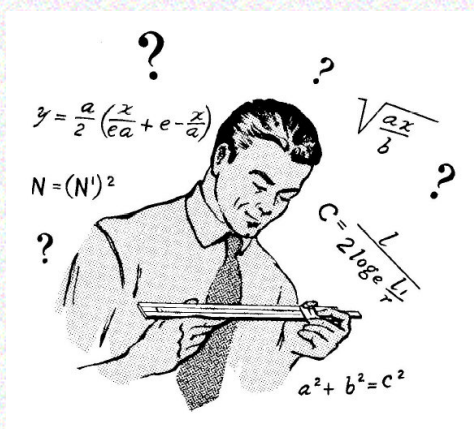




Illustrated Self-Guided Course On How To Use The Slide Rule



"Dad says that anyone who can't use a slide rule is a cultural illiterate and should not be allowed to vote. Mine is a beauty - a K&E 20-inch Log-log Duplex Decitrig" - *Have Space Suit - Will Travel*, 1958. by Robert A. Heinlein (1907-1988)



Downloadable Version of this Web Page.
Use it on your classroom computers as
a Seminar on your computer (4MB PDF)

Introduction

This self-guided course gives numeric examples of the basic calculations that a slide rule can do. Just follow the step-by-step instructions and you will be amazed by the power and versatility of the venerable Slipstick. Click on any of the images below to get a large, unmarked, blowup of each slide rule as shown in the problem.

Images created from Emulators designed by [Derek Ross](#). Initial examples based on Derek's Self Guided demo and expanded by Mike Konshak.



No Slide rule handy?

You can start up this [Virtual Slide Rule](#) (opens in new window) to try these and other problems on your own. (Hint: Teachers can use a computer projector to manipulate the slide rule in front of the class).

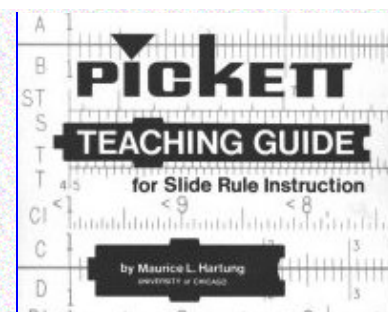
Want to try a real Slide Rule?

Participate in our [School Loaner Program](#). Sets of up to 25 slide rules are available FREE of charge for teachers to use in class.

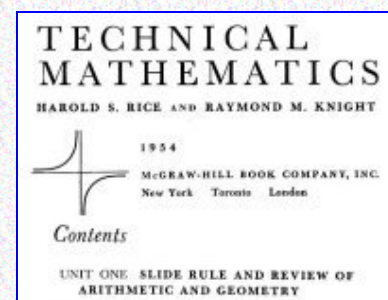
Table of Contents (TOC)

- [A Brief History the Slide Rule](#)
- [The Parts of a Slide Rule](#)
- [Reading the Scales](#)
- [Multiplication](#)
 - [Simple Multiplication \(uses C and D scales\)](#)
 - ['Wrap-Around' Multiplication \(uses C and D scales\)](#)

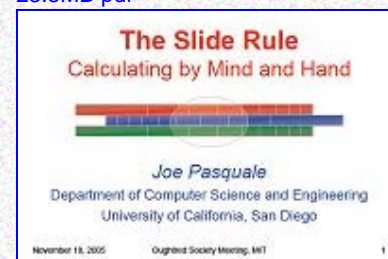
- Folded-Scale Multiplication (uses C, D, CF and DF scales)
 - Multiplication by π (uses D and DF scales)
- Division
 - Simple Division (uses C and D scales)
 - Reciprocal (uses C and CI scales)
- Trigonometry
 - Sin(x) for angles between 5.7° and 90° (uses S and C scales)
 - Cos(x) for angles between 5.7° and 90° (uses S and C scales)
 - Tan(x) for angles between 5.7° and 45° (uses T and C scales)
 - Tan(x) for angles between 45° and 84° (uses backward T and CI scale)
 - Tan(x) for angles between 45° and 84° (uses forward T and C scale)
 - Sin(x) and tan(x) for angles between 0.6° and 5.7° (using the ST and C scales)
 - Sin(x) and tan(x) for other small angles (using C and D scales)
- Squares and Square Roots
 - Square (uses C and B scales)
 - Square Root (uses C and B scales)
- Cubes and Cube Roots
 - Cube (uses D and K scales)
 - Cube Root (uses D and K scales)
- Log-Log Scales
 - Raising a Number to Powers of 10 ($N > 1$)
 - Raising a Number to Powers of 10 ($N < 1$)
 - Raising a Number to Powers of -10 ($N > 1$) or $1/X^{10}$
 - Finding the 10th Root ($N > 1$)
 - Finding the 10th Root ($N < 1$)
 - Arbitrary Powers (Staying on Same LL Scale)
 - Arbitrary Powers (Switching LL Scales)
 - Log-Log Approximations
- Slide Rule Loaner Program
- Additional Training Resources



Pickett Teaching Guide 17.7MB pdf



Good Illustrated use of Slide Rule. A Pickett 902 is used as example 23.5MB pdf



Presentation on the use of Slide Rule by Prof. Joseph Pasquaule, UCSD 12.5MB pdf

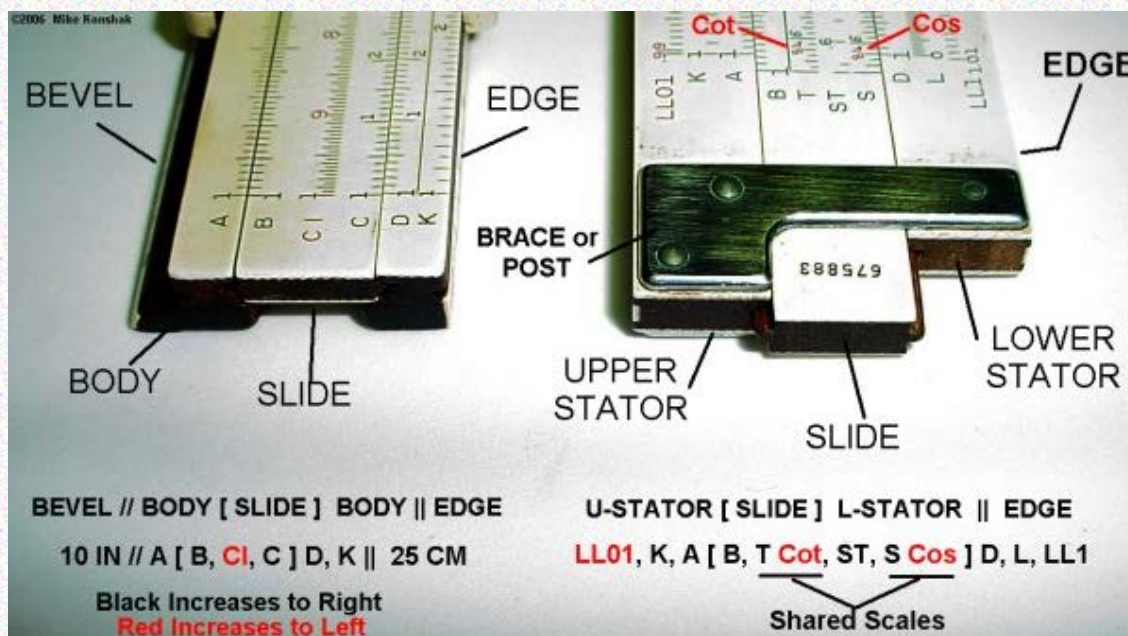
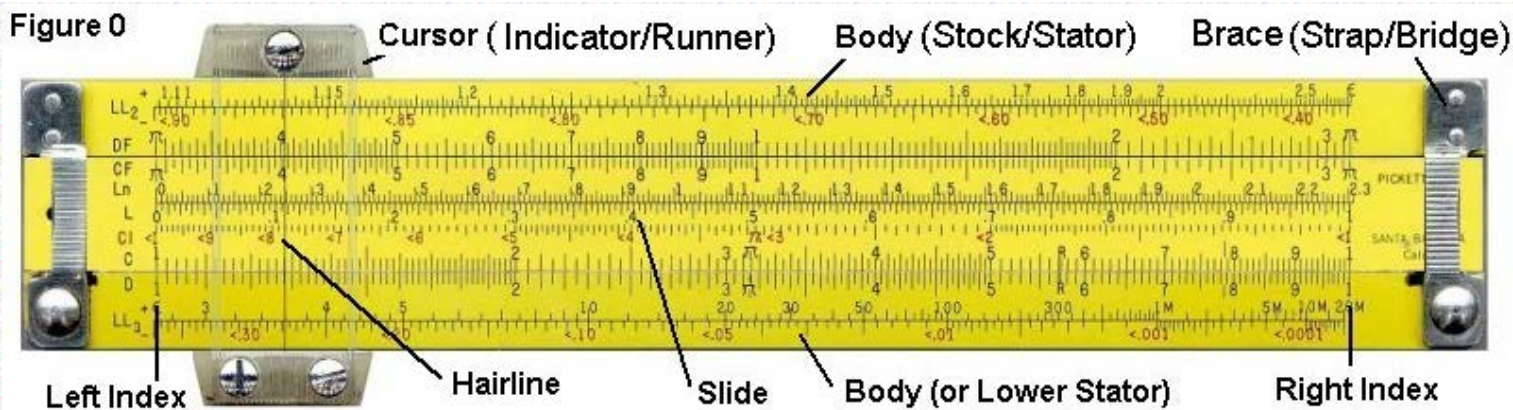
Brief History of the Slide Rule

1614 - Invention of logarithms by John Napier, Baron of Merchiston, Scotland.
 1617 - Developments of logarithms 'to base 10' by Henry Briggs, Professor of Mathematics, Oxford University.
 1620 - Interpretation of logarithmic scale form by Edmund Gunter, Professor of Astronomy, London.
 1630 - Invention of the slide rule by the Reverend William Oughtred, London.
 1657 - Development of the moving slide/fixed stock principle by Seth Partridge, Surveyor and Mathematician, England.
 1775 - Development of the slide rule cursor by John Robertson of the Royal Academy.
 1815 - Invention of the log log scale principle by P.M. Roget of France.
 1850 - Amédée Mannheim, France, produced the modern arrangement of scales.
 1886 - Dennert & Pape, Germany, introduce white celluloid as a material for inscription of scales.
 1890 - William Cox of the United States patented the duplex slide rule.
 c1900 - Engine divided scales on celluloid increases precision of slide rules.
 1976 - The final slide rule made by K&E donated to the Smithsonian Institute, Washington, DC, USA.
 Today, slide rules can be found on eBay, antique stores and estate auctions. Lost inventories of brand new slide rules turn up every year.

[TOC](#)

Parts of a Slide Rule

Figure 0



TOC

Reading the Scales

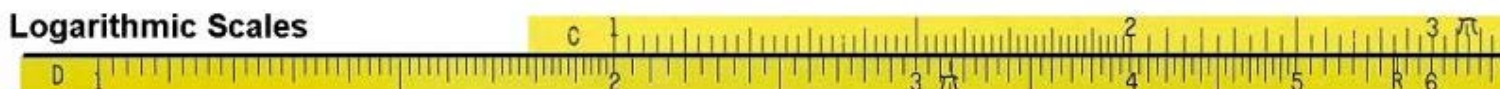
The scales on a slide rule are logarithmic, in that the spacing between divisions (the lines on the scale) become closer together as the value increases. This is why the slide rule is able to do multiplication and division rather than addition and subtraction. Compare the two sets of offset scales below in Figure B. In both cases the left index X:1 or C:1 is placed over the first whole number, either Y:2 or D:2. On a linear scale the value of any number on the X scale as read on Y is increased by 1. On a logarithmic scale, the value on any number on the C scale as read on the D scale becomes a multiple of the number under the index.

Figure B

Linear Scales



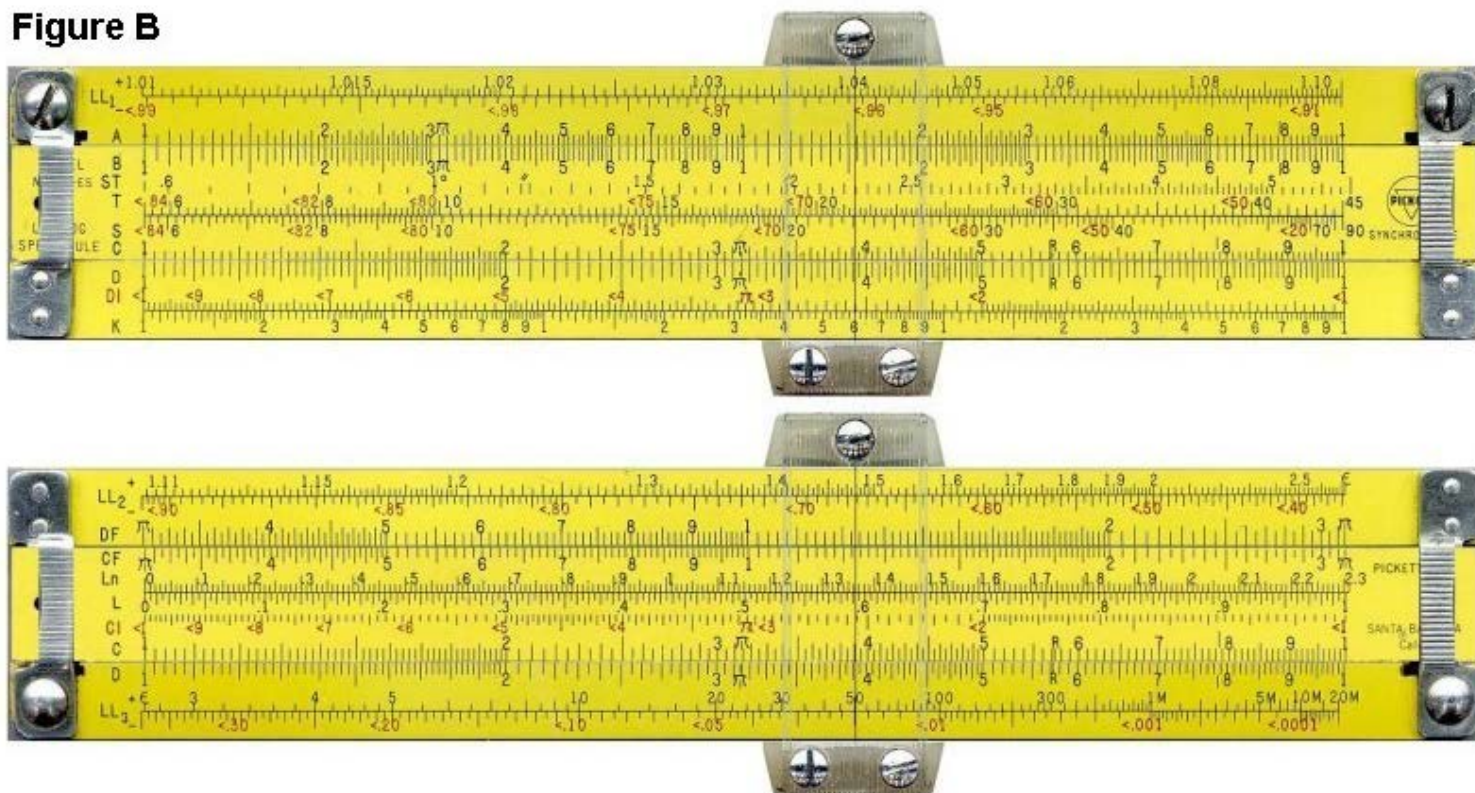
Logarithmic Scales



William Oughtred discovered the above characteristic in 1630, when he placed two logarithmic scales that were invented by his contemporary, Edmund Gunter, alongside each other. Thus the slide rule was born.

