Chapter 5 – Squares and Square Roots (A and B or X^2 Scales)

5.1 The form of the A and B Scales.

On most Slide Rules the B scale is on the top edge of the slide and the A scale on the bottom edge of the upper stock or body of the Rule. The A and B scales are labeled from 1 to 100. They consist of two parts, 1 to 10 and 10 to 100, each actually a half size replica of the C and D.

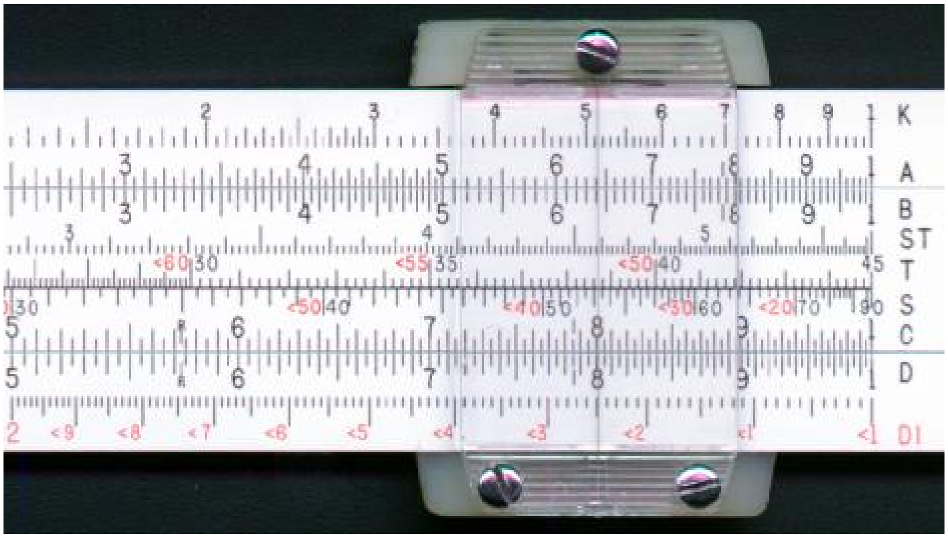

Fig 5-1

Example 1: $8^2 = 64$ (Fig. 5-1)

1. Set the hair line over 8 on the D scale.
2. Under the hair line read off 64 on the A scale as the Answer.

Note: It is advisable to use the A and D scales together, or the B and C scales together. That is, use a pair of scales that are either both on the body of the Slide Rule, or both on the slide.

5.2 Squares

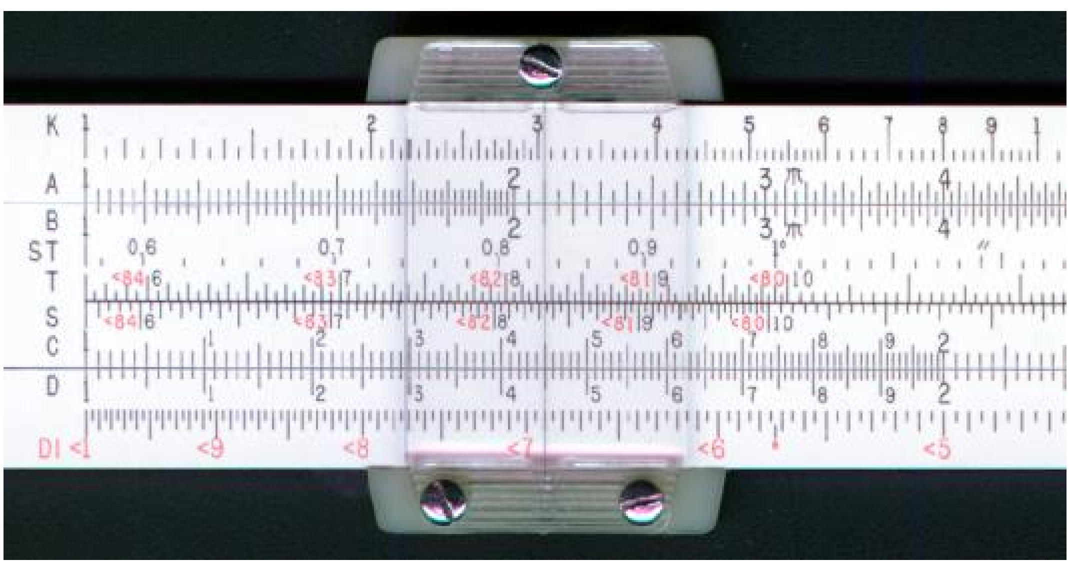

Fig 5-2

Example 2: $14.5^2 = 210$ (Fig. 5-2)

1. Set the hair line over 14.5 and the D scale.
2. Under the hair line read off 210 on the A scale as the answer. (i.e. approx. 152 = 225)
3. Therefore the answer is 210.

