8s $1\frac{151}{377}$d. (7) 4 p.c.; £6 9s $1\frac{2731}{18281}$. (8) £2000; $3\frac{99}{367}$ p.c.. (9) $1321\frac{8}{13}$. (10) £1050. (11) £130. (12) Loss £5. (13) 70. (14) £6 5s. (15) £97·962. (16) 7s $2\frac{153}{2805}$d. (17) £454 11s 3d. (18) £65 0s $4\frac{524}{769}$d; £39 8s $5\frac{179}{761}$d. (19) $97\frac{1}{3}$. (20) £4 3s 4d. (21) 22 Shares. (22) £$1299\frac{27}{167}$; 2 years. (23) £1350; £9 5s. (24) £5000.

VULGAR FRACTIONS.

(1) 4; 1321; 9; 389; 2943; 4; 16; 4; 9; 3. (2) $2^2\times3^2\times17$; $2^4\times3^2\times7^2\times11$; $3^2\times5\times7^2\times9$; $3\times5\times7^2\times9$; $5^2\times7^2\times11\times13$; $11\times13\times17$; $3\times7\times11\times13$; $2\times7\times11\times13\times17$; $2\times7\times17\times19$; $2^2\times3\times7\times11\times13$; $2\times3^2\times5^2\times7\times11$. (3) 57000; 9165; 14364; 324; 38556; 129038; 728728. (4) 4 and 3007368; 2117 and 533484. (5) $\frac{1}{120}$. (6) 2940. (7) $\frac{4}{7}$; $\frac{2039}{5071}$; $\frac{7}{13}$; $\frac{7}{11}$; $\frac{9687}{12763}$; $\frac{113}{596}$. (8) $\frac{33}{72}$, $\frac{20}{72}$, $\frac{42}{72}$, $\frac{27}{72}$, $\frac{32}{72}$; $\frac{1300}{2700}$, $\frac{750}{2700}$, $\frac{81}{2700}$, $\frac{648}{2700}$; $\frac{972}{3780}$, $\frac{567}{3780}$, $\frac{2700}{3780}$, $\frac{1120}{3780}$, $\frac{2970}{3780}$; $\frac{24}{180}$, $\frac{105}{180}$, $\frac{81}{180}$, $\frac{36}{180}$, $\frac{80}{180}$. (9) $1\frac{313}{330}$; $1\frac{11}{12}$; $8\frac{113}{693}$; $16\frac{13}{72}$; $32\frac{69}{140}$; $123\frac{19}{84}$; 23; $19\frac{5}{72}$; $21\frac{5}{21}$; $22\frac{73}{180}$; $14\frac{2099}{2652}$; $487\frac{218}{418}$; (10) $8\frac{5}{9}$; $22\frac{6}{11}$; $69\frac{9}{17}$; $13\frac{10}{13}$; $8\frac{9}{10}$; $5\frac{74}{99}$; $1\frac{23}{51}$; $2\frac{1}{52}$; $25\frac{13}{28}$; $96\frac{151}{525}$. (11) $12\frac{71}{546}$; $51\frac{2}{11}$; $2\frac{8}{15}$; $7\frac{19}{27}$; $4\frac{39}{56}$; $\frac{143}{210}$; $22\frac{29}{52}$; $55\frac{28}{45}$; $70\frac{51}{80}$; $184\frac{113}{270}$. (12) 616; $177\frac{5}{6}$; $15\frac{5}{9}$; $47\frac{1}{2}$; $1\frac{3}{4}$; $2\frac{1}{5}$. (13) $20\frac{12}{145}$; 6; $4\frac{83}{175}$; $17\frac{1}{3}$; $2\frac{6}{43}$; $2\frac{47}{86}$; $2\frac{4}{31}$; $7\frac{7}{104}$; $2\frac{13}{61}$; $2\frac{4}{7}$; $2\frac{5}{141}$. (14) $14\frac{13}{18}$; $15\frac{53}{56}$; $16\frac{3}{5}$; $17\frac{32}{33}$; $21\frac{11}{45}$; $10\frac{514}{695}$; $21\frac{107}{285}$; $-1\frac{32}{45}$. (15) $11\frac{71}{75}$; $10\frac{262}{665}$; $12\frac{52}{63}$; $10\frac{2087}{8113}$; $1\frac{2}{3}$; $10\frac{1}{7}$; $-87\frac{5743}{7072}$. (16) $\frac{5}{7}$; $\frac{7}{11}$; $\frac{47}{59}$. (17) $3\frac{1}{8}$; $1\frac{199}{256}$; $\frac{89}{264}$; $4\frac{3}{8}$; $1\frac{1283}{3168}$; $10\frac{173}{528}$; $2\frac{831137}{1133344}$; $85\frac{2657}{3082}$; 1; 1; 1 cwt. 3 qrs. $19\frac{19}{27}$ lbs. (18) $\frac{11}{16}$, $\frac{17}{36}$, $\frac{7}{15}$, $\frac{43}{96}$, $\frac{17}{45}$; $\frac{056}{309}$, $\frac{29}{15}$, $\frac{385}{200}$, $1\frac{5}{6}$; $\frac{13}{18}$, $\frac{17}{24}$, $\frac{7}{12}$, $\frac{10}{36}$; $\frac{24}{25}$, $\frac{11}{12}$, $\frac{7}{8}$, $\frac{13}{15}$, $\frac{11}{20}$. (19) 16/8; 7/6; 24/-; 30/-; 25/-; 28/-; 42/-; 15/-; 28/-; 2/-; 8/4; £12 12/-; £15 11/6; £4 4/7; 2 cwts.; 1 ac. 3 ro. 20 po.; $10\frac{2}{3}$ ozs.; 7 ac. 3 ro. $26\frac{2}{3}$ po.; 102 tons 6 cwts.; $8\frac{2}{5}$ bush.; 5 fur. $5\frac{1}{3}$ po.; £4 15s $0\frac{2}{5}$d; $8\frac{1}{2}$ lbs.; £1 12s 10d; £6 7s $9\frac{151}{336}$d; 1 ro. 36 po. $27\frac{5}{9}$ yds.; 1 bush. 1 gal. $3\frac{131}{315}$ qts.; 1 ml. 7 po. 4 yds. 2 ft. $8\frac{2}{5}$ ins.