At this point it is best to just describe how to read the scales. On almost all slide rules, the **black scales** (A, B, C, D, K, etc.) increase from left to right. The **red scales**, or inverse scales (CI, DI), increase from right to left. The pocket sized Pickett 600-ES will be used in most illustrations. The full sized Pickett N3-T for others. By the way, the Pickett 600-T (white) was taken by the Apollo 11 NASA astronauts to the moon.

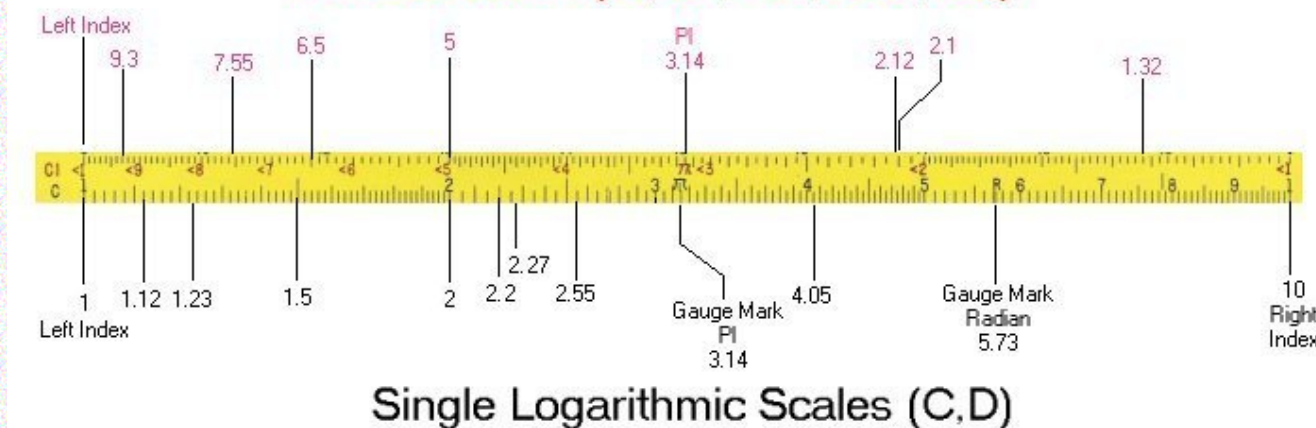
Figure B



Except for 'folded', 'trig' or Log' scales, each scale begins with 1. C and D scales are single logarithmic (1-10) scales. The A and B scales are double logarithmic (1-10-100) having two cycles of 1-10, the K scale being triple logarithmic (1-10-100-1000) having three cycles of 1-10. The Primary divisions are whole numbers. The secondary divisions divide the Primary by 10, the Tertiary divisions divide the secondary by 5. Of course as you get to the end of each scale the divisions get so close together that the tertiary divisions disappear. The scales on each side of a slide rule are aligned so that calculations can be carried from one side to the other.

Figure C

Inverse Scales (CI, DI, -LL, Cos, etc)



Its important to become familiar with not only the physical divisions as marked on the scales, but in becoming able to **extrapolate*** values when the hairline falls in the spacing between divisions. Positions of the slide and cursor shown in the examples will mention the label of the scale and the value on the scale, such as scale C at 1.5 will be referenced as C:1.5.

*In mathematics, **extrapolation** is the process of constructing new data points outside a discrete set of known data points. It is similar to the process of interpolation, which constructs new points between known points, but its results are often less meaningful, and are subject to greater uncertainty (Ref: en.wikipedia.org).

[TOC](#)

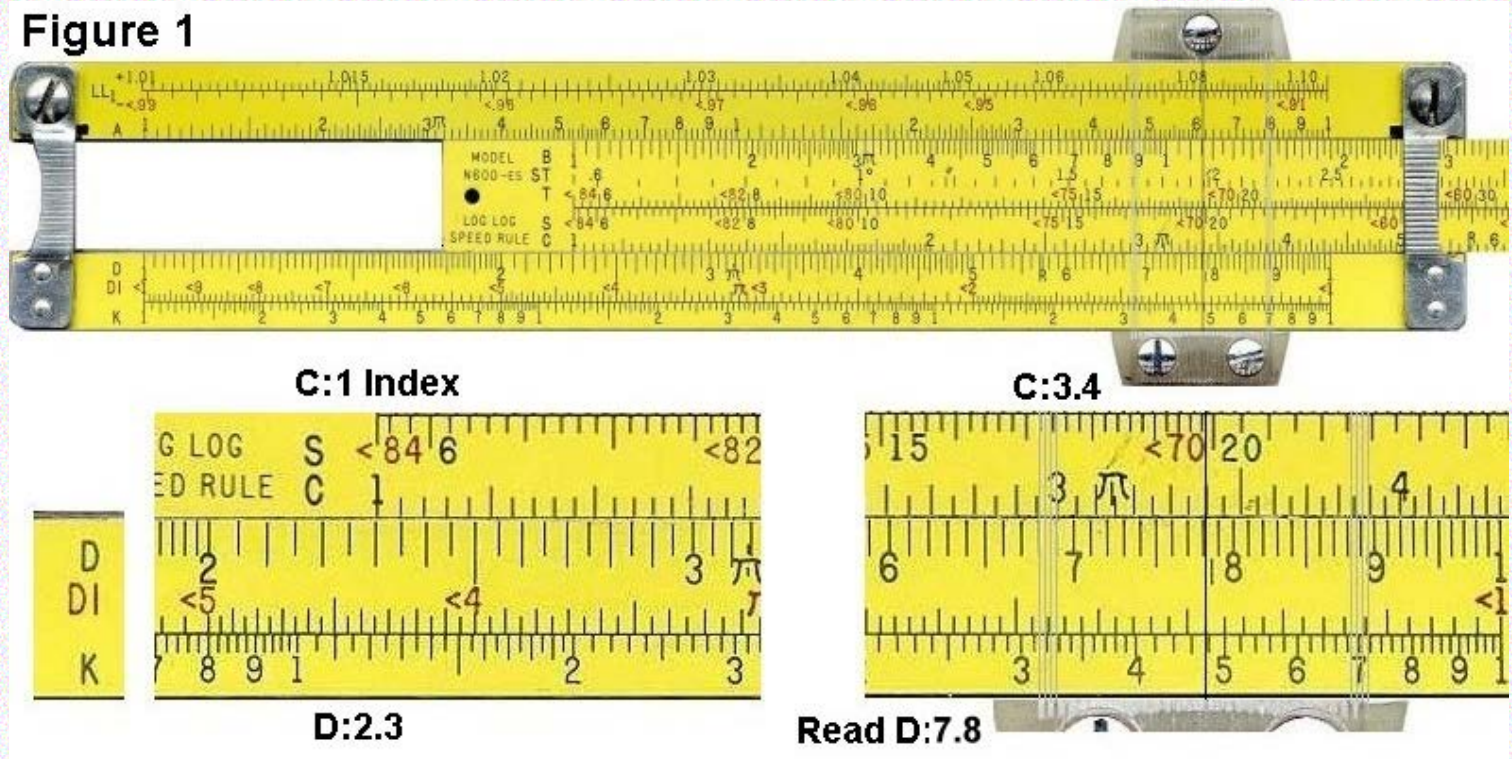
Multiplication

1. Simple Multiplication (uses C and D scales)

Example: calculate 2.3×3.4 (Figure 1)

- Slide the leftmost Index '1' on C over 2.3 on the D scale.
- Move the cursor to 3.4 on the C scale.
- The cursor is on the D scale just a bit over 7.8 or 7.82. This is the answer.

Figure 1



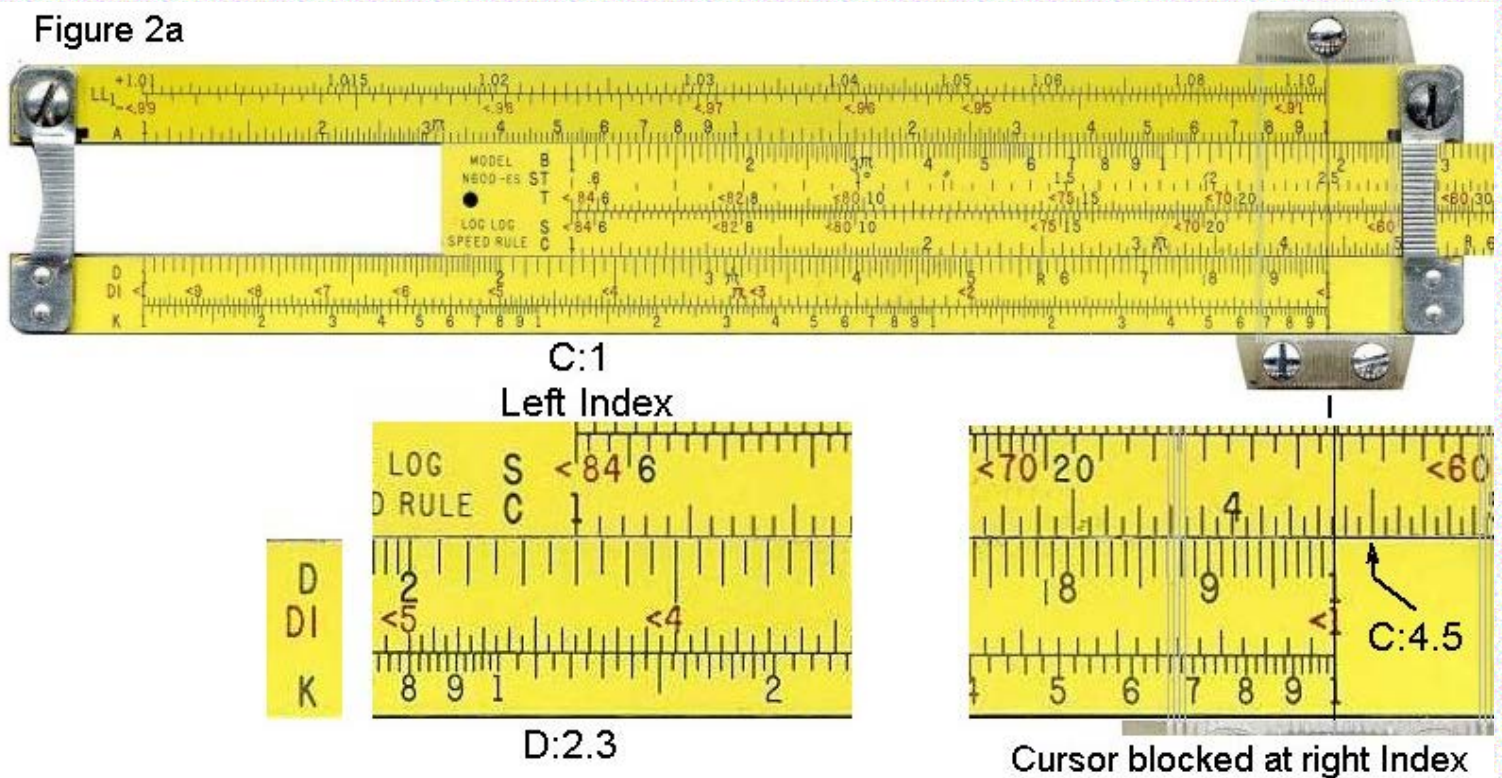
[TOC](#)

2. 'Wrap-Around' Multiplication (uses C and D scales)

Example 2a: calculate 2.3×4.5 (Figure 2a)

- Move the left Index on C to 2.3 on the D scale.
- Try to move the cursor to 4.5 on the C scale. The cursor is blocked by the brace (also called strap or bridge).
- The target C:4.5 is off the D scale. The right Index must now be used.

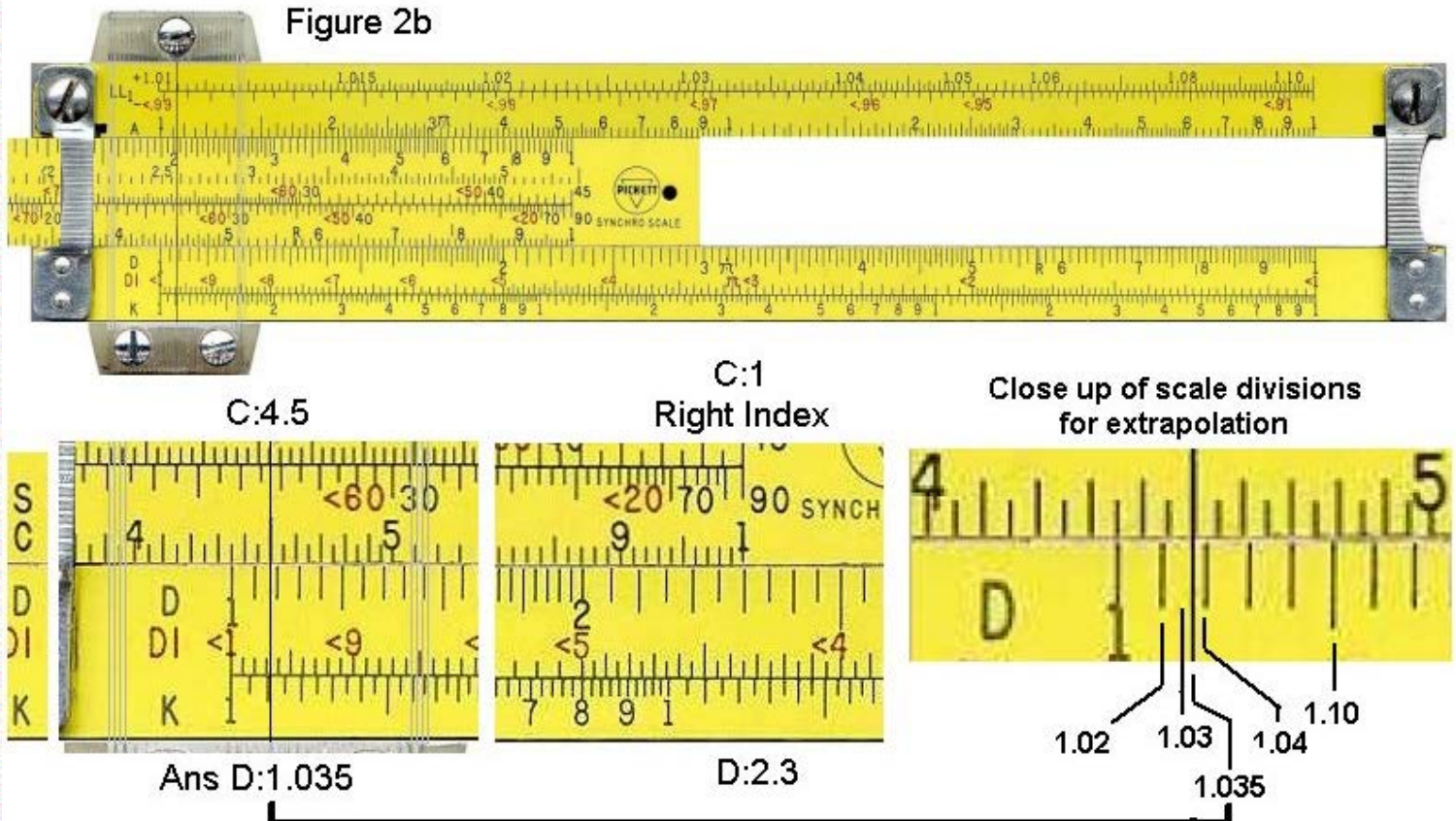
Figure 2a



Example 2b: calculate 2.3×4.5 (Figure 2b)

- Move the right Index on C (C:1) to over 2.3 on the D scale (D:2.3)
- Slide the cursor to 4.5 on the C scale (C:4.5)
- On the D scale, you'll see that the hairline is between divisions. Extrapolate the answer to 1.035.
- Do a rough approximation by rounding 2.3 to 2 and 4.5 to 5.
- We mentally calculate $2 \times 5 = 10$, so we adjust the decimal place to get 10.35 or 10.4.

