How to use

Globemaster

NO. 62205

plastic

Slide rule

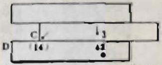
USAGE OF SCALES

SCALE	REMARKS
C & D	These are the fundamental scales of the Slide Rule and are used for multiplication and division (where greater accuracy than the use of A & B permits.)
CI	This is the reciprocal scale (inverse) and is read in the opposite direction to C & D, with which scales it is related. It is used to speed up multiplication and division.
A & B	These are used for calculation of Square and Square Root conjointly with C & D scales. A is also used for calculation of (powers of $\frac{1}{2}$).
K	This is used for calculation of Cube and Cube Root conjointly with C & D scales. K is also used for calculation of (Powers of $\frac{1}{3}$).
L	This is used to find Logarithms in "reference scale" with D scale.
S	This is used for Sin θ calculation.
T	This is used for Tan θ calculation.

USE OF RULE IN CALCULATION

(1) MULTIPLICATION

(a) Using the C & D Scales



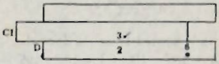
Example: $14 \times 3 = 42$

Set the index of C over 14 on D, move cursor to 3 on C and read 42 under cursor on D.

(b) Using the CI & D Scales

Example: $2 \times 3 = 6$

Set the cursor over 2 on D, move CI scale placing 3 under cursor and read 6 under the right index of CI on D.

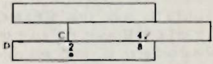


(2) DIVISION

(a) Using C & D Scales

Example: $8 \div 4 = 2$

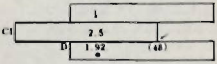
Set cursor over 8 on D scale then move C scale and place 4 under cursor reading 2 on D under the left index of C.



(b) Using CI & D Scales

Example: $4.8 \div 2.5 = 1.92$

Place right hand index of CI over 48 on D, move cursor to 25 on CI and read 192 on D.

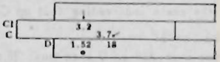


(3) CONTINUED MULTIPLICATION AND DIVISION USING C & D AND CI SCALES

(a) Using C & D Scales

Example: $18 \div 3.7 \div 3.2 \doteq 1.52$

Place cursor over 18 on D then move slide C placing 37 under the cursor, now move cursor to right index of C, but do not read off the number on D at this stage. Now move 32 on C under cursor and read 152 on D under the left index of C.



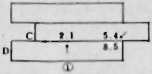
(b) Using C, D and CI Scales

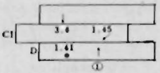
Example: 18 ÷ 3.7 ÷ 3.2 = 1.52

Place cursor over 18 on D, move C until 37 is under hairline, now move cursor over 32 on CI scale and read 152 on D under the hairline.

Example: 8.5 ÷ 5.4 × 2.1 × 1.45 ÷ 3.4 = 1.41

Place cursor over 85 on D then move 54 on C under hairline (this result will read under left hand index of C), do not move slide but place cursor over 21 C. Now place 145 on CI under the cursor hairline then move cursor over 34 on CI and read 141 under hairline on D.

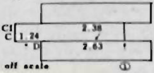


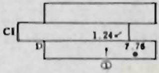


Example: 2.63 × 2.38 × 1.24 = 7.76

Place cursor over 263 D then move 238 on CI under the hairline.

Now move cursor over right index of CI, then place 124 on CI under the hairline and read 776 under the right index of CI on D.





(4) **PROPORTION** – Is calculated with C & D Scales.

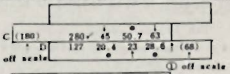
Example: Complete the following table given

127 kgs. = 280 lbs. i. e. $\frac{127}{280}$ = 1 lb.

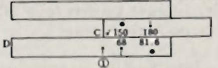
Place cursor over 127 on D scale, then move 280 on C under hairline. Read 20.4 under 45, 28.6 under 63, 50.7 over 23, which will leave 180 and 68 "off scale". Move cursor over right index of C and then move slide C until the left hand index is under the hairline. Now read off 150 over 68 and 81.6 under 180.

lbs	45	63	(50.7)	(150)	180
kgs	(20.4)	(28.6)	23	68	(81.6)

(A)

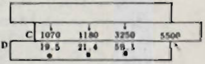


(B)



Example: Complete the following table giving percentages of the total.

