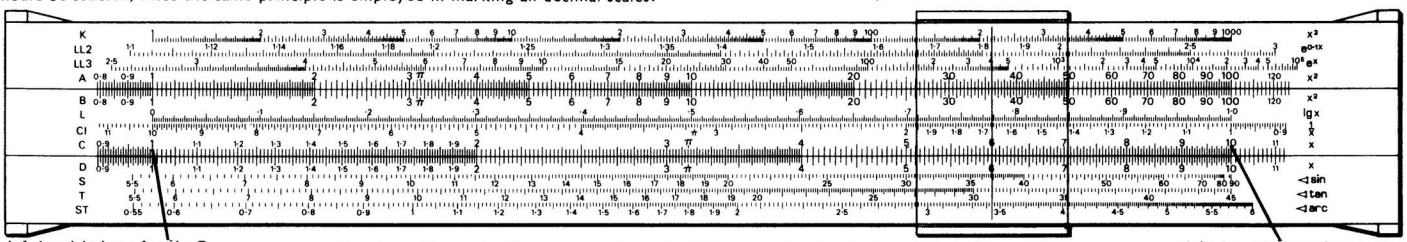
BLUNDELL HARLING
ACADEMY SLIDE RULE INSTRUCTION BOOK

INDEX

This booklet explains the basic use of slide rule scales. Full instruction covering all aspects of use can be obtained from our book, *The Slide Rule in Everyday Use*, available from W. H. Smith & Son branches. Booksellers and Drawing Office Stationers.

Before attempting to use a Blundell Slide Rule for calculations, it is necessary to become familiar with reading the scales, and for this purpose the two identical C and D scales should be studied, since the same principle is employed in marking all decimal scales.



left hand index of scale C

The above illustration is representative only. This comprehensive book applies to all models.

right hand index of scale C

Major divisions are 1 to 10.

Division 1 is the left hand index (L.H.I.).

Division 10 is the right hand index (R.H.I.).

between 1 and 10 the major divisions 1, 2, 3, etc., are figured.

between 1 and 2 major subdivisions 1·1, 1·2, etc., are figured and minor subdivisions are in tenths representing 1·01, 1·02, 1·03, etc.

between 2, 3 and 4 the subdivisions are as follows: longest lines represent 2·5, 3·5, etc. shorter lines represent 2·1, 2·2, etc. shortest lines represent 2.02, 2.04, etc.

between 4 and 10 the subdivisions are as follows: longest lines represent 4·5, 5·5, etc. shorter lines represent 4·1, 4·2, etc. shortest lines represent 4·05, 4·15, etc.

To the left of L.H.I. and to the right of R.H.I. there are some minor subdivisions known as 'extensions' in some, but not all, models.

It is necessary to remember that the position of the decimal point has no significance when finding a number on the scale, so if you want to find the point on the scale representing 152, then it will fall between major divisions 1 and 2. This will be 5/10ths of the way between 1 and 2, plus a further two minor subdivisions representing 2/10ths of the way along between 15 and 16. As the scale is graduated logarithmically, the interval between the major numbers (1-10) decreases as you proceed towards 10, so that there is insufficient room to provide 100 graduations, along the whole length. For example on a 10 in. rule there are only 50 divisions between 2 and 3 and 50 between 3 and 4. For the same reason there is room for only 20 divisions between the remaining major numbers, i.e. 4 to 10. However, one proceeds as if there are 100 divisions between each, and uses the markings as a guide to where the 100 graduations would be if there were room.

The scale is so graduated that if you add the distance between 1 and 2 to the distance between 1 and 4 you arrive at the figure 8 which is 2×4. Conversely if you take away the distance between 1 and 2 from the distance between 1 and 6 you arrive at the figure 3 which is $6 \div 2$. That is why the scale C on the slide is identical to scale D on the stock so that you can add and subtract distances by sliding one against the other.