$\frac{7}{8}$; $\frac{19}{240}$; $\frac{1}{6}$; $\frac{15}{224}$; $\frac{7}{90}$; $\frac{1}{12}$; $\frac{97}{518}$; $\frac{20}{63}$; $\frac{7}{12}$; $\frac{3}{896}$; $\frac{100}{9}$; $\frac{7}{136}$; $\frac{1225}{10584}$; $\frac{1225}{1632}$; $\frac{6125}{17}$; $\frac{17}{140}$; $\frac{1221}{240}$; $\frac{1}{4}$; $\frac{1}{240}$; $\frac{11}{100}$; $\frac{7}{4}$; $\frac{3154}{41849}$; $\frac{59}{64}$; $\frac{19}{20480}$; $\frac{8}{15}$; $\frac{4572}{713}$; $\frac{23}{100}$; $\frac{21}{20}$; $\frac{70}{1128}$; $\frac{1}{80}$; $\frac{1159}{10368}$; $\frac{27}{80}$; $\frac{31}{184}$; $\frac{28}{9}$; $\frac{1225}{2304}$; $\frac{1}{15}$; $\frac{5}{224}$; $\frac{28}{96}$; $\frac{243}{640}$.

MISCELLANEOUS, p. 23.

(1) $22\frac{7}{144}$. (2) $\frac{7}{8}$. (3) 20 lbs. (4) 10. (5) $3\frac{3}{28}$. (6) $1\frac{598}{16445}$; $\frac{5643}{6578}$; $\frac{5871}{32890}$. (7) £2 12s 6d. (8) $\frac{1}{80}$. (9) 2; $2\frac{2}{3}$; $1\frac{2}{5}$; $2\frac{1}{4}$; $\frac{5}{11}$. (10) 300 galls) (11) £113 16s $0\frac{1}{2}$d. (12) £1 5s 6d. (13) 1s 6d. (14) $\frac{1}{2}$. (15) 55; 88. (16) £$56\frac{17}{302}$. (17) $8\frac{40}{291}$ days. (18) $\frac{9}{64}$. (19) 6s $4\frac{4}{5}$d. (20) 6s 3d; 8s 4d; 5s 5d. (21) $1\frac{1}{13}$ days. (22) 12 days. (23) $8\frac{1}{3}$ days. (24) £6 7s $4\frac{3}{4}$d. (25) A 6, B 12, C 9 days. (26) $15\frac{5}{9}$ hrs. (27) 20 hrs. (28) A 16, B 14, C 12 days. (29) $8\frac{1}{3}$ hrs. (30) A 5, B $6\frac{1}{4}$, C $8\frac{1}{3}$ hrs. (31) 9:5.

DECIMAL FRACTIONS.

(1) $\frac{3}{5}$; $\frac{3}{50}$; $\frac{3}{500}$; $1\frac{3}{50}$; $16\frac{3}{50}$; $16\frac{3}{500}$; $6\frac{3}{5000}$; $\frac{3}{8}$. (2) $45\frac{23}{100}$; $17\frac{27}{500}$; $23\frac{113}{125}$; $5\frac{3}{4}$; $4\frac{27}{40}$; $18\frac{29}{400}$. (3) $\frac{8}{0}$; $\frac{4}{45}$; $\frac{17}{900}$; $3\frac{4}{45}$; $3\frac{8}{99}$; $3\frac{2}{225}$; $3\frac{4}{495}$; $3\frac{2}{11}$. (4) $413\frac{7}{9}$; $426\frac{74}{99}$; $63\frac{34}{55}$; $61\frac{1}{27}$; $1\frac{103}{270}$. (5) $\frac{3}{7}$; $\frac{6}{7}$; $6\frac{2}{7}$; $6\frac{5}{14}$. (6) $\frac{2}{13}$; $\frac{12}{13}$; $\frac{4}{13}$; $\frac{1}{13}$. (7) $\frac{6}{13}$; $\frac{2}{13}$; $\frac{11}{13}$; $\frac{653}{1666}$ (8) $37\frac{12}{13}$; $3\frac{103}{130}$; $5\frac{483}{650}$; $\frac{1}{37}$. (9) $2\frac{3}{70}$; $5\frac{13}{90}$; $7\frac{10}{50}$; $12\frac{643}{995}$; $63\frac{4}{75}$; $8\frac{17}{130}$. (10) ·75; ·3; ·4; ·875; ·86; ·4; ·230769; ·571428; ·051282; ·81. (11) 1·6; 3·83; 4·5; 7·75; 8·7; 11·571428; 6·153846; 14·45. (12) 17·7857142; 25·56; 61·2142857; 70·2916; 86·45; 74·472. (13) 793721·06715. (14) 344·588446. (15) 1016·884227409. (16) 54·088429476280961. (17) 1403·19467780111344. (18) 268·787376; 9·76866. (19) 7·78761; 55·757867. (20) 6·8118; 613·85352170. (21) 28·65077350; 286·2753605991229. (22) 1240·932; 4·00374; ·7897344. (23) ·000032614; 407·0335491044. (24) 3·0962; 36·057; 421·737+. (25) 28·258+; 523·06+; ·7160493827. (26) £16 15s 10; £2165 2s $0\frac{4}{9}$. (27) £51 9s $11\frac{3}{8}$d; £491 9s $8\frac{15}{16}$. (28) £80 17s $4\frac{1}{2}$d; £282 6s 5·7672d. (29) 1·489; 700; 12340. (30) 4·35; ·00001; 2000. (31) 250; 14·04; ·0000584795+. (32) $\frac{1}{4}$; 7·32328767+; 4·5225547+. (33) 35·482; ·206349+; 3·99384615. (34) 3·26315+; ·04265+; 27·7581475. (35) 15s $7\frac{1}{2}$d; 4s $10\frac{1}{2}$d; 7s $9\frac{3}{4}$d; £2 18s $10\frac{1}{2}$. (36) £2 4s 10·9272d; £154 6s 3·24d; 7·62d; 18s 5d. (37) 2 8s 6d; £1 1s 3d? £1 0s 5d. (38) 10·9992d; 15s 10d; 1s 5·563d; £1 9s 9·951d. (39) 7s 6·4d; £7 7s 3·27d; £19 14s 8·373d; £6 9s 5·672d. (40) 12/6; 4/6; 4d. (41) 1 cwt. 2 qrs. 24 lbs.; 3 tons 15 cwts. 1 qr. 13.888 lbs.; 2 ac. 2 ro. 38 po. 5·1304 yds. (42) 2 qrs. 10 lbs. 8 ozs; 1 lb. 3 dwts. 18 grs.; 7·78635 sq. ft.; 2 fur. 6 po. (43) 1 qt. 2·76 pts.; 286.46784 cub. ins.; 13 sq. yds. 3 ft. 60·48 ins.; 4 qts. 0·14 pts. (44) 10 ozs. 3·456 drs.; 1·2 qts.; 1 gall. 1 qt., 4 fur. 30 po. (45) £·625; £·5375; £·90625; £·778125; £·3177083; £·715625. (46) £1·58125; £13·6802083; £1·922016; £3·56875. (47) £·5796875; £1·396875; £2·792447916; £·38203125. (48) 4·5317460 gu.; 2·35317460 gu.; 1·20238095 gu.; 3·4523809 gu. (49) ·6083; ·583; 425; ·5083; ·4875. (50) ·0515; ·07775; ·0815; ·06525. (51) ·9053571428; ·875390625. (52) ·875; ·03125; ·852120535714 28. (53) 1·586805; ·605. (54) ·3688648; ·1794364. (55) 17·375; ·828125; 63·25. (56) ·622. (57) ·080918256. (58) ·7. (59) 7·2916. (60) ·06. (61) ·6745. (62) 14s $4\frac{1}{2}$d; (63) £4 6s $9\frac{3}{5}$d. (64) 1. cwt. 3 qrs. 2·2 lbs. (65) 1 cwt. 27.65 lbs. (66) 1 qr. 13 lbs. 10·126 ozs.

