The First Class Army School Certificate made easy. Group 1; arithmetic, dictation and copying manuscript

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GALE & POLDEN'S MILITARY SERIES.

THE

FIRST CLASS ARMY SCHOOL CERTIFICATE.

MADE EASY.

GROUP I.

ARITHMETIC, DICTATION & COPYING MANUSCRIPT.

BY AN

ARMY SCHOOLMASTER.

Gale & Polden Ltd.

ALDERSHOT.

ONE-AND-SIX (No. 11).

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THE FIRST CLASS ARMY SCHOOL CERTIFICATE MADE EASY.

GROUP I.

ARITHMETIC, DICTATION, & COPYING MANUSCRIPT.

BY

AN ARMY SCHOOLMASTER,

The Author of "Guides to Second and Third Class Certificates," "Examinations in Arithmetic for First, Second and Third Class Certificates," "Guide to Copying Manuscripts and Hints on Handwriting as taught in Army Schools," &c., &c.

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PREFACE.

The present volume has been prepared to meet a steadily growing demand for a work comprising the subjects required for Group I. of the 1st Class Army School Certificate. To meet this demand the Publishers decided to issue an entirely new edition of their "First Class Army School Certificate Made Easy," and to utilise the opportunity thus afforded by publishing the matter required for each group in separate volumes.

The author has endeavoured to put the subject matter before the student in a plain and practical manner, and with the introduction of as little theory as consistent with clearness. With this end in view, the methods adopted are those which, in the author's experience, are best calculated to enable the student to overcome the difficulties with which he may ordinarily be expected to have to meet.

The publishers of this book have issued a "Military Examination Arithmetic," Part I., which contains the whole of the Questions in Arithmetic which have been given since 1888, together with Hints and Solutions of the more difficult problems.

The price is 1s. 6d., post free to any part of the world.

Twelve Dictation exercises, which have actually been given, are inserted.

SEPTEMBER, 1898.

SCHEME OF EXAMINATION.

Class.	Subject.	Extent.		Marks. Full.	Qualifying Minimum.	Qualifying Averages.
1st	Writing to Dictation	A passage from any standard author.	Handwriting	40 } 100	20 } 60	200
			Spelling	60	40	
	Arithmetic	The whole subject (except Present Worth and Discount, Stocks, and Cube Root)		100	60	
	Copying MS.	Making a fair copy of a rough draft		00	50	
	English History			100	50	
	Geography			100	50	

NOTE 1.—In English History, one-half of the questions will be devoted to the events of the period from the Accession of James I. Only general knowledge of the most remarkable events, persons, &c., of the history of the preceding period will be required. In the assignment of marks, regard will be had to the manner in which the answers are written, *i.e.*, to composition and clearness of expression, and to correctness of spelling, punctuation, and grammar.

NOTE 2.—In Geography, one-half of the questions are to relate to the British Isles, India, and the Colonies. The Geography of the whole of Europe will be required to be known in detail; as regards other countries only their general physical features.

NOTE 3.—The five subjects may be taken up in two groups as follows:—

GROUP 1.—Dictation, Arithmetic, and Copying MS. The qualifying aggregate for these three subjects will be 190.

GROUP 2.—English History and Geography. The qualifying aggregate for these two subjects will be 110.

Each candidate will be provided with pens and ink for his own separate use.

In the subjects of Arithmetic, English History, Geography, and Modern Languages, candidates will write their answers and make their rough work in Army Book 4, and no other book, paper, or blotting paper of whatever kind will be used by them in those subjects. Every candidate will write his regimental number, rank, name (surname first), and corps, the station and date, on the right top corner of the cover of each book used by him where marked "Index Number."

CONTENTS.

ARITHMETIC.

GROUP I.

ARITHMETIC.

It is assumed that a knowledge of Arithmetic, so far as is contained in the publishers' "2nd Class Army School Certificate Made Easy" has been acquired.

Additional "Tables of Weights and Measures" are now given.

TROY WEIGHT (For Weighing Gold, Silver and Precious Stones).

24 grains (grs.)	=	1 pennyweight (dwt.)
20 dwts.	=	1 ounce (oz.)
12 oz.	=	1 pound (lb.)
1 lb. Avoirdupois	=	7000 grs. Troy.

APOTHECARIES' WEIGHT (For Weighing Drugs).

20 grs.	=	1 scruple (scr.).
3 scrs.	=	1 dram (drm.)
8 drms.	=	1 ounce (oz.)
12 oz.	=	1 pound (lb).

VULGAR FRACTIONS.

COMPLEX FRACTIONS.

In Complex Fractions the following points should be noted:— (1) All the fractions connected by the word "*of*" comprise one expression only. (2) Fractions connected by + or − are called *terms*. (3) Fractions connected by × or ÷ are called *factors*. (4) Brackets enclose one expression only; before the brackets are

removed, the whole of the expression enclosed within them must be shown as one expression.

In simplifying complex fractions the student will find it convenient to proceed as follows :—

(*a*) Simplify all expressions that are within brackets.
(*b*) Simplify the factors.
(*c*) Simplify the terms.

A few examples of the simplification of complex fractions, as well as a few solutions of problems involving fractions, are here shown.

EXAMPLE 1.

Simplify $3\frac{1}{2} + \frac{5}{8}$ of $2\frac{1}{3} - 1\frac{5}{8}$ of $\frac{5}{6} \div \frac{2}{3}$ of $1\frac{1}{7} \times 1\frac{3}{13}$

First bracket all *factors*.

$$3\tfrac{1}{2} + (\tfrac{5}{8} \text{ of } 2\tfrac{1}{3}) - (1\tfrac{5}{8} \text{ of } \tfrac{5}{6} \div \tfrac{2}{3} \text{ of } 1\tfrac{1}{7} \times 1\tfrac{3}{13})$$

Next simplify the factors.

$$3\frac{1}{2} + \left(\frac{5}{8} \text{ of } \frac{7}{3}\right) - \left(\frac{\cancel{13}^{1}}{8} \times \frac{5}{\cancel{6}_{2}} \times \frac{\cancel{3}^{1}}{\cancel{2}_{1}} \times \frac{7}{\cancel{8}_{1}} \times \frac{\cancel{16}^{1}}{\cancel{13}_{1}}\right)$$

$$= 3\tfrac{1}{2} + 1\tfrac{11}{24} - 2\tfrac{3}{16}$$

Perform the addition and subtraction.

$$= 2\,\frac{24 + 22 - 9}{48}$$

$$= 2\tfrac{37}{48} \quad \textit{Ans.}$$

EXAMPLE 2. Simplify $\dfrac{\frac{2}{7} \text{ of } 1\frac{7}{10} + \frac{3}{5} \div \frac{2}{3}}{1\frac{1}{4} \text{ of } 1\frac{1}{7} - \frac{3}{4} \text{ of } 1\frac{1}{2}}$

Bracket the factors and simplify

$$\frac{\left(\frac{2}{7} \times \frac{17}{10}\right) + \left(\frac{3}{5} \times \frac{3}{2}\right)}{2}$$

$$\left(\frac{\cancel{5}^{1}}{\cancel{4}} \times \frac{\cancel{8}^{2}}{7}\right) - \left(\frac{3}{4} \text{of} \frac{3}{2}\right)$$

$$= \frac{\frac{34}{70} + \frac{9}{10}}{1\frac{3}{7} - 1\frac{1}{8}}$$

Perform the remaining addition and subtraction.

$$= \frac{\frac{34 + 63}{70}}{\frac{24 - 7}{56}}$$

Simplify the fraction $= \frac{\frac{97}{70}}{\frac{17}{56}} = \frac{97}{\cancel{70}} \times \frac{\cancel{56}^{4}}{17}$

$= \frac{388}{85} = 4\frac{48}{85}$ *Ans.*

EXAMPLE 3. What does a man receive weekly, if, after paying $\frac{1}{5}$ of his wages for rent, $\frac{2}{3}$ for food and clothing, and $\frac{1}{20}$ for insurance, he has 2/6 left?

Method.—In questions of this class the whole of the original amount is the *unit*, and it is composed of the sum of the various fractions and the *value* of the remaining fraction.

First find the *sum* of the given fractions.

Fraction paid away $= \frac{1}{5} + \frac{2}{3} + \frac{1}{20} = \frac{12 + 40 + 3}{60} = \frac{55}{60}$

$\therefore$ Fraction of whole left $= 1 - \frac{55}{60} = \frac{5}{60}$ or $\frac{1}{12}$

$\therefore \frac{1}{12}$ of wages $= 2/6$ (by Question).

Apply the method of Simple Proportion.

Wanted. Value of 1 whole = x.
Given. " $\frac{1}{12}$ " = 2/6.

$\frac{1}{12} : 1 :: 2/6.$

$\frac{2/6 \times 1}{\frac{1}{12}} = 2/6 \times 12 = 30/-$

Answer £1 10s.

NOTE.—It is better to apply the method of Proportion, especially for the more difficult examples, as it greatly lessens the possibility of error.

EXAMPLE 4. A, B and C commence a work which A can do alone in 6 days, B in 8 days, and C in 10 days. After the first day A and C leave off and B works alone for 3 days more. A then returns and finishes the work alone. How many *more* days will he take to finish it?

NOTE.—In questions of this class the amount done by *each* in a day is the key to the solution.

(*a*) Amount A can do in 1 day $= \frac{1}{6}$

(*b*) ,, B ,, ,, $= \frac{1}{8}$

$\therefore$,, B ,, 4 days $= \frac{4}{8} = \frac{1}{2}$

(*c*) ,, C ,, 1 day $= \frac{1}{10}$

(*d*) ,, A, B and C have done, working 1, 4, and 1 day respectively $= \frac{1}{6} + \frac{1}{2} + \frac{1}{10}$

$$= \frac{5 + 15 + 3}{30} = \frac{23}{30}$$

$\therefore$ Amount left for A to do $= 1 - \frac{23}{30} = \frac{7}{30}$.

Work.

Wanted. No. of days for A to do $\frac{7}{30} = x$.

Given. ,, ,, ,, $1 = 6$

$1 : \frac{7}{30} :: 6$ days.

$$\text{Days } \frac{7}{\cancel{30}_{5}} \times \frac{\cancel{6}}{1} = \frac{7}{5} = 1\frac{2}{5} \text{ days.} \quad \textit{Ans.}$$

Example 5. What would be the cost of papering the walls of a room 42 ft. 6 in. long, 22 ft. broad, and 12 ft. high, with paper $\frac{3}{4}$ yard wide, at 4/6 per piece of 12 yards.

In working exercises of this class it is necessary to know that the area of a surface is the number of units in the length × the number of units in the breadth.

A simple form of working is as follows.

Total length of walls in feet $= 42\frac{1}{2} + 42\frac{1}{2} + 22 + 22 = 129$.

Area of walls (*i.e.*, the area of the paper) in sq. ft. $= 129 \times 12$.

The width of the paper in feet $= 2\frac{1}{4}$.

$\therefore$ Length of the paper in feet $= \dfrac{129 \times 12}{2\frac{1}{4}}$

$$\text{or } \frac{129 \times 12 \times 4}{9 \times 3} \text{ yards.}$$

$$\text{No. of pieces, each 12 yards} = \frac{129 \times 12 \times 4}{9 \times 3 \times 12}$$

$$\text{Cost at 4/6 per piece} = \text{S.}\frac{\cancel{43}_{1} \quad 1 \quad 2 \quad 1}{\cancel{129} \times \cancel{12} \times \cancel{4} \times \cancel{9}} \\ \cancel{9} \times \cancel{3} \times \cancel{12} \times \cancel{2} \\ 1 \quad 1 \quad 1 \quad 1$$

$= 86/- = £4\ 6\text{s.}$ *Ans.*

Note.—It is not necessary to work each portion separately—the operation may be indicated and the whole finally dealt with as in the example.

recur and some do not; thus:—$\cdot 14\dot{6} = \cdot 14666$ and $\cdot 2\dot{6}8\dot{1} = \cdot 2681681$, &c.; $64\cdot 2\dot{4}\dot{5} = 62\cdot 24545$, &c.

1. To reduce a vulgar fraction to a recurring decimal—divide the numerator by the denominator.

Example 1. Express $\frac{4}{9}$ as a decimal.

$$9\overline{)4\cdot 00}\quad \cdot 44 \qquad \tfrac{4}{9} = \cdot\dot{4} \text{ Ans.}$$

EXERCISE II.

(1) Express as recurring decimals:—

$$\frac{2}{3};\ \frac{4}{9};\ \frac{5}{11};\ \frac{14}{6};\ \frac{1}{27};\ \frac{5}{7}.$$

2. To express a recurring decimal as a vulgar fraction—place the recurring period for the numerator, and for the denominator as many 9's as there are figures in the recurring period.

Example 2. Express $\cdot\dot{4}\dot{5}$ as a V.F.

The numerator is 45, and as there are *two* figures in the recurring period, place *two* 9's for the denominator. Then reduce to the lowest terms. The work would stand thus.

$$\cdot\dot{4}\dot{5} = \tfrac{45}{99} = \tfrac{5}{11} \textit{ Ans.}$$

EXERCISE III.

(2) Express as Vulgar Fractions:—

$\cdot 9$; $\cdot 0\dot{9}$; $\cdot 40\dot{5}$; $\cdot 0\dot{6}$; $\cdot 00\dot{4}\dot{5}$; $\cdot\dot{5}$

3. To reduce a *mixed* recurring decimal to a Vulgar Fraction—place the *whole* of the decimal for the numerator and subtract the *non-recurring* part; for the denominator take as many 9's as there are figures that recur, and as many 0's as there are non-recurring figures. Then reduce to the lowest terms.

Example 3. Express $\cdot 6\dot{1}\dot{6}$ as a V. Fraction

$$\tfrac{616}{990} - \tfrac{6}{10} = \tfrac{610}{990} = \tfrac{61}{99} \textit{ Ans.}$$

Note.—If the expression consists of a whole number and a decimal, the whole number may be left as a whole number, or may

be included in the numerator. Care must be taken only to put 9's and 0's for the *decimal part* of the expression. Thus—

$$6\cdot5\dot{7}\dot{2} = 6^{5}\frac{72-5}{990} = 6\frac{567}{990} = 6\frac{63}{110} \quad \textit{Ans.}$$

$$\text{or } 6\cdot5\dot{7}\dot{2} = \frac{657\,2-65}{990} = \frac{6507}{990} = \frac{723}{110} = 6\frac{63}{110} \quad \textit{Ans.}$$

Note that the *denominator* is the *same* whichever method is used.

EXERCISE IV.

(1) Express as Vulgar Fractions in their lowest terms:—

$$\cdot3\dot{1}\dot{4}\ ;\ \cdot00\dot{8}\dot{6}\ ;\ 2\cdot1\dot{4}\dot{8}\dot{6}\ ;\ 306\cdot\dot{7}\ ;\ 14\cdot1\dot{4}\dot{5}\ ;\ \cdot63\dot{1}5\dot{7}.$$

The following results should be noticed :—

1. Fractions with the denominators, 2, 4, 8, 5, or 10 can be expressed as terminating or *finite* decimals.

(1)	(2)	(3)	(4)
$\frac{1}{2} = \cdot5$	$\frac{1}{8} = \cdot125$	$\frac{1}{5} = \cdot2$	$\frac{1}{10} = \cdot1$
	$\frac{3}{8} = \cdot375$	$\frac{2}{5} = \cdot4$	$\frac{3}{10} = \cdot3$
$\frac{1}{4} = \cdot25$	$\frac{5}{8} = \cdot625$	$\frac{3}{5} = \cdot6$	$\frac{7}{10} = \cdot7$
$\frac{3}{4} = \cdot75$	$\frac{7}{8} = \cdot875$	$\frac{4}{5} = \cdot8$	$\frac{9}{10} = \cdot9$

2. Fractions with denominators 3, 9, 11, or 7, can be expressed as *pure* recurring decimals.

(1)	(2)	(3)	(4)
$\frac{1}{3} = \cdot\dot{3}$	$\frac{4}{9} = \cdot\dot{4}$	$\frac{1}{11} = \cdot\dot{0}\dot{9}$	$\frac{6}{11} = \cdot5\dot{4}$
$\frac{2}{3} = \cdot\dot{6}$	$\frac{5}{9} = \cdot\dot{5}$	$\frac{2}{11} = \cdot\dot{1}\dot{8}$	$\frac{7}{11} = \cdot\dot{6}3$
	$\frac{7}{9} = \cdot\dot{7}$	$\frac{3}{11} = \cdot2\dot{7}$	$\frac{8}{11} = \cdot\dot{7}\dot{2}$
$\frac{1}{9} = \cdot\dot{1}$	$\frac{8}{9} = \cdot\dot{8}$	$\frac{4}{11} = \cdot3\dot{6}$	$\frac{9}{11} = \cdot8\dot{1}$
$\frac{2}{9} = \cdot\dot{2}$	$\frac{9}{9} = \cdot\dot{9} = 1$	$\frac{5}{11} = \cdot4\dot{5}$	$\frac{10}{11} = \cdot\dot{9}0$

NOTE.—That $\cdot\dot{9} = 1$ and therefore, when $\cdot\dot{9}$ appears, it can be left out and 1 added to the *preceding* figure. Thus.—

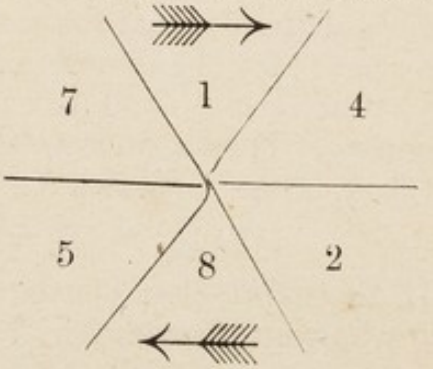
$2\cdot\dot{9} = 3.$ $\quad \cdot4\dot{9} = \cdot5.$ $\quad \cdot064\dot{9} = \cdot065.$ $\quad \cdot124\dot{9} = \cdot125.$

When 7 occurs as a denominator, the equivalent decimal is a pure recurrer of six figures which always occur in the same order.

$\frac{1}{7} = \cdot\dot{1}42857\dot{}$

$\frac{2}{7} = \cdot\dot{2}85714\dot{}$

$\frac{3}{7} = \cdot4285\dot{7}\dot{1}$



and so on.

3. Fractions with the denominators 6 or 12 can be expressed as *mixed recurring* decimals.

$\frac{1}{6} = \cdot 1\dot{6}$ | $\frac{1}{12} = \cdot 08\dot{3}$ | $\frac{7}{12} = \cdot 58\dot{3}$
$\frac{5}{6} = \cdot 8\dot{3}$ | $\frac{5}{12} = \cdot 41\dot{6}$ | $\frac{11}{12} = \cdot 91\dot{6}$

Thus $5 \cdot 08\dot{3} = 5\frac{1}{12}$. $17 \cdot 1\dot{6} = 17\frac{1}{6}$.

ADDITION AND SUBTRACTION OF RECURRING DECIMALS.

Write the given numbers under each other, and extend the recurring periods to the desired number of decimal places. Then add.

It is usually sufficient to carry out the recurrers to the fifth or sixth place.

To secure accuracy the figures should be carried out one place more than is required.

Example 1. Add $6 \cdot 14\dot{3}$; $\cdot 20\dot{9}4\dot{}$; 86 ; $31 \cdot 98\dot{7}$; $26 \cdot 5\dot{7}$ correct to five places.

As only five places are required, extend each to six places, and omit the last figure in the sum. The sum of the sixth column is 18, which is nearly 20 ∴ carry 2.

$6 \cdot 14\dot{3}43$	4
$\cdot 20\dot{9}409$	4
$86 \cdot$	
$31 \cdot 98\dot{7}77$	7
$26\ 5\dot{7}575$	7
$152 \cdot 80106$	*Ans.*

Example 2. Subtract $\cdot 26\dot{1}\dot{7}$ from $\cdot 3\dot{2}\dot{1}$ correct to four places.

Extend to five places of decimals and omit the last figure in the difference.

$\cdot 3\dot{2}\dot{1}2$	1
$\cdot 2617$	6
$\cdot 0594$	*Ans.*

EXERCISE V.

Find the value (correct to seven places of decimals) of :—

1. $\cdot 12\dot{6} + 37 \cdot 2\dot{9} + 2 \cdot 0\dot{8}3 + 6 \cdot 82\dot{7}5\dot{1}$
2. $72 \cdot \dot{8}3 + 2 \cdot 0\dot{9}6\dot{1} + 5 \cdot 43\dot{6} + \cdot 092\dot{5}1\dot{6}$
3. $2 \cdot 47 + \cdot 085 + 6 \cdot \dot{2}0\dot{7} + \cdot 3\dot{2}74\dot{1}$
4. $11 \cdot 21\dot{4}\dot{6} - 3 \cdot 3\dot{8}79\dot{8}$
5. $17 - 3 \cdot 5\dot{4}27\dot{5}$
6. $2 \cdot 093\dot{1}\dot{4} - 2 \cdot 0\dot{8}1\dot{4}$

The following method may be used when absolute accuracy is desired.

Draw a line (*a*) to the right of the non-recurring figure farthest from the dec. point. This is 8 in the fourth line.

	(*a*)		(*b*)
	6·14̇	343434	34
	2·0̇9	409409	40
	86·		
	31·98	7̇77777	77
	26·5̇7̇	575757	57
Ans.	152·80	106379̇	

The recurring periods contain respectively 2, 3, 1 and 2 figures; the L.C.M. of these figures is 6—this is the number of places in the recurring period of the answer counting from the line (*a*).