Exercise 5(a)

(i)	$7^2 =$	(iv)	$0.9^2 =$
(ii)	$5.5^2 =$	(v)	$11.3^2 =$
(iii)	$7.65^2 =$	(vi)	$1.414^2 =$

5.3 Locating the Decimal Point for Squares

An approximate answer is the best method, and quite often standard form (scientific notation) is a great help.

Example 1:

35^2 = '1225'
(i.e. approx. $40^2 = 1600$)
there for the answer is 1225.0.

Example 2:

197^2 = '389'
(i.e. approx. $200^2 = 40{,}000$
or $(2 \times 10^2)^2 = 4 \times 10^4$)
Therefore the answer is 38,900.

Note: On squaring numbers larger than 1, the answer is always greater that the original number. The opposite is the case for numbers less than 1. The following examples show us that on squaring a number less than 1, the answer is always smaller than the original number.

Example 3:

0.31^2 = '96'
(i.e. approx. $0.3^2 = 0.09$)
therefore the answer is 0.096.

Example 4:

0.0085^2 = '7225'
(i.e. approx. $0.009^2 = (9 \times 10^{-3})^2 = 81 \times 10^{-6} = .000081$)
therefore the answer is 0.00007225

5.4 Miscellaneous Squares

Exercise 5(b)

(i)	65^2	(v)	0.00022^2
(ii)	207^2	(vi)	30.25^2
(iii)	0.084^2	(vii)	$(5.4 \times 10^3)^2$
(iv)	0.123^2	(viii)	$(2.83 \times 10^{-2})^2$

5.5 Square Roots (Numbers between 1 and 100)

These are read directly by finding the number on the A and B scales, and with the aid of the hair line its square root is immediately below on the C and D scales.

Example 1: $\sqrt{56.25} = 7.5$ (Fig. 5-3)

1. Set the hair line over 56.25 on the A scale.
2. Under the hair line read off 7.5 on the D scale as the answer.

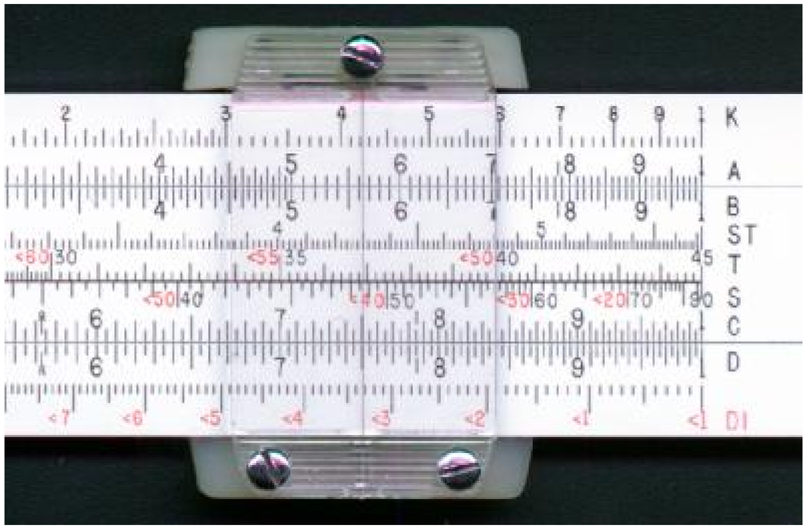

Fig 5-3

Example 2: $\sqrt{5.625}$ =2.37 Set the hair line over 5.625 on the A scale.

1. Under the hair line read off 2.37 on the D scale as the answer.

Note:

(a) In contrast to previous calculations on the C and D scales where we took 56.25 and 5.625 at the same point, on the A and B scales these two numbers are separate points.

(b) When we take the square root of the numbers between 1 and 100, there is no difficulty in locating the decimal point, as there square roots range from 1 to 10 and are read off as shown on the C and D scale graduations.