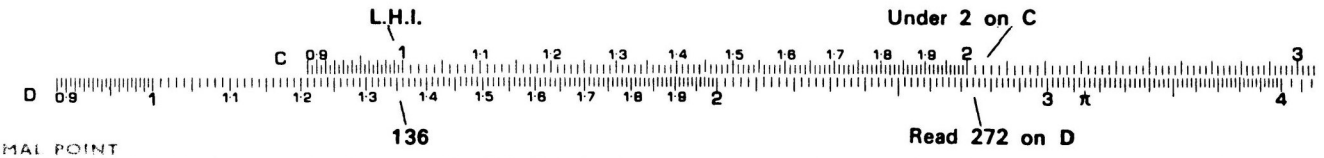
To demonstrate this, slide the 1 on scale C (L.H.I.) over 2 on scale D. You have now set the rule for multiplying by 2 and you can read 4, 6, 8, 10, etc. on D under the figures 2, 3, 4, 5, etc. on C. You will observe that the figures 6, 7, 8 and 9 cannot be multiplied in this position because they are too far to the right.
If, however, you slide the 10 on scale C (R.H.I.) over 2 you can now complete the multiplication and read 10, 12, 14, 16, 18 under 5, 6, 7, 8 and 9 on C.

This is very simply achieved by sliding the divisor on scale C over the number to be divided on scale D and reading the answer on D under the L.H.I. or R.H.I. of scale C.
As an exercise in scale reading it is suggested you set the rule for multiplying by 13·6, i.e. you slide the L.H.I. of scale C over 136 as shown in the illustration below. You can now read on D under any number on C the result of multiplying that number by 13·6.
For example

Under 2 on C you can read 27·2 on D which is $13{\cdot}6 \times 2$. Under 4 on C you can read 54·4 on D which is $13{\cdot}6 \times 4$. Under 6 on C you can read 81·6 on D which is $13{\cdot}6 \times 6$. Under ·665 on C you can read 9·04 on D which is $13{\cdot}6 \div {\cdot}665$.

To multiply by 8 and 9 you must slide the R.H.I. of scale C over 13·6 when under 8 you can read nearly 109, actually 108·8. Care must be taken here and it will be seen the first two figures in the answer are less than 11. Under 9 you can read a result just over 122, actually 122·4.

L.H.I. 136 Under 2 on C Read 272 on D



DECIMAL POINT

Before working examples it is well to remember that the position of the decimal point in an answer must be fixed mentally or, if complicated, worked roughly with paper and pencil since a position on the scale representing 136 could also represent 136000 or ·00136, etc. The quickest way to determine the position of the decimal point is to make a quick mental estimate. This has proved to be more effective than any set rules.

CURSOR

The function of the sliding cursor is to facilitate reading from one scale to another and to hold any position on a scale.

Example I *Multiply* $2{\cdot}75 \times 16{\cdot}7$. Slide L.H.I. over 2·75 on D. Place cursor over 16·7 on C. Read off answer 45·9 underneath on D.

Example II *Multiply* $192 \times {\cdot}0721$. Slide R.H.I. over 192 on D. Place cursor over 72 on C. Read off answer 13·83 on D.

Example III *Divide* $64 \div 6$. Find number to be divided (64) on D. Slide 6 on C over 64 on D. Read off answer 10·66 on D under L.H.I.

Example IV $\frac{3}{16} \times \frac{37}{7}$ Slide 16 on C over 3 on D. Place cursor over 37 on C. Slide 7 on C under cursor line. Read off answer ·991 on D under R.H.I.

The examples I-IV illustrate the use of the slide rule in multiplication and division singly or combined.
These operations can equally well be performed using scales A and B with more convenience but less accuracy.
Scale A being divided into two equal halves can be used for quickly finding the square or square root of a number.

With the cursor on any number on D, the square of that number lies on A under the hair line and vice versa.

The K scale being divided into three equal parts serves to find cubes and cube roots. Where Log-Log Scales are provided these can be used.
With the cursor on any number on D, the cube of that number lies on K under the hair line and vice versa.

