Chapter 2 – Multiplication and Division (C and D Scale)

2.1 Adding with Uniform Scales

Fig. 2-1 shows how we could construct a simple calculating device to add numbers (e.g. two ordinary rules).

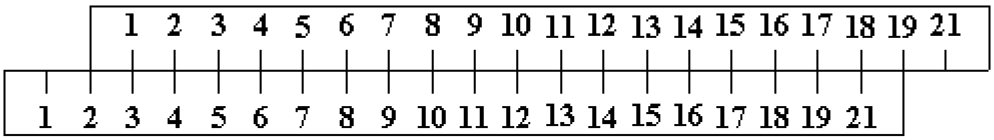

Fig 2-1

To calculate 2 + 3:

1. Find 2 on the lower scale.
2. Place the 0 (beginning) of the upper scale over the 2.
3. Move along the upper scale to 3 and read off the answer of 5 on the lower scale below the 3.

If we wish to find 2 + 7 we would follow the first two steps as above. Then for the third step go along the upper scale to 7 and read off 9 on the lower scale as the answer.

2.2 **Simple Multiplication**

The Slide Rule is designed to add or subtract lengths. In using the C and D scales, the lengths we add or subtract are logarithms of the numbers marked on the graduations. Thus when lengths are added the numbers are multiplied.

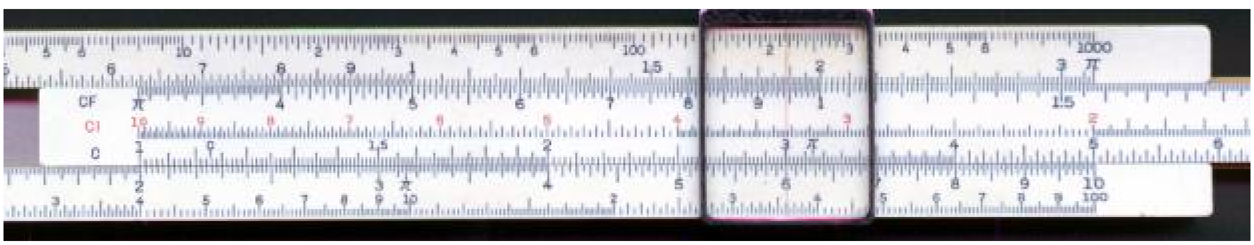

Fig 2-2

Example 1: 2 x 3 = 6 (Fig. 2-2)

1. Place the left index of the C scale over 2 on the D scale.
2. Set the hair line over 3 on the C scale.
3. Under the hair line read off 6 on the D scale as the answer.

Note: The hair line on the cursor may be used in the following ways for this method of multiplication.

(a) To mark a number on the D scale which does not fall exactly on a graduation, so that the index of the C scale may be set above it.
(b) To set over the second number on the C Scale so that the answer can be read off on the D scale.

Example 2: 1.14 x 1.32 = 1.505 (Fig. 2-3).

1. Place the left index of the C scale over 1.14 on the D scale.
2. Set the hair line over 1.32 on the C scale.
3. Under the hair line read off 1.505 on the D Scale as the answer.

Exercise 2(a)

Use the three steps as shown in the examples above to calculate the following:

(i)	1.5 x 4.7 =	(iv)	1.95 x 5.05 =
(ii)	2.2 x 2.4 =	(v)	7.6 1.25 =
(iii)	2.58 x 3.1 =	(vi)	6.88 x 1.09 =

Note: In parts (v) and (vi) of Exercise 2(a) it would be better to do the multiplication in the reverse order. (e.g. 1.25 x 7.6 instead of 7.6 x 1.25). This would mean much less movement of the slide, thus speeding up the calculation.