A practical method of completing the sum is to proceed to draw a second line (*b*) 6 places to the right of the line already drawn (*a*), carry out the recurring period one or two places more than necessary, in order to ensure accuracy. The six figures within the two lines constitute the recurring period.

EXERCISE VI.

1. Add ·73̇4̇, ·7̇9̇6̇, ·2̇3̇ and ·7̇8̇5̇4̇.
2. Add 4·3̇, 6·4̇5̇, 3·9̇0̇ and 5·73̇5̇2̇.
3. Add ·7̇8̇5̇4̇, 3·1̇4̇1̇6̇, ·2̇8̇5̇4̇, 3·9̇0̇8̇ and 8·71̇7̇.
4. From ·73̇25̇6̇ take ·6̇1̇9̇.
5. Find the difference between 1·4̇7̇8̇5̇ and 4·35̇6̇3̇.
6. Subtract ·437̇1̇4̇1̇6̇ from ·75̇3̇6̇1̇.

MULTIPLICATION AND DIVISION OF RECURRING DECIMALS.

To multiply or divide by a recurring decimal—express the decimal as a vulgar fraction, perform the operation required, and then express the result as a decimal.

EXAMPLE 1. Multiply $3\cdot\dot{6}$ by $1\cdot\dot{3}$.

$$3\cdot\dot{6} \times 1\cdot\dot{3}, = 3\tfrac{6}{9} \times 1\tfrac{3}{9}.$$

$$= \frac{\overset{11}{\cancel{33}}}{\underset{3}{\cancel{9}}} \times \frac{\overset{4}{\cancel{12}}}{\underset{3}{\cancel{9}}} = \frac{44}{9} = 4\cdot\dot{8} \quad \textit{Ans.}$$

or the fractions might be reduced to their lowest terms before conversion to improper fractions, thus:—

$$3\cdot\dot{6} + 1\cdot\dot{3} = 3\frac{\overset{2}{\cancel{6}}}{\underset{3}{\cancel{9}}} \times 1\frac{\overset{1}{\cancel{3}}}{\underset{3}{\cancel{9}}}$$

$$= \frac{11}{3} \times \frac{4}{3} = \frac{44}{9} = 4\cdot\dot{8} \quad \textit{Ans.}$$

EXAMPLE 2. Divide $\cdot 9\dot{1}6$ by $1\cdot\dot{0}\dot{9}$.

$$\cdot 9\dot{1}6 \div 1\cdot\dot{0}\dot{9} = \frac{916-91}{900} \div \frac{109-1}{99}$$

$$= \frac{825}{900} \div \frac{108}{99}$$

$$= \frac{\overset{11}{\cancel{825}}}{\underset{12}{\cancel{900}}} \times \frac{\overset{11}{\cancel{99}}}{\underset{12}{\cancel{108}}}$$

144	121
9	7·5625
	·84027$\dot{7}$

$$= \frac{121}{144} = \cdot 84027\dot{7} \quad \textit{Ans.}$$

EXAMPLE 3. Divide $\cdot 1249$ by $\cdot 4285\dot{7}\dot{1}$.

Note that $\cdot 1249 = \cdot 125$

and $\cdot 42857\dot{1} = \frac{428571}{999999} = \frac{3}{7}$

$$\therefore \cdot 1249 \div \cdot 42857\dot{1}$$

24	7
3	·875
	·2916

$$= \tfrac{1}{8} \div \tfrac{3}{7} = \tfrac{1}{8} \times \tfrac{7}{3} = \tfrac{7}{24} = \cdot 2916\dot{6}. \quad \textit{Ans.}$$

EXAMPLE 4. Express $\cdot\dot{1}42857\dot{1}$ of a guinea as the dec. of $\cdot\dot{3}$ of a £.

$$\frac{\cdot\dot{1}42857\dot{1}\text{ guinea}}{\cdot\dot{3}\text{£.}} = \frac{\frac{1}{7}\text{ of }21\text{s.}}{\frac{1}{3}\text{ of £.}} = \frac{3\text{s.}}{6\text{s.}8\text{d.}}$$

80	36
8	3·6
	·45

Reducing to pence
$= \frac{36}{80} = \cdot45$ *Ans.*

EXERCISE VII.

1. Multiply $7\cdot\dot{3}$ by $1\cdot\dot{9}\dot{2}$; $17\cdot\dot{3}\dot{6} \times 5\cdot72\dot{4}$.
2. Find the value of $27\cdot54\dot{5}$ multiplied by $8\cdot7346\dot{}$.
3. Simplify $\cdot75\dot{7}\dot{5} \times \cdot366\dot{}$, and $\cdot406\dot{} \times 62$.
4. Divide $8\cdot426\dot{3}$ by $16\cdot852\dot{7}$.
5. Divide $13\cdot\dot{2}$ by $5\cdot\dot{6}$.
6. Divide $\cdot732\dot{6}$ by $9\cdot5\dot{4}$.

EXERCISE VIII.

MISCELLANEOUS EXERCISES IN VULGAR AND DECIMAL FRACTIONS.

1. Find the value of $10\frac{3}{8} + 1\frac{5}{40} + \frac{7}{10} + \frac{13}{16}$ both in vulgar fractions and decimals.

2. What number multiplied by 125 will give the sum of $\frac{5}{8}$, ·09375, $\frac{7}{16}$, 2·46, $\frac{3}{4}$? Give the answer as a decimal.

3. Simplify, and give the results both as vulgar fractions and decimals, *(a)* $\dfrac{\cdot015 \times 2\cdot1}{\cdot035}$ and *(b)* $\dfrac{3\frac{1}{2} - \cdot04}{5 - \cdot0625}$ (the latter to 5 places of decimals).

4. Simplify $(\frac{9}{11}$ of $35\frac{1}{5} - 3\frac{1}{8}) + (2\cdot5625 + 7\frac{1}{4})$.

5. Simplify $(\cdot59\dot{3} \div 1\cdot78) \times (\cdot3\dot{6} \div \cdot07\dot{2})$.

6. Reduce $\frac{7}{8}$, $\frac{5}{11}$, $\frac{1}{29}$, $\frac{7}{25}$, $\frac{13}{17}$, and $\frac{19}{400}$, to decimals, and find the sum correct to six decimal places.

7. What is the worth of £·6 + ·3125 shillings + ·2 of a guinea?

8. What is the money value of the difference between $1\cdot6$ of $3\cdot4$ of £$1\cdot125$ and $\frac{1}{5}$ of $3\cdot\dot{6}$ of £$9\cdot1125$?

9. Find the decimal which will give the sum of $\frac{1}{4}$, $\frac{16}{25}$, $\frac{43}{50}$ and $3\frac{1}{2}$ when multiplied by $17\cdot5$.

10. Simplify and express as a decimal

$$\frac{48\frac{4}{7}}{1085\frac{7}{10}} \div \frac{7\frac{3}{11}}{174\frac{3}{17}}$$

11. Find the decimal equivalent to

$$(4\cdot4 + \tfrac{3}{5}) \div (7\cdot375 + \tfrac{3}{4} - \tfrac{1}{8}).$$

12. A pedestrian travelled 60 miles in 4 days. On the last day he had only $13\cdot95$ miles to complete. Find his average rate per day for the other three days.

13. A man owning $\frac{3}{16}$ of a ship, sells $\cdot1\dot{7}$ of his share for £1,000, find the value of the ship.

14. Find the correct result of $\cdot12\dot{5} + 4\cdot16\dot{3} + 9\cdot45\dot{7}$ as a decimal.

15. What is the diameter of the earth, if the sun's diameter be $111\cdot454$ times that of the earth, and the diameter of the sun be 883,345 miles?

16. Find the value of

$$\frac{(\frac{3}{8} \times \cdot375) - (\frac{1}{40} \times \cdot025)}{\cdot375 - \cdot025} - \cdot4$$

17. What decimal added to the sum of $1\frac{7}{24}$, $\cdot625$ and $\cdot36\dot{1}$ will make the sum total 3?

18. Reduce $2\cdot\dot{6}$ of £$\cdot877083$ to the decimal of half a sovereign.

19. Find the value of $\cdot\dot{2}85714\dot{1}$ of £30 + £$6\cdot\dot{8}57142\dot{2}$ + $\cdot\dot{6}$ of $\cdot\dot{7}14285\dot{7}$ of £$\cdot6$ + $1\cdot\dot{3}$ of $\cdot\dot{4}28571\dot{4}$ of 1s.

20. If a room be $27\cdot\dot{3}$ feet long, by $20\cdot1\dot{6}$ feet broad, how many yards of carpet, $6\frac{2}{3}$ inches less than a yard wide, will be required to cover the floor?

21. Find the value of $\cdot9178977\dot{2}$ of an acre in roods, poles, yards, feet, inches.

22. If a lb. of cheese cost $\cdot0703125$ of 8s., what should $\frac{1}{2}$ a stone cost?

23. Simplify—

$$\frac{\frac{2\cdot375}{3\cdot1\dot{6}} \text{ of } \frac{4\cdot\dot{4}}{\cdot0625} - 59\cdot06}{\frac{8\cdot\dot{8}}{7} \text{ of } \frac{4}{5\cdot625}}$$

24. Find the value of $3\cdot5.^{\text{shills.}} + 2\cdot9$ of $23\cdot375^{\text{shills.}} - \frac{1\cdot175}{3\cdot5}$ of $16\cdot\dot{6}^{\text{shills.}}$.

COMPOUND PRACTICE.

Case 1. When the number of articles contains a fraction.

Write the cost of the articles @ £1 each and proceed as in simple practice.

Example 1. Find the cost of $737\frac{3}{4}$ articles @ £3 13s. 9d. each.

$737\frac{3}{4}$ articles @ £1 = £737 15s. 0d.

The work would stand thus:—

			£	s.	d.		
10/-	$\frac{1}{2}$	£	737	15	0	=	value @ £1.
					3		
3/4	$\frac{1}{3}$	10/-	2213	5	0	=	value @ £3 each
5d.	$\frac{1}{8}$	3/4	368	17	6	=	,, ,, 10/- ,,
			122	19	2	=	,, ,, 3/4 ,,
			15	7	$4\frac{3}{4}$	=	,, ,, 5d. ,,
		£	2720	9	$0\frac{3}{4}$	=	value @ £3 13s. 9d. ,,

Occasionally it is convenient to find the value of the whole number first, then the value of the fraction, and add the two amounts.

EXAMPLE 2. Find the value of $213\frac{7}{9}$ at £3 17s. 9d. each.

£	s.	d.
3	17	9
		7
9) 27	4	3
3	0	$5\frac{2}{3}$

		£	s.	d.	
10	$\frac{1}{2}$	£ 213	0	0	
				3	
5/-	$\frac{1}{5}$	10/- 639	0	0	
2/6	$\frac{1}{2}$	5/- 106	10	0	
3d.	$\frac{1}{10}$	2/6 53	5	0	
		26	12	6	
		2	13	3	
		3	0	$5\frac{2}{3}$	$= \frac{7}{9}$ of £3 17s 9d ea.
		£831	1	$2\frac{2}{3}$	

EXERCISE IX.

1. Find the value of $2104\frac{1}{2}$ articles at £2 11 $10\frac{1}{2}$ each.
2. „ $5016\frac{1}{3}$ „ £3 17 $10\frac{1}{2}$ „
3. „ $872\frac{5}{6}$ „ £5 14 9 „
4. „ $2014\frac{3}{8}$ „ £2 11 $7\frac{1}{2}$ „
5. „ $1207\frac{11}{12}$ „ £3 19 $10\frac{3}{4}$ „
6. „ $209\frac{5}{16}$ „ £0 11 2 „
7. „ $403\frac{13}{15}$ „ £0 8 $2\frac{1}{2}$ „
8. „ $9214\frac{1}{9}$ „ £0 2 $8\frac{1}{4}$ „
9. „ $3214\frac{17}{18}$ „ £0 19 $10\frac{1}{2}$ „
10. „ $4201\frac{13}{24}$ „ £1 5 $8\frac{1}{2}$ „
11. „ $2109\frac{5}{11}$ „ £0 0 $9\frac{3}{4}$ „
12. „ $2147\frac{18}{19}$ „ £1 11 $11\frac{1}{2}$ „

CASE 2. When the given quantity is a compound quantity.

Find the value of the highest denomination as before, and then take parts for the remaining quantities.

EXAMPLE 1. Find the cost of 25 cwt. 1qr. 23lbs. at £2 2s. 8d. per cwt.

			£	s.	d.	
1 qr.	$\frac{1}{4}$	1 cwt.	2	2	8	= cost of 1 cwt.
					5	
			10	13	4	= cost of 5 cwt.
					5	
14 lbs.	$\frac{1}{2}$	1 qr.	53	6	8	= cost of 25 cwt.
7 lbs.	$\frac{1}{2}$	14 lbs.	0	10	8	= cost of 1 qr.
2 lbs.	$\frac{1}{7}$	14 lbs.	0	5	4	= cost of 14 lbs.
			0	2	8	= cost of 7 lbs.
			0	0	$9\frac{1}{7}$	= cost of 2 lbs.
		£	54	6	$1\frac{1}{7}$	= cost of 25 cwt. 1 qr. 23lbs.

EXAMPLE 2. What would be the cost of paving a road 2 mi. 3 fur. 30 poles in length, at £19 18s. $6\frac{1}{2}$d. a furlong.

2 mi. 3 fur. = 19 fur.

			£	s.	d.	
20 po.	$\frac{1}{2}$	1 fur.	19	18	$6\frac{1}{2}$	
					19	
			378	12	$3\frac{1}{2}$	4
10 po.	$\frac{1}{2}$	20 po.	9	19	$3\frac{1}{4}$	2
			4	19	$7\frac{5}{8}$	5
		Ans. £	393	11	$2\frac{3}{8}$	$\frac{1}{8}$

Note the convenient method of adding the fractions. The denominator (8) is first written in the answer, and only the numerators in the body of the sum.

EXERCISE X.

1. Find the cost of 525 feet 7 inches of cloth, at 7s. 6d. per foot.

2. What is the price of 123 acres 2 roods 20 poles, at £102 13s. 6d. per acre?

3. Find the value of 1 lb. 2 ozs. 8 dwt. 20 grs., at £3 17s. 6d. per oz.

4. What is the cost of 7 tubs of butter, each weighing 2 cwt. 1 qr. 13 lbs., at £9 16s. 0d. per cwt?

5. What should be paid for 15 qrs. 7 bushl. 3 pks. 3 qts., at £1 17s. 4d. per qr.?

6. What would be the cost of a road 20 miles 3 furlongs 25 poles in length, at £27 10s. 0d. per furlong?

7. Find the value of 27 cwt. 1 qr. 14 lbs., at £2 3s. 7¼d. per cwt.

8. What would 3 lbs. 5 dwts. 18 grs. cost, at £3 11s. 8d. per oz.?

9. Find the value of 12 acres 3 roods 25 poles, at £103 13s. 11d. per acre.

10. What would 54 cubic feet 1,152 cubic inches cost, at 4s. 7½d. per cubic foot?

11. What is the cost of 29 yards 3 quarters 3 nails 2 inches, at 9s. 6d. per yard.

12. Find the value of 79 cwt. 3 qrs. 21 lbs. at £7 15s. 10½d. per cwt.

13. What would a man receive for 25 weeks 3 days at £1 2s. 6d. per week.

14. At 2s. 6½d. per hour, find what a workman earns in four days eight hours twenty-five minutes. (NOTE—The working day = 10 hours).

15. Find by practice the cost of carpet ¾ yard wide at 3s. 11½d. per yard, to cover a room 18 feet 6 inches by 12 feet 3 inches.

16. What would be the amount paid by a bankrupt on £2,051 12s. 6d. if the assets amount to 14s. 7½d. in the £?

17. Find (by practice) what it would cost to paint a room 17 feet 6 inches long, 15 feet 4 inches wide, and 9 feet 3 inches high, at 2s. 10½d. per square yard.

18. The rent of a house is £7 17s. 6d. per week; it was occupied for 218 days, what should be paid?

19. A man's income is £305 12s. 6d. annually. He pays 5d. in the £ income tax and 11s. 6½d. in the £ for other expenses; find his expenditure and his net saving.

20. What would a log of timber cost at 9½d. per solid foot which measured 23 feet 9 inches in length, 2 feet 4 inches in depth, and 2 feet in width.

SIMPLE PROPORTION.

Exercises in Simple Proportion may be worked by the method of unity or by statement. The subject has been already fully treated of in the 2nd class "Guide," but a few examples are here inserted to illustrate the method which will be generally followed in subsequent pages.

EXAMPLE 1. If the cost of 324 rations be £9 2s. 3d., what would 117 cost at the same rate?

Rations.

Wanted—Cost of 117 = x.

Given— ,, ,, 324 = £9 2s. 3d.

324 rations : 117 rations :: £9 2s. 3d.

$$= £\frac{117 \times 9\frac{9}{80}}{324} = £\frac{117 \times 729}{324 \times 80}$$

$$= £\frac{1053}{320} = £3\ 5s.\ 9\tfrac{3}{4}d.\ \textit{Ans.}$$

EXAMPLE 2. If the 4d. loaf weigh 5 lbs. when wheat is 22s. a bushel, what ought it to weigh when wheat has risen to 38s. 6d. a bushel.

Wanted—Weight of loaf when wheat is $38\frac{1}{2}$s. = x.

Given— ,, ,, ,, 22s. = 5 lbs.

$38\frac{1}{2}$ sh. : 22 sh. :: 5 lbs.

$$\frac{22 \times 5}{38\frac{1}{2}}\text{lbs.} = \frac{22 \times 5 \times 2}{77}\text{lbs.} = \frac{20}{7}\text{lbs.} = 2\ \frac{6}{7}\text{lbs.}\ \textit{Ans.}$$

Note that the *higher* the price of wheat the *less* weight of bread will be obtainable for the same amount of money.

EXAMPLE 3. If 36 men can do a piece of work in 56 days, but after working 16 days, 24 additional men are engaged, in how many more days will the work be completed?

In problems like the above the question should be re-arranged thus:—If 36 men can finish a work in 40 days, in how many days will 60 men finish it?

Wanted—No. of days for 60 men to complete the work = x.

Given— „ „ 36 „ „ „ = 40.

60 men : 36 men :: 40 days.

$$\frac{\overset{6}{\cancel{36}} \times 40}{\underset{1}{\cancel{60}}} \text{ days} = 24 \text{ days } \textit{Ans.}$$

THE METHOD OF UNITY.

By this method the value of *one* is found, and from that the value of the required quantity.

Example 1. If 16lbs. of tea can be purchased for £2 11s. 0d., what should be paid for a can weighing 28lbs. ?

Cost of 16lbs. = £2 11 0.

„ „ 1lb. = $£\frac{2\ 11\ 0}{16}$

„ „ 28lbs. = $£\frac{2\ 11\ 0}{16} \times 28$

$$= \frac{51 \times \overset{7}{\cancel{28}}}{\underset{4}{\cancel{16}}} \text{ sh.} = \frac{357}{4} \text{ sh.} = 89\tfrac{1}{4} \text{ sh.}$$

= £4 9 3 *Ans.*

EXERCISE XI.

1. If a servant's wages for 146 days amount to £14, what should he be paid for 365 days ?

2. If the property tax on £429 8s. 3d. be 13s. 6d., what should it be on £302 3s. 7d. ?

3. If 15 cwt. 3qrs. 16lbs. of tallow cost £45 11s. 3d., what should be the cost of 6cwt. 1qr. 12lbs. at the same rate ?

4. If a friend lends me 400 guineas for $6\frac{1}{2}$ months, how many £'s should I lend him for 3 months to balance the account ?

5. The income tax being 7d. in the pound, and I pay £10 4s. 9d., what is my income?

6. If a certain amount of work is done by 81 men in 10 days, how long would 30 men take to do the same, the rate of working being equal?

7. How long would a man take to walk 80 miles if he can do 62 miles in 3 days?

8. If a man works $7\frac{1}{2}$ hours a day for 9 days to complete a piece of work, how many hours longer per day must he work to complete the work in $4\frac{1}{2}$ days?

9. How many yards at the rate of $34\frac{1}{2}$ yards for £12 7s. $11\frac{5}{8}$d. could be bought for £3 19s. $0\frac{3}{4}$d.?

10. A man owned $\frac{4}{17}$ of a vessel, and sold $\cdot\dot{2}\dot{7}$ of $\frac{3}{9}$ of his share for £$12\frac{4}{3\,3}$; what was the value of $\frac{1\frac{1}{4}}{4\cdot25}$ of $\cdot2$ of the vessel?

11. If 18 men can perform a piece of work in 28 days, how many men would be required to do the same in $\cdot25$ of the time?

12. Find, to the nearest penny, the cost of 52 cwt. 13 lbs., when 27 cwt. 17 lbs. cost £82 7s. $2\frac{1}{2}$d.

13. What number of horses could be grazed for 112 days in the same field as 63 horses for 48 days?

14. If it take the same time to empty a cistern of 230 gallons by a pipe discharging five gallons a minute, as it does to empty another by a pipe discharging six gallons a minute, find the content of the second cistern.

15. What is the price of 56 packs of wool, each 114 stones, when £13 7s. $2\frac{3}{4}$d. is paid for 28 stones?

16. Supposing 35 men working together for 50 days could finish a piece of work, find how long would be required by the remainder to finish the work if 16 men left at the end of 12 days.