MISCELLANEOUS EXERCISES, P. 27.

(1) £2 15s $2\frac{3}{4}$d. (2) £20 10s $11\frac{1}{4}$d. (3) 43·03992 ft; 6·157536 yds.; 89·0392272 mls. (4) 25·7069 days. (5) £18 17s $4\frac{1}{2}$d. (6) $1\frac{1}{2}$ hrs. (7) $6.\dot{7}14285$. (8) £67 8s 4d. (9) 542·89 lbs. (10) 10·872 hours. (11) 1639·305 square feet. (12) 61·5255d. (13) 813·5 min. (14) 20·24935 square. yards. (15) 1799·1288 grs. (16) 2·8204 grs. (17) 282·048 grs. (18) 19·08 ins. (19) ·0002. (20) 3·6464 pints. (21) 1077·85 min. (22) 14s 3d. (23) 1·002 drs. (24) 1708·2168 grs. (25) 559·32 min. (26) $\cdot0\dot{1}5$; $1\cdot0\dot{7}6923$.

SQUARE AND CUBE ROOTS, &c.

(1) 4·07; 321·67; 15125; 7·013; $51\frac{39}{67}$; $36\frac{3}{5}$; $1\frac{12}{13}$; $18\frac{31}{50}$; $4\frac{15}{29}$; $2\cdot8\dot{3}$; 2·5; ·63245; ·002236; 1·9203; $1\cdot08\dot{3}$; $9\cdot\dot{1}$; 1·76; ·95452; ·01945; ·3902436. (2) 42·7; 1·38; $29\cdot\dot{1}$; 20·37; 24·1; 14·8; ·595; ·16; ·127; $\cdot20\dot{3}$; 16·1; ·7631; $12\cdot\dot{3}$; ·215; 2·59; 2·636; 7·988; 3·976; $3\frac{2}{7}$; $5\frac{1}{3}$; $\frac{7}{13}$; $1\frac{1}{8}$; $1\frac{7}{31}$; $\frac{2}{3}$.

(1) $11\sqrt{2}$; $22\sqrt{3}$. (2) $13\sqrt{6}$; $\sqrt{5}$. (3) $3\sqrt{3}$; $13\sqrt{7}$. (4) $36\sqrt[3]{2}$; $29\sqrt[3]{2}$. (5) $10\sqrt[3]{4}$; $9\sqrt[3]{9}$. (6) $7+4\sqrt{3}$; -1. (7) $11-2\sqrt{30}$; -1. (8) $27\sqrt{6}+25\sqrt{7}$. (9) $\frac{5}{27}\sqrt{2}$. (10) $\frac{1}{4}\sqrt[3]{\frac{155}{63}}$. (11) -18; $-8\sqrt{3}$; 1. (12) $\frac{7}{2\sqrt{5}}$; 2.

(1) 34 sq. ft. $126\frac{2}{9}$ ins.; 45 sq. ft. $14\frac{13}{144}$ ins.; 211 sq. ft. $87\frac{3}{8}$ ins.; 21 sq. ft. $70\frac{7}{9}$ ins.; 10 sq. ft. $125\frac{5}{12}$ ins.; 3 sq. ft. $118\frac{1}{36}$ ins. (2) 931 cub. ft. 1107 ins.; 348 c. ft. 1456 ins.; 546 c. ft. 1256 ins.; 274 c. ft. 1491 ins.; 125 c. ft. $1200\frac{1}{2}$ ins.; 591 c. ft. 234 ins. (3) 720 sq. ft. $140\frac{1}{3}$ ins.; 254 sq. ft. 4 ins. (4) 281 sq. ft. 117 ins.; 739 sq. ft. 9 ins. (5) $785\frac{7}{9}$ sq. ft.; $676\frac{1}{12}$ sq. ft. (6) $45\frac{1}{2}$ yds. (7) $14\frac{1}{3}$ ft. (8) 22 ft. $2\frac{31}{33}$ ins. (9) 8 ft. $9\frac{27}{30}$ ins. (10) $695\frac{5}{6}$ ft. (11) $2\frac{17}{32}$d. (12) $15\frac{3}{4}$ ft.

SCALES OF NOTATION.

(1) 100010010011; 10000022; 202103. (2) 104331; 25112; 13556. (3) 6726; 4765; 2730. (4) 100111101; 1245; 225; 7806. (5) 3513; t 68. (6) 6571; 4652. (7) 534315; 222200001202. (8) 1505; 1159. (9) 2349; 32. (10) 130025. (11) 131783. (12) 255673; 26725. (13) 23423543; 58238tt. (14) $1305\frac{35}{45}$; (15) 125·75; 175·6. (16) ·3796; 3·1416. (17) 1282636; 215; 61276527; 13780410; 533; 456; $1, 2^3, 2^5\ 2^6, 2^7$.

RIGHT ANGLED TRIANGLE.

(1) 70 ft.; 429 yds.; 8545 ins. (2) 4 ft. 6 ins.; 79 ft. 9·85 ins.; 2457·72 links. (3) 11 chs. 67·6 links; 60 poles. (4) 482·54 chs.; 14·91 furlongs. (5) 5·16 fur.; 2 chs. 96·6 lks. (6) 8225 ft.; 5 ft. 8 ins. (7) 425·83 links; 27 yds. 0·38 ft. (8) 9·95 ft. (9) 6·24 ft. (10) 7·5 ft. (11) 109·3 ft. (12) 76·122 ft.

SQUARE AND RECTANGLE.