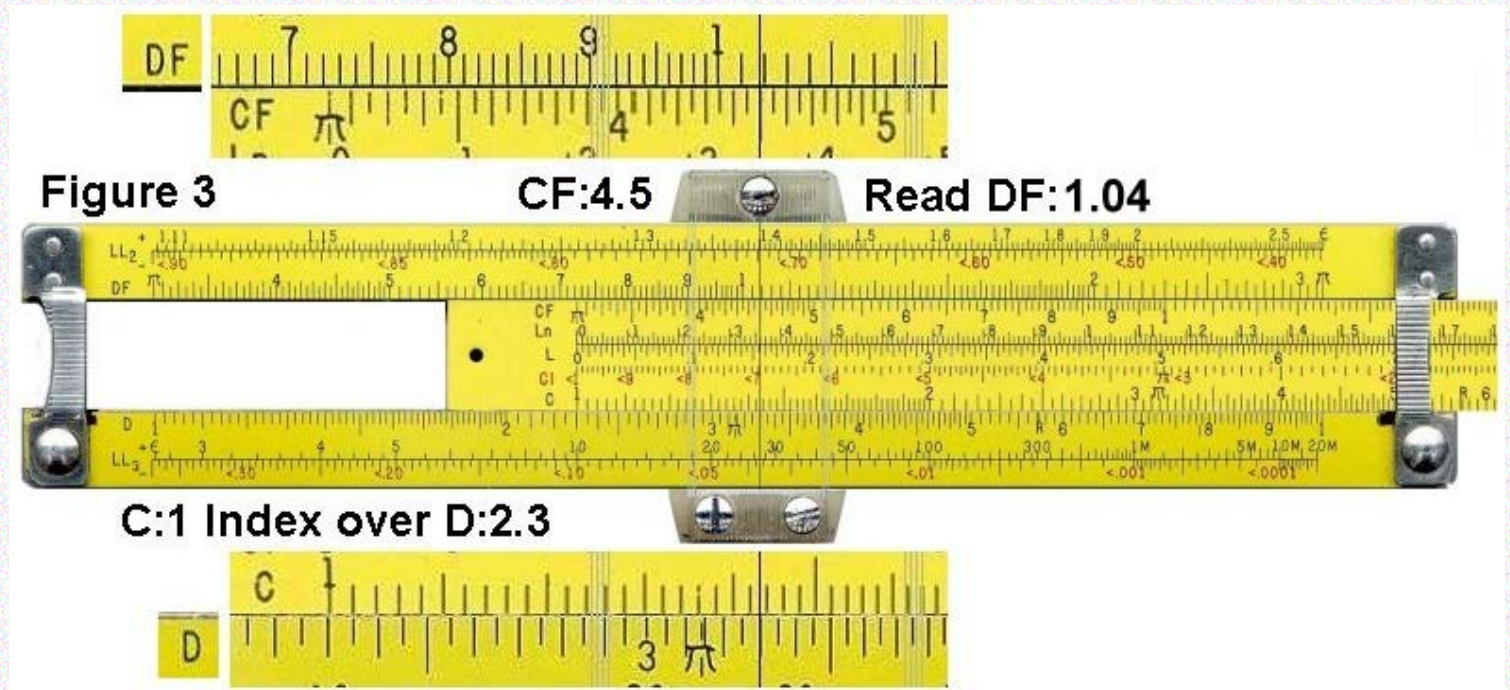
Figure 2b



3. Folded-Scale Multiplication (uses C, D, CF and DF scales)

Example 3: calculate 2.3×4.5 (Figure 3)

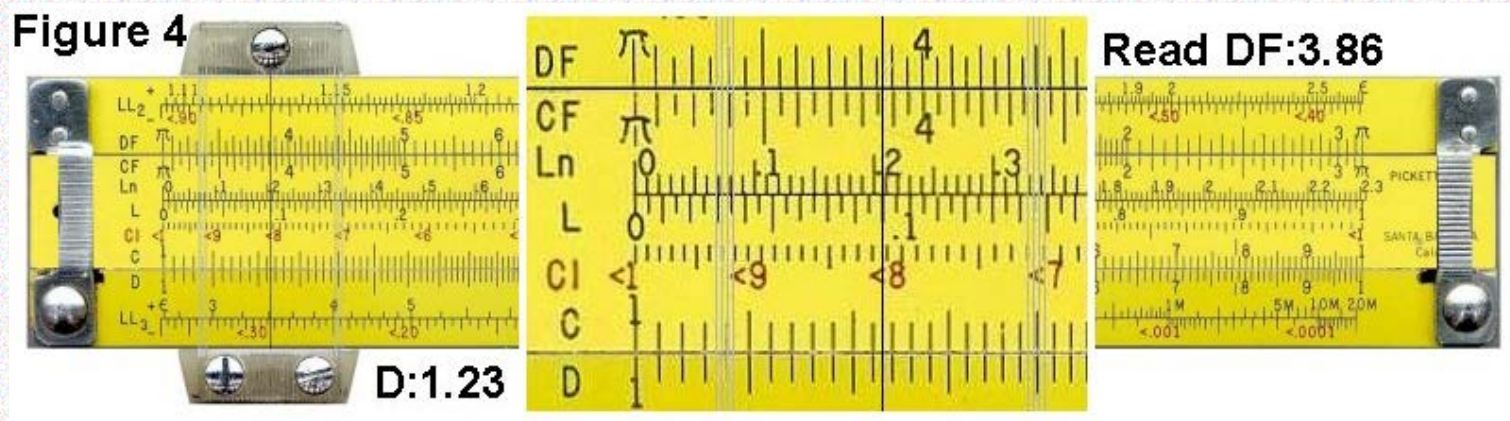
- Slide the leftmost Index, '1', on C over the 2.3 on the D scale (D:2.3).
- We can't move the cursor to 4.5 on the C scale; it's out of range. We can use the folded scales to get this answer.
- Move the cursor to 4.5 on the CF scale (CF:4.5).
- The cursor is now at 1.04 on the DF scale (DF:1.04).
- We know the correct answer is near $2 \times 5 = 10$, so we adjust the decimal place to get 10.4.



4. Multiplication by π (uses D and DF scales)

Example 4: calculate $123 \times \pi$ (Figure 4)

- Move the cursor to 1.23 on the D scale.
- The cursor is now at 3.86 on the DF scale.
- We know that the correct answer is near $100 \times 3 = 300$, so we adjust the decimal place to get 386.



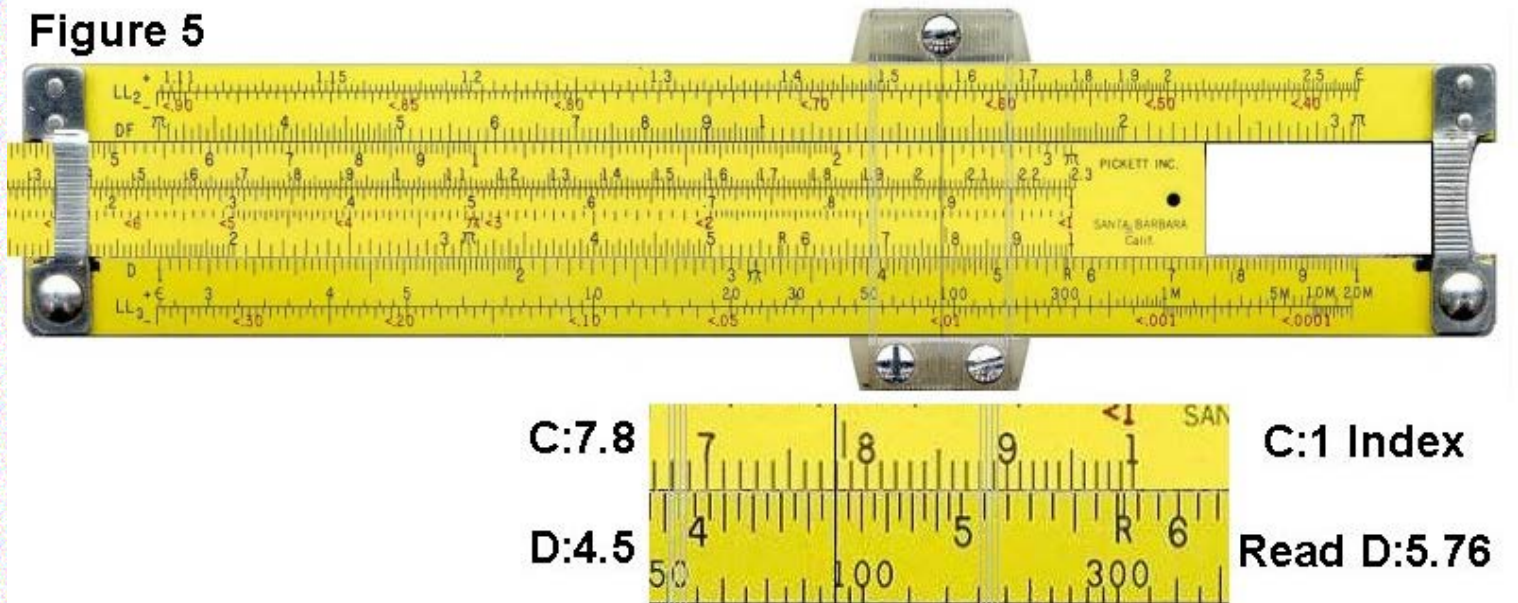
Division

5. Simple Division (uses C and D scales)

Example 5: calculate $4.5 / 7.8$ (Figure 5)

- Move the cursor to 4.5 on the D scale.
- Slide 7.8 on the C scale to the cursor.
- Move the cursor to either the leftmost or rightmost '1' on the C scale, whichever is in range. In this case, you would move it to the rightmost '1'.
- The cursor is now at 5.76 on the D scale.
- We know that the correct answer is near $4/8 = 0.5$, so we adjust the decimal place to get 0.576.

Figure 5



[TOC](#)

6. Reciprocal (uses C and CI scales)

Example 6: calculate the reciprocal of 7.8, or $1/7.8$ (Figure 6)

- Move the cursor to 7.8 on the CI scale. Note that the CI scale increases from right to left, as indicated by the '<' symbols before the numbers.
- The cursor is now at 1.28 on the C scale.
- We know that the correct answer is near $1/10 = 0.1$, so we adjust the decimal place to get 0.128.

Figure 6



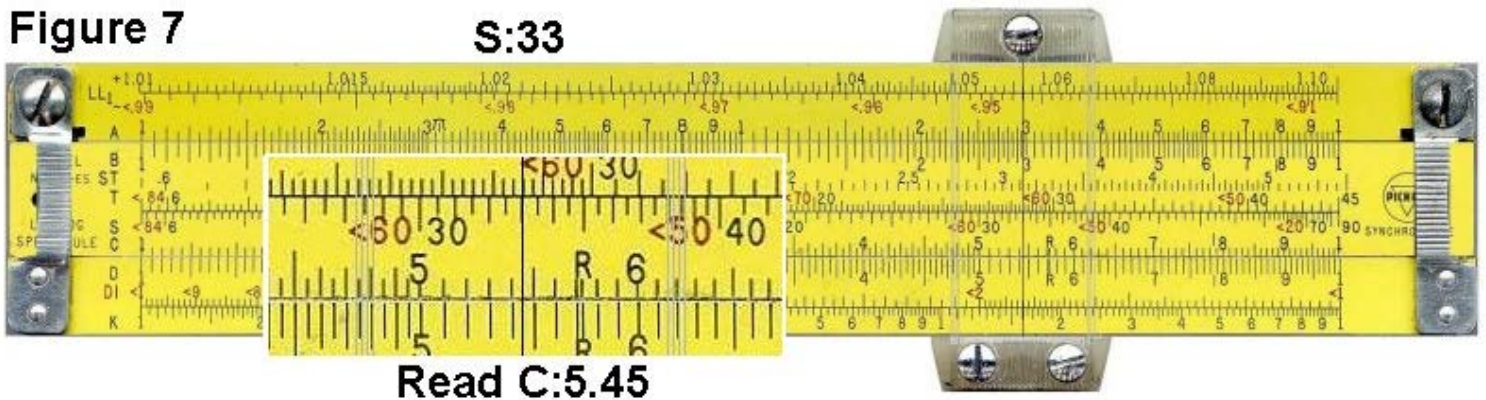
[TOC](#)

Trigonometry

7. $\sin(x)$ for angles between 5.7° and 90° (uses S and C scales)

Example 7: calculate $\sin(33^\circ)$ (Figure 7)

- Move the cursor to 33 on the S scale.
- The cursor is at 5.45 on the C scale.
- We know that the correct answer for a sin in this range is between 0.1 and 1, so we adjust the decimal place to get 0.545.

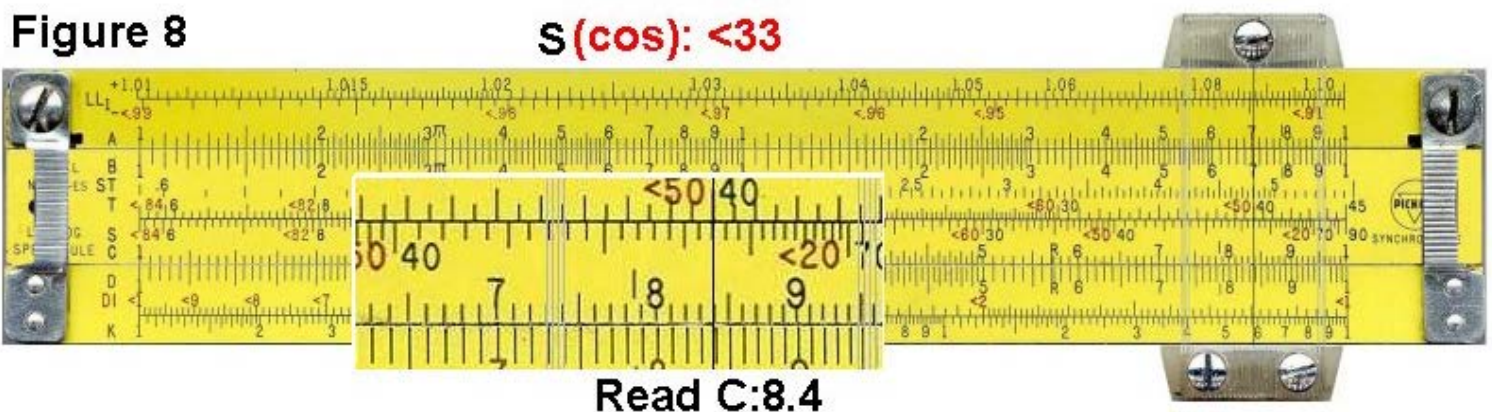


[TOC](#)

8. $\cos(x)$ for angles between 5.7° and 90° (uses S and C scales)

Example 8: calculate $\cos(33^\circ)$. (Figure 8)

- The cos scale shares the sin S scale. Instead of increasing from left to right like the sin scale, cos increases from right to left. This is indicated on the slide rule by '<' characters which remind you that the number is increasing 'backwards'.
- Move the cursor to <33 on the S scale.
- The cursor is now at 8.4 on the C scale.
- We know that the correct answer for a cos in this range is between 0.1 and 1, so we adjust the decimal place to get 0.84.