The reciprocal scale is in the centre of the slide, apart from its use in calculating the reciprocal of numbers, can be used in multiplication to save unnecessary movement of the slide, but beginners are advised first to master the use of the ordinary scales to avoid confusion.

Example V 82×3. Cursor over 82 on D. Slide 3 on CI under hair line. Read off answer 246 on D under L.H.I.
$25 \div 4$. Slide L.H.I. over 25 on D. Place cursor over 4 on CI. Read off answer 6.25 on D under hair line.

Note The reciprocal of any number on CI lies underneath on C and vice versa.

If the cursor line is placed on any number on D the mantissa of the logarithm of that number can be read off L.

Example VI

(a) Evaluate $2{\cdot}23^{4{\cdot}5}$. With cursor align the R.H.I. of C, with 2·23 on LL2. Place cursor over 4·5 on scale C. Read answer 37 under hair line on LL3.
(b) Evaluate $12^{0{\cdot}23}$. With cursor align the L.H.I. of c with 12 on LL3. Place cursor over 0·23 on scale C. Read answer 1·77 on LL2.

Example VII

Evaluate $\sqrt[4{\cdot}1]{65}$. Place cursor on 65 on LL3. Slide 4·1 on C under hair line. Slide cursor to L.H.I. and read off answer 2·768 on LL3 under hair line.

Example VIII Find $\log_e 4{\cdot}26$. With the cursor align R.H.I. with 2·718 on LL2 (at this point it will be seen that scales C and D coincide). Place cursor over 4·26 on LL3 and read the answer 1·446 on C under the hair line.

RECIPROCAL LOG LOG SCALES

These are marked LLO1, LLO2, LLO3. They bear a relationship to the D scale such that $y = e^{-x}$ where y is the reading on LLO1, LLO2 or LLO3 and x is the value on Scale D.
Value of e^{-x} can be read off directly from Scales LLO1, LLO2 and LLO3. The cursor line is placed on the value of x on Scale D and the corresponding value of e^{-x} is found immediately above on Scale LLO1, LLO2 or LLO3.

Example I To evaluate e^{-3} set the cursor line on 3 on Scale D and read off 0·0498 above on Scale LLO3.

e^{-1} that is $\frac{1}{e}$ can be seen to be 0·3675 by moving the cursor line over the index at either end of the C scale.

Example II Evaluate $0{\cdot}8^2$. Set cursor line over 0·8 on Scale LLO2. Slide 1 on C scale under cursor line. Move cursor line to 2 on C Scale and read off answer 0·640 on Scale LLO2.

Example III Evaluate $\sqrt[4]{0{\cdot}2} = 0{\cdot}2^{0{\cdot}25}$. Set cursor line over 0·2 on Scale LLO3 and slide 1 on Scale C under cursor line. Move cursor to the left on to 0·25 on Scale C. Read off answer 0·6683 on Scale LLO2.

These scales are engraved on the face of the rule and are drawn relative to scale D.
On some models there is room for an additional scale named ST. This is for small angles for which the numerical value of the sine and tangent closely approximate.
To find the numerical value of the sine cosine or tangent of an angle, place the cursor line over the angle on the appropriate scale and read off the answer either on C or D under the hair line.
The position of the decimal point can be found by memorising or referring to the following table:

Sin 0·57° = 0·01	Tan 0·57° = 0·01
Sin 5·72° = 0·1	Tan 5·72° = 0·1
Sin 90° = 1·0	Tan 45° = 1·0
	Tan 84·28° = 10·0

When no red reciprocal Tan scale is available for angles greater than 45° up to 84·28° use:

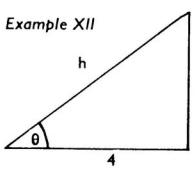
$$\text{Tan } \theta = \frac{1}{\text{Tan } (90 - \theta)}$$

Example IX To find Tan 72·50°. 90°—72·50° = 17·50°. With cursor on 17·50° on T, after aligning scales C and D read off 3·17 on the reciprocal scale CI.

