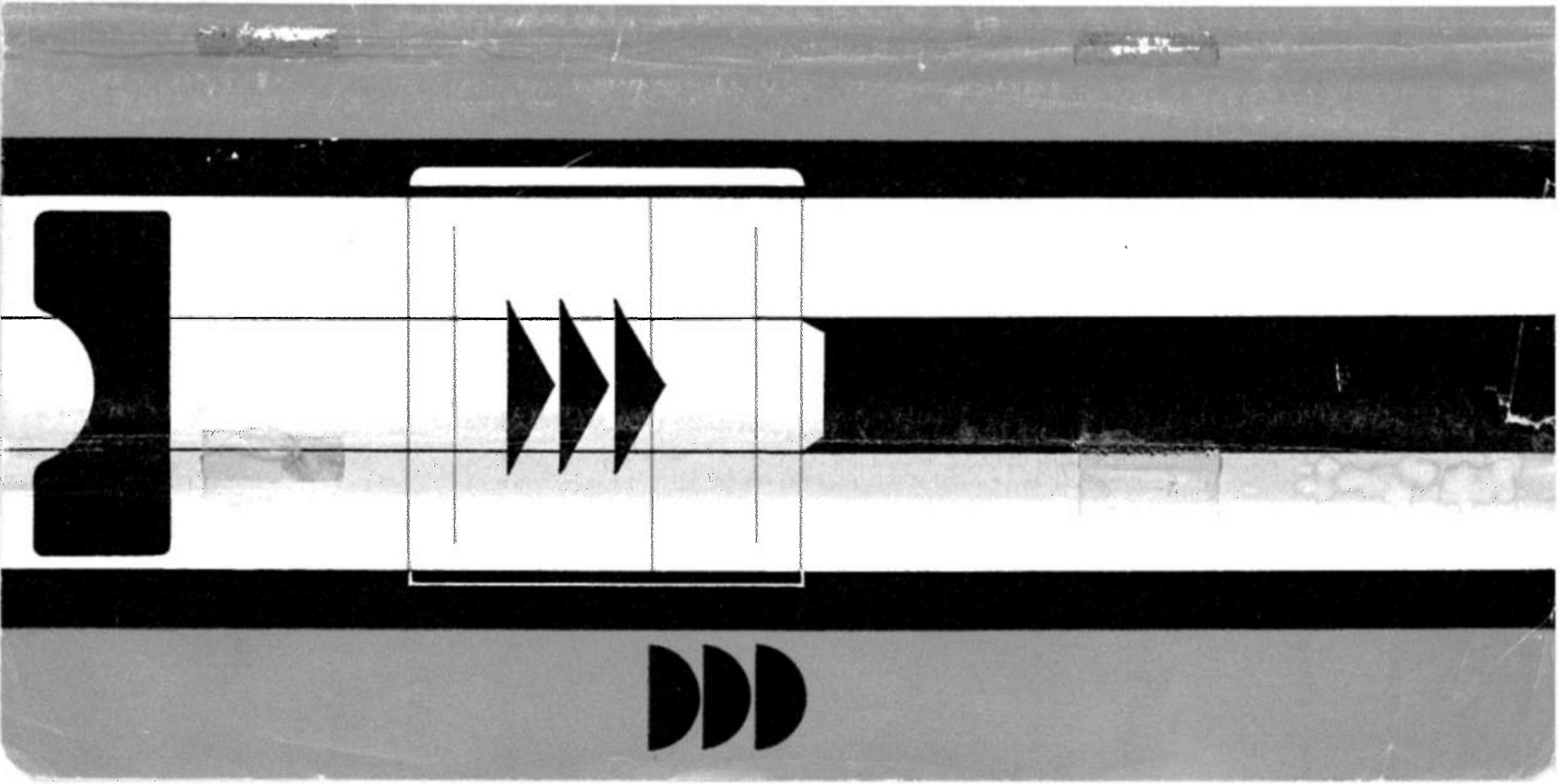
FABER-CASTELL

INSTRUCTIONS

for Use of

CASTELL Precision Slide Rules

"BUSINESS"
No. 1/22 (10" Scale Length)
No. 4/22 (20" Scale Length)
No. 67/22 (5" Scale Length)
No. 111/22 (10" Scale Length)



Contents

Can the Business Man use a Slide Rule to Advantage?

Many a business man, seeing a slide rule in the hands of a technical colleague, has watched enviously the way in which various technical problems were solved. He seldom has any desire, however, to use this labour-saving method for his own calculations, an ancient and deep-rooted prejudice making him see in the slide rule a "technical" device, an "instrument" the operation of which is a mysterious art, requiring a wide knowledge of mathematics.

That the slide rule is based on the laws of logarithmic calculation is no reason why anyone should fear to use it, even though he has no understanding of logarithms. One may be a clever photographer and produce excellent negatives without any understanding of the chemical changes of the process space after. Many motorists have but the most elementary knowledge of the working of internal-combustion engines. Exactly the same thing applies to the slide rule, for it may be efficiently employed without any thought being given to the rules of logarithms or the theory of its operation. Anyone who understands the arithmetic of his own calling will be able to use a slide rule without difficulty.

It may be suggested that a calculating machine could do the same work, but, actually, it has an entirely different sphere of application. Its usefulness lies in its capability of solving large numbers of similar problems, once the plan of calculation for that particular type of problem has been set. The slide rule, on the other hand, is an instrument for individual work, immediately available for any kind of calculation, and for quickly checking results A calculating machine can only solve the one type of problem for which it has been set.

The question put above - Can the business man use a Slide Rule to advantage? - must be answered in the affirmative. The reader should study the explanation that follows, working slowly with concentration, and after every section he should make up a number of examples from his own experience, since proficiency only comes with practice.

How to calculate with the Slide Rule

To understand the essentials of slide rule calculation it is necessary to have a clear understanding of the following:

1. The slide rule is fitted with long series of graduations. We are familiar with graduations from other apparatus, such as the barometer, the thermometer, scales for weighing and, most common, just as we find them on all good rulers. Slide rule graduations differ essentially from these other graduations — they are not spaced evenly, but the spacing becomes narrower as the value increases. This is a peculiarity of logarithmic scales, but this fact need not worry us at all. We shall see later how to read these constantly narrowing graduations.

2. Certain calculations can be carried out with an ordinary rule. In Fig. 1, two equal rules are placed side by side, with their edges touching, so that the addition 35 + 45 = 80 can be read off. The upper rule has been moved so that

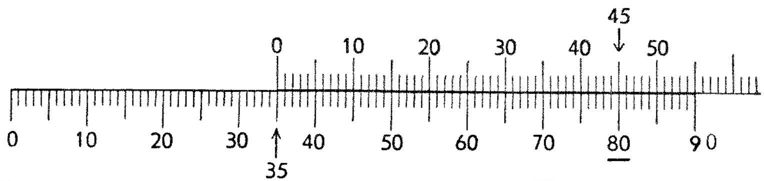


Fig. 1

its beginning, zero, lies against 35 of the lower rule. Under 45 on the upper rule we read the answer, 80, on the lower. In Fig. 2, the procedure is reversed — this is the subtraction 95 — 50 = 45. The reader can easily make up further examples, and if two metric rules are used these numbers may easily be found. Such exercises are useful, because

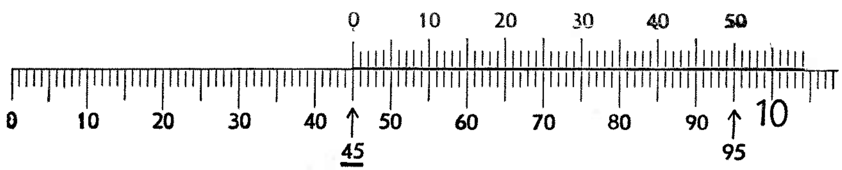


Fig. 2

they prove that calculations can really be done with graduations and, furthermore, give practice in reading graduations. These methods of adding and subtracting are not used in practice, since such operations can be done mentally.

3. The slide rule consists of two scales placed side by side. Because these scales are made up of a series of ever narrowing graduations, being placed according to a logarithmic law, the calculations done with them are not addition and subtraction, but multiplication and division. For instance, we could find the value of $3{\cdot}5 \times 4{\cdot}5$, which is $15{\cdot}75$, (Fig. 3) or calculate $\frac{95}{50} = 1{\cdot}9$. (Fig. 4)