(13) 1521 sq. ft.; 236296 sq. yds.; 481636 sq. links; 21025 sq. chains; 2328 sq. ft. 9 ins.; 214060 sq. yds. 4 ft.; 5513 sq. chains 6¼ sq. links. (14) 3854 sq. ft.; 69 sq. ft. 60 ins.; 1099 sq. ft. 126 ins.; 390678 sq. links.; 275625 sq. chains. (15) 36 yards; 48 ft.; 25 links; 21 chains. (16) 9 ft.; 27 yds.; 110 yds.; 25 ft. (17) 36 ft.; 21 yds. (18) 504·89 links. (19) 106·057 yards. (20) 816 yds.

TRIANGLES.

(21) 14 yds. 1 ft. (22) 1008 sq. ft. (23) 56 yds. (24) 12 yds. (25) 48 yds. (26) 110 yds. (27) 229·057 sq. ft. (28) 13 feet. (29) 84 sq. ft.; 497·77 sq. ft.; 1342·74 sq. ft.; 13990·8 sq. yds.; 205176·23 sq. links; 6 sq. chains. (30) 480·56 links. (31) 6·928 ft.

PARALLELOGRAMS.

(32) 19278 ft. (33) 25900 sq. poles. (34) 28⅔ yds. (35) 60¾ yds. (36) 50½ yds. (37) 1342368 links. (38) 25 ft.

TRAPEZOID AND TRAPEZIUM.

(39) 3120 yards. (40) 15½, 105½. (41) 22990 links. (42) 18, 28.

CIRCLE.

(43) 955·0464 ft. (44) 50·9294 ft. (45) 5026·55 links. (46) 26·26 yds. (47) 321699·84 yds. (48) 7 ac. 3 ro. 16·64 po. (49) 38994·4614 ft. (50) 146·86 yds. (51) 174·386 yds. (52) 5·60328 ft. (53) 2·985 yds.; 12·362 yds. (54) 72 sq. feet. (55) 8·485 feet. (56) 56·4 ft. (57) 1332 links. (58) 8 ac. 2 ro. 22 po. (59) 3899·3 ac. (60) 4·03 sq. in. (61) 48·45 yds.

AREA OF RING.

(62) 471·24 sq. ft. (63) 2261·952 sq. ft. (64) 451·605 sq. ft. (65) 15·116 ft. (66) 289·8126 sq. yds. (67) 1·977 yds. (68) 12·983 ft. (69) 118·8672 cub. in.

PRISM.

(70) 450 cub. feet 1350 in. (71) 120 cub. feet; 480 sq. feet. (72) 62·352 cub. ft.; 121·856 sq. ft. (73) 12272·27 sq. ins. (74) 64·0625 cub. ft.; 205 sq. ft.

CYLINDER.

(75) 466·5276 cub. ft.; 311·0184 sq. ft. (76) 1·5217125 cub. ft. (77) $13\frac{1}{8}$ sq. ft. (78) 11 ft. (79) $2\frac{3}{4}$ ft. (80) $4896\frac{1}{7}$ gals. (81) 2·7367 ft. (82) 137·6 c. ft.; 288 sq. ft. (83) 384·85 c. yds. (84) 241·9032 cub. ft. (85) 1585·76 cub. ins. (86) 1·7 ft. (87) 7·64 ins. (88) 19·635 ft.

CONE AND PYRAMID.

(89) 21·2058 cub. ft.; 42·996 sq. ft. (90) 314·16 cub. ft.; 282·744 sq. ft. (91) 144 c. ft. (92) 3422·5 c. ft.; 1161·5 sq. ft. (93) 2136 sq. ft. (94) 154 c. ft.; 137·5 sq. ft. (95) 301·5936 c. ft. 267·036 sq. ft. (96) 144 cub. ft.; 148·4 sq. ft. (97) 144 cub. ft.; 180·16 sq. ft. (98) 1 ft. 6 ins. (99) 18·5 ft. (100) 11·73 feet. (101) 50 ft. (102) 10 ft. (103) 144 sq. ft.; 189·83 sq. ft. (104) 128 sq. ft.; 144 sq. feet. (105) 6·366 feet. (106) 1·75 feet. (107) 6 ins.

SPHERE.

(108) 113·0976 cub. ft.; 113·0976 sq. ft. (109) 65·45 cub. ft.; 78·54 sq. feet. (110) 179·91 cub. yards; 154 sq. yards. (111) 1239·8848 c. ins. (112) 98·175 c. ft. (113) 102·9024 c. ins. (114) 162·5778 cub. feet. (115) 9·5 ins. (116) 11·22 ins. (117) 412·52 sq. in. (118) 1404928 times.

SEGMENT AND ZONE OF SPHERE.

(119) 109·5633 cub. ft.; 91·8918 sq. ft. (120) 5541·7824 c. ins.; 1922·6592 sq. ins. (121) 743·512 c. ins. (122) 54·4544 cub. ins. (123) 1328·897 sq. ins. (124) 1363·4544 sq. ins. (125) 944·7 sq. in.

FRUSTUMS OF A CONE OR PYRAMID.

(126) 871·2704 cub. ft.; 304·7352 cub. ft.; 1193·808 cub. ft.; 77·243 cub. feet. (127) $87\frac{3}{4}$ cub. feet. (128) $55\frac{1}{2}$ cub. feet. (129) 85·4453 cub. ft. (130) 65·9736 sq. feet; 125·664 sq. feet; 99 sq. feet. (131) 860·7984 sq. feet. (132) 11259·4944 sq. feet. (133) 312 sq. ft.

GAUGING.

(134) 127·9 galls.; 54·19 galls.; 112·428 galls.; 23·49 galls.; 30·6 galls.; 80·5 galls.

MISCELLANEOUS EXERCISES.

(1) 979·79 links. (2) 488·95 links. (3) 44·72 ft. (4) 48·99 ft. (5) 16 ac. 32 po. (6) 48600 yds. (7) £18 19s $5\frac{3}{4}$d. (8) $535\frac{5}{7}$ links. (9) 11 : 16. (10) 16000 yds. (11) 15795 chains. (12) 135·96 yds. (13) 117·75 yds. (14) 1000 links. (15) 7 yds.; $3\frac{1}{2}$ yds.; $3\frac{1}{3}$ yds. (16) 128 sq. ft. (17) 41·0976 sq. ft. (18) 80 ft. long, 48 ft. wide.