Example X Evaluate 2·17 sin b where b = 31·33°. Place cursor over 31·33° on S. Slide R.H.I. under cursor line. Place cursor over 2·17 on C. Read off answer 1·128 on D underneath.

Example XI To find Cos 60°. Place cursor over 60° on scale S. (Note that cosines are reciprocal values of sines and numerical value is normally shown in red). Read off answer ·5 on scale C or D.

Example XII



To find the hypotenuse h and angle θ given the two sides of a right angle triangle.

i.e. $\tan \theta = \frac{3}{4}$ and $h = \frac{3}{\text{sine } \theta}$

Slide 4 on C over 3 on D and read off 36·87° for θ on the T scale under the R.H.I.

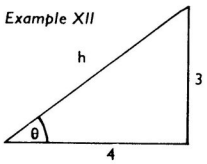
To find h place the cursor over 36·87° on S. Slide 3 on C under the cursor line and read off h = 5 over the right hand index of D.

Example IX To find Tan 72·50°. 90°—72·50° = 17·50°. With cursor on 17·50° on T, after aligning scales C and D read off 3·17 on the reciprocal scale C1.

Example X Evaluate 2·17 sin b where b = 31·33°. Place cursor over 31·33° on S. Slide R.H.I. under cursor line. Place cursor over 2·17 on C. Read off answer 1·128 on D underneath.

Example XI To find Cos 60°. Place cursor over 60° on scale S. (Note that cosines are reciprocal values of sines and numerical value is normally shown in red). Read off answer ·5 on scale C or D.

Example XII



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Slide 4 on C over 3 on D and read off 36·87° for θ on the T scale under the R.H.I.

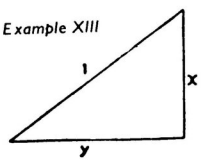
To find h place the cursor over 36·87° on S. Slide 3 on C under the cursor line and read off h = 5 over the right hand index of D.

13

PYTHAGORIAN SCALE (P)

For a right angle triangle with a hypotenuse of unity the P scale ($\sqrt{1-x^2}$ scale) can be used when available to find x or y as below.

Example XIII



$y = \sqrt{1-x^2}$

$\sqrt{1-0{\cdot}6^2} = 0{\cdot}8$

Place the cursor line on 0·6 on the D scale and read the corresponding value of y 0·8 on the $\sqrt{1-x^2}$ scale. Alternatively, place the cursor line on 0·8 on the D scale and read the corresponding value of y = 0·6 on the $\sqrt{1-x^2}$ scale.

14

DF/CF SCALES

The CF and DF scales on rules engraved with these are of the same length and dividings as the CD but they commence and end with π and the one index is near the centre of the scale. They may therefore be used for multiplying or dividing a number by π, e.g. set the hair line opposite a number on the D scale. That number is multiplied by π on the DF scale. Conversely a number on the DF scale is divided by π on the D scale. This is useful for example in calculating the diameters of circles. They may be used interchangeably with the CD and thus an answer may be read somewhere off the face of the rule without re-adjustment and with the same accuracy, or alternatively a setting can be made on either set of scales to avoid unnecessary slide movement.

To evaluate $\frac{3{\cdot}26 \times 2{\cdot}54}{9{\cdot}8}$

Slide the 9·8 on C over the 3·26 on D (which is the same thing as sliding the 9·8 on CF under the 3·26 on DF). Since 2·54 on C is off the scale use the CF and with the cursor over 2·54 on CF read the answer ·845 on DF. Reciprocal values can be calculated using the CIF scale.

15

Note to user

Your precision divided slide rule is made from a specially selected plastic material. This material will last indefinitely in normal use, and given reasonable care the slide rule will give many years' service. Care should be taken that it is not exposed to excessive temperature as damage would result. Hot radiator tops or car window sills in direct sun should be avoided.

To clean, do not use solvents or abrasives; lukewarm soapy water applied with cotton wool is best.

DUAL FACED Models have the basic C & D scales on both sides. As all scales relate to these, the slide rule is not designed to be read on both sides simultaneously in one calculation.

16