17. If an ounce of gold be worth £$4\cdot189583$, what is the value of $\cdot36822916\dot{6}$ pounds?

18. If the price of $3\frac{3}{4}$ yards of cloth be £3 16s. 6d., what should 38 yards 2 quarters 3 nails cost?

19. A garrison of 2,000 men has provisions to last 95 days, but 400 men leave, find how long the provisions will last the remainder.

20. If 3 cows or 7 horses can eat the produce of a field in 29 days, how long would it take 7 cows and 3 horses to consume the same?

COMPOUND PROPORTION.

Compound Proportion is the name given to the process by which we find the quantity which varies as *more than one* ratio to another quantity. Problems under this head really consist of two or more simple proportions, and could be solved by taking each simple proportion separately.

A convenient method of arrangement follows:—

1. Set out the problem in the following form:

   Wanted ... ... = x
   Given ... ... =

2. Write the quantity which comes under x in the 3rd term.
3. Consider each pair of terms as in a single problem and without reference to any other pair.
4. When all have been arranged, multiply the 3rd term by all the numbers in the 2nd term and divide by all the numbers in the 1st term.

Example 1. How many men can earn £26 in 10 days if 39 men can earn £54 12s. in 7 days.

		£	Days.	
Wanted,	No. of men to earn	26	in 10	= x
Given,	,, ,,	$54\frac{3}{5}$	,, 7	= 39

a) Write 39 men in the 3rd term.

: : : 39 men.

Consider each pair of quantities separately, thus—Will it require *more* or *less* men to earn £26 as compared with £$54\frac{3}{5}$? The answer is *less*; place the *less* number in the 2nd term.

Again—Will it require *more* or *less* men to earn the money in

10 days than in 7 days? The answer is *less*; place the *less* number in the 2nd term and complete thus:—

£54$\frac{3}{5}$: £26 :: 39 men.
10 days : 7 days.

$$\text{Men } \frac{\overset{1}{\cancel{2}\cancel{6}} \times \cancel{7} \times \overset{13}{\cancel{3}\cancel{9}} \times \overset{1}{\cancel{5}}}{\underset{2}{\cancel{1}\cancel{0}} \times \underset{21}{\cancel{2}\cancel{7}\cancel{3}}} = 13 \text{ men.}$$

Example 2. A contractor undertook to do a work in 40 days. He employed 375 men, working 8 hours a day. At the end of 10 days he found that only $\frac{1}{8}$ of the work was done; how many additional men must he employ if he extends the working day to 10 hours a day.

It should be noticed (*a*) that the original 375 men only do $\frac{1}{8}$ of the work in 10 days; (*b*) that there remains to be done $\frac{7}{8}$ in 30 days.

Set out as follows:—

		Work.	Days.	Hours.	
Wanted,	No. of men to do	$\frac{7}{8}$	in 30,	working 10 a day	= x
Given,	„ „	$\frac{1}{8}$	10,	8 „	= 375

$\frac{1}{8}$ work : $\frac{7}{8}$ work :: 375 men
30 days : 10 days
10 hrs. : 8 hrs.

$$\frac{\frac{7}{8} \times 10 \times 8 \times 375}{\frac{1}{8} \times 30 \times 10} \text{ men}$$

$$= \frac{\overset{1}{\cancel{7}} \times \overset{4}{\cancel{1}\cancel{0}} \times \cancel{8} \times \overset{25}{\cancel{3}\cancel{7}\cancel{5}} \times \overset{1}{\cancel{8}}}{\underset{1}{\cancel{8}} \times 1 \times \underset{15}{\cancel{3}\cancel{0}} \times \underset{1}{\cancel{1}\cancel{0}}}$$

$$= 700 \text{ men}$$

$\therefore$ 700 − 375 = Men 325 additional. *Ans.*

EXERCISE XII.

1. If 90 acres of corn be cut down by 150 men in 2 days, how many men, working equally well, will cut down 405 acres in 25 days?

2. If 15 horses be kept 14 days for £18, how many horses would be kept 10 days for £12?

3. If 400 people consume 980 lbs. of flour in 12 days, how many will consume 2,940 lbs. of flour in 2 days!

4. If 36 compositors set up 12 sheets in 4 days, how many compositors would be required to set up 105 sheets in 7 days?

5. If £250 pay the expenses of 10 people for 35 weeks 5 days, how many people would expend, at the same rate, £375 in 7 weeks 1 day?

6. If a party of seven, on a tour for four months, spent £326 13s. 4d., what would be the cost, at the same rate, to a party of five for a tour of 11 months?

7. When the carriage of 4 cwt. 3 qrs. for 140 miles is £3 16s., what weight ought to be carried 100 miles for £4 13s. 4d.?

8. If 96 men can mow 65 acres, 3 roods, 12$\frac{4}{7}$ poles in 12 days, how many men would mow 72 acres in 15 days?

9. What number of men, at half the rate of wages, must work 48 days to receive £310 10s., when 25 men receive £57 10s. in 8 days?

10. If the interest on £350 for 219 days be £3 18s. 9d., what is the rate per cent. for 365 days? (Rate per cent.—See p. 35).

11. Find the number of hours per day which 30 men would have to work for 16 days, to perform the same work that 25 men took 24 days of 8 hours each to do.

12. If 9 horses ploughed 35 acres in 20 days, find how many days it would take 6 horses to plough 21 acres.

13. If 1,000 men have provisions for 5 weeks at 16 oz. per man per day, how long would the rations last if 500 men were added to the garrison, and the allowance reduced to 6$\frac{2}{3}$ oz.?

14. If 20 men can perform a piece of work in 12 days, how many men will do 7 times as much work in one-fifth of the time?

15. If a family of 3 people can be maintained for 5 weeks for £8 15s., what number could be maintained for £31 10s. for 3 weeks 6 days?

16. If 50 horses consume £20 worth of oats at 4s. 6d. per bushel, how many would consume £72 worth at 5s. per bushel, in the same time, at the same rate of eating?

17. If 15 horses require as much corn as 24 ponies, and $7\frac{1}{2}$ quarters last 6 ponies for 8 days, how long may 25 horses be kept for £82 10s. when corn is £1 13s. per quarter?

18. Supposing it takes $13\frac{3}{4}$ days of 15 hours a day to travel 1,000 miles, how many miles would be covered in three days of 11 hours a day?

19. If when wheat is at 4s. 9d. per bushel the fourpenny loaf weighs 3·35 lbs., what should be paid for $11\frac{7}{8}$ four-pound loaves when wheat is at 13s. $4\frac{4}{5}$d. per bushel?

20. If 150,000 bricks which are 12 inches long, 6 inches broad, and 3 inches thick, are required in the construction of a cottage, how thick should the bricks be, if they were 9 inches long, 5 inches broad, and 320,000 in number?

21. If it takes 10 days for 2 women and 1 man to do a piece of work, find how long it would take 2 men and 1 woman to do 4 times as much, if a man can do half as much work more than a woman.

22. A contractor found that by employing 60 men for 54 days, he had completed only $\frac{1}{2}$ of a mile of a road $2\frac{1}{2}$ miles long, which he was under penalty to complete in 12 weeks; find how many more men he must employ to escape the penalty by completing the contract in time.

23. If 185 cu. yards of earth are thrown out in 9 hours by 20 men, find how many men would be required to do half the work in one-fifth of the time.

24. If the length of a beam weighing 11 cwt. 1 qr. 20 lbs., is 16 ft., its breadth 2 ft. 3 inches, and its thickness $\frac{2}{3}$ ft., what must be the length of another beam of the same material which weighs 2,028 lbs. and is 3 ft. 3 inches broad, and $7\frac{1}{2}$ inches thick?

SIMPLE INTEREST.

Interest is money paid for the use of money lent.

Principal is the money lent.

Time is the number of *years* for which the money is lent.

Rate per cent. is the money paid for the use of £100 for 1 year.

Amount is the Principal and Interest added.

Per Cent. is usually abbreviated thus—%.

Problems in Simple Interest are solved exactly by the same process of reasoning as questions in proportion, but as the Rate is always for £100 for 1 year the process can be stated as a rule.

Rule.—Multiply the principal by the Rate, and then by the Time, and divide by 100.

If P = Principal ; R = Rate per cent ; T = the number of *years ;* and I = Interest, the process can be expressed by the following formula :—

$$I = \frac{P \times R \times T}{100}$$

Example 1. Find the Simple Interest on £316 for $2\frac{1}{2}$ years at 4 per cent. per annum.

This solution may be shown in either of two ways.

It is generally convenient to multiply the number of years and the rate per cent. first.

$2\frac{1}{2} \times 4 = 10$

	£	s.	d.
(*a*)	316	0	0
			10
Dividing by 100	£31·60	0	0
	= 20		
	s. 12·0		

£31 12s. 0d. *Ans.*

Or, using the formula—

(*b*)

$$I = \frac{P \times R \times T}{100}$$

$$I = £\frac{316 \times 4 \times 2\frac{1}{2}}{100}$$

$$= £\frac{\overset{158}{\cancel{316}} \times \cancel{4} \times \cancel{5}}{\cancel{100} \times \cancel{2}}$$

$$\cancel{20}$$

$$5$$

$$= £\frac{158}{5} = £31\ 12s.\ 0d.\ \textit{Ans.}$$

3—2

EXAMPLE 2. Find the Simple Interest on £321 5s. 0d. for $2\frac{2}{3}$ years at $2\frac{1}{4}$ per cent.

(*a*) $2\frac{2}{3} \times 2\frac{1}{4} = \frac{\cancel{8}^{2}}{\cancel{3}_{1}} \times \frac{\cancel{9}^{3}}{\cancel{4}_{1}} = 6.$

£	s.	d.
321	5	0
		6

Dividing by 100— £19·27 10 0

20

s. 5·5$\not{0}$

12

d. 6·0

£19 5s. 6d. *Ans.*

Or, by formula—

$$I = \frac{£321\frac{1}{4} \times 2\frac{2}{3} \times 2\frac{1}{4}}{100}$$

$$= £\frac{1285 \times \cancel{8}^{2} \times \cancel{9}^{3}}{\cancel{4} \times \cancel{3} \times \cancel{4} \times 100}$$

$$= £\frac{3855}{200} = £19\ 5s.\ 6d.\ \textit{Ans.}$$

200 | 3855

2 | 38·55

£19·275

20

s. 5·500

12

d. 6·0

If the *Amount* is required the Principal is added to the Interest. Thus the *Amount* in the last example would be £321 5s. 0d. + £19 5s. 6d. = £340 10s. 6d.

EXERCISE XIII.

Find at Simple Interest:—

1. Interest on £185 0s. 0d. for 2 years at 2 per cent.
2. Interest on £240 10s. 0d. for 5 years at $2\frac{1}{2}$ per cent.
3. Amount of £520 10s. 0d. for 10 years at 3 per cent.

4. Amount of £347 16s. 8d. for 5 years at $4\frac{3}{4}$ per cent.
5. Interest on £346 10s. 2d. for 8 years at 5 per cent.
6. Interest on £2,000 0s. 0d. for $2\frac{3}{4}$ years at 3 per cent
7. Amount of £525 17s. 6d. for $6\frac{1}{2}$ years at $1\frac{1}{2}$ per cent.
8. Amount of £150 0s 0d. for $3\frac{5}{12}$ years at 4 per cent.
9. Interest on £27 4s. 6d. for $2\frac{1}{3}$ years at $2\frac{1}{4}$ per cent.
10. Amount of £3,256 17s. 5d. for 6 years at $3\frac{7}{8}$ per cent.
11. Interest on £247 19s. $1\frac{1}{2}$d. for $2\frac{1}{2}$ years at $5\frac{1}{3}$ per cent.
12. Amount of £1,008 11s. $9\frac{3}{4}$d. for $5\frac{2}{7}$ years at $7\frac{5}{8}$ per cent.

When the time is a compound quantity involving months or days, the months or days should be expressed as a *fraction of a year*.

Example 1. Find the *amount* of £362 10s. for 1 year 4 months at $2\frac{1}{4}$ per cent. per annum.

1 year 4 months $= 1\frac{1}{3}$ years.

$$\text{I} = £\frac{362\frac{1}{2} \times 1\frac{1}{3} \times 2\frac{1}{4}}{100}$$

$$= £\frac{\overset{29}{\cancel{725}} \times \overset{1}{\cancel{4}} \times \overset{3}{\cancel{9}}}{\underset{1}{2} \times \underset{1}{\cancel{3}} \times \underset{1}{\cancel{4}} \times \underset{4}{\cancel{100}}}$$

$$= £\frac{87}{8} = £10\ 17\text{s. } 6\text{d.}$$

Amount = £362 10s. 0d. + £10 17s. 6d.

= £373 7s. 6d. *Ans.*

Example 2. Find the S. Interest on £375 for 146 days at $2\frac{1}{2}$ per cent. per annum.

$$146 \text{ days} = \frac{146}{365} \text{ yr.} = \tfrac{2}{5} \text{ yr.}$$

$$\text{I} = £\frac{375 \times \frac{2}{5} \times 2\frac{1}{2}}{100}$$

$$= £\frac{\overset{15}{\cancel{375}} \times \overset{1}{\cancel{2}} \times \overset{1}{\cancel{5}}}{\underset{1}{\cancel{5}} \times \underset{1}{\cancel{2}} \times \underset{4}{\cancel{100}}}$$

$= £3\ 15\text{s. } 0\text{d.}$ *Ans.*

EXERCISE XIV.

Find at Simple Interest :—

1. Amount of £420 10s. 0d. for 3 years 6 months at 5 per cent.
2. Interest on £218 17s. 6d. for 2 years 3 months at 2 per cent.
3. Amount of £1,111 12s. 6d. for 5 years 4 months at $3\frac{1}{2}$ per cent.
4. Interest on £2,025 7s. 9d. for 3 years 8 months at 5 per cent.
5. Amount of £2,471 11s. $3\frac{1}{2}$d. for 5 years 2 months at $3\frac{1}{4}$ per cent.
6. Interest on £504 2s. $7\frac{1}{4}$d. for 2 years 7 months at 4 per cent.
7. Amount of £1,114 1s. 9d. for 4 years 1 month at $2\frac{3}{4}$ per cent.
8. Amount of £417 16s. $2\frac{3}{4}$d. for 11 months at $\frac{7}{8}$ per cent.
9. Interest on £200 10s. 6d. for 5 months at $\frac{1}{3}$ per cent.

To calculate interest for any number of days.

When *dates* are given care must be taken *not to include the first day*. In the following example a method of calculating the number of days is shown.

Example 1. Find the S. Interest on £657 from 13th October 1895, to 11th March, 1896, at $3\frac{3}{4}$ per cent. per annum.

Note that February, 1896, has 29 days.

	days.
October	= 18
Nov.	= 30
Dec.	= 31
Jan.	= 31
Feb.	= 29
March	= 11
	150

$$\frac{150}{365} \text{ yr.} = \frac{30}{73} \text{ yr.}$$

$$\text{I} = £\frac{657 \times \frac{30}{73} \times 3\frac{3}{4}}{100}$$

$$= £\frac{\overset{9}{\cancel{657}} \times \cancel{30} \times \overset{3}{\cancel{15}}}{\underset{1}{\cancel{73}} \times 4 \times \underset{2}{\cancel{100}}}$$

$$= £\frac{81}{8}$$

$$= £10\ 2s.\ 6d.$$

EXERCISE XV.

Find at Simple Interest:—

1. Interest on £425 0s. 0d. for 330 days at 4 per cent.

2. Amount of £3,741 10s. 0d. for 212 days, at $4\frac{3}{4}$ per cent.

3. Interest on £2,141 12s. 1d. for 180 days, at $1\frac{1}{8}$ per cent.

4. Amount of £100 8s. 4d. for 311 days, at $2\frac{5}{6}$ per cent.

5. Interest on £200, from 1st July to 18th October, at $1\frac{11}{12}$ per cent.

6. Amount of £525, from 8th February to 11th December, 1880, at $2\frac{3}{4}$ per cent.

7. Interest on £205 10s. 6d., from 15th March to 31st December, at 5 per cent.

8. Interest on £1,271 18s. 10d., from 8th June to 17th July, at $4\frac{1}{2}$ per cent.

COMPOUND INTEREST.

In Compound Interest the interest is *added* to the principal at stated intervals, generally yearly.

The Simple Interest for one year is obtained by multiplying by the rate per cent. and then *dividing by 100*. Division by 100 is performed by moving the decimal point *two places to the left*, but in actual practice it will be found more convenient to move the *number itself* two places *to the right*. The following example shows a convenient form of solution. It must be noticed that the result obtained in the first instance is the *Amount*. To obtain the *Compound Interest* the principal must be subtracted from this *Amount*.

Example 1. Find the Compound Interest on £325 for 2 years at 5 per cent. per annum.

£325 = 1st Principal.
5 % is $\frac{5}{100}$ of £325 = 1st Principal.
16·25 = 1st Interest.
5 % is $\frac{5}{100}$ of 341·25 = 2nd P.
17·0625 = 2nd I.
358·3125 = Amount.
Subtract 325· = 1st P.
£ 33 3125 = Compound Int.
20
s. 6·2500
12
d. 3·00

Compound Int. = £33 6s. 3d. *Ans.*

If there be a fraction in the rate take *aliquot parts* for the same.

Decimals beyond the 4th place may be neglected when the interest is to be found *to the nearest penny.*

In the following example first multiply by three, moving the 1st figure *two places to the right* (to divide by 100), then because $\frac{3}{4}$ is $\frac{1}{4}$ of 3, take $\frac{1}{4}$ of the line so obtained.

Example 2. Find the C. Int. on £275 5s. 0d. for 2 years at $3\frac{3}{4}$ % per annum. Note—£275 5s. 0d. = £275·25.

£275·25.

£
3% is $\frac{3}{100}$ of 275.25 = 1st P.
$\frac{3}{4}$% is $\frac{1}{4}$ of 3% 8·2575 = Int. @ 3%
2·0643 = Int. @ $\frac{3}{4}$%
3% is $\frac{3}{100}$ of 285·5718 = 2nd P.
$\frac{3}{4}$% is $\frac{1}{4}$ of 3% 8·5671 = Int. @ 3%
2·1417 = Int. @ $\frac{3}{4}$%
296·2806 = Amount
275·25 = 1st P.
£ 21·0306 = C. Int.
20
s. 0·6120
12
d. 7·344

C. Int. = £21 0s. 7d. (nearly) *Ans.*

When the interest is to be added at intervals other than a year, the rate per cent. is divided by the number of such intervals *in a year*.

EXAMPLE 3. Find to the nearest penny the Amount of £365 10s. 0d. for $1\frac{1}{2}$ years at 4% per annum, payable half-yearly.

Note: $\frac{1}{2}$ of 4% = 2%; £365 10s. 0d. = £365·5

	£	
2% is $\frac{2}{100}$ of	365·5	= 1st Principal
	7·310	= Int. for 1st $\frac{1}{2}$-yr.
2% is $\frac{2}{100}$ of	372·81	= 2nd P.
	7·4562	= Int. for 2nd $\frac{1}{2}$-yr.
2% is $\frac{2}{100}$ of	380·2662	= 3rd P.
	7·6053	= Int. for 3rd $\frac{1}{2}$-yr.
	£387·8715	= Amount
	20	
s.	17·4300	
	12	
d.	5·16	

Amt. = £387 17s. 5d. *Ans.*

EXERCISE XVI.

1. Find the Compound Interest on £200 for 2 years at 3 per cent.

2. Find the amount of £350 for 2 years at 5 per cent. Compound Interest.

3. Find the amount of £2,000 in 2 years at 4 per cent. Compound Interest.

4. Find the difference between the Simple and Compound Interest on £500 for 2 years at $2\frac{1}{2}$ per cent.

5. Find the Compound Interest on £675 for 2 years at $3\frac{3}{4}$ per cent.

6. What would be the difference between the Simple Interest on £200 for 3 years at 3 per cent., and the Compound Interest on £250 for 3 years at $2\frac{1}{2}$ per cent.?

Inverse questions in Interest can be solved by Proportion, but when the Interest can be found the following formulæ may be applied :—

$$(a) \qquad P = \frac{100 \times I}{R \times T}$$

$$(b) \qquad R = \frac{100 \times I}{P \times T}$$

$$(c) \qquad T = \frac{100 \times I}{P \times R}$$

Note that the numerator of the fraction is *always* 100 × I.

Example 1. What principal will produce £19 12s. 0d. in $2\frac{2}{3}$ years at $2\frac{1}{2}$ per cent. per annum Simple Interest?

Applying formula (*a*)

$$P = £\frac{100 \times 19\frac{3}{5}}{2\frac{2}{3} \times 2\frac{1}{2}}$$

$$= £\frac{\overset{1}{\cancel{100}} \times 98 \times 3 \times \overset{1}{\cancel{2}}}{\underset{1}{\cancel{3}} \times \underset{1}{\cancel{8}} \times \underset{1}{\cancel{5}}}$$

$$= £294 \text{ } \textit{Ans.}$$

When the Amount is given from which to find the Principal, the amount of £100 for the given rate and time must be found and the principles of proportion applied.

EXAMPLE 2. What principal will amount to £605 12s. 7d. in 73 days at $7\frac{1}{3}\%$ per annum?

Interest on £100 for $\frac{1}{5}$yr. @ $7\frac{1}{3}\%$ $= £\frac{100 \times 1 \times 22}{5 \times 3 \times 100}$

$= £\frac{22}{15} = £1\frac{7}{15}$

$\therefore$ *Amount* of £100 for the given rate and time $= £101\frac{7}{15}$

Applying the rule of proportion.