(19) 28·28 ft. (20) 2 yds. (21) 8 ft. long, 4 ft. wide, 3 ft. deep. (22) 126·45 sq. feet. (23) 25192·49 sq. ft. (24) 6, 8, and 10 ft. (25) 72·748 ft. (26) 12 ft. 3·65 ins.; 11 sq. ft. 6·435 ins. (27) 41 cwts. 2 qrs. $14\frac{4}{5}\frac{2}{9}\frac{3}{7}\frac{2}{5}$ lbs. (28) 15·87 ft. (29) 31·416 ft.; 62·832 ft. (30) £12 2s $11\frac{3}{4}$d. (31) 1·382 times. (32) 3·382 ins. (33) $33\frac{3}{4}$ cwts. (34) 7 inches. (35) 3·207 cub. ft.; 19/3. (36) 2837·912 cub. in. (37) 104·72 sq. yds. (38) 7125·1488 c. ins. (39) 14/8. (40) £30 1s $11\frac{3}{4}$d. (41) 584 lbs. (42) 12·98 feet. (43) 57·372 ins. (44) 7·267 ft. (45) 7·4. (46) 20·196 ins. (47) 10·2832 cub. in. (48) 1 pole 13 yards 7 feet 93·8 ins. (49) 51·051 sq. ft. (50) 103·4 gals.

EXAMINATION PROBLEMS—FIRST SERIES.

(1) 2d. (2) 4·07; 29·1. (3) £528. (4) £40000; £1200; $2\frac{1}{2}\frac{8}{0}\frac{4}{3}$ p.c. (5) 1·9205; 1·7639; $5\frac{1}{3}$. (6) $2 \times 3^2 \times 5^2 \times 7 \times 11^3 \times 13 \times 19$. (7) 544. (8) 8 : 7. (9) $\cdot 09544583$. (10) £4472; £32 16s 6d. (11) $3\frac{1}{2}$d. (12) $3\frac{3}{4}$ p.c. (13) £350 11s 8d. (14) £20 1s. (15) $\frac{4}{33}$. (16) £24000. (17) 1584. (18) 84 miles. (19) $8\frac{9}{1}\frac{7}{6}\frac{}{6}$ days. (20) £110 5s. (21) 10 mos. (22) $4234\frac{2}{2}\frac{2}{5}\frac{1}{6}$ cub. ft. (23) 14·625. (24) £1316 9s 4d. (25) $2\frac{2}{3}$ mls. (26) $3\frac{3}{5}\frac{7}{0}\frac{2}{3}$ hrs.; A $12\frac{1}{5}\frac{2}{0}\frac{0}{3}$ mls.; B $14\frac{3}{5}\frac{8}{0}\frac{3}{3}$ mls. (27) £1 5s. (28) $27\frac{3}{3}\frac{}{1}$ mins. (29) £32000. (30) 10. (31) £2000. (32) £1 1s 6d; 1 cwt. $1\frac{1}{3}$ qrs. (33) 40 yrs.; $17\frac{1}{2}$ yrs. (34) $6\frac{1}{2}$ hrs. (35) 3 dwts. $19\frac{6}{6}\frac{0}{3}\frac{9}{2}\frac{}{3}$ grs. (36) 13·14. (37) $1\frac{1}{2}$ mls.; 1 hr. (38) 240 sovs.; 480 shillings; 720 pennies. (39) 2. (40) $\frac{1}{4}\frac{9}{9}\frac{7}{6}\frac{1}{0}$; ·03961. (41) £4 9s $7\frac{1}{5}$d. (42) $7\cdot580623178959$. (43) $\cdot 2726433904651$; $\cdot 26670215$. (44) $1\cdot 593750841$; $9\cdot 0639973306$. (45) 15·6; 18·32. (46) £542 17s $7\frac{1}{7}\frac{7}{3}$d. (47) £66 13s 4d. (48) £650. (49) $7/3\frac{3}{2}\frac{}{0}$. (50) Bought at £40 and £60; Sold at £60 and £45. (51) 2/6. (52) $21\frac{9}{1}\frac{}{1}$ mins. past 4. (53) A £693 7s; B £577 15s 10d; C £495 5s. (54) A £148 16s; B £223 4s; C £297 12s; D £279. (55) £2000. (56) $4/2\frac{1}{2}$; $6/7\frac{1}{2}$; 1/9. (57) 150 cwts. 2 qrs. $18\frac{3}{4}\frac{3}{8}\frac{4}{9}$ lbs. (58) £4 10s. (59) £3 2s $5\frac{1}{2}\frac{6}{0}\frac{0}{5}\frac{1}{1}$d. (60) £3000. (61) $1\frac{2}{5}$. (62) £141 7s 8d. (63) £5 0s $6\frac{1}{9}\frac{8}{7}$d. (64) B $10\frac{1}{1}\frac{0}{1}$; T $7\frac{1}{1}\frac{1}{1}\frac{3}{1}$. (65) $\frac{5}{5}\frac{0}{2}\frac{2}{5}$. (66) (1) $10\frac{2}{3}\frac{9}{4}\frac{0}{9}$ hrs. (2) A $47\frac{6}{7}\frac{7}{9}$ hrs.; B $36\frac{9}{9}\frac{4}{7}$; C $27\frac{2}{1}\frac{7}{3}\frac{}{9}$; D $111\frac{3}{1}\frac{}{7}$. (67) 40 yds. (68) 8.48 o'clock; 12.24 o'clock. (69) $653\frac{2}{3}\frac{5}{1}$ hrs. (70) 4 cwt. (71) £25. (72) $2\frac{1}{8}$ hrs. (73) $574\frac{1}{1}\frac{4}{5}$ yds. (74) $\frac{2}{3}$ hrs. (75) £292 4s. (76) A £575 15s; B £497 12s 6d. (77) £5616. (78) 101001; $\frac{1}{1}\frac{1}{2}$. (79) 2 hrs. 24 mins. (80) Tea 112 lbs.; Coffee 140 lbs. (81) $10\frac{5}{7}$ per cent. (82) A £212 2s; £353 10s; C £388 17s. (83) $\frac{8}{1}\frac{5}{4}\frac{}{4}$. (84) £1125 10s $2\frac{1}{1}\frac{4}{2}\frac{3}{5}\frac{}{0}$d. (85) $88\frac{1}{2}\frac{9}{7}$ mls. (86) £4800 each. (87) 90. (88) £99·225. (89) $19\frac{9}{1}\frac{}{0}$ carats. (90) 17 acres 2 roods 29 poles; 1528 mls. 3 fur. 23 po. 2 ft. 11 ins. (91) £747 14s $1\frac{1}{2}\frac{7}{8}$d. (92) $48\frac{1}{2}$ p.c. (93) $7\frac{1}{7}$ p.c. (94) $2\frac{2}{3}$ hrs. (95) 10.55 o'clock. (96) 5 dwts. $14\frac{1}{7}\frac{2}{0}\frac{9}{3}\frac{3}{9}\frac{4}{9}$ grs. (97) £325 10s. (98) 30 and 20 miles an hour. (99) $26\frac{8}{2}\frac{}{7}$ miles from London. (100) $151\frac{1}{8}\frac{}{0}$ ozs.

SECOND SERIES.