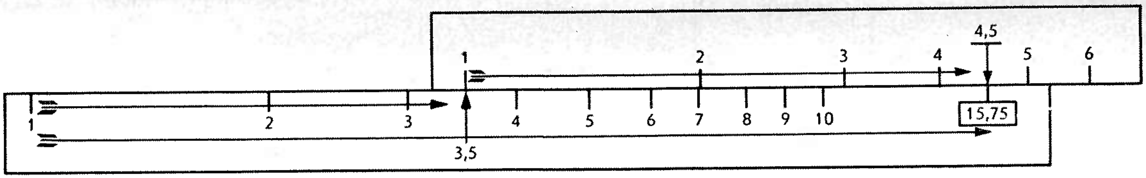


Fig. 3

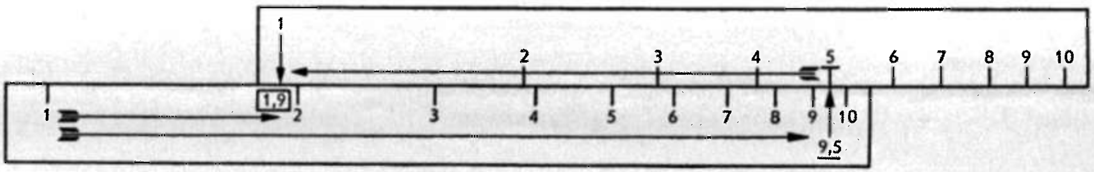
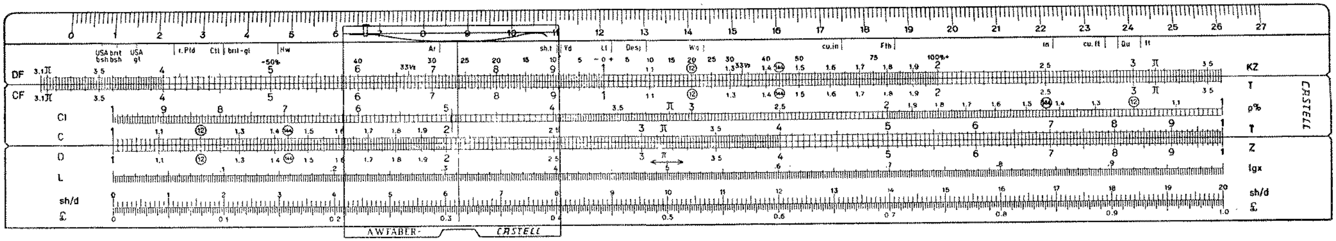


Fig. 4

What constitutes a Slide Rule?

(a) The Body (also known as the stock) (b) The Slide (c) The Cursor
Scales are provided along the body and the slide, from the upper to the lower edge.



The Main Scales

Fig. 5

International Symbols for Graduations		Explanation of Scales	Colour of Scale	Symbol for Calculation of Interest, on right-hand side of Slide Rule
1. Upper edge of body:	**DF**	Basic Scale, "displaced" by 360 (number of interest-days in year) extending from 3·1 via 1 (= 10) to 3·6*	**Black**	P/Int. (interest)
2. Upper edge of slide:	**CF**	ditto	**Red**	Days
3. Centre of slide:	**CI**	Reciprocal Basic Scale (taking the reverse direction, from 10 via 9 to 1)**	**Green**	R⁰/₀ (percentage rate)
4. Lower edge of slide:	**C**	Basic Scale extending from 1 to 10	**Red**	Days
5. Lower edge of body:	**D**	Basic Scale extending from 1 to 10	**Black**	Int. (interest)

All these scales agree with one another and differ merely in the **beginning** of the graduations.

* **displaced** = the scale does not start with the same number as the Basic Scales (C, D), i. e. with "1", but starts with "360", being aligned with 1 on other scales and thus saving a setting operation when multiplying or dividing by 360.

** **reciprocal** = a scale of this kind takes the opposite direction to the Basic Scales (C, D) and therefore has to be read from right to left.

Additional Scales

Bevelled edge: Inches	Inch-graduation	
Upper edge of body: M	fixed marks for the conversion of non-metric measurements and weights	
Upper edge of body: percentage value scale	percentages can be easily found and set	
Lower edge of body: L	logarithmic scale for D (C)	log x
Lower edge of body: sh/d	scale for conversion of sh and d	sh/d
£	into decimals of English £	£
Reverse of slide: LL_1	Exponential scale for compound	$e^{0 \cdot 01 x}$
LL_2	interest calculation from 1·01 to 1·12 and from 1·1 to 3·2	$e^{0 \cdot 1 x}$

The following should be noted:

The slide rule does not show the actual place of decimals to which a number belongs. For example, the 6 shown on the slide rule may equally well denote 0·6, 6, 60, 600, 6000or 0·006 and so forth.* The position of the decimal point is ascertained afterwards, by a rough calculation with round figures. In most practical calculations it is known in advance, so that no further rules for determining the decimal point are required. It is the basic scales C and D that give the clearest idea of the way in which the scales are sub-divided. Once familiar with the graduation of these two scales, we shall be able to understand the others equally well.

All scales marked in red run in the opposite direction (reciprocally) from right to left, the exceptions being the extended supplementary graduations which are provided to enable a calculation to be continued in the case of borderline values just below 1 (beginning of graduation) or just above 1 (which means 10, end of graduation).

Let us now have a look at the basic scales C and D on the front of the slide rule, the reading- and setting-exercises being carried out by means of the long cursor line or the index-1 (beginning of scale) or index-10 (end of scale) as the case may be.

The correct reading of the figures is the most important problem in the use of the Slide Rule. It is basically a **simple** one, when one has looked into it a little more closely. Before conducting any calculations, the user must be clear as to the value of the small individual subdivisions in each portion of the scale.

* An exception is provided by the exponential scales (see top of p. 21).

The Slide Rule of 10" scale length No. 1/22, 111/22, e.g. C, D, CI, CF, DF

A section of the graduation-range from 1 to 2 (Scale C and D)

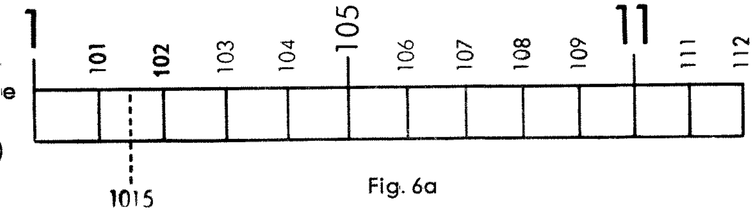


Fig. 6a

From guide-number 1 to guide-number 1·1
10 sub-divisions of 10 intervals each (= 1/100 or 0·01 per graduation mark)

Here an accurate reading can be immediately taken to 3 places (e.g. 1-0-1). By **halving** the space between two graduation marks, 4 figures can be accurately set (e.g. 1-0-1-5). In all cases the final number must then be a 5.

A section of the graduation-range from 2 to 4 (Scale C and D)

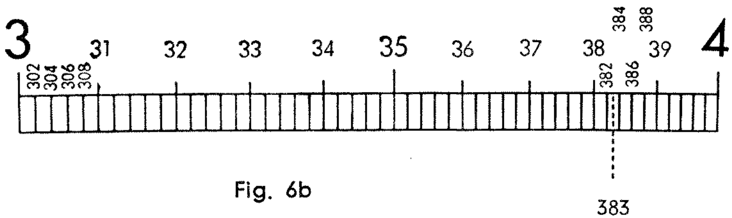


Fig. 6b

From guide-number 3 to guide-number 4
10 sub-divisions of 5 intervals each (= 1/50 or 0·02 per graduation mark)

Here an accurate reading can be immediately taken to 3 places (e.g. 3-8-2). The last number is then always even (2, 4, 6, 8). If the intermediate spaces are halved, this provides the uneven numbers 1, 3, 5, 7, 9 as well (e.g. 3-8-3).

A section of the graduation-range from 4 to 10 (Scale C and D)

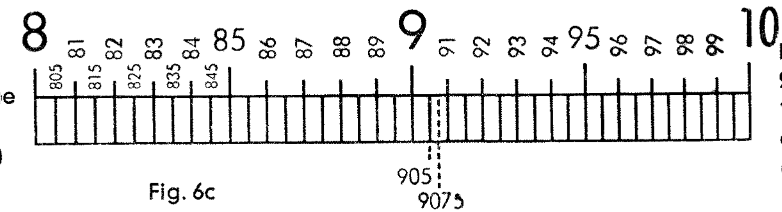


Fig. 6c

From guide-number 8 to 9 and 9 to 10
10 sub-divisions in each case, each of 2 intervals (= 1/20 or 0·05 per graduation mark)

Here an accurate reading can be taken to 3 places, when the last number is a 5 (9-0-5). By halving the intermediate spaces it is possible to take an accurate reading to 4 places. Here again the last number is always a 5 (9-0-7-5).

The Slide Rule of 5" scale length No. 67/22

Reading the Scales

Let us first examine Scales C and D. These are graduated as follows:

from graduation figure 1 to graduation figure 1·2
(Section of scale reading 1 to 2)

From graduation figure 2 to graduation figure 3.
(Section of scale reading 2 to 5)

From graduation figure 5 to graduation figure 7.
(Section of scale reading 5 to 10)

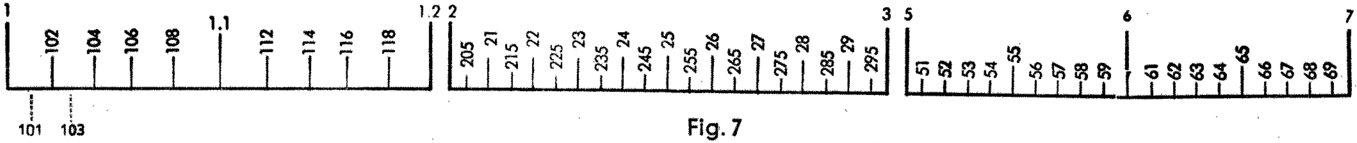


Fig. 7

Each interval is equivalent to 2 subsections. An accurate reading can be taken of the values corresponding to 3 places. The odd numbers are obtained by halving the distance between two graduation marks.

Each interval is equivalent to 5 subsections. This provides an accurate reading of the values corresponding to 3 places, if the last figure is a 5.

Each interval is equivalent to 10 sub-sections. This provides an accurate reading of the values corresponding to 2 places, which moreover are identified by graduation marks.

Other **intermediate values must be estimated.** Example: To set to 318, first find 3-1-7-5 by halving the distance between 315 and 320, and then move the cursor line slightly to the right.