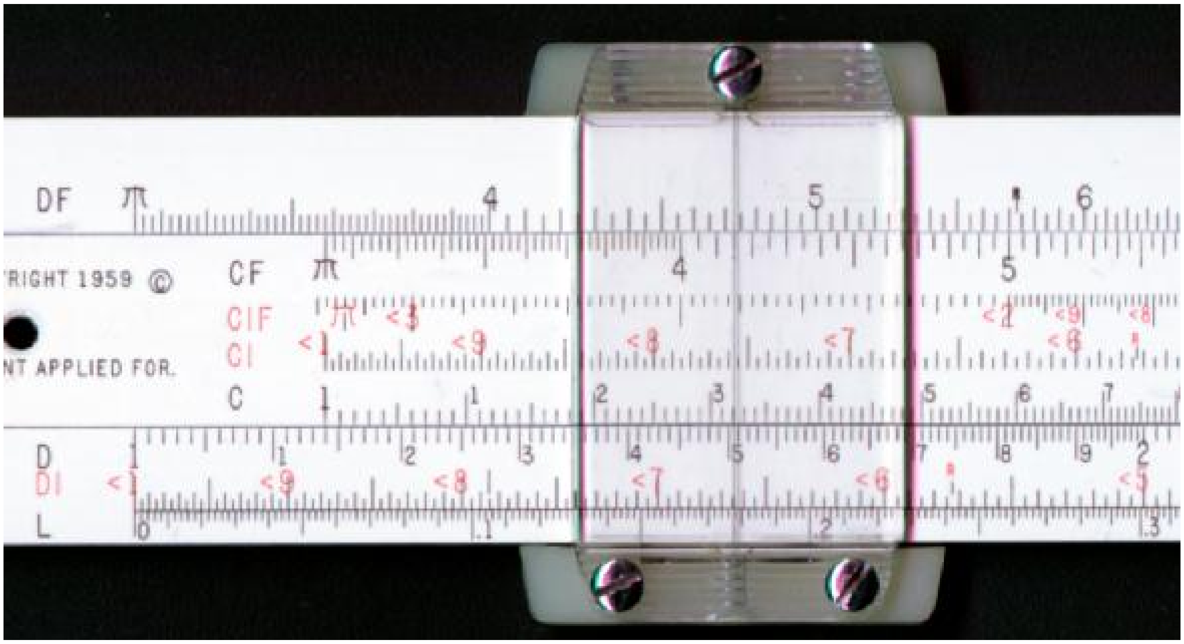

Fig 2-3

2.3 **Using the Right index for Multiplication**

Consider the product 9 x 8. If we follow the steps as used in the examples above, the 8 on the C scale falls hopelessly off the end of the D scale. The problem is overcome, by placing the right index of the C scale on the 9, instead of the left index.

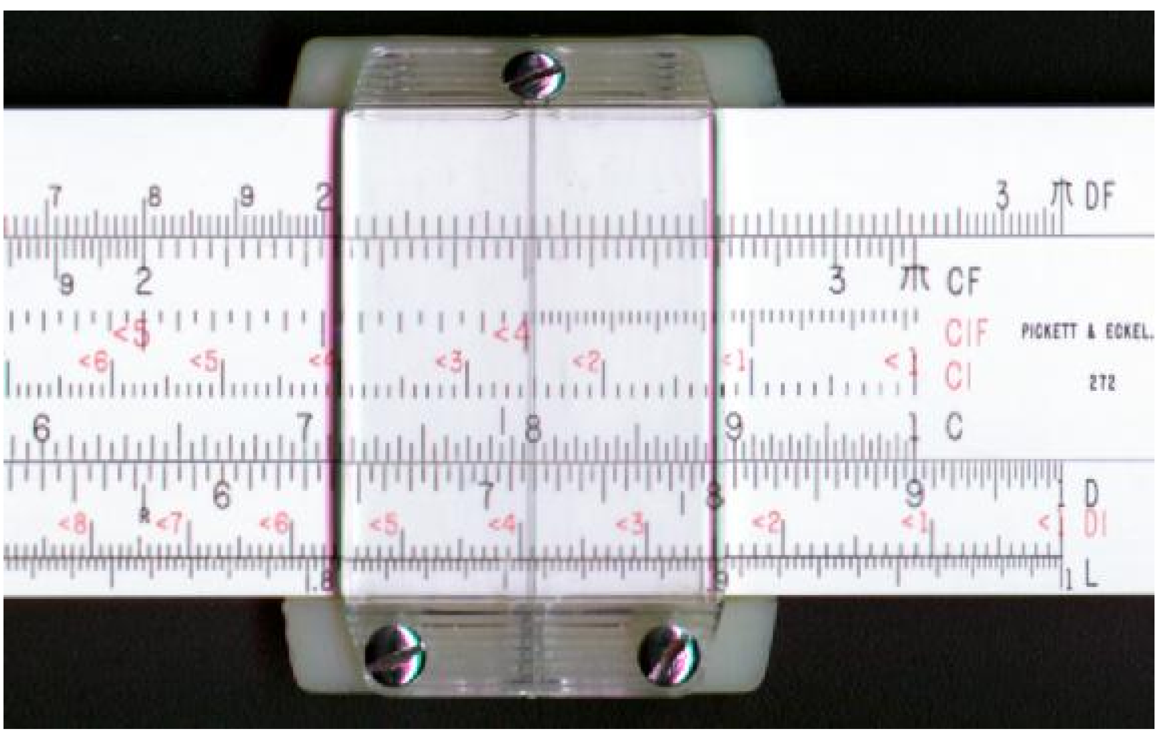

Fig 2-4

Example 1: 9 x 8 = 72 (Fig 2-4).

(i) Place the right index of the C scale over 9 on the D scale.

(ii) Set the hair line over 8 on the C scale.
(iii) Under the hair line read off 72 on the D scale as the answer.

Note:

(a) This method works as it is equivalent to subtracting the logarithm of the reciprocal of 8, that is dividing by 1/8. (i.e. 9 ÷ 1/8 = 9 x 8).
(b) The answer is read as 72, not 7.2. (The positioning of the decimal point will be treated in detail in 2.4).
(c) Avoid excessive slide movement (e.g. for 2 x 7, work it as 7 x 2 thus bringing the right index of the C scale to 7 instead of right along to 2).