Wanted—P. to amount to $£605\frac{151}{240} = x$.

Given— " " $£101\frac{7}{15} = 100$

$£101\frac{7}{15} : 605\frac{151}{240}£ :: 100£$

$$£\frac{605\frac{151}{240} \times 100}{101\frac{7}{15}}$$

$$= £\frac{\frac{145351}{240} \times \frac{100}{16} \times \frac{15}{2}}{\frac{191}{4} \times \frac{25}{1522} \times \frac{1}{2}}$$

$= £\frac{4775}{8}$

$= £596$ 17s. 6d. *Ans.*

EXERCISE XVII.

1. What sum will amount to £2,857 10s. 0d. in $12\frac{1}{4}$ years at $3\frac{1}{2}$ per cent.?

2. At what rate will the interest on £325 10s. 0d. for 4 years amount to £71 12s. $2\frac{2}{5}$d.?

3. How many years must £500 13s. 4d. be lent at $2\frac{3}{4}$ per cent. before it would amount to £538 10s. $7\frac{1}{10}$d.?

4. What sum must be put to interest for 2 years at 3 per cent. to amount to £898 14s. $0\frac{4}{5}$d.?

5. For how many months must £1,000 lie at interest at 5 per cent. to increase to £1,064 11s. 8d.?

6. At what rate will the interest on £236 6s. 8d. in $2\frac{1}{2}$ years be £17 14s. 6d.?

7. In what time will £936 13s. 4d. amount to £1,157 7s. $4\frac{1}{2}$d. at $4\frac{5}{6}$ per cent.?

8. At what rate will £157 15s. 4d. amount to £295 16s. 3d. in 25 years?

9. What principal will produce £121 15s. 5d. in $2\frac{1}{12}$ years at $2\frac{4}{5}$ per cent.?

10. At what rate per cent. will £125 double itself in 20 years?

11. Find the principal which would amount to £56 10s. $10\frac{1}{5}$d. in 2 years 73 days at $3\frac{1}{2}$ per cent.

12. How long must £270 13s. 4d. lie at interest at $1\frac{1}{2}$ per cent. to gain £9 9s. $5\frac{3}{5}$d.?

PERCENTAGES.

Besides Interest, Insurance, Commission, Brokerage, and Profit and Loss, which are discussed under their respective headings, there are other questions in which the term PER CENT. occurs.

They will best be understood from the following solutions:—

EXAMPLE 1. In a force of 2,500 men, 7 per cent. are in hospital, 18 per cent. are on duty, and the remainder in quarters. What are the numbers in hospital, on duty, and in quarters respectively?

(*a*) Since 7 per cent. $= \frac{7}{100}$

$\therefore$ No in Hospital $= \frac{7}{100}$ of $2500 = \underline{175}$ *Ans.*

And No. on Duty $= \frac{18}{100}$ of $2500 = \underline{450}$ *Ans.*

And No. in Quarters $= 2500 - (450 + 175)$

$= 2500 - 625 = \underline{1875}$ *Ans.*

EXAMPLE 2. A cask which contains $11\frac{3}{7}$ gallons, leaked $3\frac{3}{4}$ per cent. How much remained in the cask?

(1) If $3\frac{3}{4}$ gallons leak from 100 gallons, then $96\frac{1}{4}$ gallons remain.

And if the remainder of 100 gallons $= 96\frac{1}{4}$ gallons.

Then " " 1 gallon $= \frac{96\frac{1}{4}}{100}$ gallons.

And " " $11\frac{3}{7}$ gallons $= \frac{96\frac{1}{4} \times 11\frac{3}{7}}{100}$ gallons.

$$= \frac{\overset{11}{\cancel{77}}}{\underset{1}{\cancel{4}}} \times \frac{\overset{1}{\cancel{20}}}{\underset{1}{7}} \times \frac{1}{\underset{5}{\cancel{100}}} = 11 \text{ gallons } \textit{Ans.}$$

Or, applying the principle of proportion—

Wanted. Remainder from $11\frac{3}{7}$ galls. = x.

Given. " " 100 " $= 96\frac{1}{4}$.

$100 : 11\frac{3}{7} :: 96\frac{1}{4}$ galls.

Galls. $\frac{80}{7} \times \frac{385}{4} \times \frac{1}{100} = 11$ galls. *Ans.*

EXAMPLE 3. If 25 per cent. of an army be lost by sickness, and 10 per cent. of the remainder be killed in action, and the remaining effective force be 67,500 men, what was the original strength of the army?

(*a*) $25\ \% = \frac{25}{100} = \frac{1}{4}$ sick.

$\therefore \frac{3}{4}$ of army went into action.

(*b*) 10 % or $\frac{1}{10}$ of $\frac{3}{4}$ were killed.

$\therefore \frac{9}{10}$ of $\frac{3}{4} = \frac{27}{40}$ came out of action.

$\frac{27}{40}$ of army = 67,500 men (by Qn.).

$\frac{1}{40}$ " $= \frac{67,500}{27} = 2,500$ men.

$\frac{40}{40}$ " $= 2500 \times 40$

$= 100,000$ men. *Ans.*

EXAMPLE 4. If, when the duty on spirits is raised from 4s. 3d. to 5s. per gallon, the increase in the revenue is only 5 per cent., what is the decrease in the consumption?

Since 4s. 3d. is the original cost it represents 100 %. First find what percentage is represented by 5s.

Wanted. Percentage represented by 5s. 0d. = x.
Given. " " 4s. 3d. = 100.

$4\frac{1}{4} : 5 :: 100\%$.

$$\frac{5 \times 100 \times 4}{17} = \frac{2000}{17} = \underline{117\frac{11}{17}\ \%}.$$

∴ The new revenue ought to show a *gain* of $17\frac{11}{17}$ %, but it only shows a *gain* of 5 %, *i.e.*, is 105 % ∴

Wanted. Part represented by 105 % = x.
Given. " " $117\frac{11}{17}$ % = 100.

$117\frac{11}{17} : 105 :: 100\ \%$.

$$\frac{\cancel{105} \times \cancel{100} \times 17}{\cancel{2000}\ {}^{21}_{4}} = \frac{357}{4} = 89\frac{1}{4}\ \%.$$

∴ Decrease = $100 - 89\frac{1}{4} = \underline{10\frac{3}{4}\ \%}$. *Ans.*

EXERCISE XVIII.

1. If, when the duty on currants is lowered from 6d. to $4\frac{1}{2}$d. per stone, the increase in the revenue is 40 per cent., what is the increase per cent. in the consumption?

2. In a battalion 960 strong, 15 per cent are in the hospital, 10 per cent. are on guard, and the rest in barracks. How many are in hospital, on guard, and in barracks, respectively?

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

4. If a town which contained a population of 60,584 in 1881, had increased by $12\frac{1}{2}$ per cent. in 1891, what was its population in the latter year?

5. At an election 3,795 persons voted, and the successful candidate received 50 per cent. more votes than his opponent. How many voted for each?

6. The population of a city at the end of a year is 298,467, having increased in the year by 17 per cent. of its amount at the beginning of the year. What would the population have been at the end of the year, if the increase had been 16 per cent?

7. The population of a city is 132,651; it has risen 2 per cent. a year for 3 years successively. What was the population 3 years ago?

8. Of the inhabitants of a district devastated by war 45 per cent. were slain, $\frac{3}{11}$ of the remainder perished in flight, and 300 alone remained. What was the population of the district?

9. A marksman in firing 260 rounds, makes 195 bulls. What is the percentage of bulls to the rounds fired?

10. If 15 per cent. of an army be lost by sickness, and 6 per cent. of the remainder be killed in action, and the remaining effective force be 79,900 men, what was the original strength of the force?

11. If $\frac{2}{9}$ of a hogshead of porter (54 gallons) be drawn off and then replaced with water; and then $\frac{2}{7}$ of that mixture be taken out and replaced with water again; what percentage of the cask is now porter?

12. If when the duty on sugar is raised from 2d. to $2\frac{1}{2}$d. per lb., the increase in the revenue is only $12\frac{1}{2}$ per cent., what is the decrease per cent. in the consumption?

INSURANCE, COMMISSION, AND BROKERAGE.

These are calculated at so much per cent. The money paid to effect an insurance is called the premium.

In ordinary examples the amount of premium paid is found by multiplying the rate per cent. by the number of hundreds for which the goods are insured; but sometimes the insurer wishes to effect an insurance in such a manner that in case of loss he would recover both the value of the goods and the premium. An example of this kind is here shown:—

Example 1. For what amount must goods, worth £741, be insured at $2\frac{1}{2}$ per cent., so that in case of loss the value of the goods and the premium may be recovered?

In this case every £100 insured for must include the rate, viz. $2\frac{1}{2}$, ∴ the value of the *goods* insured for each £100 will be £100 − £$2\frac{1}{2}$ = £$97\frac{1}{2}$.

Wanted. Amount for which to insure £741 of goods = x.
Given. „ „ „ $97\frac{1}{2}$ „ = 100.

£$97\frac{1}{2}$ of goods : £741 of goods :: £100.

$$£\frac{\overset{20}{\cancel{100}} \times \overset{19}{\cancel{741}} \times 2}{\underset{39}{\cancel{195}}} = \underline{£760.} \quad \textit{Ans.}$$

EXERCISE XIX.

1. What would be the brokerage on £1,565 at $\frac{1}{2}$ per cent.?
2. What would be the ready money payment of an account of £326, discount being allowed at $2\frac{1}{2}$ per cent.?
3. Find the premium on a policy on the life of a person 42 years of age for £325, at £3 2s. 6d. per cent.?
4. What would the commission on £556 13s. 4d. amount to at $1\frac{3}{8}$ per cent.?
5. What would be the insurance on a vessel and cargo worth £7,275 at $3\frac{2}{3}$ per cent.?
6. For what should goods worth £4,999 18s. 3d. be insured at $3\frac{2}{3}$ per cent., so that in case of loss, both the value of the goods and the premium would be recovered?
7. Find to the nearest penny, the cash payment of an account for £73 16s. 10d., discount being allowed at $2\frac{3}{4}$ per cent.
8. What would be the premium on a policy of assurance on a life, age 25, for £525 at £2 3s. 3d. per cent.?
9. For what amount should a house and furniture worth £1,682 0s. $0\frac{1}{2}$d. be insured at $\frac{3}{8}$ per cent., so as to recover their value together with the premium?
10. What would be the net receipt (to the nearest penny), after deducting $2\frac{1}{2}$ per cent. discount and $\frac{1}{8}$ per cent. commission, of an account amounting to £312 16s. 8d.?
11. What would be the brokerage on £250 16s. 8d. at 3s. 4d. per cent.?
12. For how much should goods worth £855 10s. 6d. be insured at £4 7s. 6d. per cent., so as to recover the value of the goods and the premium on the policy?

AVERAGES.

An *average* is the mean (or middle) value of any number of quantities.

RULE. Divide the *total* of the quantities by the *number* of them.

EXAMPLE 1. Find the average of 16, 12, 18, 0, 15, 12.

Sum = 16 + 12 + 18 + 0 + 15 + 12 = 73.

Number of quantities = 6.

$$\text{Average} = \frac{73}{6} = \underline{12\ 16}. \quad \textit{Ans.}$$

NOTE.—An average is usually carried to two places of decimals.

When *groups* of quantities are involved, the *sum of the totals* of each group is divided by the *sum of the units* composing each group.

EXAMPLE 2. Find the average amount per individual when 6 men receive 2s. 6d. each, 7 women receive 1s. 6d. each, and 12 children 1s. each.

		Total. s.	d.
6 men @ 2s. 6d. ...	=	15	0
7 women @ 1s. 6d....	=	10	6
12 children @ 1s. ...	=	12	0
25 individuals receive a total of		37	7

$$\text{Each individual receives} = \frac{37\text{s. } 6\text{d.}}{25} = \underline{1\text{s. } 6\text{d. Average.}} \quad \textit{Ans.}$$

EXAMPLE 3. The mean temperature on Monday, Tuesday and Wednesday was 65°, on Tuesday, Wednesday and Thursday the mean was 64°; the temperature on Thursday was 62°; what was the temperature on Monday.

SOLUTION—

Total degrees on Tuesday, Wednesday and Thursday ... ... = 64° × 3 = 192°

Total degrees on Thursday *alone* ... = 64°

(*a*) ∴ Degrees on Tuesday and Wednesday = 128°

(*b*) But *total* degrees on Monday, Tuesday and Wednesday ... ... = 65° × 3 = 195°

Subtract (*a*) from (*b*) and the result 67° is the temperature for Monday. *Ans.*

EXERCISE XX.

(1) Find the average of 1903, 676, 274, 0, 1236, 245, 839.

(2) Find the average of $35\frac{1}{2}$, $16\frac{3}{4}$, $13\frac{5}{8}$, 0, $14\frac{1}{3}$, $70\frac{3}{8}$, $38\frac{1}{4}$, 27.

(3) Find the average of $22\frac{2}{3}$, 11, $7\frac{1}{8}$, 1114, $2\frac{3}{4}$, 0, $22\frac{7}{20}$, $14\frac{1}{2}$.

(4) The average of 21 results is 61, that of the first 8 being 64, and of the next eleven 59. Required the average of the last two.

(5) What is the middle term of 11 quantities whose average is 35, supposing that the average of the first five is 41, and of the last five 27?

(6) Find the mean temperature of the following observations:—
41°29′, 41°27½′, 39°13′, 41°33′, 37°47½′ 44°28′, and 40°13′.
(N.B.—41°29′ means 41 degrees 29 minutes. 1° = 60′).

(7) The population of five parishes is 1,236, 452, 364, 516, and 3,430 respectively; a sixth parish brings up the average population to 1256·5. What is its population?

(8) The average daily number of men passing a house for a week was 1,669, and the daily average on Tuesday, Wednesday, and Thursday was 1,549; find the daily average for the other four days.

(9) In a cricket match, where there were 11 players on each side, the following was the score on one side:—A, 42 runs; B, 6; C, 0; D, 47; E, 5; F, 112; G, 4; H, 0; I, 22; K, 29; L, 19; wides, 4; byes, 7. What must be the average score on the other side to win the match by 87 runs, including 4 wides and 6 byes?

(10) The specific gravities of fresh water and sea water are respectively 1 and 1·0263; find the specific gravity of a mixture of 40 gallons of fresh and 65 gallons of sea water.

(11) In 1841, three towns had respectively 21,336, 42,324, and 6,706 inhabitants; in 1851, the first had increased 12%, and the second 10%, and the last had decreased 18%. Find the average population in 1851.

(12) £1 per ton being the average price of coals during nine months exclusive of summer months, when the average price is only 18s. per ton, what is the average price during two months of mid-winter, that of the other 10 months being 19s. 3d. per ton?

(13) A clerk's average salary per quarter is £72 12s. 6d.

During the first quarter he is paid £66 1s. 8d. ; during the second, £81 3s. 4d. ; and during the third, £70 13s. 4d. What was the amount of his fourth quarter's salary ?

(14) A merchant bought wines at 30s., 40s., and 50s. per dozen. These he mixed in the proportion of 5, 4, and 3, and sold the mixture at 57s. 6d. per dozen. What was his gain per cent. ?

(15) If 3 quarts of stout at 9d. per quart are mixed with 10 pints of ale at $2\frac{1}{2}$d. per pint, what is the worth of a pint of the mixture ?

(16) Find the average daily takings of a canteen from the 1st to the 16th of a month, when the daily takings have been : £24 3s. 2d., £14 18s. 9d., £13 4s. 0d., £16 19s. 8d., £23 17s. 6d., £18 17s. 1d., £28 17s. 5d., £29 13s. 3d., £24 18s. 9d., £18 19s. 3d., £25 16s. 3d., £9 19s. 11d., £16 4s. 6d., £21 5s. 9d., £18 17s. 8d., £16 16s. 5d.

(17) Find the average of $21\frac{14}{25}$, $37\frac{1}{2}$, $17\frac{1}{4}$, ·2523, $11\frac{1}{8}$, $10\frac{1}{4}$, $153\frac{1}{2}$, 6·07, 0, and $4\frac{9}{20}$. Express the fractional part decimally.

(18) Find the average of 13, $21\frac{3}{4}$, ·0023, 0, $103\frac{1}{8}$, $6\frac{7}{20}$, $7\frac{12}{25}$, and $57\frac{1}{2}$. Express the fractional part decimally.

PROFIT AND LOSS.

Questions in profit and loss are best solved by means of proportion. It should be clearly understood that the gain or loss is always calculated on the *cost price*, which is assumed to be 100 per cent. In the following solutions the *total* representative per centage is first found, then the gain or loss per cent. is obtained by finding the difference between the representative per centage and 100.

Example 1. Goods bought for 3s. 6d. are sold for 4s. Find gain or loss per cent.

Wanted. Per centage represented by 4/- = x.
Given. ,, ,, 3/6 = 100.

$$3/6 : 4/- :: 100\ \%$$

$$\text{Per centage} = \frac{100 \times 4}{3\frac{1}{2}} = \frac{100 \times 4 \times 2}{7}$$

$$= \frac{800}{7} = 114\frac{2}{7}$$

$$\therefore \text{Gain } \% = 114\tfrac{2}{7} - 100 = 14\tfrac{2}{7} \text{ Ans.}$$

EXAMPLE 2. I bought goods for 6/- and sold for 5/6. Find loss per cent.

Wanted. Per centage represented by 5/6 = x.
Given. ,, ,, ,, 6/- = 100.

6/- : 5/6 :: 100 %.

$$\text{Per centage} \quad \frac{100 \times 5\frac{1}{2}}{6} = \frac{100 \times 11}{2 \times 6} = \frac{1100}{12}$$

$$= 91\tfrac{2}{3}$$

$$\therefore \text{Loss } \% = 100 - 91\tfrac{2}{3} = \underline{8\tfrac{1}{3}} \; Ans.$$

EXAMPLE 3. A jeweller buys a watch for £4 10s., at what price must he sell it to gain 15%.

Wanted. Price at 115 % = x.
Given. ,, 100 % = $4\frac{1}{2}$ £.

100 % : 115 % : : $4\frac{1}{2}$ £.

$$\text{Selling Price} = £\,\frac{115 \times 4\frac{1}{2}}{100} = £\,\frac{\overset{23}{\cancel{115}} \times 9}{\underset{20}{\cancel{100}} \times 2}$$

$$= £\tfrac{207}{40} = \underline{£5\ 3s.\ 6d.} \; Ans.$$

EXAMPLE 3. By selling sugar for 3d. per lb., a profit of 20 % is made. What is the cost price?

Wanted. Price at 100 % = x.
Given ,, 120 % = 3d.

120 % 100 % :: 3d.

$$\text{C.P.} = \text{d.}\,\frac{\cancel{100} \times \overset{1}{\cancel{3}}}{\underset{4}{\cancel{120}}} = 2\tfrac{1}{2}\text{d. per lb. } Ans.$$

EXAMPLE 4. A merchant sells wine at 13s. 6d. per gallon, and thus realises a profit of 26 %. What would be his gain % if he raised the price to 15s. a gallon.

Wanted. Percentage represented by 15s. = x.
Given. ,, ,, 13s. 6d. = 126.

$$13/6 : 15 :: 126\ \%.$$

$$\text{Per centage} = \frac{15 \times 126}{13\frac{1}{2}}$$

$$= \frac{\overset{5}{\cancel{15}} \times 2 \times \overset{14}{\cancel{126}}}{\underset{3}{\cancel{27}}}$$

$$= 140\ \%$$

$$\therefore \text{Gain } \% = 140 - 100 = 40\ \%.$$

For concise formulæ for working questions of this kind the candidate is referred to "Military Examination Arithmetic," Part I., published by Gale & Polden, Limited, a work which is of very great value to candidates working for 1st Class Certificates of Education.

EXERCISE XXI.

1. How should coffee which cost 1s. per lb. be sold, so as to gain $12\frac{1}{2}$ per cent.?

2. If butter be bought at 10d. per lb., and sold at 1s. 2d. per lb., what is the gain per cent.?

3. If by selling cloth at 5s. $2\frac{1}{4}$d. per yard, a merchant loses 17 per cent., what is the prime cost?

4. If sugar be bought at £1 17s. 4d. per cwt., and sold at $4\frac{1}{2}$d. per lb. what will be the gain or loss per cent.?

5. 2 tons 5 cwt. of coals were sold for £2 16s. 3d., gaining $7\frac{1}{2}$ per cent., find the prime cost per ton?

6. How must cheese be sold per lb., which is bought at £3 14s. 8d. per cwt., so as to gain $12\frac{1}{2}$ per cent.?

7. What is the prime cost per yard of silk, if by selling $87\frac{1}{2}$ yards for £21 17s. 6d., a loss of $2\frac{1}{2}$ per cent. is incurred?

8. A grocer mixes sugars at $2\frac{3}{4}$d., $3\frac{1}{4}$d. and $2\frac{1}{3}$d. per lb. respectively in equal quantities, and sells the mixture at 3d. per. lb., what is his gain or loss per cent. ? and how much will it be on 8 cwt. 1 qr. 12 lbs.

9. If $3\frac{1}{3}$ per cent. be gained by selling tea at 2s. 7d. per lb., what per cent. will be lost by selling it at 2s. $5\frac{1}{2}$d. per lb. ?

10. If a grocer gain $\frac{1}{2}$d. per lb. on sugar which costs him £1 1s. $9\frac{3}{4}$d. per cwt., find his gain per cent.