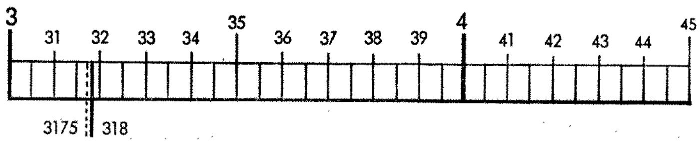


Fig. 8

A certain amount of practice should first of all be obtained in setting and reading the numbers, until one can do so with a fair degree of confidence. For this purpose, use should be made not merely of the cursor but also of the right-hand index figure 1 and left-hand index figure 1 on Scale C. (On Scale B also the right-hand and the left-hand figure 1 constitute index lines when setting values).

When you have become reasonably proficient at reading and setting the values, you can proceed to the use of the slide rule in actual practice.

The Slide Rule of 20" scale length No. 4/22

The separate graduated zones, numbering three, are **not evenly subdivided,** because they become "compressed" as they proceed towards the right. Let us get this clear by examining Scales C and D. These, we find, present the following **picture**: —

The graduated portion 1 to 2 is first of all divided into **ten** subdivisions, marked 1·1, 1·2, 1·3, 1·4 . . . . 1·9. Each of these portions has **ten** further subdivisions, but these latter are not marked with figures, the space available being insufficient. Finally, there is a tiny mark showing the centre, and thus halving spaces between these latter graduation marks. Readings can be taken as follows: 1—1—2—5; 1—3—1—5; 1—4—4—5; 1—5—2—5; . . . . . 1—9—7—5.

In the case of the graduated portion 2 to 5 the first subdivision again consists of **tenths,** but these are not marked with actual figures — except for the values 2, 2·5, 3, 3·5, 4, 4·5 and 5. The positions of the remaining tenths, i.e. the values 2·1, 2·2, 2·3 . . . . 4·7 and 4·8, 4·9 and 5 — just have to be recognised.

Between these tenths, further tenths are shown but the central positions between these latter are not marked. We thus have the following values, starting at "2" and not using the decimal point: 2—0—0; 2—0—1; 2—0—2; 2—0—3; 2—0—4; 2—0—5; 2—0—6; etc., up to 4—9—7; 4—9—8; 4—9—9; 5—0—0.

In the case of the graduated portion 5 to 10 we first of all find that the **tenths** are entered, as before, but between these latter it is only the **fifths** that are shown. This provides us, starting at "5", with the following graduation marks: 5—0—0; 5—0—2; 5—0—4; 5—0—6; 5—0—8; 5—1—0; 5—1—2; etc. as far as 9—9—6; 9—9—8; 1—0—0.

If the Rule is to be set to a number starting with an odd digit, we must set it to a position exactly central between two graduation marks. This can be done with a high degree of accuracy.

Foreword on Calculating

The following pages should only be studied after the reader has become quite proficient in setting and reading on the slide rule scales. To attempt to calculate before the scales are thoroughly understood will only lead to disappointment, since a perfect knowledge of the scales is the most important part of slide rule working.
The idea of solving practical problems with scales that only represent one decimal unit (1 to 10) is puzzling to a beginner. That this is possible, however, will be clear from this example.

A merchant is allowed a rebate of 35% on a price of £ 134. How much is the rebate?

$$\begin{array}{r} 402 \\ 670 \\ \hline 134 \times 35 = 4690 \end{array}$$

Now, without considering any rule for the location of the decimal point, we see that the answer must be £ 46·9. Obviously it cannot be £ 4·69, any more that it can be £ 469. The slide rule gives figures in the answer, but we must place the decimal point ourselves. However, since any error in placing the decimal point makes the answer one-tenth or ten-times the correct one, it should be immediately noticed.

To convert £ 0·9 to shillings, use the scale on the lower edge of the rule. The complete answer is £ 46. 18 s. 0 d.

Addition and subtraction cannot be worked on the slide rule, so we may start at once with proportion, and in that way put our knowledge of reading and setting into practice.

Proportion

We shall begin with a simple example in unitary method, using scales C and D.
The freight charges on a certain consignment of goods for 68 kilometres is £ 6 14 s. 6 d. Find the freight charges for 47 kilometres.

First, change 14 s. 6 d. into a decimal of a pound, using the scale on the lower edge of the rule. This is £0·725. This problem is solved on the slide rule immediately the two values corresponding to each other are brought together on adjacent scales. In this case, 68 km. corresponds to £6·725. Set the cursor line over 68 on scale D; then move the slide along until 6725 on C comes under the cursor line, and is thus in line with 68. This setting is illustrated in fig. 9.

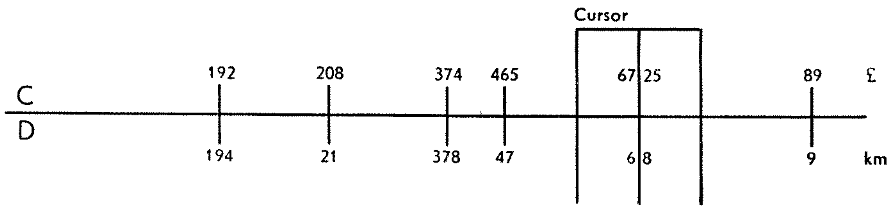


Fig. 9

The two scales, C and D, are now set so that kilometres on D coincide with the corresponding freight charges on C. Move the cursor over 47 km. on D and read the figures 465 on C, under the line. This is £4·65 (£4. 13 s. 0 d.), the charge for freight for 47 km.

From this example, we see that with only one setting, the given distance and its cost, the complete answer is found. With this one setting a table has been formed which shows kilometres on D and the corresponding freight charges on C (Fig. 9). It is only necessary to read off and place the decimal point; above 194 on D we find the graduation 192, showing that the freight for 194 km. is £19·2, or £19. 4 s. 0 d.; in the same way we read for 21 km. the charge is £2·08 (£2. 1 s. 7 d.); for 378 km. it is £37·4 (£37. 8 s. 0 d.); for 9 km. it is £0·89 (17 s. 9½ d.). The position of the decimal point may be seen at once in this example, since the freight in pounds sterling is approximately one-tenth of the distance in kilometres.

If we know that 65 grammes of a certain drug cost $ 2·59, we may determine the cost of any quantity by bringing these two values together on adjacent scales. We may, for instance, take the weight in grammes on Scale D, and the price in dollars on Scale C. Setting the cursor line over 65 on D and moving the slide until 259 on C is under it, fig. 10, we read that 70 gm. cost $ 2·79, 350 gm. cost $ 13·95. Reading may also be done in the reverse order: we may find the weight that can be purchased for a given sum of money by placing the cursor over the money on C and reading the weight on D: for $ 20·00 we can obtain 502 gm., for $ 1·50 we get 37·6 gm.

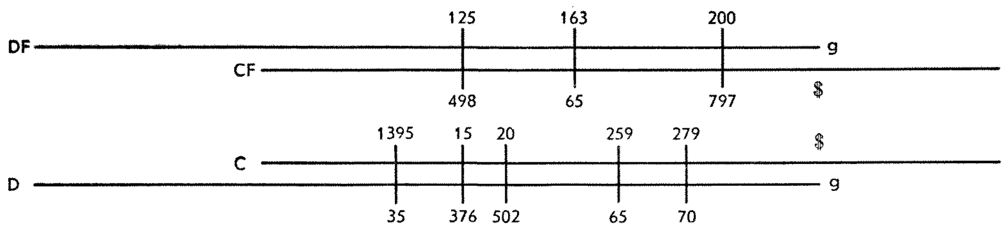


Fig. 10

The price of 125 gm. seems to elude us, however, for the slide projects so far from the rule body that scale C is not near D at the graduation 125. When the lower scales on the "Business" slide rule fail in this way, the answer can be found on the upper scales. Scale DF also gives weight in grammes, and CF the corresponding prices. Under 125 gm. on DF read $ 4·98 on CF. The cost of 200 gm. is $ 7·97, and for $ 6·50 we obtain 163 gm.

The upper and lower scales comprise an inseparable whole; the setting up of a ratio between Scales C and D, as in the last example, automatically brings DF and CF into the same ratio, and all values may be read. Alternatively, the same result is achieved if the setting is done between Scales DF and CF, the answers being found, as before, on both upper and lower scales. In order to obtain the widest possible scale range, care should be taken to see that more than half the slide does not project beyond the rule body. The red figure 1 at the middle of Scale CF should remain inside the body. The foregoing may be summarised in the following rule:

In proportion, the ratio is set between the slide scales and the rule scales. Then all corresponding values will coincide on adjacent scales. More than half the length of the slide should remain inside the rule body.

Further exercises in proportion: —

Given that 1 yard of a certain material costs $ 1·65.

Here the ratio is 1·65 to 1. Set 165 on C to 1 on D, using the left-hand end of D. The graduations of Scales DF and D now represent lengths in yards, and those of CF and C represent prices in dollars. We find that $3^1/_2$ yards (3·5) cost $ 5·78; 30 yards cost $ 49·50; 70 yards cost $ 115·50, 7 yards cost $ 11·55, and 700 yards $ 1155·00, these being read on the upper scales.

Given that 14 U. S. gallons equal 53 litres.

