

CHAPTER 1

THE FOUR RULES

Revision of Addition, Subtraction, Multiplication and Division of Numbers and Quantities

A quantity denotes a number of some definite unit or object; 10 tons, 15 seconds, 12 shillings are quantities.

Every calculation that has to be made to obtain the answer to a problem involves one or more of the above four rules.

Accuracy, therefore, is at all times essential. Always check an answer and wherever possible do this by an alternative method.

For example, when working an addition sum, do the addition, when checking, in a different order, so that any error made during the first calculation is less likely to be made in the second.

In multiplication, change the order of multiplying, when checking, for the same reason.

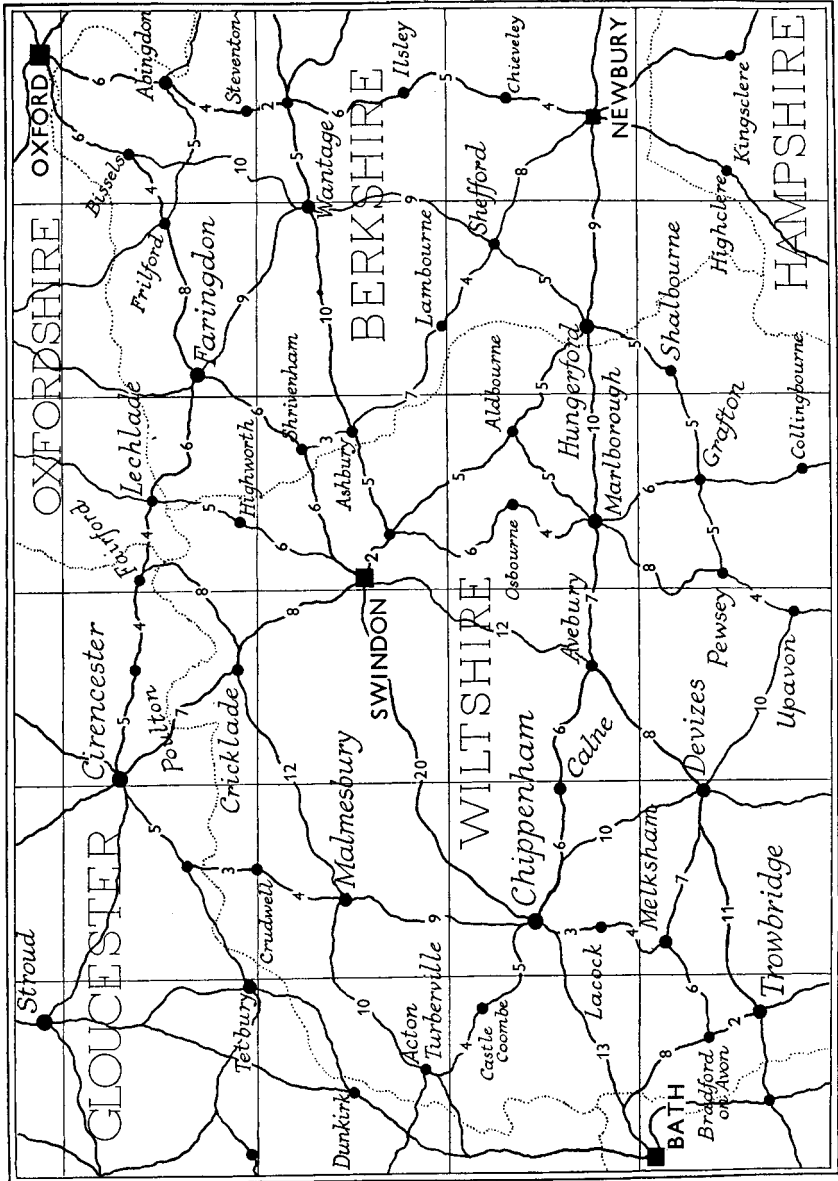
Extra care must be taken with problems that call for the use of large numbers, such as statistics of crops and acreage, census of population, etc.

EXERCISE 1

Where necessary, reference should be made to the road map on p. 2 (fig. 1).

1 (A). The wheat harvest in Great Britain, during 1938, amounted to 1,959,000 tons. In 1939 the yield was 317,000 tons less. What was the weight of the wheat crop in 1939?

Cambridge University Press
978-1-316-61266-8 — Modern Mathematics
S. A. Walling, J. C. Hill
Excerpt
[More Information](#)



Numbers represent miles between black dots.

Fig. 1

THE FOUR RULES

2 (Tr). You are in charge of a motor van and have to drive from Oxford to Bath. What would be your road mileage if you travelled (a) via Cirencester, (b) via Swindon, (c) via Hungerford?

3 (T). If the internal bore of a cast-iron main sewer is 15 in., and the thickness of metal is 1 in., what is the external diameter of the sewer?

4 (Tr). A vessel left Plymouth bound for Alexandria, a distance of 2872 nautical miles (n.m.). The distance from Plymouth to Lisbon was recorded as 770 n.m.; from Lisbon to Gibraltar as 302 n.m.; from Gibraltar to Malta as 980 n.m. What is the distance from Malta to Alexandria?