11. By selling a book for 8s. 9d., a profit of 25 per cent. was made upon the expense of sale (which was 5 per cent. of the prime cost) and the cost price of the book. Find the cost price.

12. A wine merchant bought a cask of wine containing 40 gallons, at 15s. per gallon, he kept it for 5 years, at the end of which time he found he had lost 8 gallons by leakage, at how much per gallon must he sell the remainder so as to gain 10 per cent. on the buying price, together with 5 per cent. on his outlay during the five years his cash lay idle ?

13. A milkman started on his rounds with 12 gallons of pure milk costing 3d. per quart. He sold 4 gallons pure at 2d. per per pint, then mixed 2 gallons of water with the remainder, selling the mixture at $1\frac{1}{2}$d. per pint. He had sold 7 gallons of this mixture when the remainder was seized. Find his whole gain or loss, and the percentage, and what the percentage would have been had none been seized.

14. A horse dealer purchased a horse for £162 0s. 0d. giving a bill at 3 months, he sold the animal immediately for 160 guineas and took up the bill ; find his gain per cent., reckoning the discount on the bill at 5 per cent.

15. By selling paper at 6d. a quire, a stationer cleared $\frac{1}{3}$ of the cost price, what percentage would he gain or lose by reducing the price to 5d. per quire ?

16. If apples cost $2\frac{1}{4}$d. per dozen how should they be sold per score to gain 15 per cent. ?

17. If buttons be bought by the score and sold for the same price by the dozen, find the gain per cent. ?

18. How should quills be sold per dozen to clear 45 per cent., if 20 per cent. be cleared by selling them at 25 for half-a-crown ?

PROPORTIONAL PARTS.

To divide a quantity into proportional parts is to divide it into such parts as will have a given ratio to each other. For instance, if £20 is to be divided into parts having the ratio of 2 : 3, it is clear that for every £2 in the first part there must be £3 in the second, or £4 to £6, or £8 to £12. A convenient method of working such examples is here shown.

EXAMPLE 1.—Divide 312 in the ratio of 3 : 5.

First write down the ratio	$= 3 : 5$
Find the *sum* of the ratios	$= 8$
Amount to be divided	$= 312$
Divide by the sum of the ratios which will produce the *unit* of division	$= \frac{312}{8} = 39$
Multiply the unit by each ratio for the *answer*	$3 \times 39 = 117$ $5 \times 39 = 195$ } *Ans.*

The work would thus appear—

Ratio	$= 3 : 5$
Sum of ratios	$= 8$
Amount to be divided	$= 312$
Unit	$= \frac{312}{8} = 39$

1st part $= 39 \times 3 = 117$
2nd part $= 39 \times 5 = 195$ } *Ans.*

EXAMPLE 2.—Divide £364 in the ratio of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$.

In questions of this kind the fractions must be reduced to a common denominator, the *numerators* of the fractions expressing the ratio.

Ratio	$= \frac{1}{2} : \frac{1}{3} : \frac{1}{4}$
Reducing	$= 6 : 4 : 3$
	12
Sum of ratios	$= 13$
Amount to be divided	$=$ £364
Unit	$=$ £$\frac{364}{13}$ $=$ £28
1st part	$=$ £28 × 6 $=$ £168
2nd ,,	$=$ £28 × 4 $=$ £112 } *Ans.*
3rd ,,	$=$ £28 × 3 $=$ £84

EXAMPLE 3.—A. owes £200 due in 6 months, £350 due in 5 months and £425 due in 8 months, after how long may the three sums be paid in a single payment?

Questions of the above kind are sometimes called "Equation of Payments"

£200 due in 6 months = £1,200 due in 1 month.
£350 „ 5 „ = £1,750 „ 1 „
£425 „ 8 „ = £3,400 „ 1 „

£975 is borrowed, so that it is equal to a loan of £6350 for 1 month.

Divide this total by the sum of the debts.

$$\frac{6350}{975} = 6\frac{20}{39} \text{ months.}$$

∴ The whole debt could be cleared by one payment of £975 after $6\frac{20}{39}$ months. *Ans.*

EXAMPLE 4.—A., B., and C. are partners. A. puts in £200 for a year, B. supplies £300 for 6 months, and C. £400 for 3 months. Divide a profit of £56 5s. 0d. amongst them.

A's share is equivalent to £2,400 for one month.
B's „ „ £1,800 „ „
C's „ „ £1,200 „ „

Ratio 2400 : 1800 : 1200
or cancelling 4 : 3 : 2
Sum of Ratios = 9
Amount to be divided = £$56\frac{1}{4}$

$$\text{Unit} = £\frac{56\frac{1}{4}}{9} = £\frac{225}{9 \times 4} = £6\frac{1}{4}$$

∴ A's share = £$6\frac{1}{4}$ × 4 = £25 0s. 0d.
B's „ = £$6\frac{1}{4}$ × 3 = £18 15s. 0d. } *Ans.*
C's „ = £$6\frac{1}{4}$ × 2 = £12 10s. 0d.

EXERCISE XXII.

1. Divide the number 1,264 into three parts, which shall be to one another 3, 5, and 8, and also into parts which shall be to one another as $\frac{1}{3}$, $\frac{1}{5}$, $\frac{1}{8}$.

2. Divide £221 7s. 6d. among A, B, and C in the proportions $\frac{11}{12}$, $\frac{3}{4}$, and $\frac{5}{6}$.

3. Divide £474 16s. 10½d. among A, B, C, and D, so that when A gets £2, B gets £3; when B gets £5, C gets £4; and when C gets £3, D gets £2.

4. Smith, Jones and Robinson invest respectively £435 10s. 0d., £293 15s. 0d., and £270 15s. 0d. in business; the loss is £500 in the course of the year; what is the share of each?

5. A commences business with £500; four months afterwards he takes B as partner with £350, and three months afterwards C joins with £400; the gain at the end of the year is £569 16s. 3d.; what should each get?

6. Divide £200 among 4 persons so that the second may have as much as the first, the third as much as the first and second together, and the 4th as much as the other three put together.

7. When should £400 due in 4 months, £300 due in 6 months, and £200 due in 3 months, be paid in one sum?

8. If gun metal be composed of 99 parts copper, and 11 parts tin, find the copper and tin required in the casting of a gun weighing 9 tons 19 cwts. 3 qrs. 6 lbs. 2 oz.

9. John, William, Thomas, and Andrew agreed to divide 1,365 apples among them, so that when John took 3 William should have 4, and Thomas 7, while Andrew should have half as many as the other three together. Find their shares.

10. A fatigue party, 240 strong, was to be found by 4 battalions, 315, 250, 345, and 290 duty men strong. Find the proportion each should furnish.

11. A, B, and C enter into partnership, with a capital of £8,900. A finds £4,000, B £2,140, C the remainder. At the end of the year the gain is £1,483 6s. 8d. C, who managed the business, was to receive £445 for his trouble. Find the share each had of the profits.

12. A bankrupt owes to 7 creditors £115 16s., £105, £93 11s. 5d., £71 5s. 6d., £36 14s. 7d., £15 15s., and 11s. 6d. respectively. His assets realize £329 0s. 6d. What should each creditor receive?

13. Pure water is composed of oxygen and hydrogen in the

proportion by weight of 1 : ·125 ; find the weight of each gas contained in 2 gallons 1 quart of pure water, taking the weight as 10 lbs. per gallon.

14. At the end of a year three partners, with a capital of £3,500 among them, shared the profits, thus : 1st £125, 2nd £240, and 3rd £135. What was each partner's stock ?

15. British silver coin is made of a mixture of 37 parts pure silver, and 3 parts alloy, and a lb. Troy is coined into 66 shillings ; what weight of alloy is contained in 55 shillings ? and what the weight of silver ?

16. Sugar being composed of 49.856 per cent. of oxygen, 43·265 per cent. of carbon, and the remainder hydrogen, find the weight of each in 2 tons 15 cwt. 3 qrs. 6lbs. of sugar.

17. At what time could bills for £100 due in two months, £325 due in 4 months, £250 due in 6 months, and £525 due in 8 months, be equitably settled by one payment ?

18. C rents a pasture for £5 for 6 months and places 80 sheep therein. He allows B to pasture a certain number for 4 months, and A a certain number for 2 months. B pays £1 17s. 6d. as his share of the rent, and A pays 12s. 6d. ; find the number of sheep A and B have.

19. A battalion of 365 files strong, is formed into 4 companies, so that $\frac{1}{2}$ the first, $\frac{2}{3}$ of the second, $\frac{3}{4}$ of the third, and $\frac{4}{5}$ of the fourth, are composed of the same number of men. Find the strength of the companies.

20. Thomas, Mary, and William, agree to divide 173 nuts in the following manner : for every 6 nuts William takes, Thomas is to take 7, and as often as Thomas gets 9 nuts, Mary gets 8. Find the shares of each.

THE CHAIN RULE.

There if a particular method of writing a series of ratios known as the Chain Rule. From the following considerations it will be seen that it is an adaptation of the method of unity.

EXAMPLE 1. If 4 lbs. of tea be worth 9 lbs. of coffee, and 10 lbs. of coffee be worth 11s. 8d., find the value of 10 lbs. of tea.

METHOD OF UNITY.

$$
\begin{aligned}
10 \text{ lbs. coffee} &= 11\tfrac{2}{3} \text{ sh.} \\
1 \text{ lb.} \quad ,, &= \frac{11\frac{2}{3}}{10} \text{ sh.} \\
9 \text{ lbs.} \quad ,, &= \frac{35 \times 9}{3 \times 10} \text{ sh.} \\
4 \ ,, \quad \text{tea} &= \frac{35 \times 9}{3 \times 10} \text{ sh.} \\
1 \ ,, \quad ,, &= \frac{35 \times 9}{3 \times 10 \times 4} \text{ sh.} \\
10 \ ,, \quad ,, &= \frac{\overset{3}{\cancel{35}} \times \overset{1}{\cancel{9}} \times \overset{1}{\cancel{10}}}{\underset{1}{\cancel{3}} \times \underset{1}{\cancel{10}} \times 4} \text{ sh.} \\
&= \frac{105}{4} \text{ sh.} = £1 \ 6\text{s. } 3\text{d. } \textit{Ans.}
\end{aligned}
$$

The Chain Rule is a short method of writing such solutions as the above. It may be briefly stated thus:—

Write the quantities which are equal to each other on opposite sides of the chain, taking care that quantities of similar denomination appear on each side of the chain, *i.e.* "tea" on the opposite side to "tea," "money" on the opposite side to "money," &c.

Divide the continued product of one side by the continued product of the side in which the word "Ans." appears. The quotient will be the required answer. The work would appear thus:—

4 lbs. tea = 9 lbs. coffee.

10 lbs. coffee = 11/8.

Ans. (money) = 10 lbs. tea.

$$\frac{9 \times 11\frac{2}{3} \times \overset{1}{\cancel{10}}}{4 \times \underset{1}{\cancel{10}}} \text{sh.} = \frac{105}{4} \text{sh.} = £1 \ 6\text{s. } 3\text{d. } \textit{Ans.}$$

It is really immaterial on which side the missing term appears, although it is often written first. What *is* essential is, that the name of each article should appear on *both* sides, and that the *denominator* of the fraction is the side from which the term is missing.

EXAMPLE 2. A runs a 100 yards race against B, beating him by 5 yds.; B beats C by 4 yds. A then gives C 8 yds. start; which wins, and by how much?

A 100 = B 95.
B 100 = C 96.
C ? = A 100.

$$\text{yds.}\ \frac{\overset{19}{\cancel{95}} \times \overset{24}{\cancel{96}} \times \overset{1}{\cancel{100}}}{\underset{1}{\cancel{100}} \times \underset{1}{\cancel{100}}} = \frac{456}{5}\ \text{yds.} = 91\tfrac{1}{5}\ \text{yds.}$$

i.e., C can run 91 $\frac{1}{5}$ yds. while A runs 100 yards.

∴ If C receives 8 yards start he has got to $91\frac{1}{5} + 8$ yds. = $99\frac{1}{5}$ yds. or $\frac{4}{5}$ yd. from the winning tape.

i.e., A wins by $\frac{4}{5}$ yard. *Ans.*

EXERCISE XXIII.

1. Find the cost of 14 yards of old lace if 8 yards of lace cost as much as 9 yards of velvet, and 18 yards of velvet cost as much as 5 silk dresses, and 6 silk dresses cost as much as 3 brussels carpets, and 21 brussels carpets cost £150.

2. What is the price of coal per ton when 15 cwt. of coal are worth 27 cwt. of coke, 3 cwt. of coke worth 1 cwt. charcoal, and a ton and a quarter of charcoal cost £2 10s. 0d?

3. If 57 dollars be worth 300 francs, 25 rupees worth 22 Sicilian scudi, 1 dollar worth 4s. 2d., and 44 francs worth 19 rupees, what is the value of 200 Sicilian scudi in English money?

4. When 9 pigs are worth as much as 72 geese, 7 sheep worth 20 goats, 10 chickens worth 5 geese, 7 pigs worth 24 goats, 11s. 3d. will buy 3 chickens, and 1 bullock costs as much as 7 sheep, find what would be paid for 3 bullocks.

5. What would 72 buttons cost if 30 pins cost $\frac{3}{4}$d., 6 shoe-strings be worth 2 pieces tape, $2\frac{1}{4}$ doz. needles be worth 3 pieces tape, $\frac{1}{3}$ doz. thimbles be worth $\frac{1}{2}$ doz. shoe-strings, 10 doz. pins be worth 8 thimbles, and 18 needles be worth 2 doz. buttons?

6. How much cheese will be equal to $1\frac{1}{4}$ lbs. tea, if 5 eggs be worth $\frac{1}{2}$ gallon milk, $\frac{1}{2}$ lb. butter be worth 1 lb. cheese. $\frac{1}{4}$ pint cream worth 1 qt. of milk, 2 eggs worth 1 oz. nutmegs, 2 qts. cream worth 3 lbs. butter, 3 lbs. sugar worth $\frac{1}{4}$ lb. nutmegs, and 2 ozs. tea worth $\frac{1}{2}$ lb. sugar.

SQUARE ROOT.

The *square* of a number is the product of the number multiplied by itself. Thus—the square of $7 = 7 \times 7 = 49$.

The square of a number is indicated by a small "2" written to the right of it, thus—$7^2 = 7 \times 7 = 49$.

The number which is multiplied by itself to produce a square is called the *square root*. It is indicated by the sign $\surd$. Thus—the square root of 49 is 7, and is indicated thus $\surd 49 = 7$.

EXAMPLE 1. Extract the square root of 191844.

METHOD.—Point off the given number in periods of two figures commencing at the unit figure. Take the highest square contained in the first period on the left. The highest square in 19 is 16 of which the root is 4.

$\surd 19\,18\,44 = 438$

4	16
	—
80	318
83	249
	—
860	6944
868	6944

Ans. 438.

This is the first figure of the required root; place it in the quotient and *also* in the divisor. Proceed as in division. The remainder is 3. Add the last figure in the quotient to the present divisor $4 + 4 = 8$; affix one 0, and place the next period 18 to the right of the former remainder 3. The 80 so made is called the "trial divisor"; it is contained in 318 about 3 times. Place

the 3 in the quotient and *also* in the divisor, which will become 83. Now proceed as in division. 3 times 83 = 249, place the product under the 318 and subtract; the remainder is 69. Add the last figure in the quotient 3, to the present divisor 83, = 86, affix one 0, and place the next period 44 to the right of the former remainder, making it 6944. The "trial divisor" 860 is contained in 6944 about 8 times. Place 8 in the quotient and *also* in the "trial divisor" 860, which becomes 868. Proceed as in division. There is no remainder. The required root is 438.

When there is a decimal in the given number the number is divided into periods commencing *from the decimal point.* If there be an incomplete period *in the decimal part,* complete it by adding 0.

EXAMPLE 2. Find the square root of 73·4449.

$\sqrt{73\cdot4449} = 8\cdot57$

8	64
160	944
165	825
1700	11949
1707	11949

Ans. 8·57.

Care should be exercised not to omit the decimal point. When it is reached in the given number it must be written in the quotient.

EXAMPLE 3. Find the square root of ·9.

In this example the decimal point is placed in the quotient at once, and the period must be completed by the addition of 0.

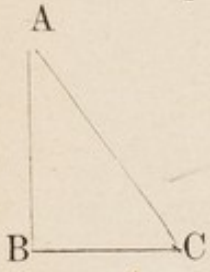
$\sqrt{\cdot90} = \cdot948$ &c.

9	81
180	900
184	736
1880	16400

Ans ·948.

The square root of a vulgar fraction is obtained by finding the root of the numerator and the root of the denominator. If, however, the numerator and denominator are not exact squares, the fraction should be reduced to a decimal and the square root of the decimal found.

In Euclid I., 47, it is proved that in any right-angled triangle the sum of the squares of the sides containing the right angle is equal to the square of the side opposite the right angle.

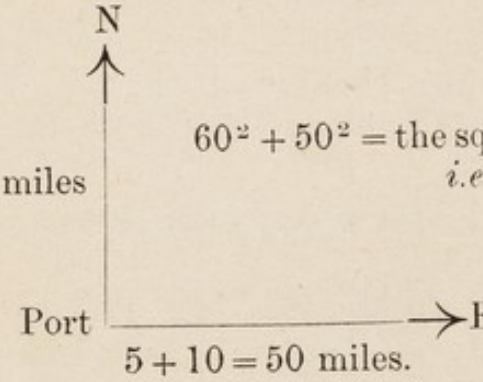


In the triangle A, B, C, where the right angle is at B, the square on A B + the square on B C = the square on A C.

This is expressed thus, $A\,B^2 + B\,C^2 = A\,C^2$.

It is plain from the above that if the length of any two of the sides of a right-angled triangle be given the length of the third can be found.

Example 4. Two ships sail from a port, one due East the other due North. The first sails 10 miles an hour, the second 12 miles an hour; how far are they apart at the end of 5 hours.



$12 \times 5 = 60$ miles

$5 + 10 = 50$ miles.

$60^2 + 50^2$ = the square of the distance apart, *i.e.*, from N. to E.

$= 3600 + 2500$

$= 7100$ miles.

$\sqrt{7100} = 84{\cdot}2$

8	64
160	700
164	656
1680	4400

Ans. 84·2 miles.

EXERCISE XXIV.

Extract the square roots of :—

1. 625 ; 99856 ; 633616 ; 254016.
2. 18232900 ; 1824485796 ; 72916740961 ; 291678845329.
3. ·0016 ; ·0004 ; ·000081.
4. ·00000576 ; ·000000073441.
5. 8587·7289 ; 4·016016 ; 51·12965025.
6. $\frac{729}{6889}$; $2 - (1\frac{1}{4} + \frac{11}{16})$; $\frac{5\frac{2}{3} - 1\frac{1}{2}}{16\frac{2}{3}}$.
7. Find to 4 places of decimals $\sqrt{\frac{3}{5}}$.
8. To 4 places $\cdot\sqrt{143}$
9. To 5 places $\sqrt{\cdot 12}$
10. Find the side of a square containing 152 sq. ft. 16 sq. inches.
11. To what length in yards would the side of a solid square containing 841 men extend, allowing 2 feet per man ?
12. What length of ladder would reach the top of a wall 12 feet high, the foot of the ladder being 9 feet from the bottom of the wall ?
13. Find the diagonal of a square, the side of which is 20 feet. (To two places.)
14. A party paid for refreshments, £2 12s. 1d., and each person paid as many pence as there were people in the party. How many were there ?
15. A and B start from a village X, A travels due North, at the rate of 12 miles an hour, and B travels due West at 9 miles an hour ; how far apart would they be in 8 hours ?
16. Find the true weight of a piece of cheese which weighed 25 lbs. in one scale and 36 lbs. in another of false balance.

N.B.—This is an example of finding the mean proportional between two given numbers and is ascertained by multiplying the given numbers together and extracting the square root of the product.

ELEMENTARY MENSURATION.

As questions are sometimes given requiring a knowledge of the mensuration of rectangular surfaces and solids, a few specimen solutions and questions for practice are given below :

(*a*) Surfaces.

1. A surface has two dimensions—length and breadth.

2. Length × breadth = area.
   ∴ breadth = area ÷ length.
   Also length = area ÷ breadth.

3. The following table of square measure should be committed to memory :

Square Measure.

144	sq. inches	= 1 sq. foot.
9	sq feet	= 1 sq. yard.
$30\frac{1}{4}$	sq. yards	= 1 sq. pole, rod, or perch.
40	sq. poles	= 1 rood.
4	roods	= 1 acre.
640	acres	= 1 sq. mile.

A chain, used in land surveying, is 22 yards long and is divided into 100 equal parts called links.

As $22^2 = 484$ ∴ 10 sq. chains = 1 acre.

10	sq. chains	= 100,000 sq. links.
25,000	sq. links	= 1 rood.
4,840	sq. yards	= 1 acre.

Example 1. Find the area of a pantry 9 ft. 9 ins. long by 5 ft. 4 ins. broad.

9 ft. 9 ins. = $9\frac{3}{4}$ ft. and 5 ft. 4 ins. = $5\frac{1}{3}$ feet.

∴ Area = $9\frac{3}{4} \times 5\frac{1}{3}$ sq. feet.

$$= \frac{\overset{13}{\cancel{39}}}{\underset{1}{\cancel{4}}} \times \frac{\overset{4}{\cancel{16}}}{\underset{1}{\cancel{3}}}$$

= 52 sq. feet. *Ans*

EXAMPLE 2. How many yards of carpet 2 ft. 6 in. wide will cover a floor 25 feet square?