	Amount	%
A	3,250.00	(59.1)
B	1,180.00	(21.4)
C	1,070.00	(19.5)
Total	5,500.00	100%



Place cursor over right index of D and move 55 on C under hairline. Now move cursor over 325, 180 and 107 on C and read 591, 214 and 195 respectively on D.

(5) **INVERSE PROPORTION** – Is performed with D and CI scales.

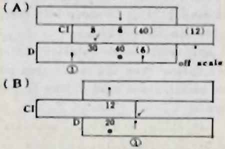
Example: 8 men can complete a job in 30 days.

(a) How many days will it take 6 men to complete the same job ?

(b) How many men will it take to complete the same job in 12 days ?

Ans. (a) Place cursor over 30 D and move CI 8 under hairline (note the left index of CI will be over 24 on D). Now move cursor over CI 60 and on D read 40 days.

(b) As the CI scale will now be "off scale" move cursor over left index of CI (reading 24 on D), move right index of CI under hairline of cursor, then move cursor over 12 CI and read on D, 20 men.



(6) **SQUARES AND SQUARE ROOTS** – Are obtained with A and D scales, numbers on A being the squares of those on D. It is necessary to note that the A scale consists of two parts i. e. numbers 1 – 10 and 10 – 100. Care is required in determining the value of the square or square root obtained.

The decimal point can be placed by inspection, and remembering that if the number is divided into groups of two significant numbers there will be one number for each group if the square root is required.

Example: $5^2 = 25$

Place cursor over 5 on D and read 25 on A (i.e. between 10 – 100).

Example: $\sqrt{64} = 8$

This being the inverse of a^2, place cursor over 64 on A and read under the hairline 8 on D.

(7) **GAUGE MARK "C"** – Is on the C & D scales at the value of 1.128 and is used for obtaining the area from circle diameter. Its use is derived from the following formulae.

$a = \frac{\pi}{4} d^2$ (a = area of a circle, d = diameter), by changing this form

$a = \left(\sqrt{\frac{\pi}{4}} \cdot d\right)^2 = \left(d \Big/ \sqrt{\frac{4}{\pi}}\right)^2$ is obtained.

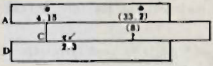
Now, $\sqrt{\frac{4}{\pi}}$, the denominator $\sqrt{\frac{4}{\pi}}$ in the parenthesis corresponds to the value of "C".

Example: Obtain the area of a circle with 2.3" dia. = 4.15 sq. ins.

Place the cursor over 23 on D, move "C" on slide C under hairline. Now move cursor over left index of C and read 4.15 on A.

Example: What is the volume of a cylinder with dia. 2.3" and length 8" = 33.2 cu. ins.

Proceed as for previous example then multiply the 4.15 by 8, so move cursor over 8 on B and read 33.2 on A.



(8) **CUBE AND CUBE ROOT** – These values are obtained by using the D and K scales.

Example: $2^3 = 8$

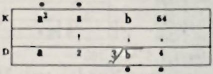
Move the cursor over 2 on D and read 8 on K scale.

Note: The K scale is divided into 3 groups of ten giving the values 1 – 10, 10 – 100, 100 – 1000.

Example: $\sqrt[3]{64} = 4$

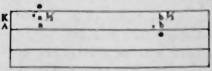
Place the cursor over 64 in the second group on the K scale and under the hairline read 4 on D.

Note: In calculating the cube root, the given number is divided into groups of three significant numbers. There will be one number in the root for each group.



(9) **FRACTIONAL POWERS OF NUMBERS $\frac{3}{2}$ AND $\frac{2}{3}$**

Calculation of $a^{\frac{3}{2}}$ and $a^{\frac{2}{3}}$ are obtained by using the K and A scales.



Example: $8^{\frac{3}{2}} = 22.6$

Place the cursor over 8 on A and under the hairline read 22.6 on K.

Note: 8 is read on A in the 1 – 10 division and 22.6 on K in the 10 – 100 division.

Example: $15^{\frac{2}{3}} = 6.06$

Place the cursor over 15 on K and under the hairline read 6.06 on A.