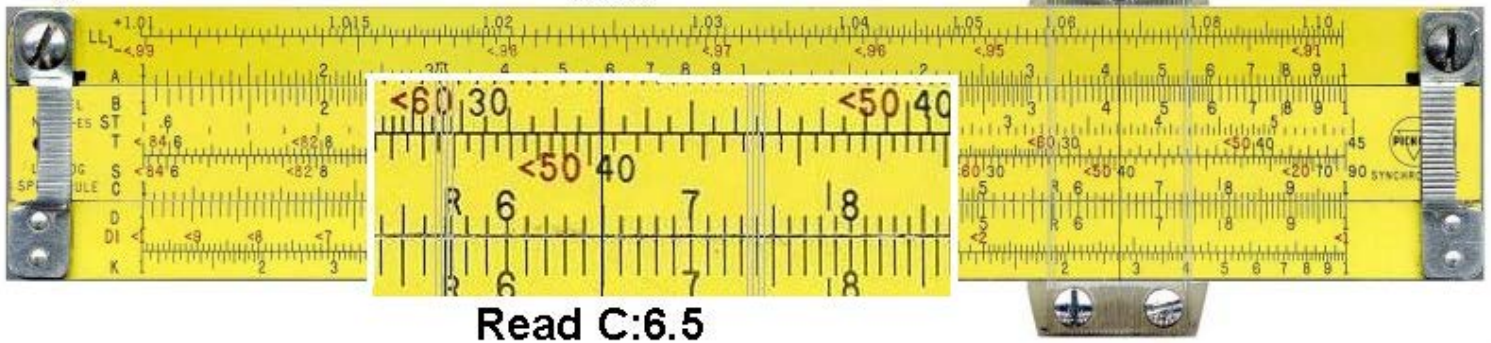


[TOC](#)

9. $\tan(x)$ for angles between 5.7° and 45° (uses T and C scales)

Example 9: calculate $\tan(33^\circ)$ (Figure 9).

- Move the cursor to 33 on the T scale.
- The cursor is now at 6.5 on the C scale.
- We know that the correct answer for a tan in this range is between 0.1 and 1, so we adjust the decimal place to get 0.65.

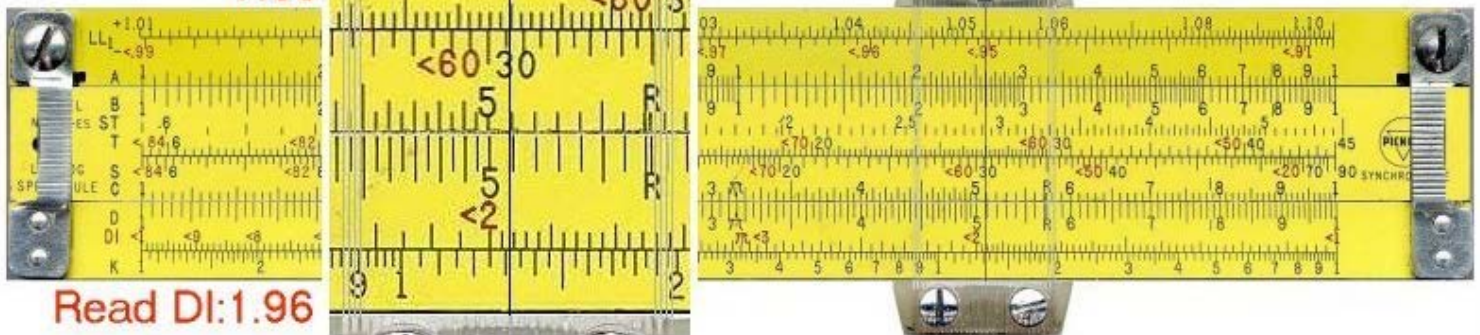
Figure 9**T:33**

TOC

10. Tan(x) for angles between 45° and 84° (uses backward T and CI scale)

Example 10a: calculate $\tan(63^\circ)$ (Figures 10a and 10b)

- Move the cursor to **<63** on the T scale. Note that this range increases from right to left, as indicated by the '<' before the numbers.
- The cursor is now at **<1.96** on the **DI** scale. Figure 10a
- If you flip to the other side the cursor is also at **<1.96** on the **CI** scale. Figure 10b
- We know that the correct answer for a tan in this range is between 1 and 10, so we don't need to adjust the decimal place.

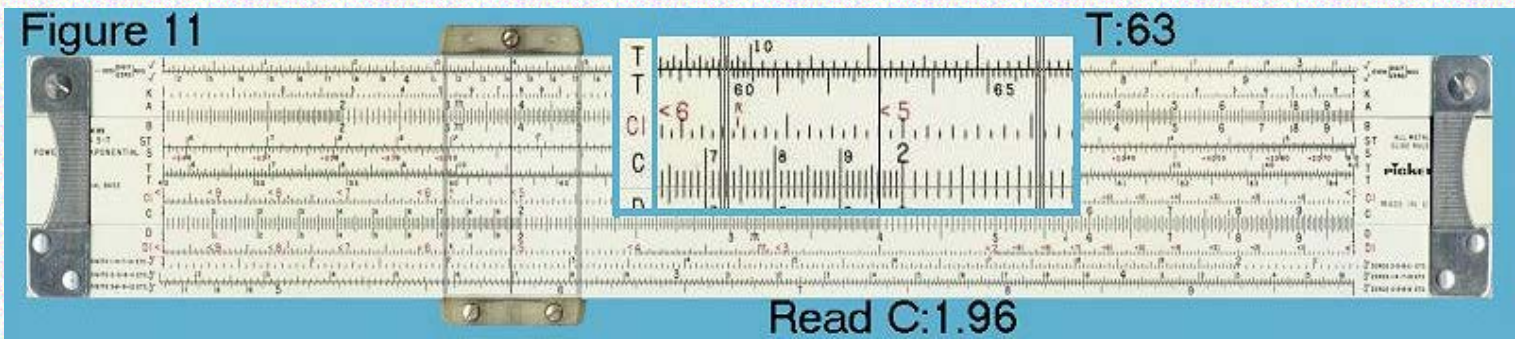
Figure 10a**T:63****Figure 10b****T:63 (other side)**

TOC

11. Tan(x) for angles between 45° and 84° (uses forward T and C scale)

Example 11: calculate $\tan(63^\circ)$. (Figure 11)

- Move the cursor to 63 on the forward T scale. This scale increases from left to right.
- The cursor is now at 1.96 on the C scale.
- We know that the correct answer for a tan in this range is between 1 and 10, so we don't need to adjust the decimal place.

Figure 11

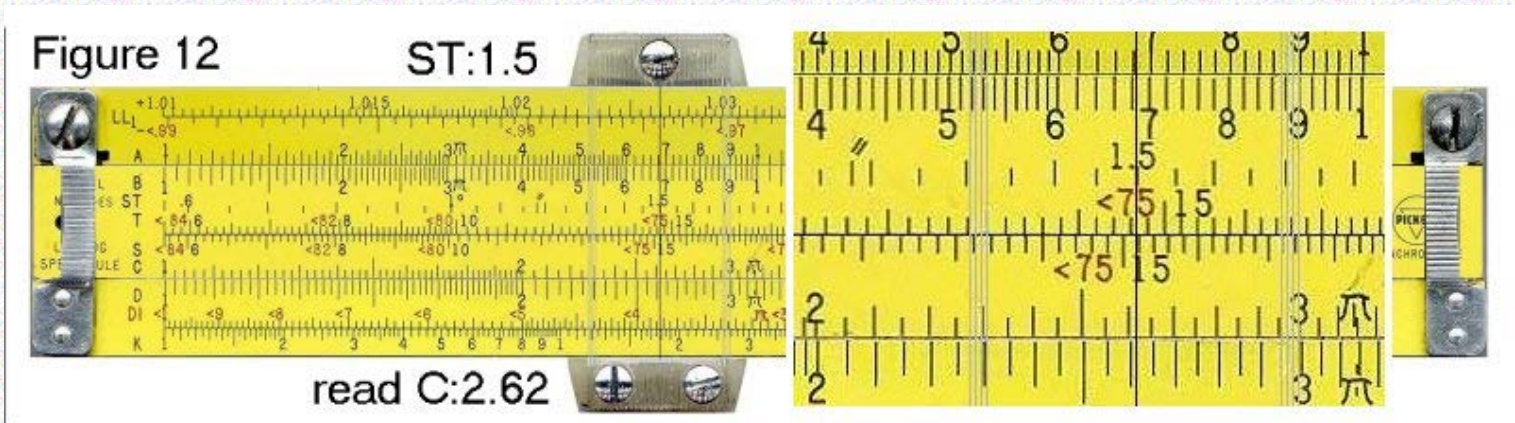
TOC

12. Sin(x) and tan(x) for angles between 0.6° and 5.7° (using the ST and C scales)

In this range, the sin and tan functions are very close in value, so a single scale can be used to calculate both.

Example: calculate sin(1.5°) (Figure 12)

- Move the cursor to 1.5 on the ST scale.
- The cursor is now at 2.62 on the C scale.
- We know that the correct answer for a sin in this range is between 0.01 and 0.1, so we adjust the decimal place to get 0.0262.



TOC

13. Sin(x) and tan(x) for other small angles (using C and D scales)

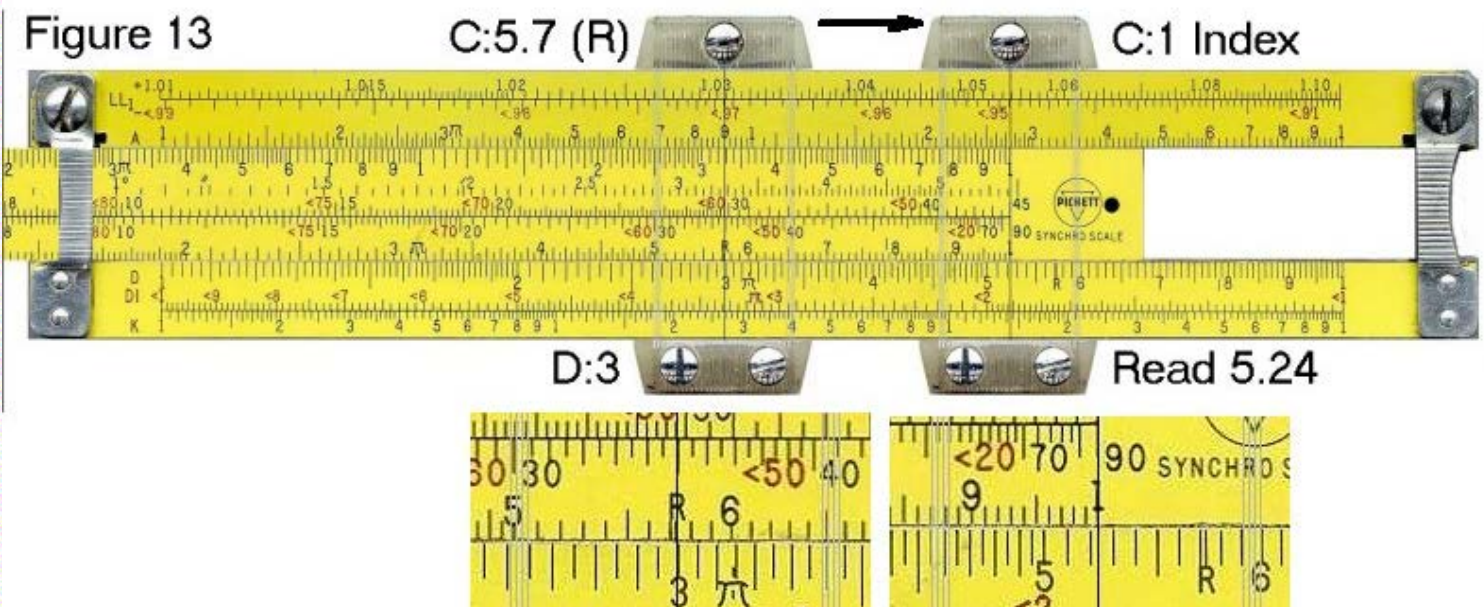
For small angles, the sin or tan function can be approximated closely by the equation:

$$\sin(x) = \tan(x) = x / (180/\pi) = x / 57.3.$$

Knowing this, the calculation becomes a simple division. This technique can also be used on rules without an ST scale.

Example: calculate sin(0.3°) (Figure 13)

- Move the cursor to 3 on the D scale.
- Slide 5.73 on the C scale to the cursor. Most rules have a tick labeled 'R' at this point.
- Move the cursor to either the leftmost or rightmost '1' on the C scale, whichever is in range.
- The cursor is now at 5.24 on the D scale.
- We know that the correct answer is near $0.3 / 60 = 0.005$, so we adjust the decimal place to get 0.00524.



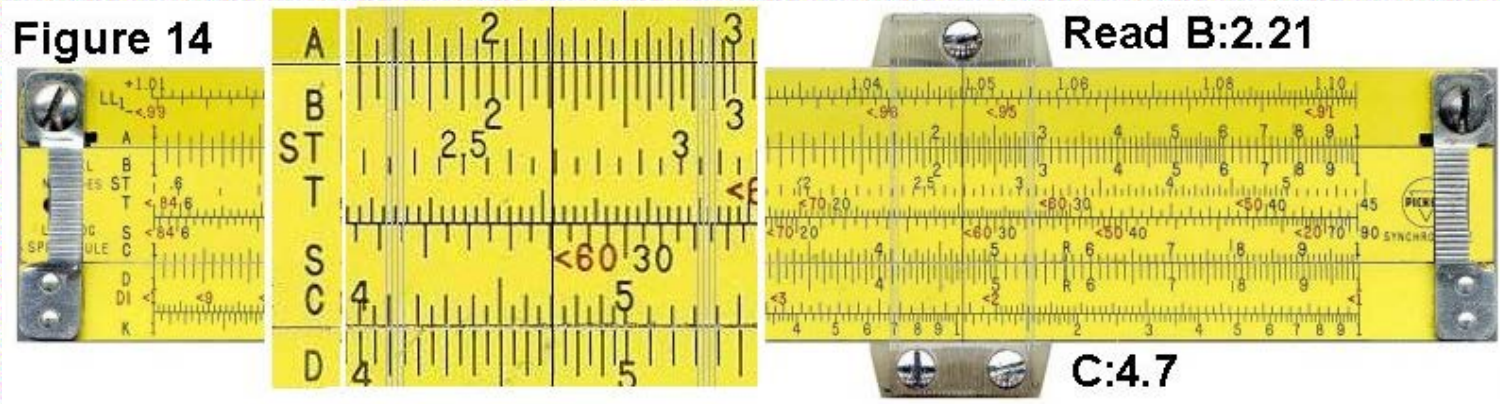
TOC

Squares and Square Roots

14. Square (uses C and B scales)

Example 14: calculate 4.7^2

- Move the cursor to 4.7 on the C scale.
- The cursor is now at 2.2 on the B scale.
- We know that the correct answer is near $5^2 = 25$, so we adjust the decimal place to get 22.