N.B.—The expression 25 feet square means 25 feet long and 25 feet broad.

Area of floor, *i.e.*, the area of the carpet = 25 feet × 25 feet. Width of carpet = $2\frac{1}{2}$ ft.

$$\therefore \frac{25 \times 25}{2\frac{1}{2}} = \text{length of carpet in feet.}$$

And $\frac{25 \times 25}{2\frac{1}{2} \times 3}$ = ,, ,, ,, yards.

$$= \frac{\overset{5}{\cancel{25}}}{1} \times \frac{\overset{5}{\cancel{25}}}{1} \times \frac{2}{\cancel{5}} \times \frac{1}{3} = \frac{250}{3} \text{ yds.} = 83\tfrac{1}{3} \text{ yds. } \textit{Ans.}$$

EXAMPLE 3. Find the area of the walls of a room 17 ft. long, 12 ft. 7 in. wide, and 8 ft. 5 in. high.

Total length of the four walls $= (17+17+12\frac{7}{12}+12\frac{7}{12}) = 59\frac{1}{6}$.

$$\therefore \text{Area} = (59\tfrac{1}{6} \times 8\tfrac{5}{12}) \div 9 = \text{sq. yards.}$$

$$= \frac{355}{6} \times \frac{101}{12} \times \frac{1}{9} \text{ sq. yards.}$$

$$= \frac{35855}{648} \text{ sq. yds.}$$

	s. yds.	s. ft.	s. ins.
648	35855 ,,	0 ,,	0
81	4481 ,,	7 ,,	126
9	497 ,,	8 ,,	126
	55 ,,	2 ,,	142 *Ans.*

(*b*) SOLIDS.

1. A solid has three dimensions—length, breadth, and depth.
2. Solidity or cubic content = Length × breadth × depth.

From this it follows that solidity divided by one dimension gives the product of the other two, or square measure. Also that solidity divided by square measure gives the third dimensions or lineal measure.

The table of cubic measure is as follows :—

1,728 cu. ins. = 1 cu. foot.
27 cu. ft. = 1 cu. yard.

33. A bankrupt's assets are £675, out of which he pays 15s. in the pound on half his debt, and 12s. on the other half; what did he owe altogether?

34. If the solid contents of a cube be 9393931 inches, what is the length of its edge?

35. Divide ·0359432 by 7160.

36. Find the value of ·475 of £128.

37. At what time between 3 and 4 o'clock will the hands of a watch be at right angles to each other?

38. What sum must be invested at 3 per cent. in order to derive an income of £138 per annum?

39. Two persons invest respectively £579 3s. 4d. and £2,895 16s. 8d. in a business which returns 12 per cent. on the invested capital; find the amount of the share of profit each should have.

40. In what time will £537 16s. 8d. amount to £591 12s. 4d. at $2\frac{1}{2}$ per cent. simple interest?

41. If A be $\frac{1}{2}$ of $2\frac{2}{3}$ of B, and C be $1\frac{1}{5}$ of B; express C as the fraction of A.

42. A can do a piece of work in 6 days, and with the help of B the work can be done in $2\frac{2}{5}$ days; how long would B working alone take to do it?

43. What is the height of a closet $8\frac{1}{3}$ ft. by $6\frac{2}{3}$ ft., which will exactly contain 12 boxes, each $4\frac{1}{6}$ ft. long, $3\frac{1}{3}$ ft. wide, and $2\frac{1}{2}$ ft. deep?

44. A has $\frac{3}{11}$ of a share in a concern and sells $\frac{1}{9}$ of $\frac{5}{8}$ of his share for £500, what is the value of $\frac{1}{11}$ of $\frac{1}{12}$ of the concern?

45. Simplify $\dfrac{435{\cdot}1 \times {\cdot}0046}{{\cdot}125}$

46. If 27 men cut down 108 acres of grass in 5 days, working 10 hours a day, how many acres, &c., would 16 men cut down in 9 days, working 12 hours a day?

47. Find the compound interest on £750 for 2 years, at 4 per cent.

48. If a certain principal amount to £318 3s. 0d. in 73 days, at 5 per cent., what is the interest?

49. Find the value of 312 cwt. 3 qrs. 14 lbs. at 16s. $7\frac{3}{4}$d. per cwt.

50. If a lb. of powder costs 3s., and the charge of a rifle be $2\frac{1}{4}$ drams, how many charges will 6s. 9d. worth of powder furnish?

51. What principal will amount to £1,434 7s. 6d. in $2\frac{1}{2}$ years at $2\frac{1}{2}$ per cent.?

52. A person contracts to make a railway 189 miles long, in 15 months. He employs 129 men, but after 3 months, finds that he has only finished 28 miles. How many more men must he employ to finish the contract within the time?

53. A grocer buys 84 lbs. of coffee at 10d. a lb., and mixes it with 12 lbs. of chicory, which costs him 3s. 4d.; what will be his gain per cent. if he sell the mixture at 1s. $1\frac{3}{4}$d. per lb?

54. A boy can buy at a fruiterer's either 2 cocoa-nuts or 12 dozen filberts. He buys the cocoa-nuts, and then commences a series of exchanges, getting 5 pears for a cocoa-nut, 5 apples for 2 pears, 2 oranges for 3 apples, 21 hazel nuts for an orange, 2 filberts for 5 hazel nuts; is he better or worse off than if he had bought filberts at the fruiterers, and by how much?

55. What is the cost of paper for the walls of a room 30 ft. long, 15 ft. broad and 15 ft. high, the paper being $1\frac{1}{2}$ yards wide and its price $4\frac{1}{2}$d. per yard?

56. If a publican uses a false measure containing ·93 of a pint instead of a pint, out of how much will he have cheated his customers when he has really sold 23 gallons 2 pints?

57. If 12 men or 18 boys can do $\frac{3}{4}$ of a piece of work in $8\frac{1}{2}$ hours, how long would 11 men and 9 boys take to finish it?

58. A man buys 27 sheep for £30, and sells 12 of them so that he loses 3 per cent. on the sale, at what price per sheep must he sell the remainder that he may gain $2\frac{1}{2}$ per cent. on the whole purchase?

59. A person buying railway shares paying a dividend of 4 per cent., receives 5 per cent. for his money; what is the price of the shares?

60. Four men working 8 hours a day, take 22 days to pave a road 440 yards long and 35 feet broad, how many days will four men, two of whom work 8 hours and two 10 hours a day, take to pave a road 1,575 yards long and 36 feet 6 inches broad?

61. What principal will amount to £678 7s. 6d. in 2 months at 3 per cent., simple interest?

62. Extract the square root of ·5 to three places.

63. If needles be bought for 2s. 6d. a gross, how many may be sold for 1d. to gain 20 per cent?

64. A, B, & C divide £120 among them so that B has a third more than A, and C a fourth more than B, what is the share of each?

65. A tank can be filled by two separate pipes; by the first in 10 hours, by the second in 8 hours. When empty, the first pipe is turned on, and the second pipe also when the tank is half full. What was the whole time taken in filling the tank?

66. A cargo of corn cost £1,200; 200 quarters being damaged were sold at 22s. per quarter, and the loss sustained on them was £80; the remainder was sold at such a price that there was a gain of £100 on the whole. Find the quantity, cost price per quarter, and the selling price of the undamaged part.

67. A can do a piece of work in 12 hours, B in four hours, and C in three hours. A, B, & C, work together for half-an-hour, when A leaves off. How long will it take B & C to finish the piece of work?

68. A man has two silver cups of unequal weight and a cover which fits both, weighing five ounces. Now, when the cover is put on the less cup, the weight is double that of the greater cup, but when the cover is put on the greater, the weight is triple that of the less cup; find the weight of the cups.

69. Find the value of ·73125 lb. Troy.

70. A met two beggars, B & C, and having $\frac{3\frac{7}{11}}{4\frac{2}{7}}$ of $\frac{10\frac{5}{7}}{7\frac{1}{2}}$ of $\frac{77}{540}$ of £1 7s. 0d. in his pocket, gave B $\frac{1}{7}$ of $\frac{3}{4}$ of that sum, and C $\frac{3}{5}$ of the remainder, what did each receive?

71. The length of a wall, French measure, is 9 metres, 4 decimetres, 8 centimetres ; reduce this to English feet, the metre being 39·371 inches in length.

72. A piece of work can be done by A and B together in 14 hours, by B & C in $10\frac{1}{2}$ hours, or by A and C in 12 hours. In what time could each do it by himself ?

73. If 9 gallons spirits at 18s. 6d. per gallon are mixed with 7 gallons at 21s. per gallon, how much water must be added to reduce the price to 16s. 6d. per gallon ?

74. A charges 4 per cent. less for an article than B ; how much per cent. does B charge more than A ? If they both gain at the same rate, what should B pay when A pays 30s. ?

75. At what time between 11 and 12 o'clock do the hour and minute hands make an angle, intercepting 27 of the minute divisions ?

76. What sum of money increased by $\frac{2}{3}$ of $\frac{4}{5}$ of $\frac{6}{7}$ of itself becomes 4s. 3d. ?

77. At 4 per cent. what principal will become £157 10s., in 5 years at simple interest ?

78. Four persons purchased a ticket which drew a prize in a State lottery of 7,530 dollars, the first paid for $\frac{1}{2}$ of the ticket, the second $\frac{1}{3}$, the third $\frac{1}{6}$, and the fourth $\frac{2}{15}$; how much should each obtain ?

79. If 11·65 Dutch florins be given for 24·89 francs, 383 florins for 437 Hambro' marks, and $68\frac{1}{4}$ marks for 32 silver roubles of St. Petersburg, how many francs should be given for 932 silver roubles ? (Three places of decimals.)

80. A piece of cloth, 5 times as long as broad, cost £19 ; supposing the price to be 4s. 9d. per square yard, find the length and breadth.

81. If 15 horses and 148 sheep can be kept for 9 days for £75 15s. 0d., what sum will keep 10 horses and 132 sheep for 8 days, supposing 5 horses to eat as much as 84 sheep ?

82. How long will it take to march 16 miles at the rate of 110 paces of 30 inches per minute ?

83. A certain number of men, twice as many women, and three times as many boys, earn £7 15s. 0d. in 5 days; each man is paid 1s. 6d., each woman 10d., and each boy 8d. per day. How many were there of each?

84. A Cochin China hen eats a pint of barley and lays a dozen eggs, while an English hen eats half a pint of barley and lays five eggs. Supposing the eggs of the latter to be half as large again as the eggs of the former and priced accordingly, which would be the more economical to keep, and what per cent. would the gain be on 5 pints of barley?

85. If the side of a cubical box measure 84 inches, find the cost of painting the whole of its outside surface at $2\frac{1}{2}$d. per sq. foot.

86. For every $4\frac{3}{8}$ miles A walks, B goes $5\frac{1}{9}$ miles; how long after A should B start, so as to reach the same spot at the same time as A, supposing A to have been travelling $7\frac{7}{9}$ hours?

87. What is the net weight of 7 hogsheads of tobacco each weighing 12 cwt. 1 qr. 25 lbs., draft 2 lbs. per hogshead, and tare 1 cwt. 2 qrs. 27 lb. per hhd.?

88. A rope 100 ft. in length reaches from the top of a wall 45 ft. high, to the further bank of the stream; find the width from the foot of the wall in yards, to two places of decimals.

89. Find the cost of framing a picture 40 inches by 30 inches, with a gilt frame 4 inches wide, at 3s. $4\frac{1}{2}$d. per square foot.

90. A owes B a debt payable in 8 months, but he pays $\frac{1}{4}$ in 2 months, $\frac{1}{8}$ in 4 months, $\frac{1}{8}$ in 6 months; when ought the remainder to be paid?

91. Reduce $\frac{1}{4}$ of $\frac{\frac{1}{8}}{\frac{1}{5}}$ of a quarter of an acre to the decimal of

$$\frac{\frac{3}{7}}{(4 \times 8) - (3 \times 7)}$$ of 2 poles.

92. A bag contains a certain number of sovereigns, three times as many shillings, four times as many fourpenny pieces, five times as many threepenny pieces, twice as many pence, and six times as many half-pence. The whole sum in the bag is £78; find the number of each coin the bag contains.

93. A fruiterer sold 2,500 cocoa-nuts for £26 0s. 10d., and cleared $\frac{3}{7}$ of what they cost him; find the prime cost.

94. Divide 560 into two parts, such that $\frac{1}{10}$ of one part added to $\frac{1}{5}$ of the other, shall be equal to 82.

95. £175 is made up of guineas, sovereigns, half-guineas, half-sovereigns, crowns, half-crowns, and shillings, an equal number of each. Find the number.

96. A plot of ground 60 yards by 30, is divided into four equal parts by two footpaths, three feet wide, which cut one another in the centre at right angles: find the area of one of the parts, and the cost of paving the paths at 9d. per square yard.

97. A and B working together do a piece of work in $4\frac{4}{5}$ hours, B and C take $3\frac{3}{7}$ hours, and A and C. take 4 hours; find how long each would take, also how long if the three worked together.

98. Extract the square root of ·00044521.

99. If five men or seven women can do a piece of work in 37 days, in what time will seven men and five women do a piece of work twice as great?

100. When will the hands of a clock be first together after 12 o'clock?

ANSWERS TO QUESTIONS IN ARITHMETIC.

EXERCISE I.

(1.) $3\frac{3}{5}$ (2.) $2\frac{2}{5}$. (3.) $\frac{385}{458}$. (4.) $\frac{3}{56}$. (5.) $\frac{1}{4}$. (6.) Sum $2\frac{43}{60}$, difference $1\frac{47}{60}$, product $1\frac{1}{20}$, quotient $4\frac{23}{28}$. (7.) $\frac{1}{70}$. (8.) 10s. 6d. (9.) Result of division the greater by $\frac{5}{36}$. (10.) Man's share $\frac{2}{15}$, brother's $\frac{4}{5}$, uncle's $\frac{1}{15}$. (11.) 5 days. (12.) 2 days. (13.) $\frac{32}{69}$. (14.) $35\frac{5}{17}$ minutes. 1st pipe $794\frac{2}{17}$ gallons, 2nd pipe $635\frac{5}{17}$ gallons, 3rd pipe 529 $\frac{7}{17}$ gallons. (15.) $\frac{5}{18}$. (16.) A 10d., B 2s. 6d. (17.) 1 qr. $15\frac{1}{5}$ lb. (18.) £7 8s. $1\frac{7}{9}$d. (19.) $107\frac{23}{27}$ yds.; 5s. $11\frac{73}{81}$d. (20). £4 10s. 0d. (21.) 148 $\frac{9}{52}$ gallons. (22.) 4 oz. 16 dwt. 6 grs. (23.) $14\frac{7}{10}$. (24.) $24\frac{1}{5}$ ft.

EXERCISE II.

$\dot{6}$; $\cdot\dot{4}$; $\cdot\dot{4}\dot{5}$; $2\cdot\dot{3}$; $\cdot\dot{0}3\dot{7}$; $\cdot\dot{7}14285\dot{7}$.

EXERCISE III.

$\frac{1}{1}$; $\frac{1}{11}$; $\frac{15}{37}$; $\frac{2}{33}$; $\frac{5}{1111}$; $\frac{5}{9}$.

EXERCISE IV.

$\frac{311}{990}$; $\frac{43}{4950}$; $2\frac{11}{74}$; $306\frac{7}{9}$; $14\frac{8}{55}$; $\frac{31547}{49950}$.

EXERCISE V.

(1.) 46·3568608. (2.) 80·4637632. (3.) 9·0896199.
(4.) 7·8266576. (5.) 13·4572457. (6.) ·0116599.

EXERCISE VI.

(1.) $2\cdot5\dot{4}8\dot{9}48\dot{9}$. (2.) $20\cdot4\dot{3}22049\dot{}$.
(3.) $16\cdot83\dot{9}23394141215\dot{}$. (4.) $\cdot1\dot{1}33\dot{7}$.
(5.) $2\cdot827\dot{7}78505\dot{}$. (6.) $\cdot316\dot{4}71999452197\dot{}$.

EXERCISE VII.

(1.) $14\cdot\dot{1}4\dot{8}$, $99\cdot39\dot{7}\dot{1}$.
(2.) $240\cdot600\dot{3}\dot{6}$.
(3.) $\cdot2\dot{7}$, $25\cdot21\dot{3}$.
(4.) $\cdot\dot{5}$.
(5.) $2\cdot\dot{3}$.
(6.) $\cdot0\dot{7}67519900853234186\dot{5}$.

EXERCISE VIII.

(1.) $13\frac{1}{80}$, 13·0125. (2.) ·03493. (3.) $\frac{9}{10}$ or ·9, $\frac{138}{197}\frac{4}{5}$ or ·70076 nearly. (4.) $35\frac{39}{80}$ or 35·4875. (5.) $1\cdot\dot{6}$. (6.) $2\cdot274416$. (7.) 16s. $11\frac{3}{4}$d. (8.) 11s. 3d. (9.) ·3. (10.) $1\cdot0\dot{7}14285\dot{7}$. (11.) ·625. (12.) 15·35 miles. (13.) £30,000. (14.) $13\cdot74\dot{6}\dot{9}$. (15.) 7925·646 + miles. (16.) 0. (17.) $\cdot7\dot{2}$. (18.) $4\cdot6\dot{7}$. (19.) £15 14s. $10\frac{2}{7}$d. (20.) 75·16 yards. (21.) 3 roods 26 poles 26 yards 1 square foot 18 square inches. (22.) 3s. $11\frac{1}{4}$d. (23.) ·0025. (24.) £3 5s. $8\frac{43}{140}$d.

EXERCISE IX.

(1.) £5458 10s. $11\frac{1}{4}$d.
(2.) £19532 6s. $11\frac{1}{2}$d.
(3.) £5007 17s. $7\frac{1}{2}$d.
(4.) £5199 12s. $1\frac{5}{16}$.
(5) £4825 7s $6\frac{5}{48}$d.
(6.) £116 17s. $3\frac{7}{8}$d.
(7.) £165 15s. $0\frac{13}{15}$d.
(8.) £1238 2s. $11\frac{1}{12}$d.
(9.) £3194 17s. $0\frac{1}{4}$d.
(10). £5400 14s. $7\frac{29}{48}$d.
(11.) £85 13s. $11\frac{2}{11}$d.
(12.) £3432 4s. $9\frac{31}{38}$d.

EXERCISE X.

(1.) £197 1s. $10\frac{1}{2}$d.
(2.) £12693 3s. $11\frac{1}{4}$d.
(3. £55 19s. $2\frac{3}{4}$d.
(4.) £162 6s. 3d.
(5.) £29 16s. $7\frac{1}{4}$d.
(6.) £4499 13s. 9d.
(7.) £59 13s. $7\frac{31}{32}$d.
(8.) £130 0s. $7\frac{1}{4}$d.
(9.) £1338 6s. $5\frac{27}{32}$d.
(10.) £12 12s. 10d.
(11.) £14 4s. $11\frac{5}{24}$d.
(12.) £623 0s. $3\frac{3}{32}$d.
(13.) £28 12s. $1\frac{5}{7}$d.
(14.) £6 3s. $0\frac{17}{24}$d.
(15.) £6 12s. $10\frac{83}{108}$d.
(16.) £1500 5s. $0\frac{3}{16}$d.
(17.) £9 14s. $0\frac{31}{72}$d.
(18.) £245 5s. 0d.
(19.) £182 14s. $9\frac{3}{16}$d. Exp., £122 17s. $8\frac{13}{16}$d. saved.
(20.) £4 7s. $8\frac{11}{12}$d.

EXERCISE XI.

(1.) £35. (2.) 9s. 6d. (3.) £18 4s. 6d. (4.) £910. (5.) £351. (6.) 27 days. (7.) 3·8709 + days. (8.) $7\frac{1}{2}$ hours longer. (9.) 11 yards. (10.) £50. (11.) 72 men. (12.) £158 1s. $8\frac{1}{2}$d. (13.) 27 horses. (14.) 276 gallons. (15.) £3046 8s. 3d. (16.) 70 days. (17.) £18 10s. $3\frac{17}{320}$ (18.) £39 9s. $2\frac{7}{10}$d. (19.) $118\frac{3}{4}$ days. (20.) $10\frac{1}{2}$ days.

EXERCISE XII.

(1.) 54 men. (2.) 14 horses. (3.) 7200 people. (4.) 180 compositors. (5.) 75 people. (6.) £641 13s. 4d. (7.) 8 cwt. 0 qrs. $18\frac{2}{3}$ lbs. (8.) 84 men. (9.) 45 men. (10.) £1 17s. 6d. (11.) 10 hours. (12.) 18 days. (13.) 8 weeks. (14.) 700 men. (15.) 14. (16.) 162 horses. (17.) 8 days. (18.) 160 miles. (19.) 13s. 4d. (20). $2\frac{1}{4}$ inches. (21.) 35 days. (22.) 372 men. (23.) 50 men. (24.) $18\frac{18}{25}$ ft.

EXERCISE XIII.

(1.) £7 8s. 0d. (2.) £30 1s. 3d. (3.) £676 13s. 0d. (4.) £430 8s. $10\frac{1}{2}$d. (5.) £138 12s. $0\frac{4}{5}$d. (6.) £165 0s. 0d. (7.) £577 2s. $11\frac{19}{40}$d. (8.) £170 10s. 0d. (9.) £1 8s. $7\frac{7}{200}$d. (10.) £4014 1s. $10\frac{157}{400}$d. (11.) £33 1s. $2\frac{3}{5}$d. (12.) £1415 1s. $9\frac{879}{3200}$d.

