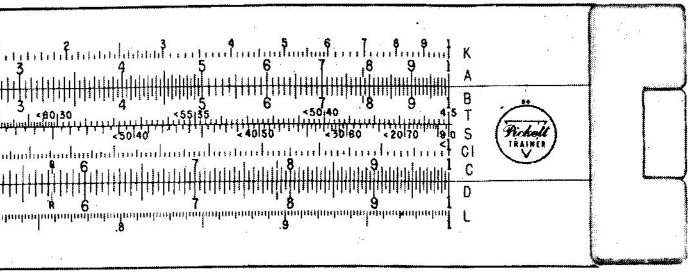


HOW TO USE BASIC SLIDE RULES IN 3 EASY STEPS

"COMPLETELY ILLUSTRATED"

with practice examples included

how to do square roots, finding cube roots, using sines to solve triangles

easy to refer to diagrams

principles based on logarithms, trigonometry, mathematics, arithmetic,

accuracy to three figures

basic use for multiplying and dividing numbers

by MAURICE L. HARTUNG
Associate Professor of the Teaching of Mathematics
THE UNIVERSITY OF CHICAGO

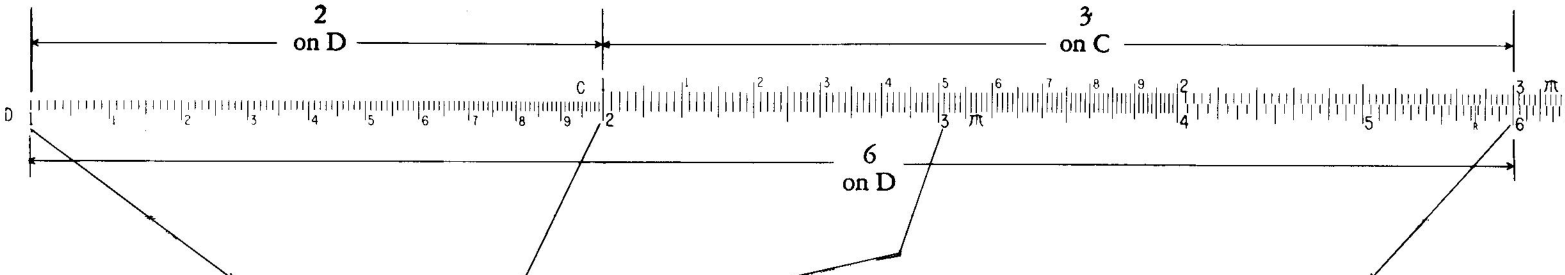
Price 35 Cents

PART 1

In Part 1 you will learn how to multiply and divide with a slide rule. A slide rule has several number scales named by letters: A, B, C, D, etc. In Part 1 only basic scales C and D will be used. The use of other scales will be explained later.

When you study the charts in this manual always set the slide on your rule like the ones pictured in the lesson. Study the *slide rule itself* along with the charts. Set the slide on your rule like the one pictured below. This setting is used for $2 \times 3 = 6$.

(a) How to multiply:



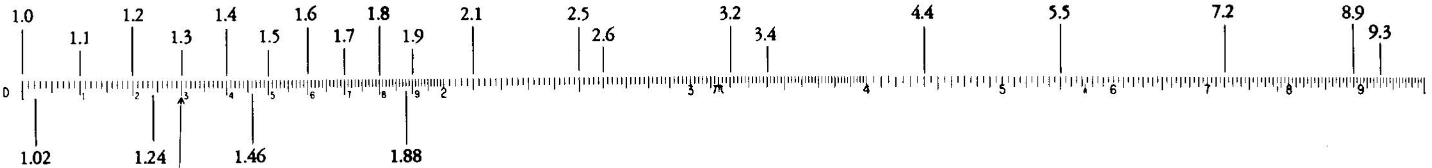
The large numerals are read as follows:
1 = 1, or 10, or 100, etc.; also .1, or .01, or .001, etc.
2 = 2, or 20, or 200, etc.; also .2, or .02, or .002, etc.
3 = 3, or 30, or 300, etc.; also .3, or .03, or .003, etc.
This is true on both the C and the D scale.

***Rule:* To multiply one number by another:**
Set 1 of the C scale over one of the numbers on the D scale. Set hairline of cursor over the other number on the C scale. Read answer under the hairline on the D scale.