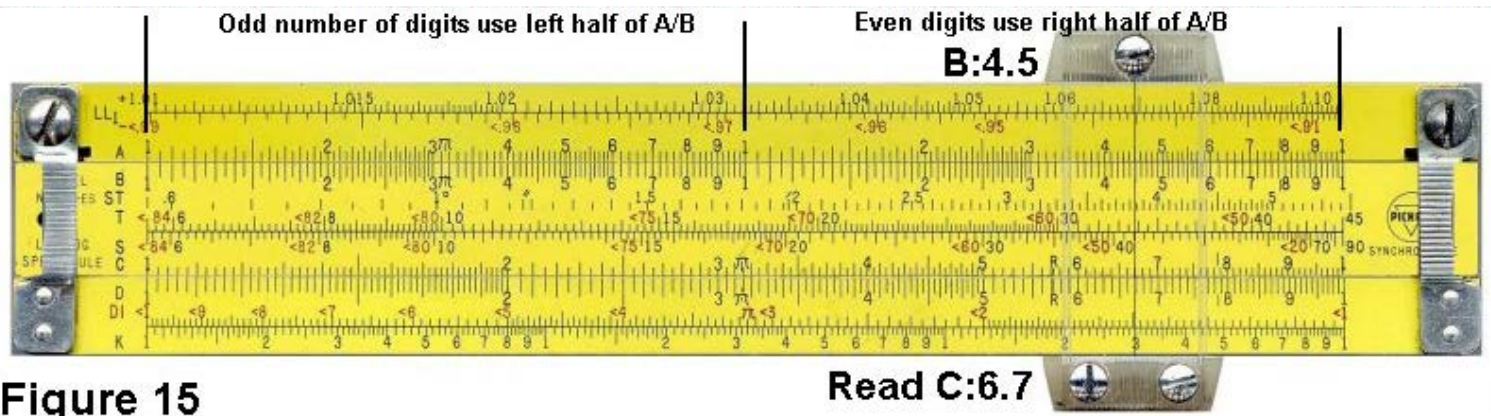


TOC

15. Square Root (uses C and B scales)

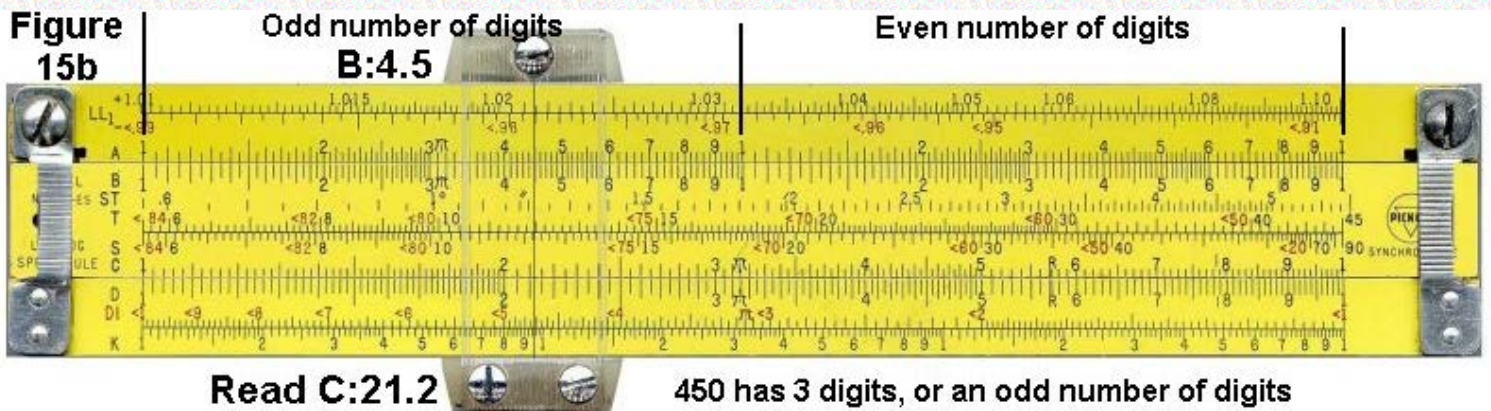
Example 15a: calculate $\sqrt{4500}$ (Figure 15)

- You will notice that the B scale has two similar halves. The first step is to decide which half to use to find a square root.
- The left half is used to find the square root of numbers with odd numbers of digits or leading zeros after the decimal point. The right half is used for numbers with even numbers of digits or leading zeros. Since 4500 has an even number of digits, then we'll use the right half of the scale.
- Move the cursor to 4.5 on the right half of the B scale.
- The cursor is now at 6.7 on the C scale.
- We know that $70^2 = 4900$, which is in the ballpark of 4500. Therefore we adjust the decimal point to get a result of 67.



Example 15b: calculate $\sqrt{450}$ (Figure 15b)

- Try it a again with a three digit number.
- Move the cursor to 4.5 on the left half of the B scale.
- The cursor is now at 2.12 on the C scale.
- We know that $20^2 = 400$, which is in the ballpark of 450. Therefore we adjust the decimal point to get a result of 21.2



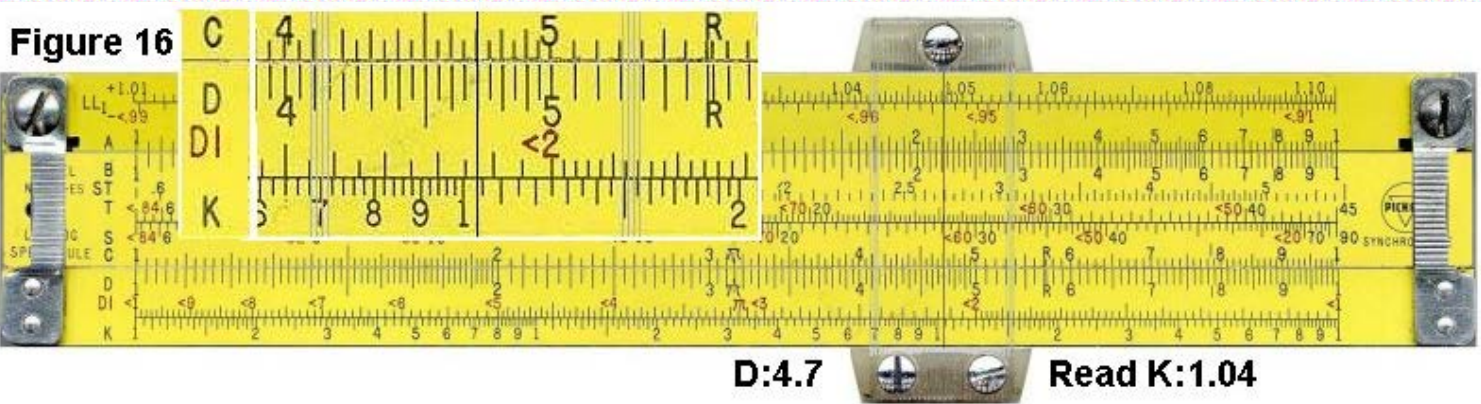
TOC

Cubes and Cube Roots

16. Cube (uses D and K scales)

Example 16: calculate 4.7^3 (Figure 16)

- Move the cursor to 4.7 on the D scale.
- The cursor is now at 1.04 on the K scale.
- We know that the correct answer is near $5 \times 5 \times 5$, which, to further approximate, is near $5 \times 5 \times 4 = 5 \times 20 = 100$. Therefore we adjust the decimal point to get a result of 104.

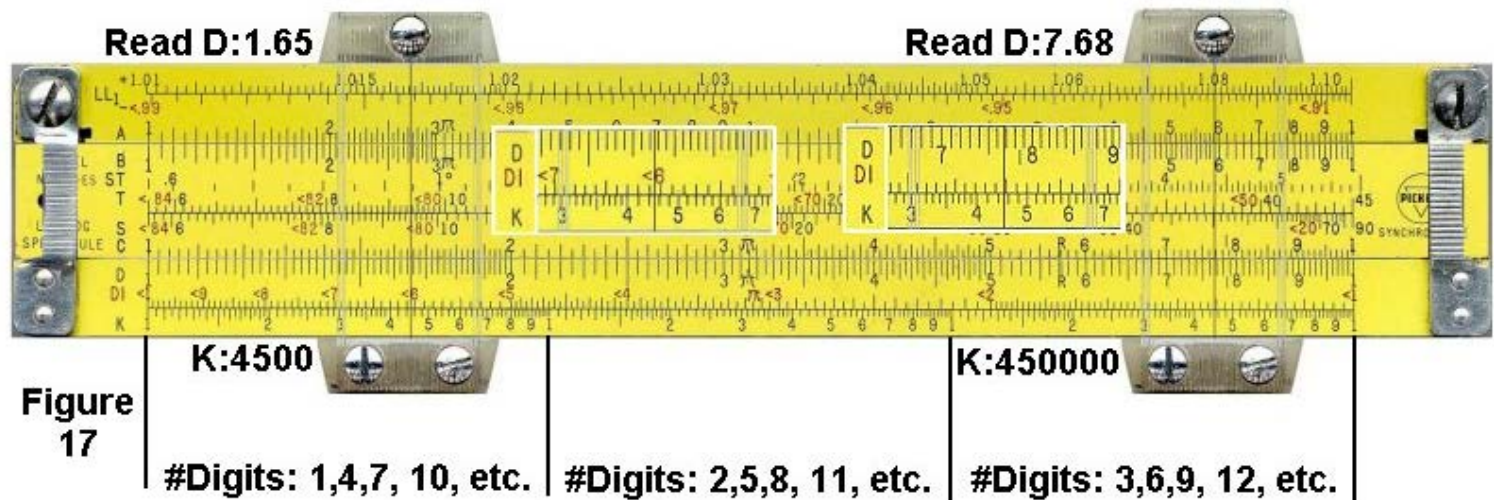


[TOC](#)

17. Cube Root (uses D and K scales)

Example 17a: calculate $\sqrt[3]{4500}$ (Figure 17 - left)

- You will notice that the K scale has three similar thirds. The first step is to determine which third to use to find the cube root.
- The first third is used to find the cube root of numbers with one digit. You can cycle through the thirds, increasing the number of digits by one for each third, to find which part to use. Just like having a line of people and you count off into 3's.
- For the value of 4500, which has 4 digits, we cycle through the thirds and find that we would use the first third.
- Move the cursor to 4.5 on the first third of the K scale.
- The cursor is now at 1.65 on the D scale.
- We can take a guess that the correct answer is around 10. The cube of 10 is 1000 and the cube of 20 is 8000. Thus we know that the correct answer is between 10 and 20, therefore we can move the decimal place and get the correct result of 16.5.



Example 17b: calculate $\sqrt[3]{450000}$ (Figure 17 - right)

- For the value of 450000, which has 6 digits, we cycle through the thirds and find that we would use the third third.
- Move the cursor to 4.5 on the third third of the K scale.
- The cursor is now at 7.68 on the D scale.
- We can take a guess that the correct answer is around 10. The cube of 10 is 1000 and the cube of 100 is 1000000. Thus we know that the correct answer is between 10 and 100, therefore we can move the decimal place and get the correct result of 76.8.

[TOC](#)

Log-Log Scales

Log-log scales are used to raise numbers to powers. Unlike many of the other scales, log-log scales can't be learned simply by memorizing a few rules. It is necessary to actually understand how they work. These examples are intended to gradually introduce you to the concepts of log-log scales, so you gain that understanding. Hopefully, the power of 10 examples don't bore you, as they lay the foundation for later examples.

Since there are many slight variations of log-log scales on different slide rules, I'll refer only to the scales found on the Pickett N3, Pickett N600 and Pickett N803 slide rules (among others). If you want to view a virtual N3, click [here](#), if you want a virtual N600, click [here](#) (opens in a new window.)

Another interesting aspect of LL scales is that the decimal point is "placed." That is, you don't have to figure out afterwards where the decimal point belongs in your result. The disadvantage to this is that LL scales are limited in the numbers they can calculate. Typically, the highest result you can get is about 20,000, and the lowest is 1/20,000 or 0.00005. One exception to this is the Pickett N4 (virtual [here](#)), which goes up to 10^{10} .

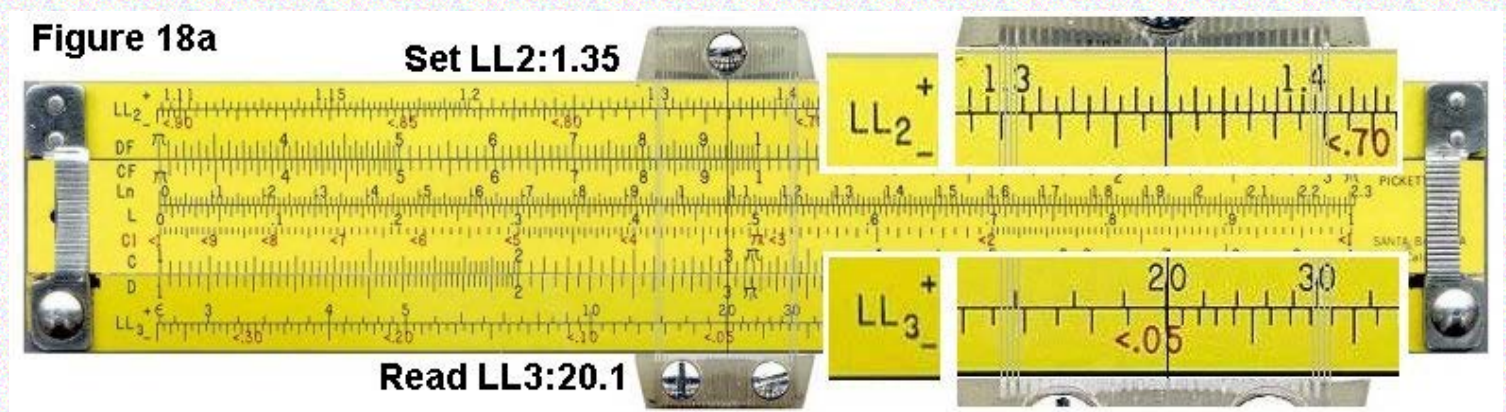
[TOC](#)

18. Raising a Number to Powers of 10 ($N > 1$)

To raise a number to the power of 10, simply move the cursor to the number and look at the next highest LL scale. (These examples are for numbers greater than 1.)

Example 18a: calculate 1.35^{10} (uses LL2 and LL3 scales) (Figure 18a)

- Move the cursor to 1.35 on the LL2 scale.
- The cursor is at 20.1 on the LL3 scale. This is the correct answer.



[TOC](#)

Example 18b: calculate 1.04^{100} (uses LL1 and LL3 scales) (Figure 18b)

- Set the cursor over 1.04 on the LL1 scale.
- Flip the SR over
(on some advanced SR's the LL0, LL1, LL2 and LL3 will be on the same side)
- The cursor is at 50.5 on the LL3 scale.

Figure 18b

Set LL1:1.04

Do not move the cursor while flipping the SR over!

Figure 18b Flipped

Read LL3:50.5

Do not move the cursor while flipping the SR over!

Read LL3:50.5

Read LL3:50.5

TOC

Example 18c: calculate 1.002^{1000} (uses LL0 and LL3 scales) (Figure 18c)

- Set the cursor over 1.002 on the LL0 scale.
- The cursor is on 7.4 on the LL3 scale. This is the correct answer.

Figure 18c shows a slide rule with multiple scales. The top scale is labeled "Set LL0:1.002" and the bottom scale is labeled "Read LL3:7.37". The middle scales are labeled "Read LL1:1.02" and "Read LL2:1.22". The scales show various numerical values and markings, including "LL0", "LL1", "LL2", "LL3", "DF", "CF", "CIF", "Ln", "L", "C", "D", and "LL2", "LL3".

Read LL1:1.02

Read LL2:1.22

Example 18d: calculate sequential powers of ten of 1.002 (uses LL0, LL1, LL2 and LL3 scales) (use the above Figure 18c)

- Set the cursor to 1.002 on the LL0 scale. This the same as 1.002×10^0
- On LL1, the cursor is at 1.002×10^1 , or 10.20
- On LL2, the cursor is at 1.002×10^2 , or 122.
- On LL3, the cursor is at 1.002×10^3 , or 737.