(1) $3\frac{40633}{127512}$. (2) ·630219; 9·889. (3) 5 tons 18 cwts. 3 qrs. 7·6 lbs. (4) $1543\frac{161}{58122}$ cub. ft. (5) £4 18s. (6) 7/8½. (7) £35; $36\frac{6}{21}$ p.c. (9) 2nd income a loss of $6\frac{6}{31}$d. (10) £304 14s 8d; $26\frac{101}{6124}$ p.c. (11) A £3000; B 2000; C £1500. (12) 63 hours. (13) $8\frac{19}{22}$ secs. (14) 7 hrs. 10 mins. $17\frac{1}{7}$ sec. (15) £16 19s $3\frac{77}{80}$d. (16) £31 7s 5¼d. (17) £1500; £1312 10s; £687 10s. (18) 6/3; 8/4; 5/5. (19) 880 gals.; gain 3/9. (20) 15 at 12/6; 25 at 15/-. (21) 50 mins.; 6 and 6½ circuits. (22) $9\frac{4}{5}$ hrs. (23) £576 17s 6d. (24) 772. (25) Purse £8 1s 5d; Contents £12 2s 1½d. (26) 68. (27) $34\frac{4}{9}$ mins. past 4. (28) £1041 13s 4d. (29) $3\frac{1}{2}$ years. (30) A £56 5s; B £22 10s; C £9; D £3 12s. (31) $32\frac{8}{11}$ min. and $54\frac{6}{11}$ min. past 8. (32) 12·02. (33) 20 gals. (34) 54s. (35) 1012240000. (36) 2 mins. (37) 203. (38) $1/8\frac{4}{7}$. (39) 10 dys. (40) 15 days. (41) £520. (42) 32. (43) £520. (44) 50 acres. (45) $\frac{2}{3}$ hrs.; $16\frac{2}{3}$ and $23\frac{1}{3}$ mls. (46) 60 hrs.; 2 and 3 times. (47) 63 gals. (48) $6\frac{34}{999}$; $6\cdot\dot{3}531986$; $5\frac{502}{999}$; $5\cdot\dot{4}986532$; $34\frac{311}{332}\frac{81}{667}\frac{9}{7}$; 34·93733; $1\frac{8467}{54997}$; 1·1539. (49) 12. (50) $21\sqrt{2}$; 0. (51) 4·86 lbs. (52) 24s $7\frac{11}{17}$d. (53) $33\frac{1}{3}$ p.c. (54) $6\frac{6}{7}$ mos. (55) A $1\frac{1}{15}$; B $\frac{9}{10}$; C $\frac{1}{30}$. (56) A £82 10s; B £68 15s; C £44. (57) 55·1625. (58) Men 5400; Women 675; Boys 150; Girls 45. (59) 72·015; $\frac{23}{27}$; $4\frac{15}{29}$. (60) 84 men. (61) $33\frac{1}{3}$ days. (62) 192. (63) 20s. (64) 5. (65) £8450. (66) £120 7s 6d. (67) £20250; £15750; £6750. (68) 1515 ac. 3 ro. 19 po. 30 yds. 2 ft. 36 ins. (69) 120. (70) £230 11s $0\frac{87}{169}$d. (71) 86 lbs. (72) $15\frac{1}{17}$ oz.; $6\frac{1}{4}$ p.c. (73) £2193 7s 6d. (74) Dearer 50/-; Cheaper 40/-. (75) $42\frac{2}{3}\frac{8}{6}\frac{8}{5}\frac{5}{1}$ min. past 2. (76) 3328. (77) 1322·5; 2765; 1537·5. (78) £1 12s. (79) £1 4s $1\frac{68}{17}$7d. (80) £169 13s $11\frac{3}{4}$d; £219 12s $2\frac{1}{2}$d; £259 10s $9\frac{1}{2}$d. (81) 758 and 609. (82) £20. (83) $34\frac{4}{5}$ mins. past 4. (84) $2\frac{2}{5}$ hrs. (85) $3\cdot\dot{2}835497\dot{}$. (86) $1\frac{81}{11}\frac{81}{61}\frac{81}{6}$. (87) Prime Factors 3, 5, 7, 11. (88) £22666 13s 4d. (89) $7\frac{44}{64}\frac{1}{0}$. (90) 10 days. (91) $\frac{37}{48}$. (92) $3\frac{1}{2}$; $£\frac{25}{91}$. (93) 53°.6. (94) 564. (95) 3 : 1. (96) $5\frac{17}{18}\frac{3}{0}$ grs. (97) £82. (98) $12\frac{1}{2}$. (99) 25 p.c. (100) £5246 5s.

EXAMINATION PAPERS.—No. 1.

(1) ·3125. (2) £350 11s 8d. (3) 79·032; 20·37. (4) 848 sq. ft. $2\frac{1}{3}$ ins.; $10\frac{1}{2}$ ft.; £63 2s 0½d. (5) 4334; $43\cdot32\,t : 100$. (6) A $533\frac{1}{3}$ ac.; B $166\frac{2}{3}$ ac.; C 100 ac. (7) 4 p.c. (8) $3\frac{1}{2}$ p.c.; $2\frac{1}{2}$ years. (9) 86 yards; 72 secs. (10) 18 miles. (11) $1\frac{2}{3}$; $12\sqrt{3}-4\sqrt[3]{3}$. (12) 58 min. (13) 42 ac. 21 po. (14) £37,125; £12,375; £17,750. (15) £13 10s.

No. 2.

(1) $\frac{1}{20}$. (2) 30·507; $244\frac{1}{3}$; $\frac{2}{3}$. (3) £3600. (4) 7 *e.t*; 402·583; ·256+ . (5) £1,450,000; £125,000. (6) 28 mls. (7) 5400 oz.

(8) 35 min. $2\frac{6}{7}\frac{6}{1}\frac{2}{3}$ sec. past 12. (9) 50 yards. (10) Equal. (11) 20 yds.; 3/6. (12) £51 16s 8d; $3\frac{3}{4}$ p.c. (13) £340. (14) £50; £260. (15) $4\frac{7}{8}$ miles an hour.

No. 3.

(1) 4224 Th. + 1s $3\frac{1}{101}$d. (2) £7843 15s. (3) 45; 50. (4) £$136\frac{1}{24}$. (5) £$29690\frac{20}{97}$. (6) $108\frac{1}{3}$ p.c. (7) 680. (8) 19 mls. (9) £281 5s; $6\frac{1}{4}$ p.c. (10) 11·247 min. (11) 234·521. (12) $35\frac{73}{99}$. (13) £975. (14) $17\frac{1}{4}$ miles. (15) £1380.

No. 4.