The setting shown above would also be used for all of the examples following: $20 \times 3 = 60$; $20 \times 30 = 600$; $.2 \times 3 = .6$; $20 \times 3000 = 60{,}000$; $.02 \times 300 = 6$; $.02 \times .03 = .0006$.

As soon as you have learned how to locate or read other numbers on the scales, you can multiply *any* two numbers in this way.

(b) ***How to read the C and D scales:*** **Below is a D scale. Study the readings shown.**



This mark also represents 13, or 130, or 1300, or .13, or .013, or any number with figures 13, no matter where the decimal point is located. A similar statement can be made for the other "tenth" marks.

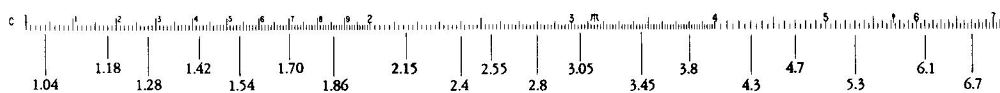
Between 1 and 2, the spaces between "tenth" marks are sub-divided into 10 parts. Count as though each space represents "one hundreth." Between 1.0 and 1.10, read 1.01, 1.02, 1.03, etc. to 1.10.

From 2 to 4 there are only 5 spaces between "tenths." Count as though each space represents "two hundreths." Between 2 and 2.1 read: 2.02, 2.04, 2.06, 2.08, then 2.10. From 4 to 10, there is only one mark between tenths.

Summary:

Any mark represents many different numbers. They all have the same figures (digits), but the decimal point is in different positions in each. There is a definite mark for the first two figures of any number.

The C scale is just like the D scale. For practice in reading it, study the one below.

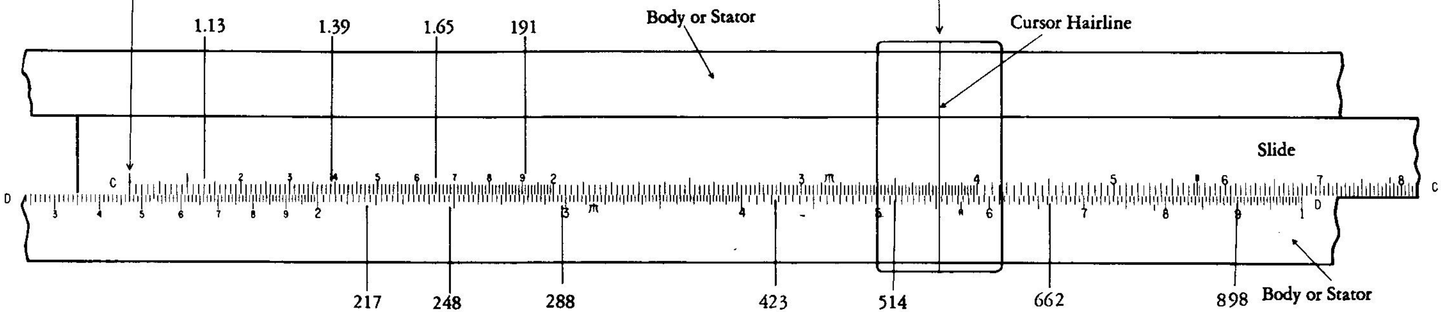


On the next page you will learn more about how the scales are read.

(c) More about reading the scales: **The rule pictured below is set to multiply 14.7 by 3.76.**

The 1 of the C scale is set over 147 of the D scale. The number 147 is located by the 7th mark after 14. For practice, check these readings on the C scale: 1.13, 1.39, 1.65, 191. The arrows point to them in order from left to right.

The cursor hairline set over 376 of the C scale comes over 553 of the D scale. The number 376 is located to the right of 37 by reading the marks as "two," "four," "six." The number 553 is located between 550 and 555, and is just a little nearer 555. The answer for 14.7 × 3.76 is 55.3 approximately.



Locate the decimal point by estimating. Thus 14.7 is near 15, and 3.76 is near 4. The result for 14.7 × 3.76 will be near 15 × 4 or 60. The reading is 553. The answer must be 55.3. You would also get the decimal point placed right by rounding off 14.7 to 10, and 3.76 to 4, using 10 × 4 = 40 to decide roughly how large the answer is. Usually you will know where the decimal point must be placed so the answer will "make sense."