Exercise 5(c)

(i)	$\sqrt{6.25}$ =	(iii)	$\sqrt{3}$ =
(ii)	$\sqrt{93.5}$ =	(iv)	$\sqrt{1.125}$ =

5.6 Square Roots (Numbers greater than 100)

The difficulty for numbers greater than 100, is knowing where to locate them on the A and B scales. In previous calculations 5.625, 56.25, 562.5, 0.5625, etc. have all been placed at the same point on the C and D scales, but now the question arises, where to locate 562.5 on the A and B scales to obtain its square root. It is on 5.625 or 56.25? The best method to decide this, also find the decimal point, is as follows:

Example 1:

$\sqrt{562.5}$ =23.7

$\sqrt{562.5} = \sqrt{5.625x100}$

$= \sqrt{5.625}x\sqrt{100}$

$= \sqrt{5.625}x10$

(The $\sqrt{5.625}$ is found as shown by Example 2 in 5.5)

$\sqrt{562.5}$ =2.37 x 10

= 2.37

Note: We could break 562.5 up into any two factors (each smaller than 100) and find their individual square roots. Then multiply these together to give the square root of 562.5. This would present difficulties and extra steps, where as when we make 100 as one of the two factors, the other factor is immediately obtained by moving the decimal point two places to the left. The location on the A and B scale is established, and also there is no need for any extra work to decide the position of the decimal point in the answer.

Example 2:

$\sqrt{272}$ =16.5

$\sqrt{272} = \sqrt{2.72x100}$

= 1.65 x 10

therefore the answer is 16.5

(The $\sqrt{2.72}$ is found as outlined in the Examples in 5.5)

Exercise 5(d)

(i) $\sqrt{324} =$

(ii) $\sqrt{960} =$

(iii) $\sqrt{425} =$

(iv) $\sqrt{1000} =$

Example 3:

$\sqrt{5625}$ =75

$\sqrt{5625} = \sqrt{56.25x100}$ =7.5 x 10

Therefore the answer is 75

Example 4:

$\sqrt{56250}$ =237

$\sqrt{56250} = \sqrt{5.625x10{,}000}$ =2.37 x 100

Therefore the answer is 237

Note: For numbers greater than 10,000 always break them up with one of the factors at 10,000. We do not use 1000 as a factor because it does not have a neat square root.

Exercise 5(e)

(i) $\sqrt{2{,}000}$

(ii) $\sqrt{20{,}000}$

(iii) $\sqrt{2{,}720}$

(iv) $\sqrt{82{,}000}$

5.7 Square Roots (Numbers less than 1)

We must have numbers between 1 and 100 to use the A and B scale. In the case of numbers less than 1, we do not break the number up into a factor multiplied by 100, 10,000, etc.; but as a number over 100, 10,000 etc.

Example 1:

$\sqrt{0.5625}$ =0.75

$$\sqrt{0.5625} = \sqrt{\frac{56.25}{100}} = \frac{7.5}{10}$$

Therefore the answer is 0.75

Note:

(a) we do not express $\sqrt{0.5625} = \sqrt{\frac{5.625}{10}}$ as this would mean dividing by $\sqrt{10}$, which is not a simple value.

(b) It is good to remember that the square root of a fraction less than one is always large that the original number (e.g. $\sqrt{0.64}$ =0.8).

Example 2:

$\sqrt{0.05625}$ =0.237

$$\sqrt{0.05625} = \sqrt{\frac{5.625}{100}} = \frac{2.37}{10}$$

Therefore the answer is 0.237

Example 3:

$\sqrt{0.005625}$ =0.075

$$\sqrt{0.005625} = \sqrt{\frac{56.25}{10{,}000}} = \frac{7.5}{100}$$

Therefore the answer is 0.075

(In each of the above examples $\sqrt{5.625}$ and $\sqrt{56.25}$ are obtained in the usual way.)

Exercise 5(f)

(i) $\sqrt{0.9}$

(ii) $\sqrt{0.06}$

(iii) $\sqrt{0.143}$

(iv) $\sqrt{0.0025}$

5.8 Miscellaneous Problems

Exercise 5(g)

(i) 35^2 =

(ii) 265^2 =

(iii) 0.34^2 =

(iv) 5260^2 =

(v) $\sqrt{61.6}$ =

(vi) $\sqrt{0.4}$ =

(vii) $\sqrt{0.0076}$ =

(viii) $\sqrt{496}$ =

(ix) 21^2 x $\sqrt{130}$ =

(x) $\sqrt{36.5^2 x 6.3}$ =

(xi) $\sqrt{81.5}$ ÷14.2 =

(xii) $\sqrt{6.2^2 + 5.7^2}$ =

(xiii) $\sqrt{375 x 0.6^2}$ =

(xiv) $\sqrt{1000 x 3.6}$ =

(xv) $\sqrt{6} + \sqrt{8}$ =

(xvi) $\frac{1}{\sqrt{2}} - \frac{1}{\sqrt{3}}$ =