TOC _____

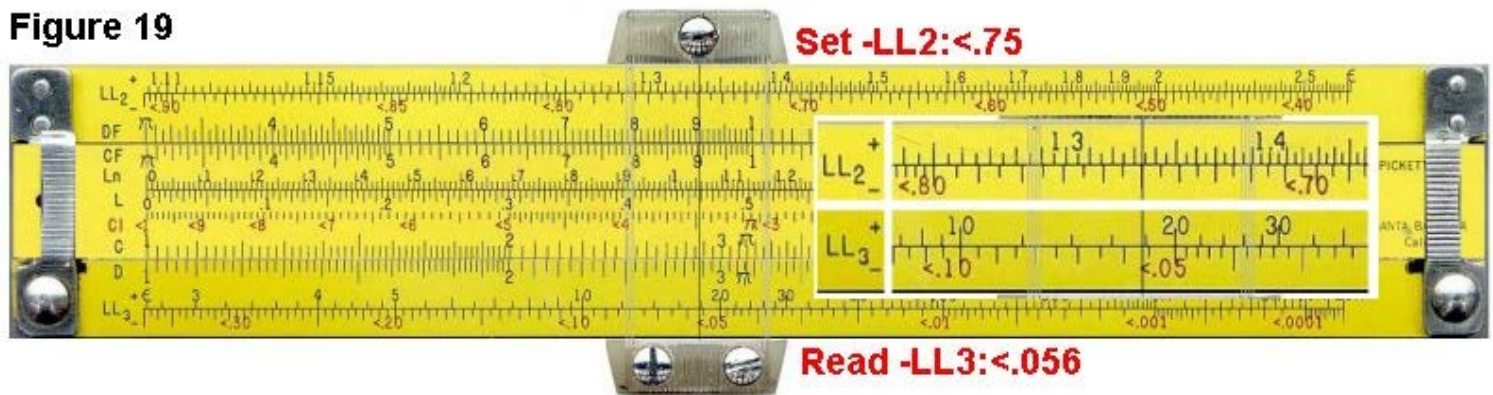
19. Raising a Number to Powers of 10 ($N < 1$)

The reciprocals of the LL scales are the -LL scales. They work the same way, but you have to make sure that you look for the answer on a -LL scale. They are **RED** scales so they increase in value from right to left.

Example 19: calculate 0.75^{10} (uses -LL2 and -LL3 scales)

- Move the cursor to **<0.75** on the -LL2 scale.
- The cursor is at **<0.056** on the -LL3 scale. This is the correct answer.

Figure 19



TOC

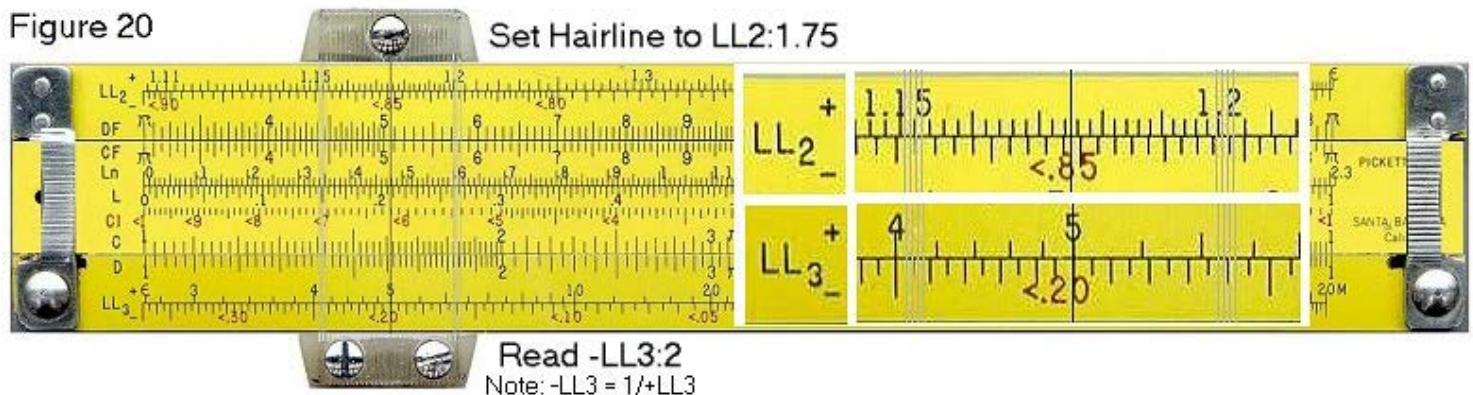
20. Raising a Number to Powers of -10 ($N < 1$), N^{-10} or $1/N^{10}$

The reciprocals of the LL scales are the -LL scales. They work the same way, but you have to make sure that you look for the answer on a -LL scale.

Example 20: calculate 1.175^{-10} (uses LL2 and -LL3 scales)

- Set the cursor hairline to 1.175 on the LL2 scale.
- The hairline is over 5 on the LL3 scale. This is 1.175^{10}
- The cursor is also over .2 on the -LL3 scale. This is the reciprocal of 1.175^{-10} or $1/1.175^{10}$ and is the correct answer.

Figure 20



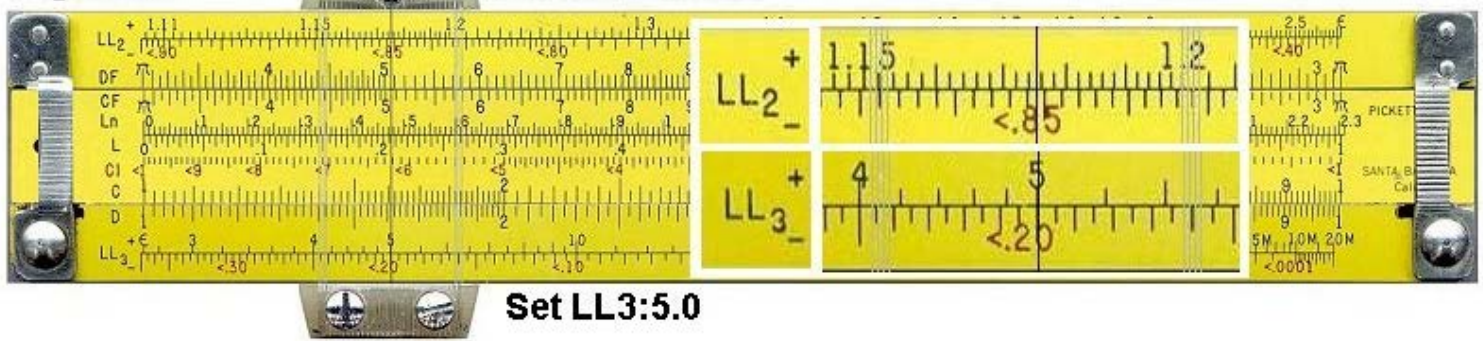
TOC

21. Finding the 10th Root ($N > 1$)

As you've seen in the previous examples, to raise a number to the 10th power, you simply look at the adjacent number on the next highest LL scale. To find a tenth root, you look at the adjacent number on the next lowest LL scale. Remember also that finding the tenth root is the same as raising a number to the power of 0.1.

Example 21: calculate $10^{\sqrt{5}}$, or $5^{0.1}$ (uses LL2 and LL3 scales) (Figure 21)

- Set the cursor over 5 on the LL3 scale.
- The cursor is now at 1.175 on the LL2 scale. This is the correct answer.

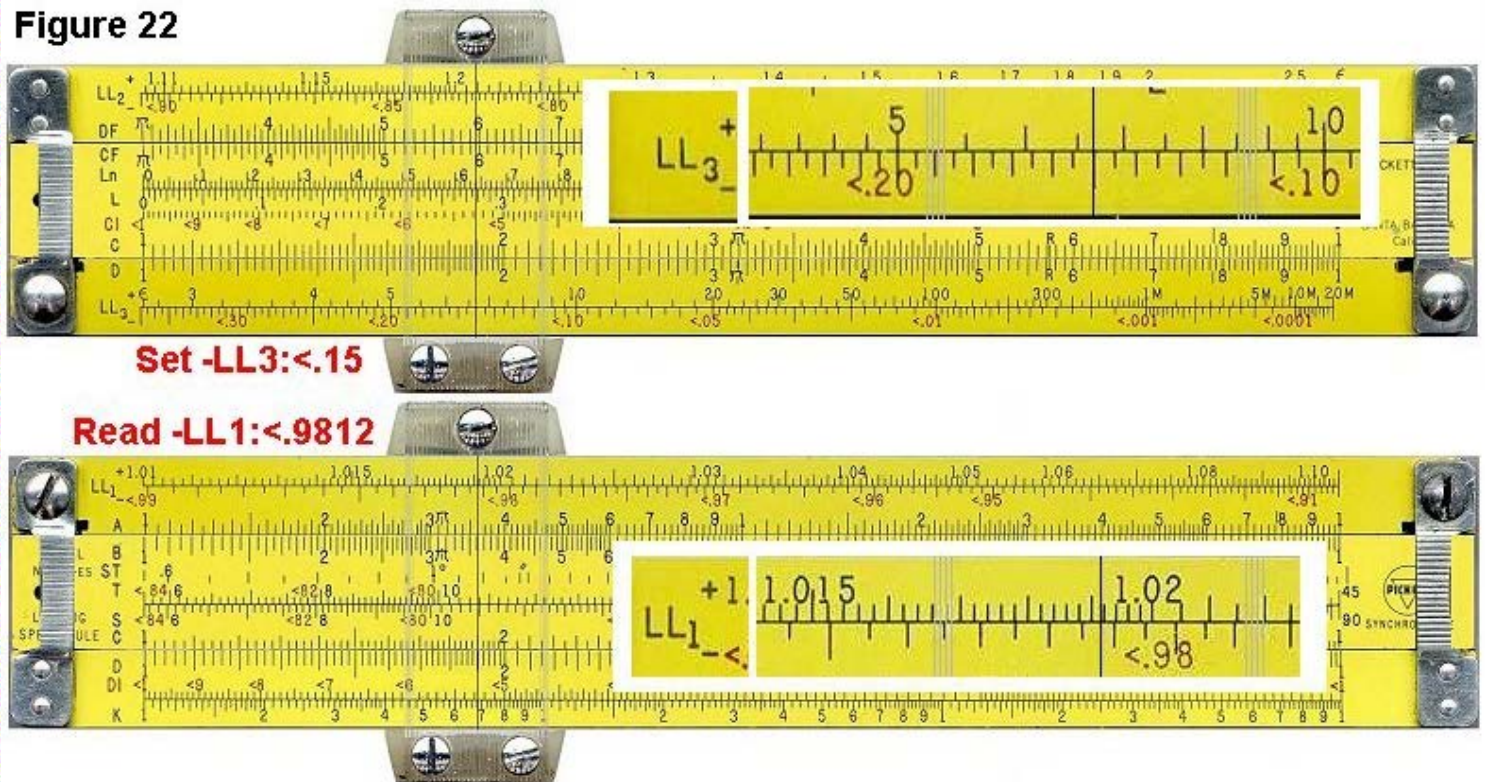
Figure 21**Read LL2:1.175**

TOC

22. Finding the 10th Root ($N < 1$)

Example: calculate $^{100}\sqrt{0.15}$, or $0.15^{0.01}$ (uses **-LL3** and **-LL1** scale) (Figure 22)

- Set the cursor to 0.15 on the **-LL3** scale.
- Flip the SR to the other side to read the **-LL1** scale.
- The cursor reads 0.9812 on the **-LL1** scale. This is the correct answer.

Figure 22

TOC

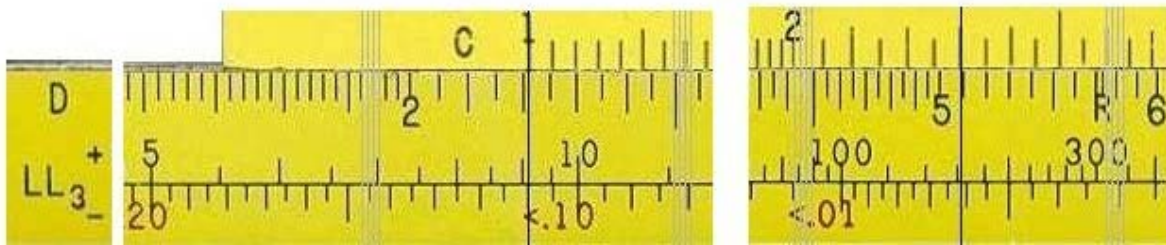
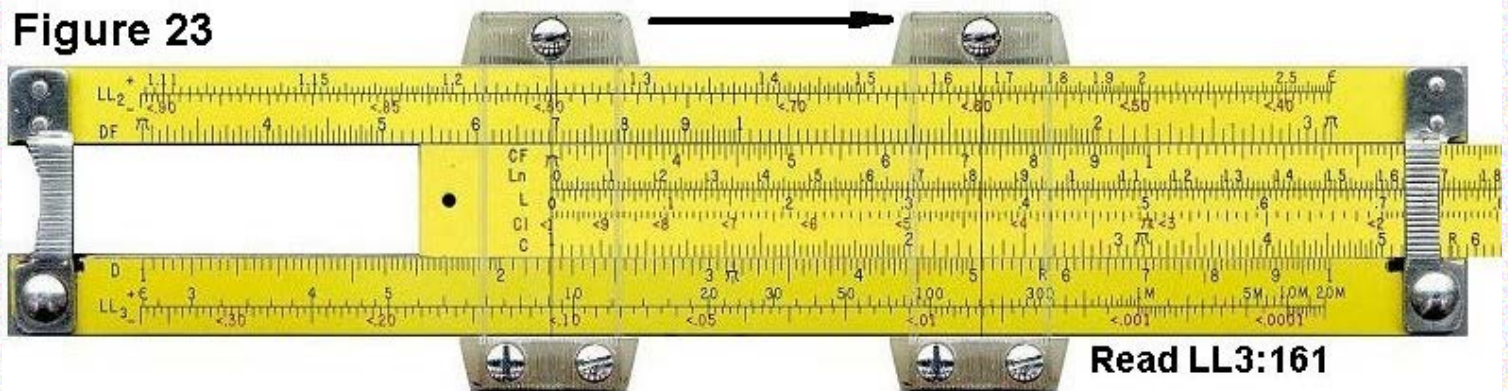
23. Arbitrary Powers (Staying on Same LL Scale)

Occasionally, depending on the numbers, it is possible to calculate a power without switching scales.

Example: calculate $9.1^{2.3}$ (uses **LL3** scale) (Figure 23a)

- Set the cursor hairline to 9.1 on the LL3 scale.
- Slide the leftmost Index '1' on C to the hairline.
- Move the hairline over 2.3 on the C scale.
- The cursor is now at about 161 on the LL3. This is very close to the correct answer of 160.6. One of the problems with LL scales is that their accuracy diminishes as the numbers increase in value.