(1) $3\times5\times11\times13$; $2\times3^2\times5\times13$; $3^2\times11\times13$; 1. (2) 24. (3) £6500. (4) £$10666\frac{2}{3}$; £$146\frac{2}{3}$. (5) £11 9s 2d; £7 7s 11d. (6) 109 *t* 9; 918+ ; 23121. (7) £4 11s $10\frac{1}{2}$d; £4 4s; $9\frac{3}{8}$ p.c. (8) 15 ft.; 20 ft. (9) 50 feet; 61·2372 feet. (10) 4 times. (11) 96. (12) $5\frac{1}{4}$ p.c.; £665. (13) $\frac{3}{4}$ mile. (14) $4\frac{2}{5}$; £682 10s. (15) £$54\frac{35}{424}$; £$42\frac{138}{424}$; £$28\frac{23}{106}$.

No. 5.

(1) $\frac{25}{37}$; $\dot{6}\dot{7}\dot{5}$. (2) 4 ac. 21 po. 8 yds. (3) 3/-; 2/-; 1/8. (4) $4\frac{1}{2}$ p.c.; £63 13s 7d. (5) $3\frac{1}{2}$d. (6) £481 17s $6\frac{1}{2}$d. (7) 1 *t e.e* 3; 168743; 3 *t* 8. (8) 7 hrs. 48 min. (9) $22\frac{1}{2}$ ft. long; $11\frac{1}{4}$ ft. broad; $9\frac{1}{2}$ ft. high. (10) $\frac{240}{608}\frac{80}{13}$ oz. (11) $43\frac{6}{17}$/-; $29\frac{5}{17}$/-; $19\frac{8}{17}$/-. (12) Ordinary 3 hrs. 10 min.; Express 2 hours 13 min. (13) 3 hrs. 17 mins. 38·3 secs. (14) £1325. (15) $\frac{75}{133}$; $6\frac{2}{3}$; $\frac{45}{632}$.

No. 6.

(1) $1\frac{9883}{33300}$; $\frac{20983}{33300}$; $\frac{32083}{99900}$; 1·29678; ·63012; ·32115. (2) 90 days; 11 hrs. 36 min.; 12 hrs. 27 min. (3) $90\frac{6}{7}$. (4) £4 18s. (5) 3·3303; ·0836; 1·38; 18·62. (6) £64; £8 16s. (7) $7\frac{1}{2}$; $8\frac{3}{4}$. (8) $510\frac{1}{8}$ sq. ft.; 4/$10\frac{1}{3}$; £10 11s $3\frac{3}{4}$d. (9) $10\frac{1}{2}$ hrs. (10) 8/4. (11) 12 : 13. (12) $9\frac{2}{5}$ p.c. (13) Gold $35\frac{85}{144}$ oz.; Silver $28\frac{131}{144}$ oz. (14) $4\frac{251}{376}$; $4\frac{1055}{2632}$; $3\frac{615}{1316}$. (15) £333 6s 8d; 17/$4\frac{1}{2}$.

No. 7.

(1) $3\frac{159}{220}$; 30·019; ·3. (2) ·125; (·75 : ·96). (3) £8871 1s $10\frac{1}{2}$d; £283 17s 6d; £3365. (4) 16325130; 6460 *e* 9; 23 *e t* 3+. (5) 24640. (6) $7\frac{1}{2}$ miles; 15 min. (7) 22 and 10. (8) ·132; 936 ft. $143\frac{5}{8}$ in.; 30 ft. $7\frac{1}{2}$ in. (9) $77\frac{1}{7}$ p.c. (10) $5\frac{2}{3}$ days. (11) $\frac{5}{9}$; $\frac{1}{2}$. (12) £25 loss. (13) A £230; B £300. (14) $163\frac{1}{5}$ dys. (15) 25 min. 5 sec.

No. 8.

(1) £1386. (2) £2500. (3) £2000. (4) $\dot{1}\dot{6}$; ·203; $12\dot{3}$ (5) ·0396678; £$\frac{1}{271}$. (6) 2·6; 11100; ·139092398. (7) 2 hrs. (8) 1 grain. (9) 4000 gals. (10) 3 yrs.; £21. (11) 8 hrs. $38\frac{2}{7}\frac{13}{07}$ min. (12) 54 boys. (13) 4 days. (14) $32\frac{1}{2}$ ft. (15) £338 17s $10\frac{1}{2}$d; £7116 15s $4\frac{1}{2}$d.

No. 9.

(1) $2\frac{14}{38}\frac{17}{64}$; $\cdot\dot{1}8\dot{3}$. (2) 2483; 1, 3^2, 3^4, 3^5. (3) £720. (4) £715. (5) 13 cwt. 3 qrs. 23 lbs. $2\frac{5}{12}$ oz. (7) £249 2s 8d; £262 10s. (8) Twice. (9) £27 8s $6\frac{2}{3}$d. (10) £108. (11) 6 weeks. (12) $\frac{1}{4}$. (13) £7358400 (14) 5·4773; ·31072; 69·57 yds. (15) 35; 1320 min.

No. 10.

(1) 8·175. 5906. (2) £957 18s 4d; 54450 yds. (3) 6·45 P.M.; $5\frac{1}{4}$ mls. (4) $4977\frac{7}{9}$ cub. ft.; $3\frac{3}{8}$ ft. (5) £5 10s 6d. (6) $186\frac{2}{3}$ lbs. (7) 2·446; 1·233. (8) $92\frac{1}{2}$; 8s 9d. (9) *toto;* 85488400. (10) 266·6 in. (11) $8\frac{7}{15}$; ·043; 1. (12) $10\frac{10}{41}$ min. past 7; 21 dys. after at 12 noon. (13) 3·6126 metres. (14) 507. (15) £500.

No. 11.

(1) $\frac{19}{132}$; $\frac{13}{132}$; $1\frac{6}{13}$; $\cdot\dot{1}4\dot{3}\dot{9}$; $\cdot0\dot{9}8\dot{4}$; $1\cdot\dot{4}61538$. (2) 1725 yds. (3) £1260; A £420; B £540; C £300. (4) 3/-; 1/$1\frac{1}{2}$; $4\frac{1}{2}$d. (5) $4\frac{2}{5}$ hrs.; $3\frac{3}{10}$ hrs. (6) £7875. (7) £5415. (8) 7 cwts. 110·51 lbs. (9) $\frac{1}{4}$ hr. (10) £6400. (11) 658·1248 cub. in. (12) £6700; 18s 5d. (13) $92\frac{116}{1477}$. (14) £320. (15) 569 acres.

No. 12.