If we set 53 on C to 14 on D, the red figure 1 at the middle of Scale CF would be outside the body of the rule, though even then many conversions would be possible. To obtain a wider scale range, set 53 on CF to 14 on DF. Now we have litres on the red scales and gallons on the black. We find that 100 litres = 26·4 gallons; 125 litres = 33 gallons; 157 litres = 41·5 gallons. Reading in the reverse order, we find that 51 gallons = 193 litres; and 75 gallons = 284 litres. To convert from pounds (avoirdupois) to kilogrammes, given that 75 lb. equal 34 kg., set the number 34 on C to 75 on D. Pounds are now on the black scales and kilogrammes on the red. We find that 53 lb. equal 24 kg.; 30 lb. = 13·6 kg.; 140 lb. = 63·5 kg. In the reverse order, 72·5 kg. = 160 lb.; and 127 kg. = 280 lb.

It is more suitable, in setting this particular ratio, to make 75 lb. equal 34 kg. than to use the form 1 lb. equals 0·454 kg. In the first case we have two graduations coinciding on the scales, while in the second the value 4—5—4 comes in a space between graduations. A table of conversion factors will be found on the back of this slide rule (not No. 67/22).

To set up a table to give the prices of various numbers of an article that costs 2 s. 1 d. per gross. Taking the price in pence, we set 25 on C to 144 on D. Then the number of articles is on the black scales, with the corresponding prices on the red: 19 articles cost 3·3 d. (just over $3^1/_4$ d.), 30 cost 5·2 d. (just under $5^1/_4$ d.), 49 cost 8·5 d. ($8^1/_2$ d.), and reading in the reverse order, for 1 s. 8 d. (20 d.) 115 can be bought, for 1 s. 4 d. (16 d.) 92 articles, etc.

Every business man has his own particular problems which can be solved in the foregoing manner, by setting up ratios between scales. Although only two or three answers may be required from the same setting, it will be necessary to set up the ratio table to find them. As much time as possible should be spent over this section.

Percentages

The determination of percentages is the calculation most frequently employed in business. As this is simply proportion, the answers are found by setting up a ratio between scales. We shall begin with a simple example.

Find 68% of £735.

The ratio is found by taking £735 as 100%. Therefore, set 100% (the right-hand graduation 1) on Scale C to 735 on D (Fig. 11). Then the rates per cent. are on the red scales, and the corresponding sums of money are on the black. Under 68% on C read £500, the required answer, on D. Other percentages of £735 may be read from the rule as it is now set. For instance, 70% is £514, 67% is £492·5 (£492. 10 s. 0 d.). Also, reading in the reverse order, £ 460 is 62·6%, and £530 is 72·1%.

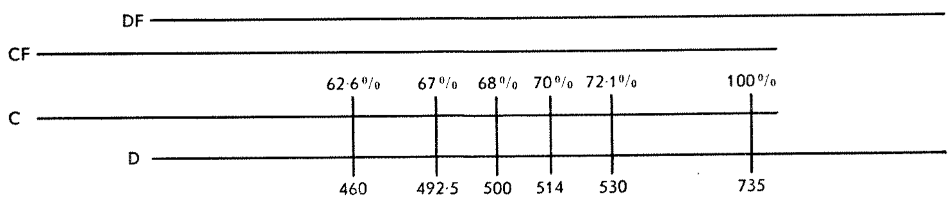


Fig. 11

It will be seen that the lower scales, as now set, do not show less than 13·6%, which is £100, and so the upper scales must be used for anything below this.

The turnover in each of three departments A, B, and C, of a business for a certain period is, A — £375, B — £403, and C — £617. It is required to compare these as percentages.

The ratio is the total turnover to 100%. The total is £1395. Set 1 at the left-hand end of Scale C, which is now 100%, to 1395 on Scale D. The black scales represent the turnover, and the red scales the percentages. Over £375 on Scale D read the figures 269, which can only mean that A's turnover is 26·9%; over £ 403 read 28·9%, for B; and over £ 617 read 44·2%, for department C. These may be checked to see that they add up to 100%.

It is useful to check the answers in this way whenever possible. Sometimes discrepancies are discovered which can be easily rectified after a little consideration.

The expenses of the three departments, in the last example, amount to £ 88. 10 s. 0 d. It is required to divide this between them in proportion to turnover. The total, £ 88·5 is 100%. Therefore, set the right-hand 1 (100%) of Scale C in line with 885 on Scale D. Rates per cent. are on the red Scales, and expenses on D and A. Under 26·9% on C read £ 23·8 (£ 23. 16 s. 0 d.), A's part of the expenses, on scale D. Under 28·9% the reading is £ 25·6 (£ 25. 12 s. 0 d.), the expenses of department B. And under 44·2% the expenses of department C are read as £ 39·1 (£ 39. 2 s. 0 d.). As a check, these three amounts may be added together, totalling £ 88. 10 s. 0 d.

It is equally convenient to apportion the £ 88. 10 s. between the three departments without first finding the percentages. The ratio is the total turnover, £ 1395, to the expenses, £ 88·5. Set 855 on Scale CF to 1395 on DF. Turnover is now on the black scales, and expenses are on the red. Over £ 375 on D read £ 23·8 on C; over £ 403 on D read £ 25·6; and over £ 617 read £ 39·1 (Fig. 12).

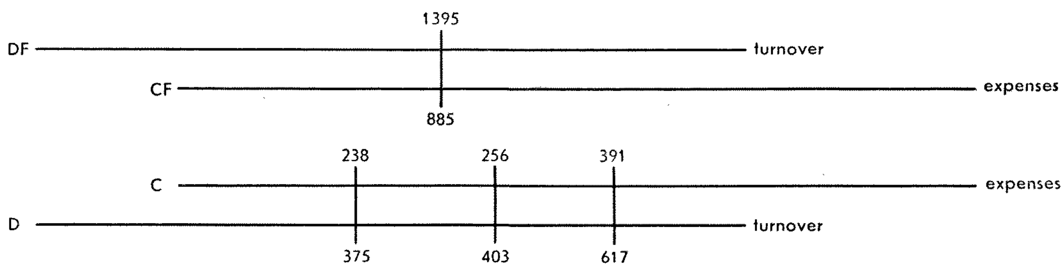


Fig. 12

A	£	375	£	23·8
B	£	403	£	25·6
C	£	617	£	39·1
	£	1395	£	88·5

It is required to increase all the items of a price-list by $6^{3}/_{4}\%$. To find the ratio, it must be understood that every £ 100 (or, if preferred, 100 s.) becomes £ 106·75. These two values must be brought together, the left-hand 1 on Scale C being taken as 100%. Therefore, set 100% (1) on Scale C to 10675 on Scale D (Fig. 13). Now the original prices are on the red scales, and the new, increased prices on the black. What cost £ 3 before now costs £ 3·2 (£ 3. 4 s. 0 d.); 3 s. becomes 3·2 s. (3 s. $2^{1}/_{2}$ d.); £ 3. 10 s. (£ 3·5) becomes £ 3·74 (£ 3. 14 s. 10 d.); 3 s. 6 d. (3·5 s.) becomes 3·74 s. (3 s. $8^{3}/_{4}$ d.); £ 4. 10 s. (£ 4·5) becomes £ 4·8 (£ 4. 16 s. 0 d.); 4 s. 6 d. becomes 4·8 s. (4 s. $9^{1}/_{2}$ d.).

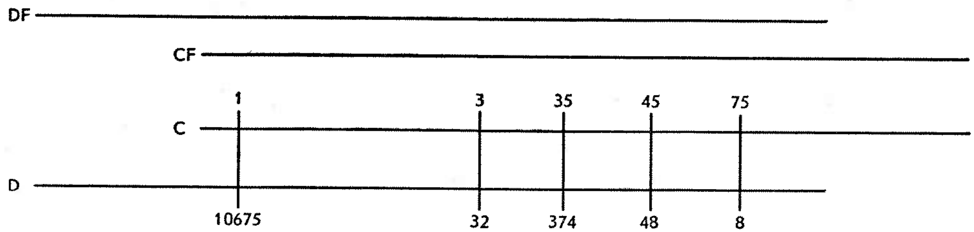


Fig. 13

The items of a price-list are to be decreased by $14^{1}/_{2}\%$. Now £ 100 becomes £ 85·5, which gives the ratio. Set 100% (1) at the right-hand end of Scale C to 855 on D. The original prices are on the red scales, and the decreased prices on the black. £ 4 becomes £ 3·42 (£ 3. 8 s. 5 d.); £ 3. 8 s. 0 d. (£ 3·4) becomes £ 2·91 (£ 2. 18 s. 2 d.); £ 1. 16 s. (£ 1·8) becomes £ 1·54 (£ 1. 10 s. 10 d.); 2 s. becomes 1·71 s. (1 s. $8^{1}/_{2}$ d.); 9 s. becomes 7·7 s. (7 s. $8^{1}/_{2}$ d.); and 10 s. becomes 8·55 (8 s. $6^{1}/_{2}$ d.).

Certain increases and discounts are required on a basic price of £ 6. 13 s. 0 d. The ratio is £ 6·65 to 100%. Set the middle 1 (100%) of Scale CF to 665 on DF, which establishes the ratio between scales. An increase of 3% must be read on Scale DF over 103 on CF, becauses £ 100 becomes £ 103. Thus a 3% increase on £ 6·65 gives £ 6·85 (£ 6. 17 s. 0 d.). An addition of 10½% will be found on Scale DF over 110·5 on CF, and is £ 7·35 (£ 7. 7 s. 0 d.). A deduction of 15% gives £ 5·65 (£ 5. 13 s. 0 d.), this being read on DF over 85 (100%—15%) on CF. The last reading will also be found on the lower scales.