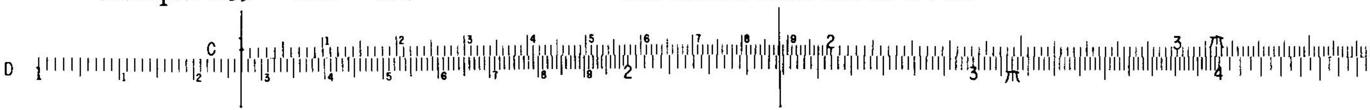
From 4 to 10 there is only one mark between "tenths." The "hundreths" position is set by estimating. One arrow points to 5.14, or 514, or 51.4, etc. Check the readings shown by the other arrows. Each short graduation mark stands for "five-hundredths." You can estimate where the other "hundredths" mark would be if there was room.

Examples for practice.

1. 18 × 3.7 — Set 1 of C scale over 18 of D scale. Set hairline over 3.7 of C. Read 66.6 on D.
2. 280 × 0.34 — Set 1 of C scale over 280 of D scale. Set hairline over 0.34 of C. Read 95.2 on D.
3. 0.0215 × 3.54 — Set 1 of C scale over 0.0215 of D scale. Set hairline over 3.54 of C. Read 0.0761 on D.
4. 4.15 × 2.35 — Set 1 of C scale over 4.15 of D scale. Set hairline over 2.35 of C. Read 9.75 on D.

(d) How to divide: **Division is the opposite of multiplication. The slide pictured on page 4 above is set to divide 55.3 by 3.76. The answer is 14.7. The rule for division is in a box below.**

Example: 2.39 ÷ 1.88 = 1.27 — Use hairline to set 1.88 on C over

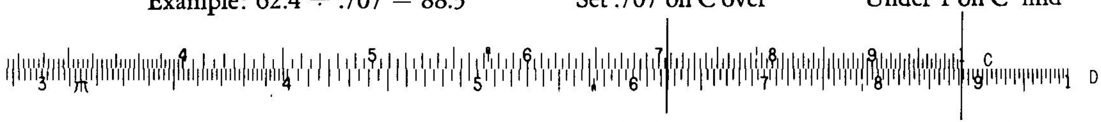


Find 1.27 under 1 on C — 2.39 on D

Dividend ÷ divisor = quotient
Example: 12 ÷ 3 = 4

Rule: **Set divisor on the C scale over the dividend on the D scale. Read answer on the D scale under 1 of the C scale.**

Example: 62.4 ÷ .707 = 88.3 — Set .707 on C over — Under 1 on C find



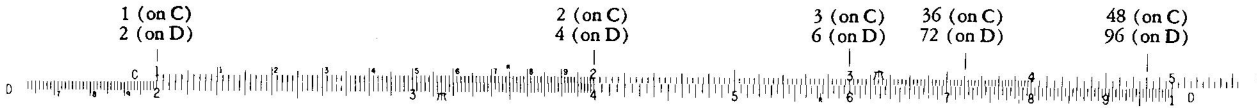
62.4 on D — 88.3 on D

The decimal point in division:
To locate the decimal point in a division example, round the numbers off to one or two figures. Divide mentally. For example, 55.3 is near 50 and 3.76 is near 5. Then since $50 \div 5 = 10$, the answer must be near 14. It is not 147 or 1.47. Usually you will know where to locate the decimal point to have a sensible answer.

Examples for practice.

Find	
1. $82 \div 7$	Set 7 on C over 82 on D. Under 1 on the C scale read 11.7 on the D scale.
2. $75 \div 92$	Over 75 on D set 92 on C. Under 1 on the C scale read 0.815 on D. To locate the decimal point notice that the fraction $^{75}/_{92}$ is about equal to $^{8}/_{10}$.

(e) Proportions: **For any setting of the slide, many equal ratios are shown. Proportions are easy to solve.**

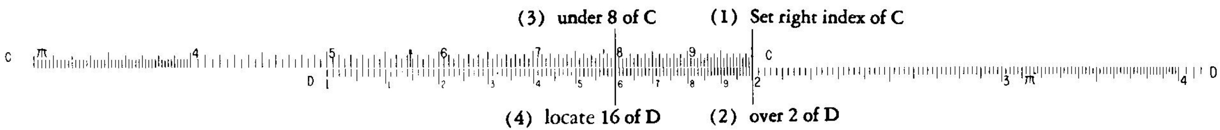


Example. Find x in the following proportion: $\frac{7}{5} = \frac{2.1}{x}$.
Set 7 on C over 5 on D. Under 2.1 on C read 1.5 on the D scale. Then $x = 1.5$.