5 (B). If a 5-ton truck can carry 1600 bricks when fully loaded and takes 17 full loads from a stack of 50,000 bricks, find (a) the number of bricks delivered, (b) the number remaining in the stack.

6 (T). From the measurements given in fig. 2, of the dimensions of a screwed spindle, find the thickness of the packing gland.

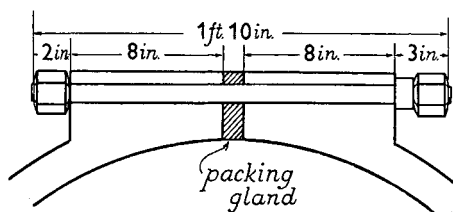


Fig. 2

7 (A). In 1938 there were 41,100 acres under sugar-beet in the county of Norfolk. If the yield of beet worked out at 15 tons per acre, what was the total tonnage of sugar-beet raised in the county for that year?

THE FOUR RULES

8 (Tr). What would be the weekly mileage involved in a daily return run between Newbury and Bath if there is no Sunday service?

9 (B). If a lorry can carry 1600 bricks and four of such lorries are under contract to deliver 44,800 bricks to a builder, how many trips must each lorry make if they all make the same number?

10 (A). In eight successive weeks a poultry keeper collects the following numbers of eggs: 1484, 1491, 1466, 1501, 1492, 1533, 1538, 1577. In this period he uses 226 eggs for his own household needs, and sells the rest. How many dozen eggs does he sell?

11 (T). For the artificial lighting of a certain workshop it is estimated that 17,440 candle-power will be required. How many lighting 'points' will be needed if lamps of 160 candle-power are to be used?

12 (B). A contractor for a drain-laying operation estimates that the work will require 23 men working for 13 days at 8 hr. a day. How many man-hours of labour does this represent in his estimate of costs?

13 (Tr). A delivery van makes a regular round trip once a day, for 6 days a week, from Cirencester through Malmesbury, Cricklade and Fairford. If the mileage recorder, before setting out on Monday morning, reads 24,334 miles, what would you expect the reading to be at the end of the round on the following Saturday?

14 (B). The estimate for plastering a wall is £3. 6s. If the wall is found to measure 24 sq.yd. in area, what is the price per square yard for the plastering?

THE FOUR RULES

15 (A). The following table gives the total area of agricultural land (T.A.A.) in the five counties in S.W. England. The area not under cultivation, being mountain and heath (M. and H.), is also shown:

County	T.A.A. (acres)	M. and H. (acres)
Cornwall	721,000	111,000
Devon	1,438,000	303,000
Somerset	891,000	92,000
Wiltshire	743,000	133,000
Dorset	490,000	61,000

Find (a) the total agricultural area in the five counties of S.W. England, (b) the total area under mountain and heath, (c) the total area under cultivation.

16 (Tr). What would be the amount of petrol used in a return journey by lorry from Lechlade to Upavon via Wantage and Hungerford if its petrol consumption is 8 miles per gallon?

17 (B). Best Marchioness slates are usually cut so that 1200 slates weigh 48 cwt. (a) How many of these slates would weigh 1 cwt.? (b) What weight of slates must be supported on a roof carrying 850 of these slates?

18 (T). A box-making machine turning out fourteen finished boxes every 3 min. is operating for 8 hr. daily. If the weight of material required for each box is 1 lb., what weight of material, in tons, is used in a week of 5 working days?

THE FOUR RULES

19 (Tr). A flying-boat sets out at 06.00 hr. on 15 June to fly from New York to Archangel in Russia. The route is given by the following table:

From	To	Distance in nautical miles
New York	St John's	1080
St John's	Reykjavik	1060
Reykjavik	Murmansk	1560
Murmansk	Archangel	300

If the flying-boat flies throughout at a ground speed of 160 knots, at what time should it be due at Archangel, allowing 8 hr. for landing and refuelling on the journey?

20 (A). The following table shows the number of head of cattle, sheep and pigs for England and Wales in 1928 and in 1939:

	Cattle	Sheep	Pigs
England (1928)	5,208,376	12,889,126	2,724,659
Wales (1928)	818,057	4,000,484	246,384
England and Wales together (1939)	6,770,000	17,986,000	3,515,000

- (a) From this table find the respective totals of (i) cattle, (ii) sheep, (iii) pigs, for England and Wales together in 1928.
 (b) From the totals given for 1939 find and state the increase or decrease in each kind of livestock as compared with 1928.

21 (B). A brick pillar has to be constructed, forty courses high with thirty-two bricks in each course. If each brick weighs

THE FOUR RULES

7 lb., which of three available lorries could be used to deliver the bricks in one load, a 30-cwt., a 3-ton or 4-ton lorry?

22 (Tr). On a straight section of railroad the permanent way is laid with rails each 30 ft. long, and the steel in each rail weighs 84 lb. per yard length. Find (a) the total number of 30 ft. rails, (b) the total weight in tons of the rails, in one mile of straight single-track permanent way.