Example 2: 6.62 x 6.4 = 42.4

1. Place the right index of the C scale over 6.62 on the D Scale.
2. Set the hair line over 6.4 on the C scale.
3. Under the hair line read off 42.4 on the D scale as the answer.

Exercise 2(b)

(i)	5.7 x 6.5 =	(iv)	2.07 x 3.26 =
(ii)	6.9 x 3.9 =	(v)	1.85 x 7.4 =
(iii)	5.3 x 3.1 =	(vi)	3.24 x 0.56 =

2.4 Locating the Decimal Point

From the last set of exercises we can readily see that for multiplication on the C and D scales the Slide Rule does not give us the position of the decimal point. This we have to decide for ourselves. Do not try to learn a rule for locating the decimal point as this has been proved to be inadequate and confusing.

The Best method is to make a quick estimate of the answer. This will always give you the position of the decimal point and checked the magnitude of your answer too.

Example 1:

3.96 x 124.5 = ‘493’
(i.e. approx. 4 x 125 = 500)
therefore the answer is 493.0

Example 2:

488 x 0.283 = ‘1381’
(i.e. approx. 500 x .3 = 150)
therefore the answer is 138.1

Note: The other possibilities are 13.81 and 1,381 which are a long way off 150. So even if the approximation is fairly rough, it will not spoil this method.

Example 3:

0.46 x 72.3 x 52.2 = ‘1735’
(i.e. 0.5 x 70 x 50 = 0.5 x 3500 = 1750)
therefore the answer is 1735.0

When very large or very small numbers are involved, the above method can be streamlined by using standard form (or scientific notation). For example, we can express 2900 as 2.9×10^3 and 0.0012 as 1.2×10^{-3}. Thus 2900 could be approximated by 3×10^3 and by 1×10^{-3}. Always approximate 2.5, 2.6 etc. by 3 and 2.4, 2.3 etc. by 2.

Example 4:

640 x 0.00024 = ‘1538’
(i.e. approx. $6 \times 10^2 \text{ X } 2 \times 10^{-4} = 12 \times 10^{-2} = .12$)
therefore the answer is 0.1538

Example 5:

0.024 x 36 x 430 x 0.057 = ‘1538’

(i.e. approx. 2 x 10^{-2} X 4 X 10 X 4 x 10^{2} X 6 x 10^{-2} = 192 x 10-1 X = 19.2)

therefore the answer is 21.2

Exercise 2(c)

Locate the decimal point in the following:

(iv) 150 x 0.019 = ‘285’
(v) 0.0836 x 0.0042 = ‘351’
(vi) 1300 x 63 = ‘819’
(vii) 250 x 0.0025 = ‘625’
(viii) 0.125 x 0.5 = ‘625’
(ix) 304 x 75.6 = ‘230’
(x) 720 x 0.35 x 24.1 = ‘607’
(xi) 781 x 0.682 x 0.207 = 1102
(xii) 144 x 0.146 x 10.8 = ‘227’
(xiii) 0.03 x 0.81 x 0.362 = ‘880’

2.4 Continuous Multiplication

To Multiply three or more numbers together:

1. Multiply the first two together.
2. Hold this answer with the hair line on the cursor.
3. Multiply this answer by the next number. (The hair line acts as a memory, enabling us to hold a number for further use).

Example: 2 x 15 x 88 = 2640

Step 1

1. Place the left index of the C scale over the 2 on the D scale.
2. Set the hair line over 15 on the C Scale.
3. The hair line hold the answer on the D scale.

Step 2

4. Place the right index of the C scale under the hair line.
5. Reset the hair line over 88 on the C scale.
6. Under the hair line read off ‘264’ on the D scale as the answer.

To locate decimal point:

2 x 15 x 88 ≈ 2 x 20 x 90 ≈ 360

there for the answer is 2640

(≈ stands for “approximately equals”)

Exercise 2(d)

(i) 0.11 x 175 =
(ii) 50.2 x 31.8 =
(iii) 0.14 x 0.26 =
(iv) 25.6 x 142 =
(v) 18.3 x 0.031 =
(vi) 650 x 6.5 =
(vii) 0.945 x 61.5 =
(viii) 111 x 0.941 =
(ix) 2 x π =
(x) 40.25 x 51.5
(xi) 17 x 28 x 46 =
(xii) 0.18 x 104 x 0.043 =
(xiii) 62 x 1.2 x 0.47 =
(xiv) 36.2 x 38 x 0.042
(xv) 80.4 x 0.171 x 0.0316 =
(xvi) 2 x 0.31^2 =
(xvii) 52^3 =
(xviii) 29.2 x 4 x 75 x 132 x 72 =
(xix) 70^2 x 0.31^2 =
(xx) 20.25 x 22.5 x 0.0005 =