Note: $a^{\frac{3}{2}} = a^{\frac{1}{2} 3} = (\sqrt{a})^3$ = Cube of Square Root

$a^{\frac{2}{3}} = (\sqrt[3]{a})^2$ = Square of Cube Root

LOGARITHMS

(1) Common Logarithms

The L scale is graduated for values of the mantissa of numbers from 0-10 and is read on D scale. For numbers larger or smaller than 10 the characteristic must be given its correct value, according to the rules of common logarithms.

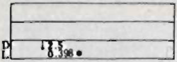
Example:

$\log_{10} 2.5 = 0.398$

$\log_{10} 25 = 1.398$

$\log_{10} 0.25 = \bar{1}.398$

$\log_{10} 0.025 = \bar{2}.398$



Example: $\log_{10} 2.5 = 0.398$

Place the cursor over 25 on D, read 398 under the hairline on L. This number will be the mantissa of the required logarithm and as the number is less than 10 its characteristic will be 0 giving 0.398 as the required log.

Example: $\log_{10} 0.025 = \bar{2}.398$

The procedure will be exactly the same as for $\log_{10}$ 2.5 with the exception of the characteristic's value, and as this is less than one-tenth, will be $\bar{2}.398$.

(2) Anti Logarithm

Example: Given $\log_{10} = 2.690$ = anti log 490

Only the mantissa value is required, the characteristic 2 indicating the positional placing of the decimal point. Place 690 on the L scale under the cursor and under the hairline read 49 on D. The number required has 2 as its characteristic, giving 490 as the answer.

(3) Natural Logarithm - $\log_e a$ can be obtained using the formulae ·

Natural logarithm = 2.3026 × common logarithm

or $\log_e a = 2.3026 \times \log_{10} a$

Common logarithm = 0.4343 × natural logarithm

or $\log_{10} a = 0.4343 \times \log_e a$

Example: Find the natural logarithm of 7.

$\log_e 7 = 2.3026 \times \log_{10} 7 = 1.945$

or $\log_e 7 = 2.3026 \times .845 = 1.945$

Place cursor over 7 on D, read 845 on L under the hairline, this being the common logarithm of 7.

The natural log can now be obtained by multiplication - place cursor over 845 on D, now move 2.302 on CI under the hairline and under the left hand index read 1.945 on D.

Example: What is the common logarithm of 9, given $\log_e 9 = 2.197$

or $\log_{10} 9 = 0.434 \times \log_e 9$

$\log_{10} 9 = 0.434 \times 2.197 = .954$

Place cursor over 2197 on D, move CI scale placing 434 under the hairline, then under the right hand index of CI read 954 on D.

TRIGONOMETRIC FUNCTIONS

The S (Sine) scale on the rule is read in relation to the A scale.

The T (Tangent) scale is read in relation to the D scale.

Note: The range of S scale of the 10" slide rule is 35°-90°.
The range of T scale of the 10" rule is 6° - 45°.

(1) Sine

Example: $\sin 35^\circ = 0.574$

Place 35 on S scale under the hairline and read 574 on A.

Example: $\cos 35^\circ = .819$

from the formulae $\cos 35^\circ = \sin (90^\circ - 35^\circ) = \sin 55^\circ$

To obtain the cosine of angle it is only necessary to convert the cosine value to that of a sine value.

Example: $\operatorname{cosec} 35^\circ = 1.74$

$$\text{or } \operatorname{cosec} 35^\circ = \frac{1}{\sin 35^\circ}$$

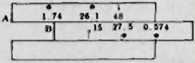
Place 35 on S scale under the hairline and read 574 on A. Then place 574 on C against the right index of D and read 1.74 on D under left index of C.

Example: $48 \sin 35^\circ = 27.5$

Place 35 on S scale under hairline and read 574 on A. Now move cursor over 574 on D, then place 48 on CI under the hairline and read 275 on D under the left hand index of CI.

Example: $\sin 35^\circ = 0.574$ $\quad$ cosecant $35^\circ = 1.74$

$48 \sin 35^\circ = 27.5$ $\quad$ $\dfrac{15}{\sin 35^\circ} = 26.1$



After the value of $\sin 35^\circ = 0.574$ has been obtained by use of S and A scales, transfer this value to the B scale by placing 574 under the right index of A.