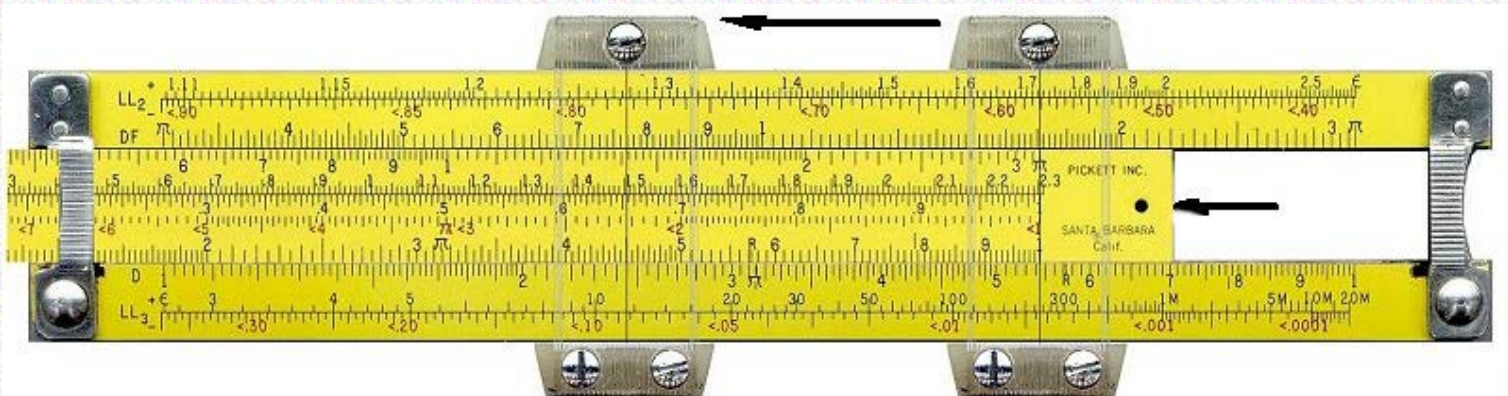
Figure 23



TOC

Example: calculate $230^{0.45}$ (uses LL3 and C scale) (Figure 23b)

- Set the cursor to 230 on the LL3 scale.
- Since we're raising to a power that's less than 1, we have to go left on the LL scale.
- Slide the rightmost Index '1' on the C scale to the cursor hairline.
- Move the cursor to 4.5 on the C scale.
- The cursor is now at 11.6 on the LL3 scale. This is close to the correct answer of 11.56.

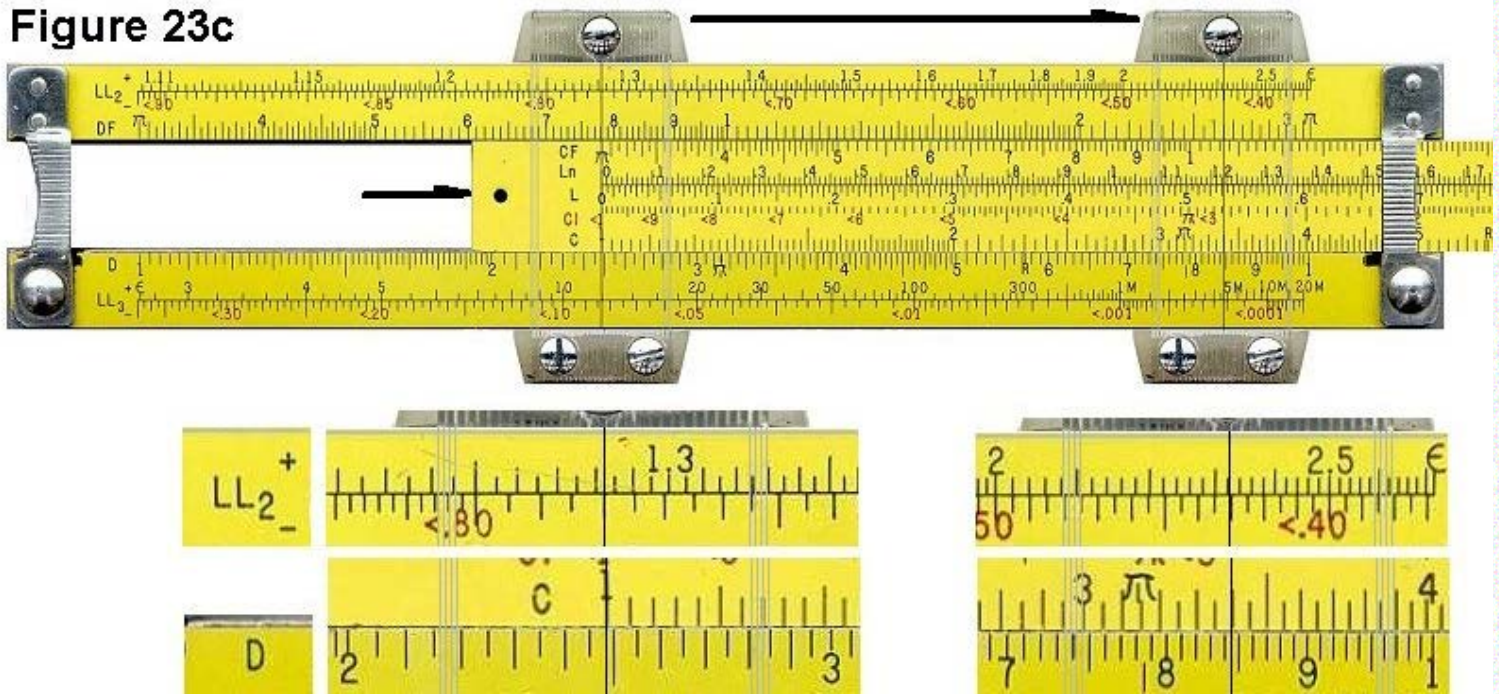


TOC

Example: calculate $0.78^{3.4}$ (uses -LL2 and C scale) (Figure 23c)

- Set the cursor to 0.78 on the -LL2 scale.
- Slide the leftmost Index '1' on the C scale to the cursor hairline.
- Move the cursor to 3.4 on the C scale.
- The cursor is now at 0.43 on the -LL2 scale. This is the correct answer.

Figure 23c



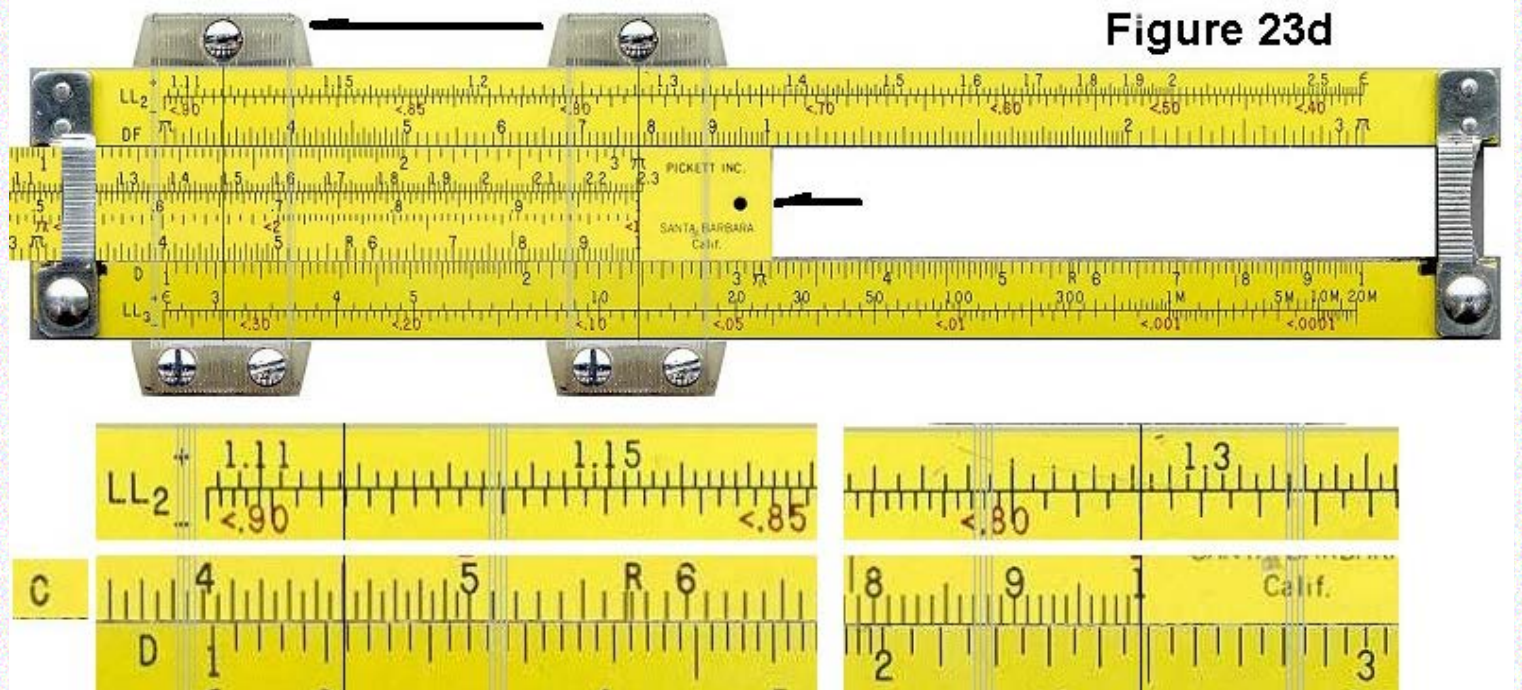
TOC

Try another:

Example: calculate $0.78^{0.45}$ (uses -LL2 and C scale) (Figure 23d)

- Set the cursor to 0.78 on the -LL2 scale.
- Since we're raising to a power that's less than 1, we have to go left on the LL scale.
- Slide the rightmost Index '1' on the C scale to the cursor hairline.
- Move the cursor to 4.5 on the C scale.
- The cursor is now at 0.894 on the -LL2 scale. This is the correct answer.

Figure 23d



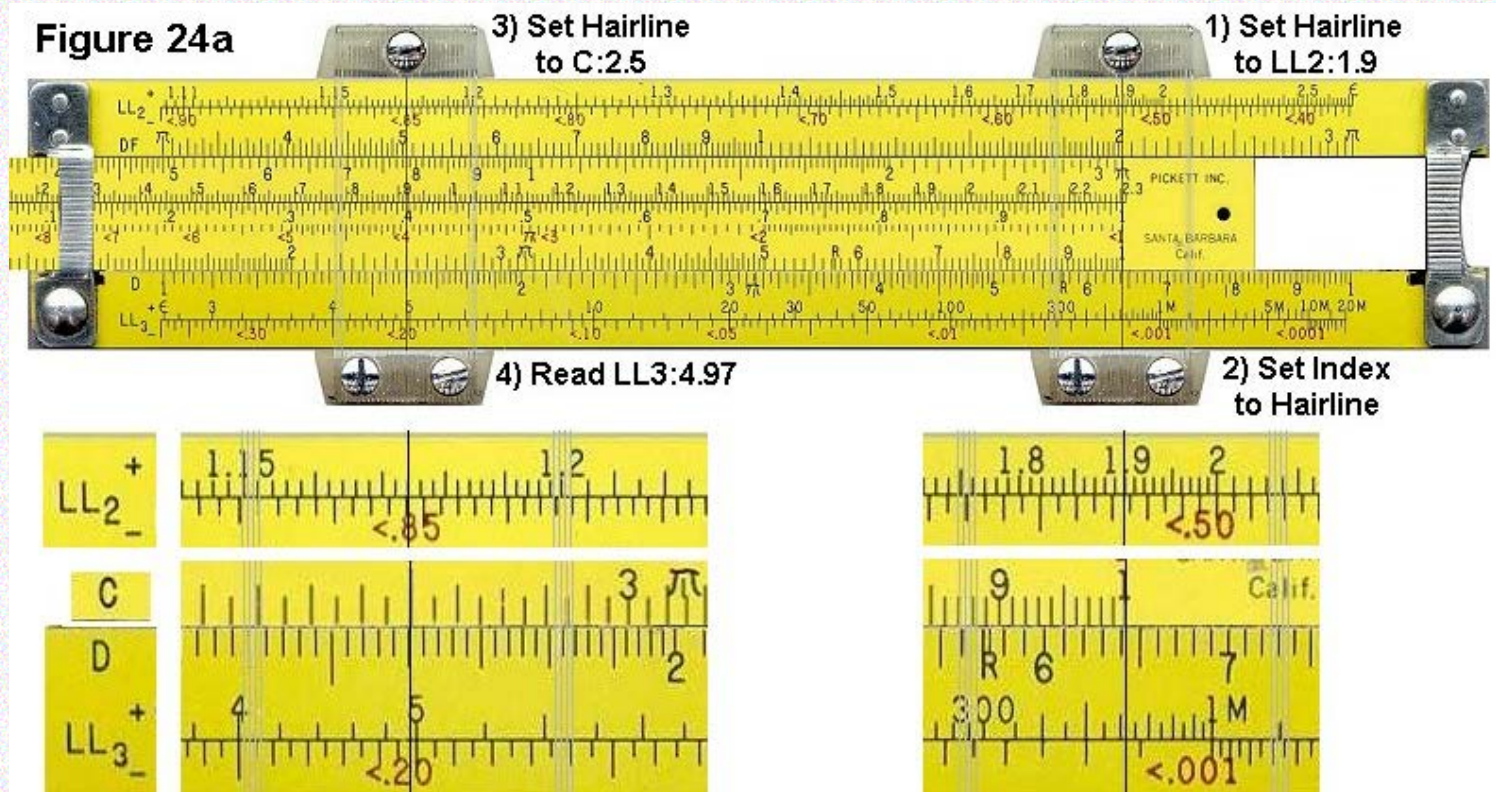
TOC

24. Arbitrary Powers (Switching LL Scales)

One of the rules of exponents is that $(A^B)^C$ is equal to $A^{B \times C}$. We can use this fact, along with our knowledge of powers of ten, to calculate arbitrary powers.

Example: calculate $1.9^{2.5}$ (uses LL2, C and LL3 scales) (Figure 24a)

- If we try to calculate this the easy way, the power 2.5 is out of range for the scale.
- We can reinterpret the problem as:
Calculate $(1.9^{0.25})^{10}$
Because 0.25×10 is 2.5.
- Set the cursor hairline to 1.9 on the LL2 scale.
- Slide the rightmost Index '1' on the C scale to the hairline.
- Shift the cursor hairline to 2.5 on the C scale.
- The hairline is now at $1.9^{0.25}$ on the LL2 scale. Since we want to also raise this to the power of 10, we look "one scale higher" at the LL3 scale.
- The cursor is at 4.97 on the LL3 scale. This is the correct answer.