EXERCISE XIV.

(1.) £494 1s. 9d.
(2.) £9 16s. $11\frac{17}{20}$d.
(3.) £1319 2s. $6\frac{4}{5}$d.
(4.) £371 6s. $5\frac{1}{20}$d.
(5.) £2886 11s. $7\frac{2685}{4800}$d.
(6.) £52 1s. $10\frac{103}{240}$d.
(7.) £1239 3s. $9\frac{1053}{1600}$d.
(8.) £421 3s. $3\frac{1423}{38400}$d.
(9.) £0 5s. $6\frac{101}{120}$d.

EXERCISE XV.

(1.) £15 7s. $4\frac{56}{73}$d.
(2.) £3844 14s. $5\frac{1561}{1825}$d.
(3.) £17 3s. $2\frac{2689}{2920}$d.
(4.) £102 16s. $9\frac{1777}{2190}$d.
(5.) £1 2s. $10\frac{54}{73}$d.
(6.) £537 2s. $10\frac{29}{73}$d.
(7.) £8 3s. $10\frac{1033}{3650}$d.
(8.) £6 2s. $3\frac{28683}{36500}$d.

EXERCISE XVI.

(1.) £12 3s. $7\frac{1}{5}$d. (2.) £385 17s. 6d. (3.) £2163 4s. 0d.
(4.) £0 6s. 3d. (5.) £51 11s. $5\frac{13}{16}$d. (6.) £1 4s. $5\frac{7}{16}$d.

EXERCISE XVII.

(1.) £2000. (2.) $5\frac{1}{2}$ per cent. (3.) $2\frac{3}{4}$ years.
(4.) £847 16s. 8d. (5.) $15\frac{1}{2}$ months. (6.) 3 per cent.
(7.) $4\frac{7}{8}$ years. (8.) $3\frac{1}{2}$ per cent. (9.) £2087 10s. 0d.
(10.) 5 per cent. (11.) £52 10s. 0d. (12.) 2 years 4 months.

EXERCISE XVIII.

(1.) 12 per cent. (2.) 144; 96; 720.
(3.) $3\frac{1}{8}$ per cent. (4.) 68157.
(5.) 2277; 1518. (6.) 295916.
(7.) 125000. (8.) 750.
(9.) 75 per cent. (10.) 100000.
(11.) $55\frac{5}{9}$ per cent. (12.) 10 per cent.

EXERCISE XIX.

(1.) £7 16s. 6d. (2.) £317 17s. 0d.
(3.) £10 3s. $1\frac{1}{2}$d. (4.) £7 13s. 1d.
(5.) £266 15s. 0d. (6.) £5190 4s. $4\frac{2}{2}\frac{7}{8}\frac{2}{9}$d.
(7.) £71 16s. 3d. (8.) £11 7s. $0\frac{3}{4}$d.
(9.) £1688 6s. 8d. (10.) £304 12s. 5d.
(11.) £0 8s. $4\frac{1}{3}$d. (12.) £894 13s. 4d.

EXERCISE XX.

(1.) 739. (2.) 26·9625.
(3.) 10·154875. (4.) 60.
(5.) 113. (6.) 40°, 53′.
(7.) 1541. (8.) 1759.
(9.) 34. (10.) 1·0162.
(11.) 25313·48. (12.) £1 0s. 9d.
(13.) £72 11s. 8d. (14.) 50 per cent.
(15.) $3\frac{1}{4}$d. (16.) £20 4s. 4d.
(17.) 26·19573. (18.) 26·1509125.

EXERCISE XXI.

(1.) 1s. $1\frac{1}{2}$d. per lb. (2.) 40 per cent. (3.) 6s. 3d. per yard.
(4.) $12\frac{1}{2}$ per cent. gain. (5.) £1 3s. $3\frac{3}{43}$d. (6.) 9d. per lb.
(7.) 5s. $1\frac{7}{13}$d. (8.) 8 per cent. gain, 17s. 4d.
(9.) $1\frac{2}{3}$ per cent. (10.) $21\frac{413}{1047}$ per cent. (11.) 6s. 8d.
(12.) £1 5s. $3\frac{3}{4}$d. (13.) 4d., $2\frac{7}{9}$ per cent., $27\frac{7}{9}$ per cent. gain.
(14.) 5 per cent. (15.) $11\frac{1}{9}$ per cent. gain.
(16.) $4\frac{5}{16}$d. (17.) $66\frac{2}{3}$ per cent. (18.) 1s. $5\frac{2}{5}$d.

EXERCISE XXII.

(1.) 237, 395, 632, and 640, 384, 240.
(2.) A £81 3s. 5d., B £66 8s. 3d., C £73 15s. 10d.
(3.) A £105 10s. 5d., B £158 5s. $7\frac{1}{2}$d., C £126 12s. 6d., D £84 8s. 4d.
(4.) Smith £217 15s. 0d., Jones £146 17s. 6d., Robinson £135 7s. 6d.
(5.) A £316 11s. 3d., B £147 14s. 7d., C £105 10s. 5d.
(6.) 1st £25, 2nd £25, 3rd £50, 4th £100. (7.) In $4\frac{4}{9}$ months.
(8.) Copper, 8 tons 19 cwts. 3 qrs. 8 lbs. 5 oz. Tin, 19 cwt. 3 qrs. 25 lbs. 13 oz.
(9.) John 195, William 260, Thomas 455, Andrew 455.
(10.) 63, 50, 69, 58. (11.) A £466 13s. 4d., B £249 13s. 4d., C £767.
(12.) £86 17s. 0d., £78 15s. 0d., £70 3s. $6\frac{3}{4}$d., £53 9s. $1\frac{1}{2}$d., £27 10s. $11\frac{1}{4}$d., £11 16s. 3d., £0 8s. $7\frac{1}{2}$d.
(13.) Oxygen 20 lbs., hydrogen $2\frac{1}{2}$ lbs. (14.) £875, £1680, £945.
(15.) 15 dwt. alloy, 9 oz. 5 dwt. silver. (16.) 1 ton 7 cwt. 3 qrs. 8lbs. oxygen, 1 ton 4 cwt. 16lbs. 1 oz. carbon, 3 cwt. 3 qrs. 9 lbs. 15 oz. hydrogen.
(17.) In six months. (18.) B 90, A 60.
(19.) 1st company, 120 files, or 240 men ; 2nd company, 90 files, or 180 men ; 3rd company, 80 files, or 160 men ; 4th company, 75 files, or 150 men.
(20.) William 54, Thomas 63, Mary 56.

EXERCISE XXIII.

(1.) £15 12s. 6d. (2.) 24s. per ton. (3) £20 16s. 8d.
(4.) £52 10s. 0d. (5.) $4\frac{1}{2}$d. (6.) 2 lb. cheese.

EXERCISE XXIV.

(1.) 25; 316; 796; 504.
(2.) 4270; 42714; 270031; 540073.
(3.) ·04; ·02; ·009. (4.) ·0024; ·000271.
(5.) 92·67; 2·004; 7·1505.
(6.) $\frac{27}{833}$; $\frac{1}{4}$; $\frac{1}{2}$.
(7.) ·7745+. (8.) ·3783+. (9.) ·34815+.
(10.) 12 feet 4 inches. (11.) $19\frac{1}{3}$ yards. (12.) 15 feet.
(13.) 28·28 feet. (14.) 25 persons. (15.) 120 miles.
(16.) 30 lb.

EXERCISE XXV.

(1.) 3 sq. ft. 64 sq. ins.
(2.) £2 0s. 0d.
(3.) £60 15s. 0d.
(4.) £48 8s. 0d.
(5.) 37 ac. 14 pls.
(6.) £1 15s. 0d.
(7.) $15\frac{1}{6}$; $10\frac{5}{27}$; 5; $2\frac{19}{36}$.
(8.) 7650 tons.
(9.) 40 ft.
(10.) 7776 bricks.

EXERCISE XXVI.

(1.) Thirty-three thousand and thirty. 33030. (2.) 9376. (3.) Eldest son 31, youngest 13, daughter 16. (4.) 71 children. (5.) In same direction $13\frac{1}{2}$ miles; opposite $241\frac{1}{2}$ miles. (6.) 37. (7.) 58. (8.) £350 2s. $2\frac{1}{4}$d. (9.) 39 days, 30 minutes. (10.) 7480 revolutions. (11.) 11s. 11d. (12.) 14 years, 27 days, 15 hours, 50 minutes, $5\frac{35}{113}$ seconds. (13.) Man 3s., woman 2s., child 1s. (14.) 8 inches. (15.) 12 days. (16.) $\frac{7}{24}$. (17.) 48. (18.) 1,000 gallons. (19.) £73 17s. $6\frac{1}{2}$d. (20.) $2\cdot\dot{2}85714\dot{}$. (21.) 18 francs, $26\frac{11}{32}$ cents. (22.) $22\frac{1}{2}$ minutes. (23.) 100 acres, 4000 trees. (24.) 100 francs. (25.) 3s. $3\frac{27}{40}$d. per yard. (26.) $\frac{16}{21}$. (27.) $\cdot\dot{0}76923\dot{}$, ·375. (28.) 77s. $10\frac{1}{3}$d. (29.) 1·3401+ (30.) 108 days. (31.) £395 3s. 11·76d. (32.) £129 15s. 10d. (33.) £1,000. (34.) 211 inches. (35.) ·00000502. (36.) £60 16s. 0d. (37.) $32\frac{8}{11}$ minutes past 3 o'clock. (38.) £4600. (39.) £69 10s. 0d., £347 10s. 0d. (40.) 4 years. (41.) $\frac{9}{10}$. (42.) 4 days. (43.) $7\frac{1}{2}$ feet. (44.) £200. (45.) 16·01168. (46.) 138 acres, 0 roods, $38\frac{2}{5}$ poles. (47.) £61 4s. 0d. (48.) £3 3s. 0d. (49.) £260 8s. $0\frac{25}{32}$d. (50.) 256 charges. (51.) £1350

0s. 0d. (52.) $56\frac{7}{16}$. (53.) 50 per cent. (54.) 4 filberts worse. (55.) £1 17s. 6d. (56.) 13·02 pints. (57.) 2 hours. (58.) £1 3s. $9\frac{1}{15}$d. (59.) 80. (60.) 73 days. (61.) £675. (62.) ·707+. (63.) 4 needles. (64.) A £30, B £40, C £50. (65.) 7 hours $13\frac{1}{3}$ minutes. (66.) 800 qrs.; cost price 30s. per qr., selling price 36s. per qr. (67.) $1\frac{1}{7}$ hours. (68.) 3 ozs. and 4 ozs. (69.) 8 ozs., 15 dwt., 12 grains. (70.) B receives 6d., C 2s. 6d. (71.) 31·10309 feet. (72.) A $33\frac{3}{5}$ hours, B 24 hours, C $18\frac{2}{3}$ hours. (73.) 3 gallons. (74.) $4\frac{1}{6}$ per cent., 31s. 3d. (75.) 24 minutes and $30\frac{6}{11}$ minutes past 11. (76.) 2s. 11d. (77.) £131 5s. 0d. (78.) 3765, 1506, 1255 and 1004 dollars. (79.) 3722·073+ francs. (80.) 20 yards long 4 yards wide. (81.) £50 10s. 0d. (82.) 5 hours, 7 minutes, 12 seconds. (83.) 6 men, 12 women, 18 boys. (84.) The English hen; 25 per cent. (85.) £3 1s. 3d. (86.) 1 hour, 31 minutes, 40 seconds. (87.) 3 tons, 15 cwt. (88.) 29·76+ yards. (89.) 14s. $7\frac{1}{2}$d. (90.) After $12\frac{1}{2}$ months. (91.) 57·2916. (92.) 60 sovereigns, 180 shillings, 240 fourpences, 300 threepences, 120 pennies, and 360 halfpennies. (93.) £18 4s. 7d. (94.) 300, 260. (95.) 50. (96.) $427\frac{3}{4}$ sq. yards, £3 6s. 9d. (97.) A 12 hours, B 8 hours, C 6 hours. Together $2\frac{2}{3}$ hours. (98.) ·0211. (99.) 35 days. (100.) $5\frac{5}{11}$ minutes past 1.

DICTATION.

The following twelve exercises in dictation have actually been given. The candidate is recommended to keep a book in which any mis-spelled, new, or unfamiliar word should be correctly written. By frequently referring to this book the chances of failure will gradually diminish. An excellent way of impressing a word on the memory is by *writing* the word a number of times, the oftener the better.

The publishers of this book have issued a "Soldier's Spelling Book," which is strongly recommended. Price 6d., Post Free.

OCTOBER, 1888.

EXAMINATION OF CANDIDATES

FOR

FIRST CLASS CERTIFICATES OF EDUCATION.

DICTATION.

Time allowed—Half-an-Hour.

The year 1851, the first of the new half-century, was signalized by an event renowned throughout the world, and which brought together in London the representatives of all civilized peoples. The Great Exhibition in Hyde Park, which opened in May, displayed such an assemblage of wealth and magnificence as mankind had never witnessed before—all classified and arranged under one crystal roof, in a building capable of accommodating a hundred thousand spectators at a time. That memorable summer was the glorious carnival of industry and the arts; and it was notably the season of universal intercourse and brotherhood. As the treasures of all nations were piled in generous rivalry beneath the same roof—so pilgrims from all countries met in peace and good fellowship, and London became the common home of the representatives of the whole industrial world. The original idea of the Great Exhibition is ascribed to the Prince Consort; it was eminently the want of the epoch, and it aroused the enthusiastic energies of labour throughout Europe; it was successful beyond the most sanguine hopes, not merely in the accumulation of untold treasures but in the spread of generous emulation, and the diffusion of artistic and constructive knowledge to an appreciable amount. Paxton, the architect of the building, won a lasting reputation; and numbers of ingenious and talented men, unknown before, emerged from obscurity, and took their proper place in the estimation of their fellows. Of the multitudinous treasures exhibited, the catalogue alone fills a couple of large volumes.

[*Extract from "Old London," Vol. II., page 382.*]

March, 1893.

The Council met, and Clive stated to them his full determination to make a thorough report, and to use for that purpose the whole of the ample authority, civil and military, which had been confided to him.

Clive redeemed his pledge. He remained in India about a year-and-a-half; and in that short time effected one of the most extensive, difficult, and salutary reforms that ever was accomplished by any statesman.

This was the part of his life on which he afterwards looked back with most pride. He had it in his power to triple his already splendid fortune; to connive at abuses while pretending to remove them; to conciliate the good-will of all the English in Bengal, by giving up to their rapacity a helpless and timid race, who knew not where lay the island which sent forth their oppressors, and whose complaints had little chance of being heard across fifteen thousand miles of ocean. He knew that, if he applied himself in earnest to the work of reformation, he would raise every bad passion in arms against him. He knew how unscrupulous, how implacable, would be the hatred of those ravenous adventurers who, having counted on accumulating in a few months fortunes sufficient to support peerages, should find all their hopes frustrated.

But he had chosen the good part; and he called up all the force of his mind for a battle far harder than those he had previously fought.

At first, success seemed hopeless; but soon all obstacles began to bend before that iron courage and that vehement will. The receiving of presents from the natives was rigidly prohibited, and the private trade of the servants of the Company was put down.

MARCH, 1894.

Instructions to the Superintending Officer.

The piece of Dictation is to be read through once in the hearing of the men, in order to make them acquainted with the subject; it is then to be dictated a few words at a time, and finally read over a second time. The whole time occupied in this exercise must not exceed half-an-hour.

N.B.—*Punctuation is to be left to the Candidates; no stops are to be dictated.*

All ancient writers agree in representing the first inhabitants of Britain as a tribe of the Gauls or Celts, who peopled that island from the neighbouring continent. Their language was the same, their manners, their government, their superstition; varied only by those small differences which time, or a communication with the bordering nations, must necessarily introduce. The inhabitants of Gaul, especially in those parts which lie contiguous to Italy, had acquired from a commerce with their southern neighbours, some refinement in the arts, which gradually diffused themselves northwards, and spread but a very faint light over this island. The Greek and Roman navigators, or merchants (for there were scarcely any other travellers in those ages), brought back the most shocking accounts of the ferocity of the people, which they magnified as usual, in order to excite the admiration of their countrymen. The south-east parts of Britain, however, had already, before the age of Cæsar, made the first and most requisite step towards a civil settlement; and the Britons, by tillage and agriculture, had there increased to a great multitude. The other inhabitants of the island still maintained themselves by pasture; they were clothed with skins of beasts; they dwelt in huts, which were reared in the forests and marshes, with which the country was covered; they shifted easily their habitations, when actuated either by hopes of plunder or the fear of an enemy. The convenience of feeding their cattle was even a sufficient motive for removing their seats; and, as they were ignorant of all the refinements of life, their wants and their possessions were equally scanty and limited. The Britons were divided into many small nations or tribes. Each state was divided into factions within itself; it was agitated with jealousy or animosity against the neighbouring states, and wars were the chief occupation of the people.

MARCH, 1895.

Frederic had, from the commencement of his reign, applied himself to public business after a fashion unknown among kings. A love of labour for its own sake, a restless and insatiable longing to dictate, to intermeddle, to make his power felt, a profound scorn and distrust of his fellow-creatures, made him unwilling to ask counsel, or to confide important secrets. The highest functionaries under his government were mere clerks, and were not so much trusted by him as valuable clerks are often trusted by the heads of departments. He was his own treasurer, commander-in-chief, and intendant of public works, his own minister for trade and justice, for home and foreign affairs, his own master of the horse, steward and chamberlain.

Matters of which no chief of an office in any other government would ever hear were, in this singular monarchy, decided by the the King in person. The public business would assuredly have been better done if each department had been put under a man of talent and integrity, and if the King had contented himself with a general control.

In this manner the advantages which belong to unity of design and to the division of labour, would have been to a great extent combined. But such a system would not have suited the peculiar temper of Frederic. He could tolerate no will, no reason, in the State, save his own. He wished for no abler assistance than that of penmen who had just understanding enough to translate and transcribe, to make out his scrawls, and to put his concise "Yes" and "No" into an official form. Of the higher intellectual faculties, there is as much in a copying machine or a lithographic press, as he required from a Secretary of the Cabinet.—MACAULAY.

October, 1895.

The whole aspect and outline of the man is one of originality. An absolute monarch, at the age of twenty-five leaving his kingdom merely to learn how to govern it: a despot determined to educate himself: putting aside power and pleasure for a while that he might gain knowledge—and doing all this against the wills and despite of the dangerous opposition of his subjects—I call this great, I call this wise.

It is an act of self-denial and of far seeing preference of the future to the present which is the chief characteristic, if not the chief constituent, of greatness. And throughout his whole life a curious and profitable spectacle is this man, full of apparent contradictions and yet really throughout consistent. A thorough reformer of the state, an imperfect reformer of himself, and such with penitence: a promoter of education, yet a man of no learning: half savage and yet the civiliser of his people: impatient yet indefatigable; capricious yet self-denying; boundless in magnificent projects yet most sparing in all personal expenses: an inland prince yet giving all his best energies to the creation of a navy: both planning and executing his own projects, even calling into existence the means as well as the objects of his wishes: equally capable of commanding an army or a navy; as well able to make a ship as to be a sailor, to do soldier's work as general's: knowing how to forge iron as well as to rule men; in all handicraft and statecraft equally experienced: so singularly original a man is Peter of Russia. In fact he did what no one had ever done before him: he changed the manners, the laws, and the very residence of an innumerable people.

MARCH, 1896.

This was the turning point of Pitt's life. It might have been expected that a man of so haughty and vehement a nature, treated so ungraciously by the court, and supported so enthusiastically by the people, would have eagerly taken the first opportunity of showing his power and gratifying his resentment; and an opportunity was not wanting.

The members for many counties and large towns had been instructed to vote for an enquiry into the circumstances which had produced the miscarriage of the preceding year. A motion for enquiry had been carried in the House of Commons, without opposition; and, a few days after Pitt's dismissal, the investigation began. Newcastle and his colleagues obtained a vote of acquittal; but the minority were so strong that they could not venture to ask for a vote of approbation, as they had at first intended; and it was thought by some shrewd observers that, if Pitt had exerted himself to the utmost of his power, the enquiry might have ended in a censure, if not in an impeachment.

Pitt showed on this occasion a moderation and self-government which was not habitual to him. He had found by experience that he could not stand alone. His eloquence and his popularity had done much,—very much for him. Without rank, without fortune, without borough interest,—hated by the king, hated by the aristocracy,—he was a person of first importance in the state. He had been suffered to form a ministry, and to pronounce sentence of exclusion on all his rivals,—on the most powerful nobleman of the whig party,—on the ablest debater in the House of Commons. And he now found that he had gone too far.

October, 1896.

The conduct of Elizabeth, who then governed England, is an admirable study for politicians who live in unquiet times. It shows how thoroughly she understood the people whom she ruled, and the crisis in which she was called to act. What she held she held firmly. What she gave she gave graciously. She saw that it was necessary to make a concession to the nation; and she made it not grudgingly, not tardily, not as a matter of bargain and sale, not, in a word, as Charles the first would have made it, but promptly and cordially. Before a bill could be framed or an address presented, she applied a remedy to the evil of which the nation complained. She expressed in the warmest terms her gratitude to her faithful Commons for detecting abuses which interested persons had concealed from her. She died; and the kingdom passed to one who was, in his own opinion, the greatest master of king-craft that ever lived, but who was, in truth, one of those kings who seem to be sent for the express purpose of hastening revolutions. Of all the enemies of liberty whom Britain has produced, he was at once the most harmless and the most provoking. His office resembled that of the man who in a Spanish bull-fight, goads the torpid savage to fury, by shaking a red rag in the air, and by now and then throwing a dart, sharp enough to sting, but too small to injure. The policy of wise tyrants has always been to cover their violent acts with popular forms. James was always obtruding his despotic theories on his subjects without the slightest necessity. His foolish talk exasperated them infinitely more than forced loans would have done.