It will be noted that 574 on B scale will be indexed on both portions of A scale (1–10 and 10–100).

For value of 48 sin 35°, move cursor to 48 on A and under hairline read 27.5 on B.

For value cosec 35° (which is equivalent to $\frac{1}{\sin 35^\circ}$) move cursor to left index of B and read under hairline 174 on A.

For value $\frac{15}{\sin 35^\circ}$ (which is equivalent to 15 × cosecant) move cursor over 15 on B scale and read 26.1 on A.

Note: By this method the three values required are obtained with one setting of the B scale on A scale.

(2) <u>Tangent Scale</u> – is read against D scale.

Example: Tan 14° = 0.249

Place 14 on T scale under the hairline and read 249 on D.

Example: Tan 70° = 2.747

As only the values of Tangents for 6°–45° are shown on scale T, the use of formulae –

$$\tan \theta = \frac{1}{\tan (90^\circ - \theta)}$$

$$\tan \theta = \text{Co-tangent } (90^\circ - \theta)$$

$$\tan 70^\circ = \frac{1}{\tan (90^\circ - 70^\circ)} = \frac{1}{\tan 20^\circ} = \text{Co-tangent } 20^\circ$$

Place 20 on T under the hairline and read 2.747 on CI. It is to be noted that values of Tangents 6°–45° will range between values .1–1, and 45°–90° between 1–∞ (infinity).

Example: Tan 14° = 0.249 Cot 14° = 4.01

26 Tan 14° = 6.48 $\frac{6.4}{\tan 14^\circ} = 25.7$

Using T, CI, C and D Scales –

Determine the value of Tan 14° by placing 14 on T under hairline and reading 249 on D.

Co-tangent 14° (i.e. $\frac{1}{\text{Tan } 14^\circ}$) can be read on the same setting of the scale and reading 4.01 on CI.

Example: 26 Tan 14° = 6.48

Place cursor over 249 on D then move 26 on CI scale under the hairline and against the right hand index of CI read 648 on D.

Example: $\frac{6.4}{\text{Tan } 14^\circ} = 25.7$

Place right hand index of CI against 64 on D, then move 249 on CI scale under the hairline and read 257 on D.

Example: 26 Tan 14° = 6.48

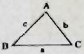
Place left hand index of C over 249 on D, move cursor over 26 on C and under the hairline read 648 on D.

Example: $\frac{6.4}{\text{Tan } 14^\circ} = 25.7$

Place cursor over 64 on D then move 249 on C (Tan 14° = .249) under the hairline and read 257 on D under the left index of C.

(3) Sine Proportion

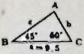
When the sides of a triangle are expressed as a, b and c respectively, the following equations exist –



$$\frac{a}{\text{Sin A}} = \frac{b}{\text{Sin B}} = \frac{c}{\text{Sin C}}$$

These equations are called the Law of Sines.

Example: Obtain b and c given the values in the following figure.



Angle A is computed from the formulae

$$A = 180^\circ - (B+C) = 180^\circ - 105^\circ = 75^\circ$$

From the Law of Sines formulae –

$$\frac{a}{\text{Sin A}} = \frac{b}{\text{Sin B}} = \frac{c}{\text{Sin C}} \qquad b = 6.96$$

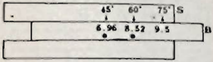
$$\text{or} \quad \frac{9.5}{\text{Sin } 75^\circ} = \frac{b}{\text{Sin } 45^\circ} = \frac{c}{\text{Sin } 60^\circ} \qquad c = 8.52$$

Place cursor over 75° on S and set 95 on B under the hairline.

As this will be the proportion of a, the required values of b and c will be in the same proportion.

Now move cursor over 45° on S and under the hairline read 696 on B giving b = 6.96.

Move cursor over 60° on S giving c = 8.52.



CLEANING

When it is necessary to clean the plastic a minimum of soap and water (not hot) should be used. Care should be taken to avoid any chemical solvents as the plastic may be defaced. Conditions of heat or damp should also be avoided.

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