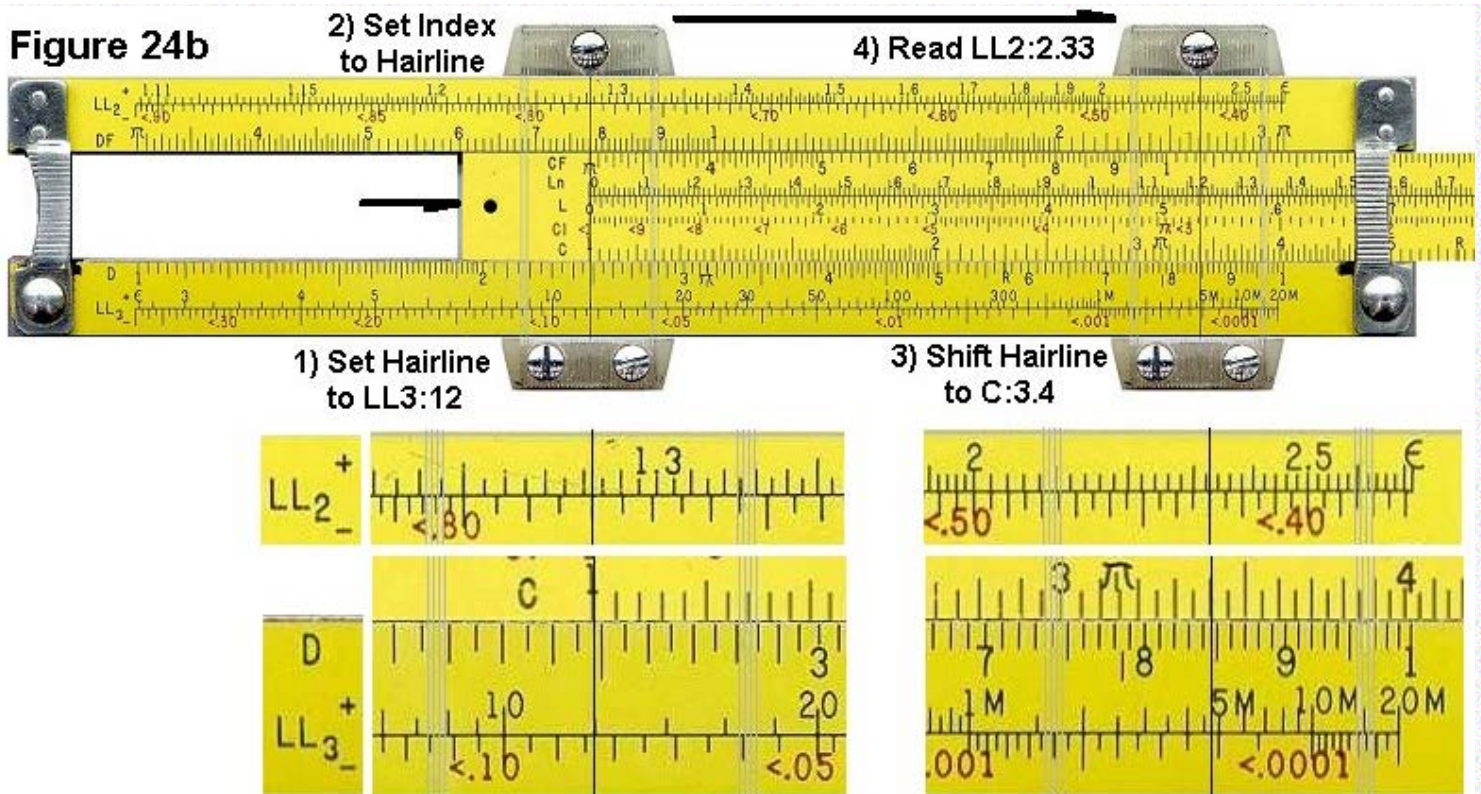


TOC

Example: calculate $12^{0.34}$ (uses LL3, C and LL2 scales) (Figure 24b)

- Like the previous example, if we try to calculate this the easy way, the power 0.34 is out of range for the scale.
- We can reinterpret the problem as:
Calculate $(12^{3.4})^{0.1}$
Because 3.4×0.1 is 0.34.
- Move the cursor to 12 on the LL3 scale.
- Slide the leftmost '1' on the C scale to the cursor.
- Move the cursor to 3.4 on the C scale.
- The cursor is now at $12^{3.4}$ on the LL3 scale, which is about 5000 (which is not the number we're looking for). Since we also want to raise this to the power of 0.1, we look at the LL2 scale.
- The cursor is now at 2.33 on the LL2 scale. This is the correct answer.

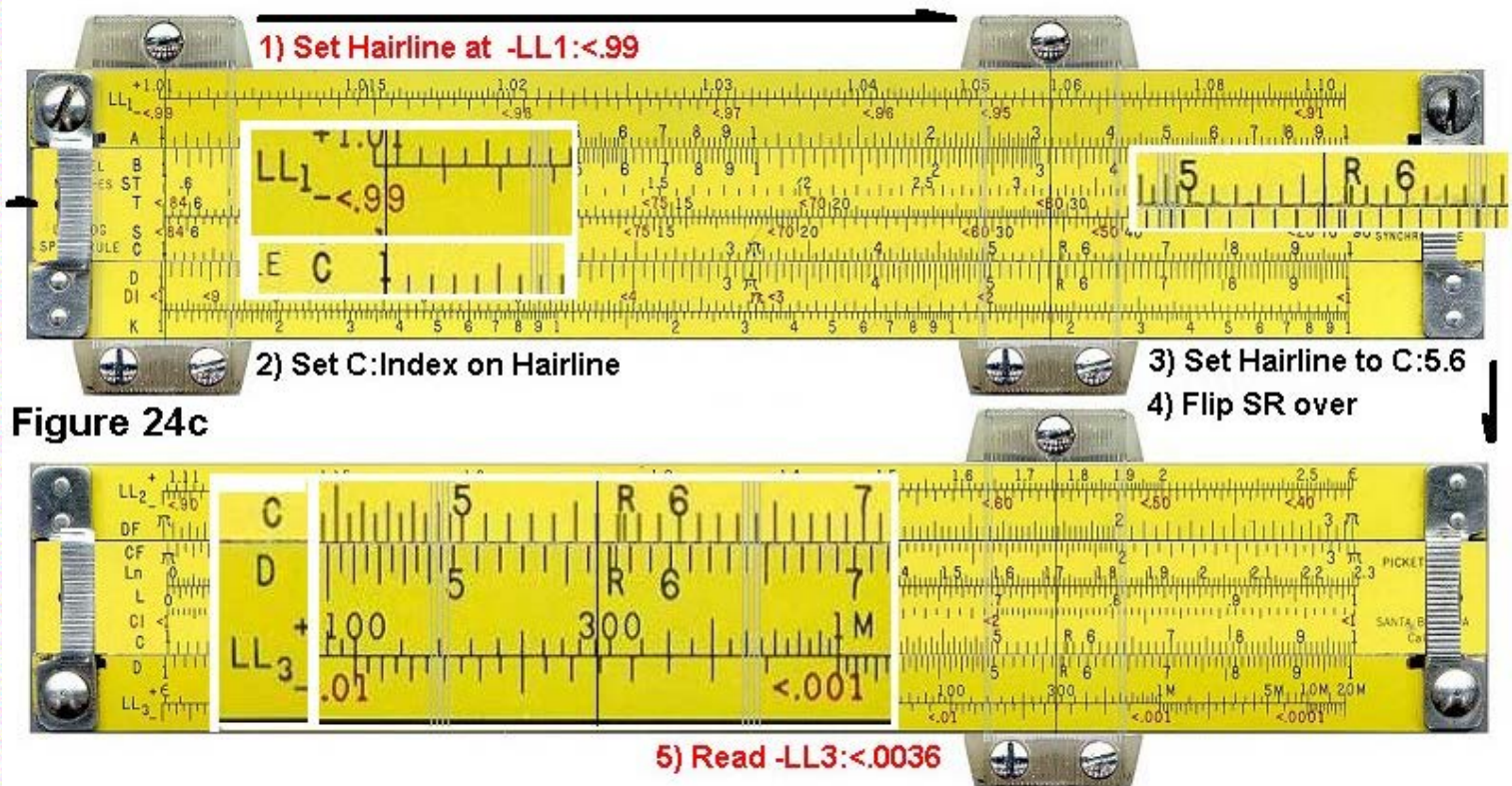
Figure 24b



TOC

Example: calculate 0.99^{560} (uses -LL1, C and -LL3 scales) (Figure 24c)

- We can reinterpret this problem as:
Calculate $(0.99^{5.6})^{100}$
Because $5.6 \times 100 = 560$
- Set the cursor Hairline to <0.99 on the -LL1 scale.
- Shift the leftmost Index '1' on the C scale to the cursor hairline.
- Move the cursor to 5.6 on the C scale.
- The cursor is now at $<0.99^{5.6} = <.9452$ on the -LL1 scale.
- Since we also want to raise this to the power of 100, we look "two scales higher", or the -LL3 scale.
- The cursor is now at <0.0036 on the -LL3 scale. This is the correct answer.



TOC

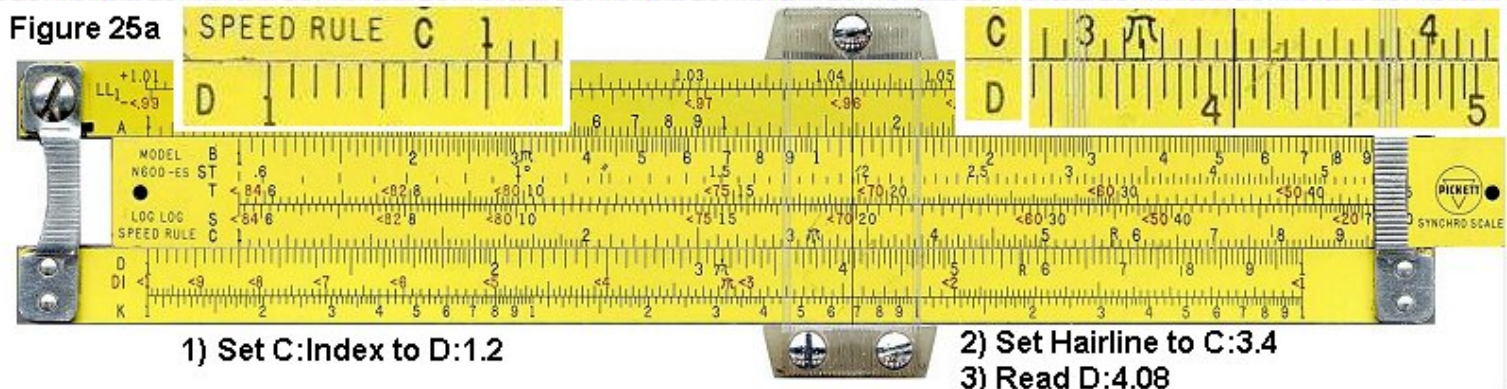
25. Log-Log Approximations

In general, LL scales don't handle numbers extremely close to 1, such as 1.001 or 0.999. This is not a problem because there is an accurate approximation for numbers in this range. In general, if you have a very small number 'd', then:

$$(1 + d)^P = 1 + d p$$

Example: calculate 1.00012^{34} (uses C and D scales) (Figure 25a)

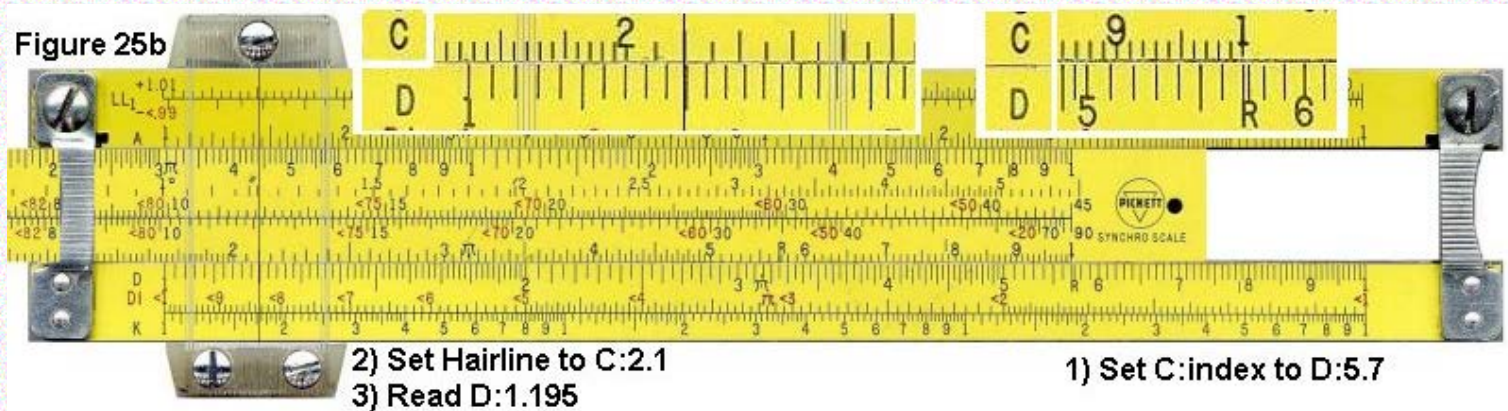
- In this case, if we use the approximation $(1 + d)^P = 1 + d p$, then:
 $d = 0.00012$, and
 $p = 34$
- We must calculate $0.00012 * 34$.
- Set the leftmost Index '1' on the C scale to 1.2 on the D scale..
- Set the cursor hairline on 3.4 on the C scale.
- The cursor is now at 4.08 on the D scale.
- We know that the correct answer would be near $0.0001 * 30$, or 0.003. Therefore we adjust the decimal point to get a value of 0.00408.
- Add 1 to 0.00408. The result is 1.00408, which is very close to the correct answer of 1.004088.



TOC

Example: calculate 0.99943^{21} (uses C and D scales) (Figure 25b)

- Like before, we'll use the approximation $(1 + d)^P = 1 + d p$. In this case:
 $d = (0.99943 - 1) = -0.00057$, and
 $p = 21$
- We must calculate $-0.00057 * 21$.
- Slide the rightmost Index '1' on the C scale to 5.7 on the D scale.
- Move the cursor hairline over 2.1 on the C scale.
- The hairline is at 1.195 on the D scale.
- We know that the correct answer would be near $-0.0006 * 20$, or -0.0120 . Therefore we adjust the decimal point to get a value of -0.01195 .
- Subtract 0.01195 from 1. The result is $(1 - 0.01195) = 0.98803$. This is very close to the correct answer of 0.98809.



[TOC](#)

ISRM Slide Rule Loan Program

If you are an educator or home schooler wishing to give your students a hands-on experience and instruction with actual slide rules, the museum is able to supply quantities of up to 25 matching slide rules for temporary use, free of charge, to many countries, courtesy of several collectors and members of the Oughtred Society, Dutch Kring, and German RST. [Find out more about it here.](#)

[TOC](#)

Additional Resources

Instructions, Manuals, Scales and Construction

You can download additional instructions from [the ISRM museum library](#) or visit one of the following sites.

- [How Did A Slide Rule Work \(and advanced topics\)](#) by John Savard
- [About Slide Rules](#) by Nigel Bromley
- [Basic Slide Rule Instructions](#) by David G. Hicks, the HP Museum
- [How to make a slide rule \(or log-log or semilog graph paper\)](#) by S. A. Fulling's
- [Explanation of Slide Rule Scales](#) by Chris Osburn
- [JAVA Slide Rule Emulator](#). A real slide rule, digital readout of tick marks.
- [Slide Rule Emulator Several models to choose from](#) by Derek Ross
- [Slide Rule Calculations by Example](#) by Derek Ross
- [Slide Rule Emulator \(executable program\)](#) by Steve Burton
- [Slide Rule Calculator at CCL.NET](#) by K. Hirayama
- [Rechenmaschinensammlung](#) - German site - use Google to translate.
- [Calculators Online Center](#) - Jim Martindale - contains over 17,000 useful calculators.
- [Rechenschieber_Bibliographiert](#) Dr. Ranier Stumpe, on-line manuals and books (German).
- [Rechenschieber](#) by Universität Würzburg (German)
- [Use of Slide Rule as a Teaching Tool](#) - by Martin Cohen.
- [Homemade Slide Rules](#) - Robert Munafò's Obsession - good information as well
- [AntiQuark](#) - Derek Ross's Virtual Slide Rule Gallery - Pickett 904, 909, N4, 525, N600 emulated
- [What Can You Do With A Slide Rule?](#) - The University of Utah

[TOC](#)

In the beginning, at the time of the great flood, Noah went thru his ark after it landed, and found two small snakes huddled in a corner. Noah looked at these poor specimens - and said "I told you to go forth and multiply - why haven't you?"

The poor snakes looked up at Noah and replied "We can't because we are adders....."

Noah looked a bit perplexed, and then proceeded to tear bits of planking from his ark. He went on to build a beautiful wooden platform. He gathered up the snakes and placed them on the platform, and joyfully told the snakes - "Now go forth and multiply, because even adders can multiply on a log table"

D. Scott MacKenzie, PhD

Metallurgist specializing in Heat Treatment and Quenching

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