Multiplication

The foregoing problems in proportion will have given the reader considerable practice in reading these scales. Because of this, the remaining methods of calculating will be easy to learn.

We shall begin a simple multiplication, 2 x 3. It was explained on Page 4 how addition can be carried out with two evenly graduated scales. The slide rule scales give, in the same way, the result of multiplication problems. Move the slide to the right until 1 on Scale C comes in line with 2 on Scale D. Now move the cursor over 3 on C and read the product, 6, on D (Fig. 14).

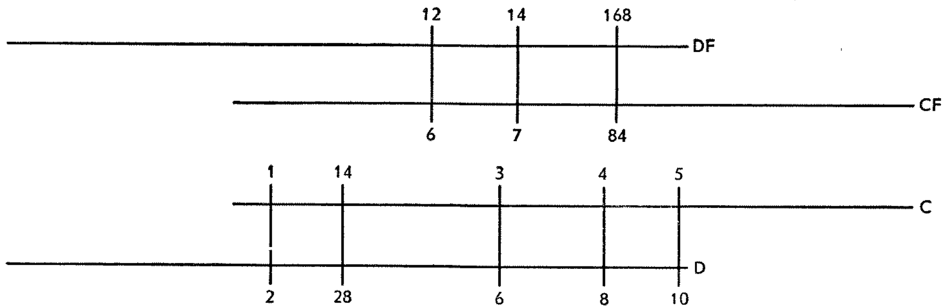


Fig. 14

Here a valuable characteristic of the slide rule becomes apparent; without moving the slide, we may find the product of 2 × 4 = 8 (it is only necessary to move the cursor line over 4 on C to find 8 underneath), also, with the slide in the same position, we can read: —

2 × 14 = 28; 2 × 2·5 = 5; 2 × 0·35 = 0·7; 2 × 440 = 880; 2 × 4·85 = 9·7, and so on.

It might appear that, with this setting, nothing can be read beyond 2 × 5 = 10, since the lower rule scale does not extend further to the right. The missing graduations, however, will be found on the upper scales — above 6 on Scale CF, for instance, read 12 on Scale DF. The second factor of the multiplication is on the slide scale, CF or C, while the product is on the rule scale, DF or D. Thus the following may be found: —

2 × 70 = 140; 2 × 0·84 = 1·68; 2 × 9·35 = 18·7; 2 × 525 = 1050.

The setting of a multiplication with 2 as one factor establishes a ratio by which all products of numbers multiplied by 2 is given. Taking any figure at random on the slide scale, we find it doubled on the rule scale. As we have already seen, in unitary method, the slide rule gives a complete range of answers for all numbers.
Further practice may be obtained from the following: —

Set the rule for multiplication by 3.
Set the rule for multiplication by 2·5.
Set the rule for multiplication by 1·75.
Set the rule for multiplication by 1·17.

14 × 1·5 = 21.	134 × 2·76 = 370.	2·08 × 31 = 64·5.
3·07 × 2·28 = 7.	213 × 0·258 = 55.	1·28 × 0·68 = 0·87.

When 1 yd. of material costs $ 1·80, 2¾ yd. costs $ 4·95.

In all the foregoing settings the left-hand 1 of Scale C was brought to the first factor on D. In some cases, however, this setting causes the slide to project too far to the right for the answer to be read. When this happens the right-hand 1 of Scale C should be used. For instance, in multiplying 6 by 7, we find that 7 on Scale C is beyond the end of the rule body. We, therefore, bring the right-hand 1 of Scale C to 6 on D, move the cursor over 7 on C and read 42, the required answer, on D. Further examples of the use of the right-hand 1 of Scale C, in multiplying by 4, are shown in Fig. 15.

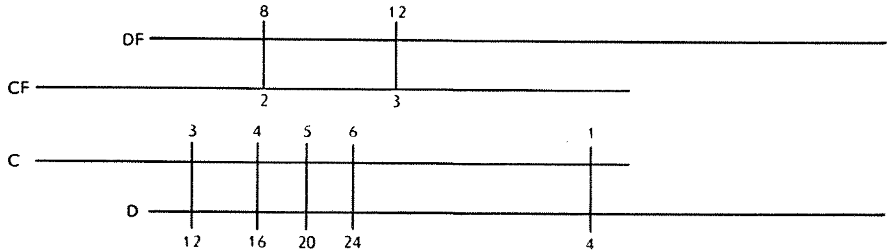


Fig. 15

A general rule for multiplication is as follows: —

> **To multiply two numbers together, set the left- or right-hand 1 of Scale C to the first factor on Scale D. Move the cursor over the second factor on Scale C or CF, and read the product on Scale D or DF under the cursor line.**

Whether the left- or right-hand 1 of Scale C is used in multiplication will depend on the size of the factors. The slide should be set so that more than half its length remains inside the rule body. Thus the right-hand 1 should not go to the left of the mark ⟵|⟶ on the lower scale, and the left-hand 1 should not be moved to the right of it.

Exercises: —

Set the ratio for multiplication by 4·2.
Set the ratio for multiplication by 6·7.
Set the ratio for multiplication by 0·835.

The reader should now be able to solve every multiplication problem. A few more difficult examples will be given, in which the last figure will provide practice in estimating values that do not fall exactly on graduations.

14·43 × 0·418 = 6·03. Approximation. — half of 14.
838 × 3·13 = 2620. Approximation. — 800 × 3 = 2400.
0·498 × 0·207 = 0·103. Approximation. — half of 0·2 = 0·1.
1579 × 0·0469 = 74. Approximation — 1600/20 = 80.

The estimate, shown to the right of the above examples, need only be done very roughly, just sufficient to show the number of figures in the answer. Care must be taken to see that the answer is not taken ten times or one-tenth of the correct one, as this is about the only error that can occur in such calculations.

As we have already noticed the numbers set have mostly three figures in which ciphers or noughts at the beginning and end do not count, such as 2640 and 0·0469. There may also be fourfigure numbers if they start with 1. More figures cannot be set, at least by a beginner. What should we do when confronted with 147·318 × 36·496?

As this calculation contains six figures and will yield an answer of about ten figures, if cannot be worked exactly on the slide rule. However, it seldom happens that such large numbers have to be dealt with in trade, otherwise the problem may be rounded off and treated as 147·3 × 36·5. Multiplied together on the slide rule, these factors give 5375 as the product, the number of figures being found from the rough estimate, 150 × $33^{1}/_{3}$ = 5000 (the exact product is 5376·517728, and the error, caused by this rounding off, is 0·028%).

The reader should employ the slide rule for all multiplication that he requires in his work, and thereby gain additional practice.

Multiplication of three factors

The business man frequently meets with calculations in which the product of three numbers has to be found. Such problems can, of course, be solved by multiplying the first two factors together and multiplying the product by the third factor. Thus 2 × 3 × 5 = 30, worked like this, will be 2 multiplied by 3 in the ordinary way, but this product need not be read off, the cursor line is moved over it and left while the right-hand 1 of Scale C is brought under it, then the cursor is moved over 5 on C, and the answer, 30, is read underneath the cursor line on Scale D. In this example the slide was moved twice.

The answer to such a double multiplication can be found with one movement of the slide, if the scale CI on the centre of the slide, is used. The last example, 2 × 3 × 5, worked in this way, is shown in Fig. 16.

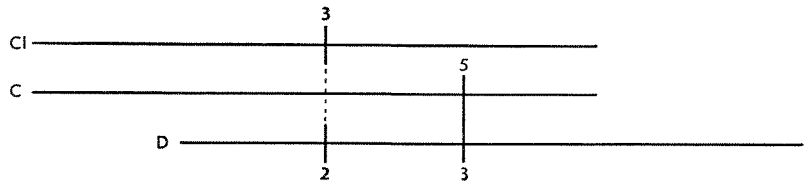


Fig. 16

Set 3 on CI to 2 on D, using cursor line. Then move the cursor over the third factor, 5, on C and read 30, the required product, on Scale D under the cursor line.

Where convenient, the upper scales, DF and CF, may be used for this method of finding the product of three factors. For instance, to find product of 2 × 25 × 15, we set 25 on CI to 2 on D (note that 25 on CI is to the left of 20). Now 15 on C projects beyond the rule body, so the third factor must be taken on Scale CF; over 15 on CF read the figures 75, which means that 2 × 25 × 15 = 750. It is necessary in multiplication for more than half the slide to remain within the rule body.

Rule for multiplication of three numbers: —

Take the first factor on the rule scale D and set the second factor on CI against it. In line with the third factor on the slide scale (CF or C) read the answer on the rule scale (DF or D).

There are limitations to this convenient method of multiplying, for sometimes the numbers are such that all three cannot be found on that part of the slide scales that is within the rule. In that case, the multiplication must be carried out with two movements of the slide, using different ends of the C scale.
The product of three factors is met with when the price, measures, and weights of goods have to be calculated, as in the following example.

It is required to find the cost of covering a floor 27 yd. by 18 yd. with carpet that costs 11 s. 6 d. per square yard. The product of 27 × 18 × 11·5 can be found with one setting of the slide, and read as 5590 s. (£ 279. 10 s. 0 d.). The exact price is 5589 s. (£ 279. 9 s. 0 d.). Though the slide rule cannot be read to give the exact answer, in this case, such a close approximation would be extremely useful when the question of cost was being discussed. In checking estimates and calculations, a glance at the slide rule will show whether an error has been made or not. It is in such cases that the business man will find the slide rule of the greatest use.