(1) $2\cdot08\dot{3}$; 4460; $1\cdot\dot{3}$. (2) 35; 7525. (3) £168; £35; 40 °/₀. (4) £2 6s 8d; (20 °/₀. (5) 42 ac. 21 po. (7) 9868; 54; 1131. (8) £543 15s; £362 10s; £271 17s 6d; £392 14s 2d. (9) 8.325 °/₀. (10) 8s 1·3199d. (11) 8·30 P.M. (12) 105. (13) £6380; £6039 18s 4d. (14) $\cdot0\dot{4}3\dot{6}$. (15) $6\frac{2}{3}$ min.; 6 ac. 1 ro. 18 po. 17 yds.

No. 13.

(1) $5\frac{1}{4}$ yds. (2) £163 15s. (3) 8 yrs. (4) 18·905 ins. (5) $3\frac{3}{4}$ °/₀. (6) 1; $\frac{30}{49}$. (7) 3 o'ck. A.M. on 27th May; 12·45 o'ck. P.M. (8) 4413717; $21\frac{1}{4}$ yds. (9) 4230·688 cub. in. (10) £32 10s. (11) $109\frac{7}{10}$ galls.; $18\frac{1}{5}$ galls. (12) 1d. (13) £2 11s 8d. (14) £40700. (15) 6d.

No. 14.

(1) $1\frac{291}{1568}$. (2) 2312; 23·12; 595. (3) $3\frac{1}{8}$ days. (4) A $16\frac{1}{2}$ hrs., B 17 hrs.; 405 hrs. (5) £8 6s 8d. (6) £50 6s 3d. (7) £3693 6s 8d. (8) 91 oz. (9) £4000. (10) 39 hrs. (11) £285 19s $0\frac{1}{2}$d; £1 19s $11\frac{1}{2}$d. (12) 1728. (13) 340 ft. (14) 24; $26\frac{2}{3}$; 25 mls. (15) £$242914\frac{2}{24}\frac{2}{47}$.

No. 15.

(1) $\frac{585}{1474}$. (2.) 76 lbs. 6 oz.; 5 galls. 1 qt. (3) £1715. (4) 171 sq. ft. 126 sq. in.; 2200. (5) $61\frac{1}{2}$ yds.; 5s $1\frac{1}{2}$d. (6) 3·2808. (7) £2972 6s $1\frac{1}{13}$d. (8) £20 1s. (9) 362. (10) $\cdot0\dot{4}3\dot{6}$. (11) 162.788. (12) £17 3s 6d. (13) 360 galls.; 1 gall. per hr. (14) 3s. (15) $46285\frac{5}{7}$; $38571\frac{3}{7}$; $37028\frac{4}{7}$.

No. 16.

(1) £4 7s $2\frac{1}{4}$d. (2) £750. (3) A £450; B £825; C £1525. (4) 1·0472 cub. ft. (5) £22 1s 8d. (6) £141 7s 8d. (7) £5 0s $6\frac{18}{77}$. (8) 61:35. (9) $16\frac{2}{3}$. (10) $\frac{1}{4}$ ml.; $\frac{1}{128}$ ml. (11) 90 qrs. (12) £5000. (13) £10 1s 11d. (14) 5·10 P.M. (15) $\frac{1}{3}$ of 1st, $\frac{2}{3}$ of 2d.

No. 17.

(1) 8s 6d; 14s 6d. (2) $\frac{1}{63000}$; $\cdot\dot{0}0\dot{0}15873\dot{}$. (3) 25 °/₀ loss; 25 °/₀ gain. (4) £1750. (5) £2 9s 7·7d. (6) 2 mls. (7) $3\frac{9}{40}$. (8) 5, 10, 15. (9) £70, £168; $4\frac{4}{9}$ °/₀. (10) £14414 1s 3d; 16 fold. (11) $18\frac{2}{3}$ °/₀. (12) 35 ft., 21 ft. (13) £1627 12s 1d. (14) B by 88 yds. (15) Gold, £12 3s $6\frac{27}{40}$d; Silver, £2 9s $5\frac{13}{40}$.

ERRATA.

Page 6, No. 21, for "per" read "fur."
,, 10, No. 22, for "30 yds. 2 ft." read "30 ft. 2 in."
,, 13, No. 10, insert "Exchange being 26 fr. 25 cents per £."
,, 15, No. 2, for "£284 10s." read "£184 10s."
,, 17, No. 19, for "28 carats" read "20 carats."
,, 21, No. 17 (2), for "$4\frac{1}{4} + \frac{1}{17}$ read "$4\frac{1}{4} \times \frac{1}{17}$."
,, 23, No. 15, for "find the sum" read "find the numbers."
,, 28, No. 10, for "$\sqrt[3]{\frac{186}{144}}$" read "$\sqrt[3]{\frac{186}{324}}$."
,, 28, No. 11, for "$\sqrt{4} \times \sqrt{5}$" read "$\sqrt{4} + \sqrt{5}$."
,, 46, No. 41, for "per cent." read "per cwt."
,, 49, No. 73, delete "an hour" after 6 miles.
,, 51, No. 5, for "$21\sqrt{3}$" read "$21\sqrt{3}$ feet."
,, 57, No. 89, insert "decreases" after "annually."
,, 128, No. 43, for "80" read "78." Ratio and Proportion, No. 31, for "$7\frac{1}{2}$" read "$8\frac{1}{3}$." Simple Interest, No. 20, read "£1665" only. Nos. 25 to 29, read £3215 16s. 8d., £499 3s. $10\frac{1}{20}$d., £433 15s. $11\frac{2}{5}$d., £424 13s., £668 5s. $3\frac{1}{5}$d.
,, 130, Vulgar fractions, No. 2, read "$2^2 \times 3^3 \times 17$," "$3^4 \times 5 \times 7^2$," "$3^3 \times 5 \times 7^2$."
,, 131, No. 32, for $\frac{1}{4}$ read "2.3+."
,, 131, No. 36, for "18s. 5d." read "18s. 3d."
,, 132, Cube Root, No. 8, delete "27 and 25."
,, 135, Examination Problems—First Series—(16) £2400. (35) 3 dwts. $19\frac{607}{63237}$ grs. (62) £141 12s. $2\frac{1}{4}$d. (66) B $39\frac{17}{91}$. (69) $635\frac{19}{31}$ hrs. (85) $89\frac{5}{27}$ mls.
,, 136, Second Series—(9) No difference. (15) £31 2s. $1\frac{1}{2}$d. (16) £31 7s. $4\frac{1}{2}$d. (27) $34\frac{26}{43}$ min. past four. (73) £3000. (90) $12\frac{32}{33}$ days.
,, 137, No. 3 (6), for "$108\frac{1}{3}$" read "120."
,, 138, No. 11 (13), for "$92\frac{110}{1477}$" read "90."