23 (Tr). A 3-ton lorry is loaded with eighteen bundles of steel rods, each bundle weighing 2 cwt. How many kegs of white lead each weighing 56 lb. can be added to the load without overloading the lorry?

24 (T). A certain type of rotary press can print, fold, count and stack 5400 copies of newsprint per hour. What is the smallest number of such machines that will be needed to print 500,000 copies of the paper, if each machine operates for 4 hr. non-stop?

CHAPTER 2

FRACTIONS

Revision of Vulgar Fractions

A fraction is always a part of something and the number above the line is called the *numerator* and that below the line the *denominator*. It is the number below the line that decides the name of the fraction. For example, $\frac{3}{16}$ denotes three-sixteenths of one whole number (unity) and $\frac{5}{32}$ in. denotes a length which is five thirty-seconds of 1 in.

Any fraction may be multiplied both in the numerator and the denominator by the same number without changing its value. All that is changed is its name, i.e. $\frac{5}{16} = \frac{5 \times 4}{16 \times 4}$ (twenty sixty-fourths).

In the same way, any fraction may be divided both in the numerator and the denominator by the same number without altering its value. In fact, no fraction which can be so divided by any number should be left without the division being made.

The fraction is then said to be reduced to its *lowest terms*.

Addition and Subtraction of Fractions

Fractions may be added to or subtracted from one another just as whole numbers are, except that before doing so it is necessary to bring all fractions to the same name.

Example. What is the value of $\frac{15}{16} + \frac{5}{8} - \frac{1}{2}$? By bringing them all to sixteenths we have

$$\frac{15}{16} + \frac{10}{16} - \frac{8}{16}.$$

[8]

FRACTIONS

This is usually written, for convenience, as

$$\frac{15+10-8}{16} = \frac{17}{16}.$$

In this case we have a fraction with its numerator greater than the denominator (called an *improper fraction*). By dividing by 16 we obtain the answer $1\frac{1}{16}$, which is called a *mixed number*.

When adding or subtracting mixed numbers, find the sum or difference of the whole number part first and then deal with the fractions.

Example. What is the value of

$$4\frac{3}{16} + 2\frac{1}{4} - 3\frac{7}{8}?$$

Taking the whole number part first, we have

$$6 - 3 + \frac{3}{16} + \frac{1}{4} - \frac{7}{8} = 3 \frac{3+4-14}{16} = 3 \frac{7-14}{16}.$$

We cannot subtract 14 from 7 so we ‘borrow’ one of the three whole numbers (leaving 2) and write it as $\frac{16}{16}$.

$$\text{So that, } 3 \frac{7-14}{16} = 2 \frac{16+7-14}{16} = 2\frac{9}{16}.$$

In actual practical measurement, apart from scientific and microscopic measurement, only very few fractions are used and they are almost invariably half, quarters, eighths, sixteenths, thirty-seconds and sixty-fourths, and, in accurate machining, thousandths. Nuts and bolts measure $\frac{5}{8}$ in., $\frac{3}{4}$ in., $\frac{1}{2}$ in. and so on. Commodities, when sold by weight, are sold in their appropriate units (cwt., lb., etc.) and the fractions, if they are needed, are $\frac{1}{2}$ and $\frac{1}{4}$. No one buys $\frac{3}{11}$ lb. of nails.

In industry you would never be troubled with such problems as $\frac{1}{2} \cdot \frac{3}{9} + \frac{1}{5} \cdot \frac{1}{7} - \frac{2}{13}$ and all such types are omitted from these

FRACTIONS

exercises. The addition or subtraction of fractions in industrial work is usually a simple and straightforward operation.

Multiplication and Division of Fractions

When two fractions have to be multiplied or divided the process is very simple. The need for this usually arises from having to alter the scale of a working drawing, or for some similar reason. For example, a drawing may have to be made $\frac{1}{8}$ full size and some of the dimensions of the full-scale object are in fractions.

The rule is: in multiplication always multiply the numerators together to get the new numerator, and the denominators to obtain the new denominator.

In division, invert the fraction by which you are dividing, and then multiply as above; cancelling when possible.

Example.

$$\frac{3}{16} \times \frac{3}{4} = \frac{9}{64}$$

and

$$\frac{5}{8} \div \frac{1}{4} = \frac{5}{8} \times \frac{4}{1} = \frac{5 \times 4}{2} = 2\frac{1}{2}.$$

The last answer, $2\frac{1}{2}$, is perhaps at first sight rather unexpected. But if the problem is considered to mean ‘how many quarters are there in five eighths?’ or better ‘how many times will two eighths divide into five eighths?’ then the answer is seen to be correct.

When multiplying or dividing mixed numbers always change the mixed number into an improper fraction and proceed as before.

Example.

$$2\frac{3}{4} \times \frac{1}{16} = \frac{11}{4} \times \frac{1}{16} = \frac{11}{64}$$

and

$$2\frac{3}{4} \div \frac{1}{16} = \frac{11}{4} \times \frac{16}{1} = 44.$$