Division

Division is the reverse of multiplication, and the method of dividing with the slide rule is just that of multiplication reversed. Taking a simple example, 8 ÷ 4, we set the cursor line over 8 on Scale D, bring 4 on C under it, as shown in Fig. 17, and read the answer, 2, on Scale D, in line with 1 on C.

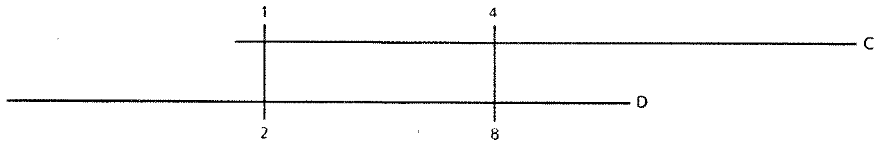


Fig. 17

The quotient is read on Scale D against the right- or left-hand 1 of C, whichever is within the rule body (it can also be found on Scale A against 1 on B). Divide 180 by 30; set 30 on Scale C to 180 on Scale D, and read the answer, 6, on D, in line with the right-hand 1 of C (Fig. 18).

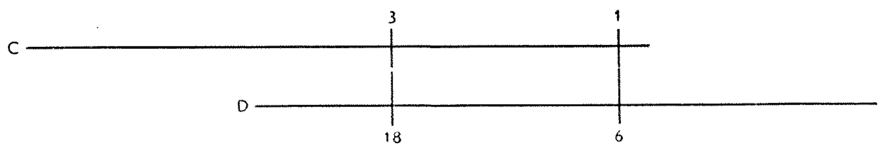


Fig. 18

Again, the answer may be read on the upper scales.

Rule for division: —

> **Set the divisor on C (or CF) to the dividend on D (or DF) and read the quotient on D (or DF) in line with the right-hand or left-hand 1 of C (or the centre 1 of CF).**

Examples:	$36{\cdot}4 \div 2{\cdot}46 = 14{\cdot}8$	$0{\cdot}561 \div 54{\cdot}8 = 0{\cdot}01024$
	$23{\cdot}5 \div 53{\cdot}2 = 0{\cdot}442$	$0{\cdot}353 \div 0{\cdot}434 = 0{\cdot}814$
	$631 \div 0{\cdot}468 = 1348$	$109 \div 1725 = 0{\cdot}0632$

When $1^3/_4$ yd. of material costs \$ 5·90, 1 yd. costs \$ 3·37.

A freight-charge amounts to 12 s. 4 d. for 75 miles. Find the rate per mile.

Expressed as a decimal of a shilling, 4 d. is $\frac{1}{3}$ or 0·33 s. Therefore, the charge is 12·33 s. and the problem is $\frac{12{\cdot}33}{75}$

Using the upper scales, although this division could be done on the lower, we set 75 on CF to 1233 on DF. The answer, which is found on DF over 1 at the centre of CF, is in decimals of a shilling. As it would be convenient to read directly in pence, we move the cursor line over 12 on CF and read 1·975 d. on DF. The rate per mile may be taken as 2 d. In this case, a combined multiplication problem $\frac{12{\cdot}33 \times 12}{75}$ was solved with one movement of the slide.

Such combined problems of three terms can always be solved with one setting if the scales to be used are chosen correctly. Divide the denominator into the first term of the numerator and read the answer on the rule scale against the second numerator term on the slide scale. This will be clear from the following example.

Find the value of $\frac{72 \times 192}{98}$. Set 98 on C to 72 on D, move the cursor over 192 on C and read the answer, 141, on D. Alternatively, the setting and reading could have been done on the upper scales.

In an exchange transaction, \$ 59·00 were bought for £ 12. What was the rate of exchange?

Since $\frac{59}{12} = 4{\cdot}92$, £ 1 is worth \$ 4·92. This could have been calculated as $\frac{12 \times 20}{59} = 4{\cdot}07$, which shows that \$ 1 = 4·07 s., or 4 s. 1 d. nearly. The reader should take every opportunity of applying the foregoing to practical problems.

Application to Percentages

Percentage calculations frequently occur in a sequence where increases and decreases are to be made to a basic price. We shall consider some important cases, and from these the reader will gain an understanding of the principles of such calculations.

Cost Price and Selling Price

1. The cost price of some goods is £ 23. 10 s. 0 d., and the selling price is £ 35. Express the profit as a percentage of the selling price.

   In this case, the selling price, £ 35, must be taken as 100%. Therefore, set the right-hand 1 (100%) of C over 35 on D. Over 23·5 on D will be found the figures 671, which must be read as 67·1%. As the cost price is 67·1% of the selling price, the profit is 100% — 67·1%, or 32·9% of the selling price.

2. Express the above profit as a percentage of the cost price. The cost price, £ 23·5, is now 100%. Set the left hand 1 (100%) of Scale C to 235 on D. Over 35 on D read 149 on C, which means that the selling price is 149% of the cost price, and, therefore, 49% (149% — 100%) has been gained on the cost price.

3. With a cost price of £ 23·5, the selling price can be fixed at any figure according to the percentage profit required. The last setting gives all the information necessary. Should a selling price be required that will leave a profit of 60% on the cost price, it will be found on Scale D under 160 (100% — 60%) on Scale C. This £ 37·6 (£ 37. 12 s. 0 d.). Again should 20% be considered adequate, the corresponding selling price, £ 28·2, can be read on Scale D under 120 on C.

4. With a selling price of £ 35, to find a cost price that will leave any required percentage profit. The setting is as in Case 1. For a gain of 40% on the selling price, the goods must be purchased for £ 21, read on D under 60 (100% — 40%) on Scale C. For 30%, the cost price is 24·5, this being on D under 70 on C.

5. A profit of 35% on the cost price was made when certain goods were sold for £ 4. 4 s. 0 d. What was the cost price? The ratio of cost price to 100% cannot be used, since the cost price is not known. However, it is known that the

selling price is 135% of the cost price. Therefore, the ratio is £ 4·2 to 135%. Set 135 on C to 42 on D, and read £ 3·11, the required cost price, under left-hand 1 (100%) of C.

6. Goods are bought for £ 26. 12 s. 0 d., and sold to leave a 30% profit on the selling price. At what price must they be sold?
As the selling price is unknown, the ratio is taken as £ 26·6 to 70% (100% — 30%). Set 70 on C to 266 on D and read £ 38 on D under the right-hand 1 of Scale C.

These six cases cover almost all types of calculation relating to cost and selling prices. The reader should take as many examples as possible from his own experience, so as to thoroughly master these important principles.

Unit Percentage

To a cost price of £ 4. 9 s. 0 d. $7^1/_2$% has to be added for trade charges, 17% for overhead expenses, and the profit is to be 38%. What is the selling price?

For the first increase, the cost price, £ 4·45, is taken as 100%. Set the left-hand 1 (100%) of Scale CF to 445 on DF and move the cursor line over 1075 (100% + 7·5%)* on CF. The cursor now shows, on Scale DF, £ 4·45 increased by $7^1/_2$%. This value need not be read, but is taken as 100% for the next increase, by 17%. Move the slide to the right until 1 on Scale CF is under the cursor line. Now move the cursor line over 117 on CF. This position on Scale DF will represent 100% for the increase of 38%. Bring 1 (100%) on CF under the cursor line, move the cursor over 138 on Scale CF, and read 772 on DF under the cursor line. Therefore, the required selling price is £ 7·72, or £ 7. 14 s. 5 d.

It is tiresome to repeat all these settings when different cost prices are to be increased or decreased by the same percentages. It is, however, possible to simplify the work, as will be seen from the following.

Set 1 on CF to 1075 on DF, thus increasing £ 100 to £ 107·5. Put the cursor over 117 on CF, thus adding 17%. Move the slide to the right until 1 on CF comes under the cursor line, and move the cursor over 138 on CF, thus adding 38%. The cursor line now indicates 1736 on DF, which means that, by adding these three percentages consecutively, the same result is obtained as if 73·6% (173·6% — 100%) were added at once, or that the cost price were multiplied by 1·736. This number might be called the unit percentage, for it is the value that 1 would become after the foregoing additions. Finally, if 1 on CF be brought under the cursor line (in line with 1736 on Scale DF) a ratio is established which increases all values 1·736 times. Cost prices are on the red scales, and selling prices are on the black. Without further movement of the slide, read £ 4·45 **becomes £ 7·72**, £ 5·76 becomes £ 10, £ 6·16 becomes £ 10·7 and £ 8·7 becomes £ 15·1.

Annotation: The commercial slide rules 1/22, 111/22, 67/22 are provided with an auxiliary scale, the "percentage value scale", by means of which frequently used percentages (25%, $33^1/_3$%) can be easily found and set.

On a list price of 13 s. 9 d. a retailer is allowed 6½%, a rebate of 23%, and a discount of 2% for cash. What will the cash payment be?

Set the centre 1 (100%) of Scale CF to 1375 (13 s. 9 d.) on DF, put the cursor line over 935 (100%—6·5%) on CF, bring 1 on CF under the cursor, move the latter over 77 (100% — 23%) on CF, bring 1 on CF under the cursor again, and move the cursor over 98 (100% — 2%) on CF. The required price, 9·7 s. (9 s. 8½ d.) is now on Scale DF under the cursor line.