India, September, 1896.

The Mexican monarch, meanwhile, was a prey to the most dismal apprehensions. It was intended that the embassy above noticed should reach the Spaniards before they crossed the mountains. When he learned that this was accomplished, and that the dread strangers were on their march across the valley, the very threshold of his capital, the last spark of hope died away in his bosom. Like one who suddenly finds himself on the brink of some dark and yawning gulf, he was too much bewildered to be able to rally his thoughts, or even to comprehend his situation. He was the victim of an absolute destiny, against which no foresight or precautions could have availed. It was as if the strange beings who had thus invaded his shores had dropped from some distant planet, so different were they from all he had ever seen in appearance and manners. They were now in the valley. The huge mountain screen, which nature had so kindly drawn round it for its defence, had been overleaped. The golden visions of security and repose in which he had so long indulged, the lordly sway descended from his ancestors, his broad imperial domain, were all to pass away. It seemed like some terrible dream, from which he was now, alas! to awake to a still more terrible reality. In a fit of despair he shut himself up in his palace, refused food, and sought relief in prayer and in sacrifice. But the oracles were dumb. He then adopted the more sensible expedient of calling a council of his principal and oldest nobles. Here was the same division of opinion which had before prevailed. His nephew counselled him to receive the Spaniards courteously, as ambassadors of a foreign prince.

March, 1897.

'Called into action at the most critical and eventful period in the annals, not merely of his country, but of modern times, Pitt firmly and nobly fulfilled his destiny : placed in the vanguard of the conflict between ancient freedom and modern democracy, he maintained his ground from first to last, under circumstances the most adverse, with unconquerable resolution. If the coalitions which he formed were repeatedly dissolved ; if the projects which he cherished were frequently unfortunate, the genius which had planned, the firmness which had executed them, were never subdued ; and from every disaster he rose only greater and more powerful, till exhausted nature sank under the struggle. If the calamities which happened to Europe during his administration were great, the advantages which accrued to his own country were unbounded ; and before he was called from the helm he had seen not merely its independence secured by the battle of Trafalgar, but its power and influence raised to the very highest pitch by an unprecedented series of maritime successes. Victories unexampled in the annals of naval glory attended every period of his career ; in the midst of a desperate strife in Europe he extended the colonial empire of England into every quarter of the globe ; and when the continental nations thought all the energies of his country were concentrated on the struggle with Napoleon, he found means to extend the British dominion over the wide extent of the Indian peninsula. Under his administration the revenue, trade, and manufactures of England were doubled, its colonies and political strength quadrupled ; and he raised an island in the Atlantic, once only a remote province of the Roman empire, to such a pitch of grandeur as to be enabled to bid defiance to the world in arms.

England had made good use of this extraordinary combination of advantages during the whole course of the contest. Her industry, constantly protected alike from foreign aggression and domestic spoliation, had flourished amidst the revolutionary devastation, or military oppression of other nations; her agriculture, keeping pace with the rapid growth of her population, had even outstripped the wants of the people, and for the first time, for nearly a century, had rendered the empire, in ordinary seasons, independent of foreign supplies of food; while her commerce and manufactures, enjoying a virtual monopoly of all the lucrative intercourse which the dreadful contest that was raging had left to mankind, though inconsiderable in amount to what they have since become, were attended in general with large profits, and occasioned a vast accumulation of wealth in a comparatively small number of hands. But though due weight is by no means to be denied to these concurring circumstances, they were not the most important causes which conspired to produce this result; they merely brought to maturity the crop prepared by centuries of previous regulated freedom, protected industry, and natural advantages. And all these causes, powerful as they were, would have failed in producing the result if they had not been aided at the decisive moment by a noble constancy in the government and spirit of the people, which made them face difficulties and undertake burdens which would have been deemed unbearable in any other age or country, and poured forth long accumulations of British wealth in the cause of humanity, with a profusion which must render this the most glorious and animating of our history.

While the states were thus severally preparing for the final struggle between Revolutionary and Conservative principles, the Allied Sovereigns adopted a measure which tended to elevate their cause.

At length the terrible purification was accomplished; and the second civilization of mankind commenced, under circumstances which afforded a strong security that it would never retrograde and never pause. Europe was now a great federal community; her numerous states were united by the easy ties of international law and a common religion. Their institutions, languages, manners, tastes in literature, modes of education, were widely different. Their connection was close enough to allow of mutual observation and improvement, yet not so drawn together as to destroy the idioms of national opinion and feeling.

The balance of moral and intellectual influence thus established between the nations of Europe, is far more important than that of political power. Indeed, we are inclined to think that the latter is valuable principally because it tends to maintain the former. The world has thus been preserved from uniformity of character, fatal to all improvement. Each part of it has been illuminated with light reflected from every other. Competition has produced activity where monopoly would have brought sluggishness. The number of experiments in moral science which the speculator has an opportunity of witnessing, has been increased beyond all calculation. Society and human nature, instead of being seen in a single point of view, are presented to him under ten thousand different aspects. By observing the manners of surrounding nations, studying their literature, comparing it with that of his own country and of the ancient republics, he is enabled to correct those errors into which the most acute men must fall when they reason from a single species to a genus. He learns to discriminate between exceptions and rules; to trace the operation of disturbing causes; to separate those general principles, which are always true and everywhere applicable, from the accidental circumstances with which in every community they are blended.

As the Scots Greys passed through and mingled with the Highlanders, the enthusiasm of both corps was extraordinary. They mutually cheered. "Scotland for ever!" was their war shout. The smoke in which the head of the French column was enshrouded had not cleared away when the Greys dashed into the mass. So eager was the desire, so strong the determination of the Highlanders to aid their compatriots in completing the work so gloriously begun, that they were seen holding on by the stirrups of the horsemen, while all rushed forward, leaving none but the disabled in the rear. The leading portion of the column soon yielded to this infuriated onset; the remainder, which was yet in the act of ascending the exterior slope, appalled by the sudden appearance of cavalry at a moment when, judging by the sound of musketry fire in front, they had naturally concluded that it was with infantry alone they had to contend, were hurled back in confusion by the impetus of the attack.

The dragoons, having the advantage of the descent appeared to mow down the mass, which, bending under the pressure, quickly spread itself outwards in all directions.

Yet, in that mass were many gallant spirits, who could not be brought to yield without a struggle, and these fought bravely to the death; not that they served to impede, but only to mark more strongly the course of the impetuous torrent as it swept wildly past them, presenting to the eye of the artistic observer those streaks which, arising from such partial and individual contests, invariably characterize the track of a charge of cavalry. Within that mass, too, was borne the imperial eagle of the 45th Regiment, proudly displaying on its banner the names of many a victory.

COPYING MANUSCRIPTS.

COPYING MANUSCRIPTS.

The publishers of this work have issued a book which contains full instructions on this subject, as well as on the system of hand-writing as taught in Army Schools. It is strongly recommended. Price 2s., post free.

Candidates should particularly note (1) That all abbreviations, except dates, are to be written *in full*.

(2) That *correctness* is of more value than the amount of the manuscript which is copied. Note that *one-half* of the exercise *correctly* and neatly written will secure success.

A War Office letter has recently been circulated which concludes by instructing army schoolmasters "to impress upon all candidates that it is more to their advantage to leave a portion of the exercise unfinished than to slur over the latter part with a view to completing the paper."

KEY TO COPYING MANUSCRIPTS.

KEY TO COPYING MANUSCRIPT.

I.

Report on Alterations and Improvements proposed to be made in the Ventilating Channels over the House of Commons. The ventilating pipes are all collected into two main horizontal pipes which are fixed in the upper portion of the roof. As there is under them, and between them and the wooden ceiling, a floor of tiles and cement arches, I recommend that they be left undisturbed, for I do not see that they could be rendered safer than they are at present. But their mouths, which now open into the ventilating chamber over the lobby, should I think be connected more directly with the ventilating shaft, so that its draught should be always acting with certainty on them, and that the noxious products which they discharge should be carried into the shaft without inconveniencing the attendants in the ventilating channels.

The Partitions for forming Ventilating Channels in the Roof.

At present these partitions are somewhat complex in their arrangement, because they were erected in order to provide chambers of ingress for fresh air to the ceiling, as well as for egress of vitiated air from it. Moreover they are of lath and plaster, and no doubt their woodwork is very dry and combustible. I recommend that they be entirely removed, and that a single central channel for discharge of vitiated air be formed in lieu of the complex channels now existing. In order to form this channel I should advise that casings of sheet-iron be fixed to the sloping ties of the iron roof, riveting those sheets together at the joints and securing them in their places by hook bolts to the principals, and providing such stiffening ribs as may be necessary to make them firm, and to retain their shape. The outer portions of the roof chamber are already floored with tile and cement, and the sheet-iron casing being made good to this flooring, the whole of the necessary channels would be formed without any combustible materials.

Stairs, Gangways, and Valves in Roof.

At present these are of wood, and therefore liable to the same objections as the partitions. I should advise that they be entirely removed, that the gangways should be formed of light iron gratings, with hand-rails of iron tube, that the stairs for giving access to different levels be light iron ladders, and that the valves be of sheet-iron with stiffening ribs.

II.

Earl Russell to Mr. Drummond Hay.

(Extract) Foreign Office, *October 10th, 1861.*

It appears from the communication which Mr. Forde has made, verbally, to me, through Mr. Layard, that the capitalists in this country, to whom he has applied with reference to the loan which the Sultan of Morocco is desirous of contracting in England to enable him to meet the demands of Spain, evince much hesitation as to embarking in such an undertaking, unless they can obtain, in some shape or other, collateral security for the fulfilment of the conditions under which the loan may be contracted.

The security which they would naturally prefer would be the guarantee of the British Government; but this, as you are well aware, Her Majesty's Government are not prepared to give. They could not do so without the consent of Parliament, and the Legislature of this country is decidedly opposed, on principle, to contracting a guarantee of that description, and would not consent to do so except under special circumstances, which do not appear to exist in the present case.

Mr. Forde, however, infers that the success of his endeavours to procure a loan might be much facilitated if the Emperor of Morocco were, by treaty, to engage to assign to an agent, to be named by His Majesty, the revenue set apart for meeting the charges for interest and sinking fund of the loan. Such an assignment would bear the character of an international engagement between England and Morocco, and, although it would not in any way bind the British Government to make good any deficiencies in the revenues set apart for the purpose, it would give an assurance to the contractors that, at least as far as the revenue went, it would be faithfully appropriated to the purposes of the loan. For it would be provided in any such treaty between

Her Majesty and the Sultan, that the agent named by Her Majesty for receiving from the Moorish authorities the appropriated revenues should, from time to time, pay over to the contractors of the loan a sufficient sum to meet the charges thereof for interest and sinking fund, and, if any balance should remain after doing so, should pay over such balance to the Moorish Treasury.

Her Majesty's Government being anxious to contribute, as far as they can properly do so, to extricate the Sultan from his present difficulties, are prepared to adopt Mr. Forde's suggestion.

The revenue to be set apart for the purposes of the loan is that half of the custom duties levied in the Moorish ports which still remain unpledged to the Spanish Government, and Her Majesty's Government understand that the Sultan is prepared to assign this revenue as security to the contractors.

III.

Memorial.

We, the undersigned British residents and visitors in Florence, most respectfully call the attention of your Excellency to the following circumstances.

On the 15th current, Dr. McCarthy, a British resident at Pisa, was stabbed by a facchino from the railway station, in consequence, as is understood, of a refusal to pay an unjust demand, and died of the wounds so inflicted on the following Sunday.

We believe that such a lamentable event was in consequence of the absence of all regulation regarding the payment of such facchini.

As a similar want of system has long existed in Florence, from which the British residents and visitors, and indeed all classes, have been put to serious inconvenience, and even personal risk, we are apprehensive that unless some effectual regulations are adopted, the like unhappy results may be here experienced.

Influenced by this feeling, a meeting of British residents and visitors in Florence has been held, at which it was determined respectfully to memorialize your Excellency, requesting you to adopt such measures as in your wisdom may seem best calculated to regulate the payment of porters, and thus in a great degree to prevent the occurrence of such deplorable collisions at Florence.

We do not bring this grievance under your Excellency's notice as of recent origin, and we feel convinced that your Excellency on

inquiry will be satisfied of the urgency of the case we now venture to bring to your notice.

In conclusion, we trust that while so many other improvements have been introduced under the rule of the present Government, the same benignant care will be extended towards the removal of the evil in question by the establishing of fixed rules of payment for facchini, as we believe to be the case at Turin and Genoa.—On behalf of the meeting.

(Signed) W. M. Compton, *Chairman.*

IV.

Naples, *May 12th, 1860.*

An act of the most barbarous piracy has been perpetrated by a horde of brigands, publicly enlisted and armed, in a not hostile State, under the very eyes of that Government, and in spite of its promises to prevent it.

The Royal Government having been informed of the preparations which were being made in Genoa, Turin, Leghorn, Milan, and Vienna, for an expedition against the kingdom of Naples, hastened to call the attention of the Piedmontese Government to such an outrage against the rights of nations and international obligations. The evasive answers of that Government in the first place, and, secondly, its promises to impede such an expedition, should have sufficed to convince the Royal Government of the sincerity of its assurances and assertions, which confirmed the good harmony and reciprocal policy of non-intervention which we have never ceased to have the intention of preserving.

Nevertheless, the King's Government has continued to watch the plotting of the insurgents, who united themselves in Genoa and Leghorn for a well-known purpose, and has followed their proceedings, the account of which is abridged in the enclosed Memorandum.

Vainly hoping that the departure of those pirates would be prevented after their embarkation in Genoa and Leghorn in three merchant vessels, of which two were Piedmontese and one English, the two first of the said vessels, having started from Leghorn, directed their course to the port of Marsala, where they arrived yesterday without any flag, and were preparing to land the bands which they had on board, when the two Royal ships of the

squadron cruising near opened a fire on the aggressors. But the fire was obliged to be suspended to give two English steamers, which had arrived a few hours before, time to take on board their officers who were on shore, and when these were embarked, the steamers put to sea, and then only was the firing on those pirates resumed, nevertheless without being able any more to impede their landing in Marsala, city of the Province of Trapani.

With this sketch of the scandalous attempt, the disastrous consequences of which, in our insular dominions, where the insurrection had hardly been repressed, the short time does not permit us to foresee, the Undersigned, charged with the portfolio of Foreign Affairs, has the honour to communicate to Mr. Elliot, &c., &c., the details of the occurrence in order that he may inform his Government; and in order that, whatever the consequences may be of an attempt perpetrated against all right, in violation of international law, and by reason of which Italy may find itself plunged in the most bloody anarchy, comprising at the same time the whole of Europe, the responsibility of such an act may not fall on any others than the authors, the aiders, and abettors of the barbarous invasion which has taken place.

(Signed) CARAFA.

V.

Mr. Layard to Safvet Pasha.

THERAPIA, *June* 11th, 1887.

SIR,

I duly transmitted to Her Majesty's Government your Excellency's note of the 15th April last, in reply to the joint representations made by the British and French Governments, on the 17th February last, in favour of the bond-holders of the Turkish Loan of 1854.

The Porté was urged, in the note addressed by Her Majesty's Chargé d'Affaires to your Excellency in pursuance of his instructions, to come to some satisfactory agreement with them, and Her Majesty's Government expressed their willingness to grant their good offices to facilitate its conclusion. Her Majesty's Government have now learnt with much regret your Excellency's answer. They believe that the Turkish Government has needlessly added to its difficulties by leaving unsettled a question which appears to admit of an amicable settlement.

As your Excellency is no doubt aware, certain proposals were made through me by his Excellency the Minister of Finance to Her Majesty's Government as to the Egyptian tribute, which might enable the Turkish Government to raise a loan in England or elsewhere. Her Majesty's Government feel great difficulty in replying to the questions addressed to them on this subject so long as the Turkish Government is unwilling to entertain favourably the representations made to it in February last. They believe that the proposal then laid before the Turkish Government would, if accepted, satisfy the bond-holders of 1854, and would, at the same time, obviate the inconvenience now arising from the method in which provision is made for paying the interest and sinking fund of the Guaranteed Loan of 1855. Its acceptance would satisfy the requirements of the British and French Governments, and would relieve the Porte from embarrassing questions, which must cause needless irritation and anxiety as long as they remain unsettled. It would, at the same time, cause an actual saving of money, inasmuch as the Egyptian tribute would suffice for the demands to be made on account of the three loans, whereas, at present, not only are the bond-holders of 1854 (to say nothing of those of 1871) profoundly dissatisfied, but, over and above the amount of the tribute, the Turkish Government has half-yearly to provide a certain sum out of its general revenue to meet the interest of the Guaranteed Loan. This issue is only made, moreover, after urgent representations, to which the Guaranteeing Powers, with great regret, feel themselves under the necessity of having recourse, and the sinking fund of the Loan of 1855 is not provided at all.

A more unsatisfactory state of things could hardly be imagined, and Her Majesty's Government trust that the Porte will, in its own interest, apart even from any other consideration, bring it to a speedy settlement.

I am consequently instructed by Her Majesty's Government to urge upon the Turkish Government to reconsider its decisions conveyed in your Excellency's note of the 25th April last.

I have the honour to be,

Sir,

Your obedient servant,

(Signed) A. H. LAYARD.

VI.

The Secretary to the Treasury to the First Commissioner of Works.

TREASURY CHAMBERS, *January 14th, 1869.*

SIR,

The Lords Commissioners of Her Majesty's Treasury have had before them your letter of the 4th inst.

Their Lordships desire me to state, in reply, that they are pleased to sanction the new arrangement of the Secretariat of the Department under your control, according to the recommendation contained in your said letter, namely, that it should consist of a Secretary, to have the management of all financial matters and the general correspondence of the Department, together with the supervision and control of the office, under direction of the First Commissioner, and likewise the management of the public parks and gardens; and a Secretary of Works and Buildings, who should have the superintendence of the works and buildings undertaken by the Department, the supervision of all architects' plans and estimates, and a general control over the expenditure connected with public edifices, under the charge of the Office of Works, it being understood to be a part of his duty to act generally under the direction of the First Commissioner in matters connected with public works.

My lords are of opinion that a salary of £1,000 a year should be assigned to the Secretary, and £1,000 a year to the Secretary of Works and Buildings.

I am to add that their Lordships are pleased to appoint Mr. George Russell to the office of Secretary, and Mr. James Fergusson to that of Secretary of Works and Buildings, the salary in each case commencing from 1st instant, and that they have given instructions for the preparation of the necessary warrants of appointments.

I am,
Sir,
Your obedient servant,
(Signed) G. A. HAMILTON.

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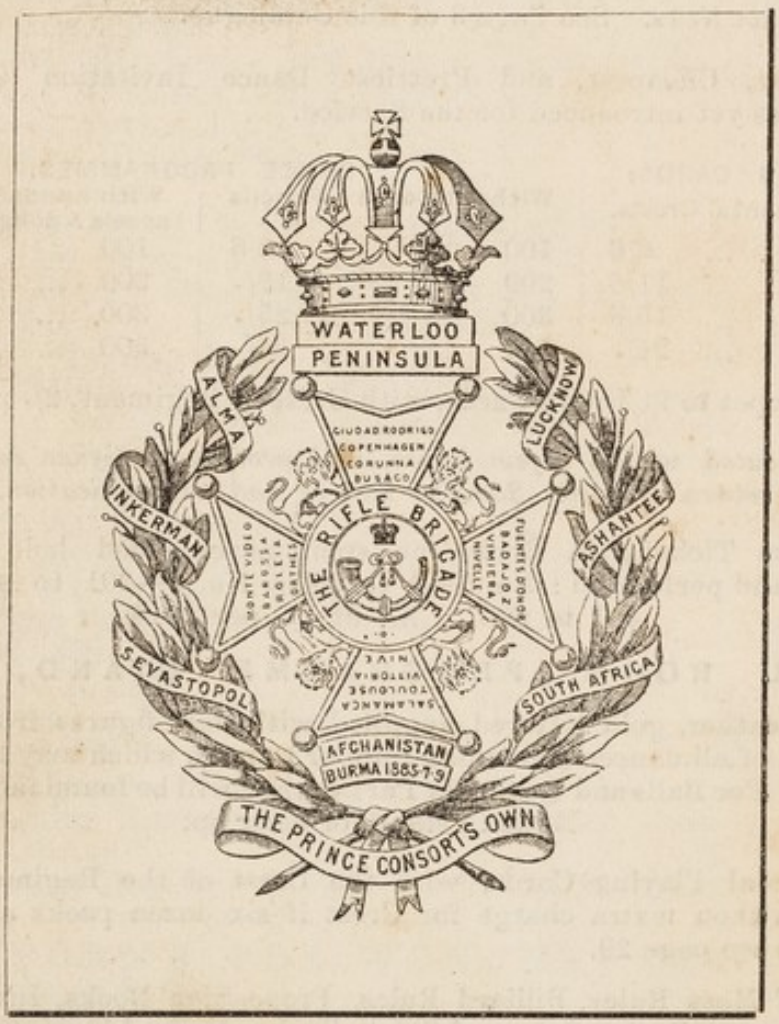

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