Should it be necessary to modify different prices in the foregoing manner, it would be convenient to find the unit percentage, as follows: set 1 on CF to 935 on DF; with this movement 100 s. has been changed into 93·5 s., put the cursor over 77 on CF; to deduct the rebate of 23%, bring 1 on CF, under the cursor and move the cursor line to 98 on CF. Then on Scale DF; under the cursor line, read 705, which means that deducting the above percentages is equivalent to deducting 29·5% (100% — 70·5%) in one operation, or multiplying by the unit percentage, 0·705, this being the result of deducting all the above percentages from 1. If 1 on Scale CF be now brought under 705 on DF, the conversion table is ready, list prices being on the red scales and new prices on the black. 13 s. 9 d. (13·75 s.) becomes 9·7 s. (9 s. 8½ d.); 11 s. 8½ d. (11·7 s.) becomes 8 s. 3 d.; 7 s. 9 d. becomes 5·46 s. (5 s. 5½ d.).

It is important that the reader should work as many practical examples of this kind as possible, since it is in solving this type of problem that the slide rule proves most useful.

Simple Interest

The determination of simple interest per year is a very easy percentage calculation, so no examples are needed. Usually, however, the interest is not required for a year, but for a number of days. The "Business" slide rule is specially arranged to solve such problems. At the right-hand end of the rule are the symbols P/INT, DAYS, R%. They mean that the corresponding scales represent principal, interest, number of days, and rate per cent. The method of working is explained in the following rule: —

Move the main cursor line over the principal on Scale DF — the principal must only be taken on Scale DF — set the rate per cent. on the green scale, CI under the short cursor line, and read interest on the black scale (DF or D) in line with the number of days on the red scale (CF or C).

Find the interest on £115 for 46 days at 3% per annum.

Set the main cursor line over 115 on DF (Fig. 19), bring 3 on CI under the short cursor line, and read 435 on DF over 46 days on CF, or alternatively, on D under 46 days on C. An approximate answer can be simply found; since the interest on this principal for 365 days is about £3, the interest for 46 days can be taken as one-tenth. Therefore, the approximate interest may be taken as £0·3, which fixes the answer at £0·435. This can be mentally converted into shillings and pence, but, if desired, or where the figure is less convenient, the scale at the lower edge of the rule can be used (on the reverse of model 67/22). It will be seen that £0·4 = 8 s., leaving £0·035. Next £0·033 = 8 d., leaving £0·002. It will be seen that £0·004 = 1 d., thus £0·002 = ½ d. The answer is 8 s. 8½ d.

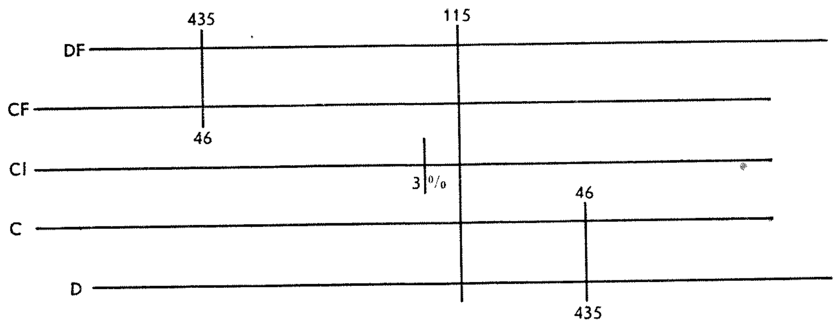


Fig. 19

Determine the interest on £615 for 58 days at 4¼% per annum.

Set the cursor line over 615 on DF, bring 4·25 on CI under the short cursor line, and read 415 on either of the black scales in line with 58 on the red. To estimate the position of the decimal point in the answer, it should be noted that for a year the interest is about £6 × 4 = £24, and that 58 days is about one-sixth. Thus the answer is £4·15, or £4. 3 s. 0 d.

Usually the interest can be **found with** only one setting of the slide, but sometimes it becomes necessary to **re-set** the slide, as in the following example.

Find the simple interest on £ 308 for 28 days at $4^1/_4$% per annum.

The graduation 308 is close to the right-hand end of Scale DF. Set the main cursor line to it (Fig. 20), and bring 4·5 on CI under the short cursor line. Now the graduation for 28 days, on the red scale, projects beyond the rule body, and so cannot be read. The slide must now be **re-set,** to bring 28 within the rule body.

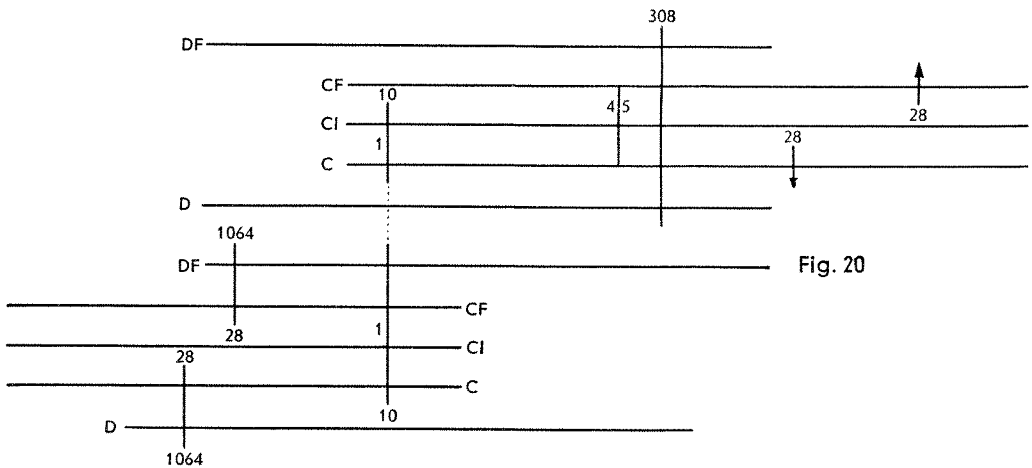


Fig. 20

Move the cursor line over 1 at the left-hand end of Scale C and push the slide to the left until the right-hand 1 of C is under the cursor line. This **re-setting,** which does not alter the ratio between scales, brings the graduation 28 on CF and C into a readable position. In line with 28 on the red scales read 1064 on the black. Obviously, the answer is £ 1·064, or £ 1. 1 s. 3 d.

Rule: —

To reset the slide, place the cursor over 1 on Scale C and move the slide through until 1 at the other end of C comes under the cursor line.

In the foregoing examples the rate per cent. is based on a year of 365 days. Should it be necessary to calculate the interest when the rate is given for a year of 360 days, as is the case in many countries, the method is the same, but the rate is set under the main cursor line, instead of under the short line. This will be understood from the following example. Find the interest \$ 115 for 35 days at 3% per annum. (360 days.)

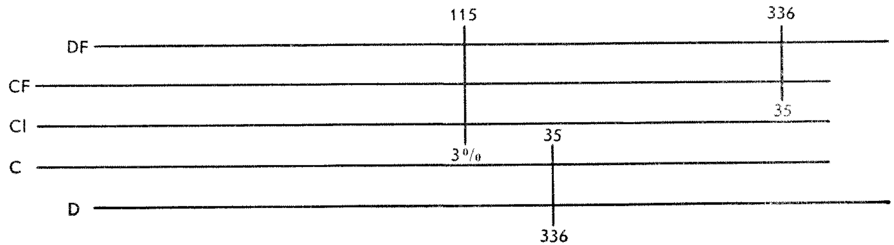


Fig. 21

Set the main cursor line over 115 on DF (Fig. 21), bring 3% on CI under it, and, in line with 35 on the red scale, read 336 on the black. This is \$ 0·336, or 34 cents.
Find the interest on \$ 615 for 43 days at $4^1/_4$% per annum. (360 days.)
Set the main cursor line to 615 on DF, bring 425 on CI to it. This time the number of days is found only on Scale C, and in line with it will be found the figures 312 on D. The answer is \$ 3·12.

Compound Interest (only on 1/22, 111/22, 4/22)

The scale on the back of the slide, which lies between the LL_2 and C scales, and which is used in conjunction with scales LL_1 and LL_2, enables compound interest to be calculated on these slide rules. This scale, which we shall call F, supplies a factor which can be used in calculating on the main scales.

Find the amount of £415 for 10 years at 4% per annum. compound interest.

Over 4% on Scale F, on the back of the slide, read the factor 1·48. Then multiply the principal, £415, by this factor. The multiplication can be carried out on the face of the rule, the product being £614.

If £3150, invested at compound interest, grows to £4450 in 10 years, find the rate per cent.

The factor must be determined first. This is found by dividing 4550 by 3150, which gives 1·445. The rate of interest, on Scale F, corresponding to 1·445 is 3¾%.

It is possible to find the factors for all other years by inverting the slide, so that Scale F is at the front. If, for instance, the factor for 8 years at 3% is required, set 3% on F to the right-hand 1 of Scale D. Now a table is arranged for all years at 3%; over 8 on D, read the factor 1·267; over 5 years; read 1·159; over 6 years, read 1·194; and for 7 years, 1·230. (Fig. 22.)

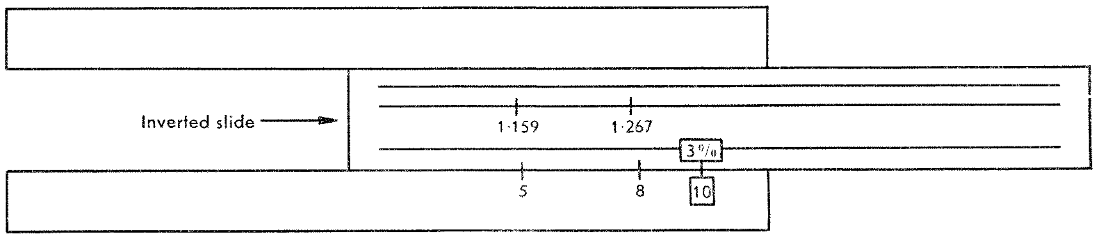


Fig. 22

Should it be required to find the factor for 3½% for 13 years, set 3½% on Scale F over the left-hand 1 of Scale D, which may be read as 10. Then the required factor, 1·567, is found on Scale F over 13 on D. Again a table has been established, and we can read: 1·619 for 14 years, and 1·675 for 15 years, etc.

£285, invested at compound interest, has grown to £532 in 15 years. What was the rate per cent?

Use the C and D scales to divide 532 by 285, and read 1·867. This is the factor for 15 years. Set 1·867 on Scale F to 15 on D. Over 10 (the left-hand 1) on D is the factor for 10 years, 1·516 and next to it the rate of compound interest $4^1/_4\%$. Sometimes this operation does not give a solution.

Example: What is the factor for 3 years and $2^1/_2\%$?

Setting 2·5% on the F scale of the slide over the right-hand **1** on scale D only permits the reading of the factor for 4 (1·1038) and more years. In this position put the cursor line over 1·1 on the left end of scale F and move the slide along to the left until the vertical index (1·1 in the upper scale) is under the cursor line. Now set the cursor over 3 on scale D and read the factor 1·0768 on scale LL_1 (Fig. 23a and b).

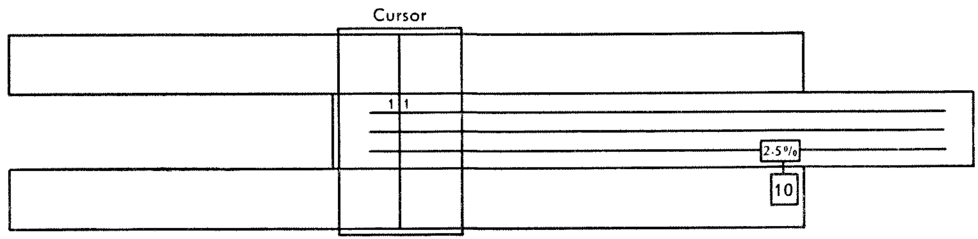


Fig. 23 a

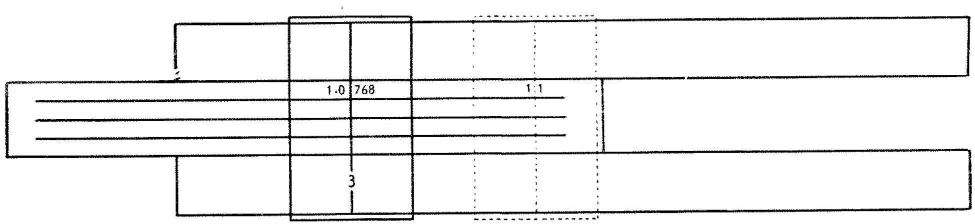


Fig. 23 b

The simplest way for this exercise is the following:—

If a lower per cent (less than 3%) and a small number of years is given, immediately set the rate of interest (in the mentioned example 2·5%) over the left-hand 1, move the cursor to 3 on scale D and read over it the result 1·0768. The exponent of the factor, that is the number of the years for investing at compound interest, will mostly be a low figure. In certain rare cases, the factor must be calculated with higher exponents. Two methods can be applied:

1. by decomposition of the power.

Find the factor for 30 years at 4¼% per annum. compound interest.

The power 30 is to be composed into 15 + 15. Read the factor 15 and determine the square of the factor.

Set the graduation 4¼% on the inverted slide over the left-hand 1 of the scale D and then move the cursor line to 15 on scale D.

Read under the cursor line on the lower part of the scale F the power $q^{15} = 1{\cdot}867$, and set the left-hand 1 of scale C over this value on scale D.

Square may be found by multiplying with 1·867, setting the cursor line to this value on scale C and reading the result 3·486 on scale D.

2. by use of the index engraved near 4—1—4 on DF.

To find the factor for 30 years at 4¼%, set the red line, which runs across the left end of the underside of the slide, by means of the cursor, to the index near 4—1—4 on scale DF. Then bring the main cursor line over 1·0425 on scale LL_1 and move the slide to the left so long until the right-hand end of scale C and the cursor line stay in line.

After moving the cursor to 30 of scale C, may be read on scale DF the value

$$\log 1{\cdot}0425^{30} = 0{\cdot}542.$$

To determine the antilog of 0·542, set the main cursor line to 5—4—2 on scale L (under scale D) and read 3—4—8, the significant figures in the antilog on D under the cursor line. Since the characteristic is 0, the required antilog is 3·48.

Exchange Calculations

The most important examples of foreign exchange conversions are directly between two countries, at a known rate. If pounds sterling are quoted in Switzerland at £ 6·6 = 100 Francs, then the corresponding price in London 15·15 Francs = £ 1. This equivalent rate is found on the slide rule "Business" on scale C under the rate on scale CI. Thus, directly under 6·6 on CI read 15·15 on C.

Examples: Dollars are quoted in London at 4·97; at this rate $ 10 = £ 2·012 (£ 2. 0 s. 2·9 d.).

Norwegian kronors are quoted in London at 19·90. The corresponding rate gives £ 5·025 = 100 kronors.

It is good practice to find the corresponding values of all the rates of exchange for a few days.

Inverse Proportion

Inverse proportion is less common than the ordinary method, but, when required, the slide rule will prove very useful. It is only necessary to set a graduation on the green scale CI to a graduation on D to establish an inverse ratio between the scales.

43 yards of material, 60 inches wide, are required to make a covering. How much would be needed if the width were 90 inches?

Set 6 (60 inches) on CI to 43 on D, and, under 9 (90 inches) on CI, read 28·7 yards on D.

If the speed of a train is 24 feet per second and it takes 2·5 minutes between stations, what time will be required if the speed be raised to 27·5 feet per second?

Set 25 (2·5) on CI to 24 on D and read 2·18 minutes, the required time, on CI over 275 on D.

The Logarithmic Scale L (only on 1/22, 4/22, 111/22)

This scale is placed on the face of the rule below the lower rule scale D, in conjunction with which it is used. The number is on D, and directly below it the mantissa of the logarithm will be found. The characteristic must be affixed in the same way as when using a table.

Ex. Log. 35·4 = 1·549.

Set the cursor line over 3—5—4 on D, and read the required mantissa, 5—4—9, on the logarithm scale. The characteristic is 1; whence, log 35·4 = 1·549.

Ex. The antilog of 2·909 = 811.

Find the mantissa, 0·909, on the logarithm scale, and above it on D read the numbers 8—1—1. Since the characteristic is 2, the required antilog is 811.

The Scale for non-metric Measures (only on 1/22, 4/22, 111/22)

Marks (gauge points) for the most important non-metric measures are placed on this scale; they give the value of the measure on the upper scale DF. Instead of seeking the particular measure on the upper scale, for which it would probably be necessary to consult a table, the cursor line is put over the appropriate mark.

Reading from left to right, the following measures will be found:—

1 U.S. Bushel (Dry Measure) = 35·238 Litres
1 Imperial Bushel = 36·35 Litres
1 U.S. Gallon = 3·785 Litres
1 Russian Pound = 409·512 Gr.
1 Central (100 lb.) = 45·359 Kg.
1 Imperial Gallon = 4·543 Litres
1 Hundredweight (112 lb.) = 50·8 Kg.
1 Russian Arshine = 0·712 Metres
1 Short Ton (2000 lb.) = 907·18 Kg.
1 Yard = 0·9144 Metres
1 Long Ton (2240 lb.) = 1016 Kg.
1 Russian Dessiatine (2·6997 ac.) = 109·25 Ares
1 Russian Vedro (2·705 Imp. Gal.) = 12·299 Litres
1 Russian Pood (40 Russ. Pounds) = 16·381 Kg.
1 Fathom = 1·829 Metres
1 Register Ton (100 cu. ft.) = 2·83 Cu. Metres
1 British Quarter (8 Bushels) = 290·78 Litres

Care of the Slide Rule

CASTELL Precision Slide Rules are the result of many years experience, a culmination of the skilled workmanship of men with long training; the rules are unsurpassed for precision and should be handled with care.

To preserve the legibility of the graduations, the facial scales and the cursor should be protected from dust and scratches, and cleaned at frequent intervals with the special CASTELL cleaning agent No. 211 (liquid) or No. 212 (in paste form).

Slide Rules of Special Wood Construction

are impervious to climate· they should nevertheless be protected from any considerable temperature fluctuations and from humidity. The resilient base gives the Slide Rule great elasticity, making it easier to move the slide and adjust its mobility. There are metal inserts ensuring exceptional stability in the basic structure of the Slide Rule and preventing deformation by climatic influences.

Slide Rules of Geroplast

are absolutely "climate-proof", as well as heat-proof and damp-proof, and they stand up to the effects of the majority of chemicals. Geroplast Slide Rules should not, however, be allowed to come in contact with corrosive liquids or strong solvents, as these — even if the material itself remains unaffected — are at any rate liable to cause the colour of the graduation marks to deteriorate.

1068 ® Printed in Germany 1/722 engl.

FABER-CASTELL

A. W. FABER-CASTELL · STEIN BEI NÜRNBERG, GERMANY