Rule: **To find x in $\frac{a}{b} = \frac{c}{x}$, set a on the C scale opposite b on the D scale. Under c on the C scale, read x on the D scale.**

(f) What to do if the answer is "outside" the D scale.
Example: Find 2×8. Set 1 of the C scale over 2 of the D scale. Locate 8 on the C scale. It is "outside" the rule. Therefore move the slide end-for-end so the right-hand 1 of C is over 2 of D. Under 8 of C read the answer 16 on D.

Rule: **Either the left or the right index (1) of C may be used. Use the one that puts the answer on the D scale.**

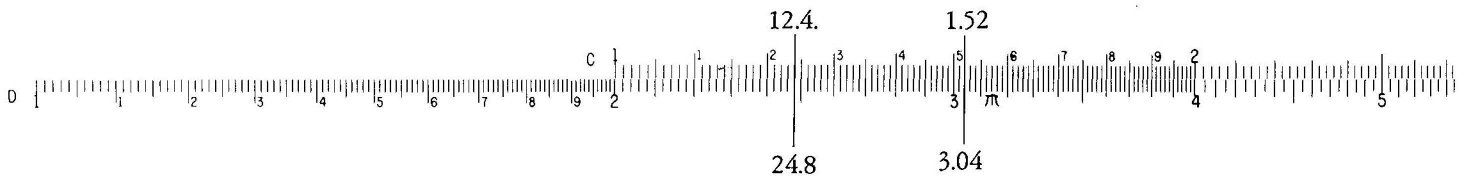


(g) *Combined operations:* Many examples require both multiplication and division.

Example. Find $\frac{24.8 \times 1.52}{12.4}$

Set the rule to divide 24.8 by 12.4. Then move the hairline over 1.52 on C. Read answer 3.04 on D.

Rule: **For $\frac{a \times b}{c}$, divide *a* by *c*, then multiply by *b*. Set *c* of C scale over *a* on D scale. Move hairline to *b* of C scale. Read answer under hairline on D scale.**



Examples for practice.

1. Find $\frac{42 \times 37}{65}$. Set 65 on C over 42 on D. Move hairline to 37 on C. Read answer 23.9 under hairline on D.
2. Find $\frac{2.7 \times .43}{19}$. Set 19 on C over 2.7 on D. Move hairline to 43 on C. Read answer .0611 on D under hairline.
3. Find $\frac{182 \times 4.58 \times 67.3}{2.84 \times 32.2}$. Over 182 on D set 2.84 on C. Move hairline over 4.58 on the C scale. Move slide so 32.2 is under the hairline. Move hairline to 76.3 on C. Read the answer on D under the hairline. It is 613.

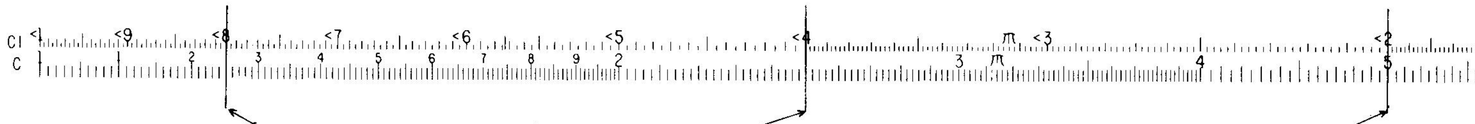
Examples for you to do.		Answers
1. $x =$	$\frac{13.2 \times 42.5}{1.87}$	300
2. Find	$\frac{2.37 \times 60.4}{5.42}$	26.4
3. Find	$\frac{2430 \times 34.5}{73.8}$	1136
4.	$\frac{0.063}{0.51} = \frac{34.1}{x}$	276
5.	$\frac{18}{91} = \frac{13}{x}$	65.7

PART 2

In Part 2 you will learn how to use some of the special scales on a slide rule. The CI scale has many different uses. The A and B scales are used to find squares or square roots of numbers. The K scale is used to find cubes or cube roots of numbers.

When you study the charts in this manual, always set the slide on your rule like the ones pictured in the lesson. Study the *slide rule itself* along with the charts.

(a) ***How to read the CI scale:*** **Below is part of a CI scale and C scale. The CI scale reads from right to left. Note (<) beside the numbers to help remember. The CI scale is just like the C scale except that it reads the other way.**



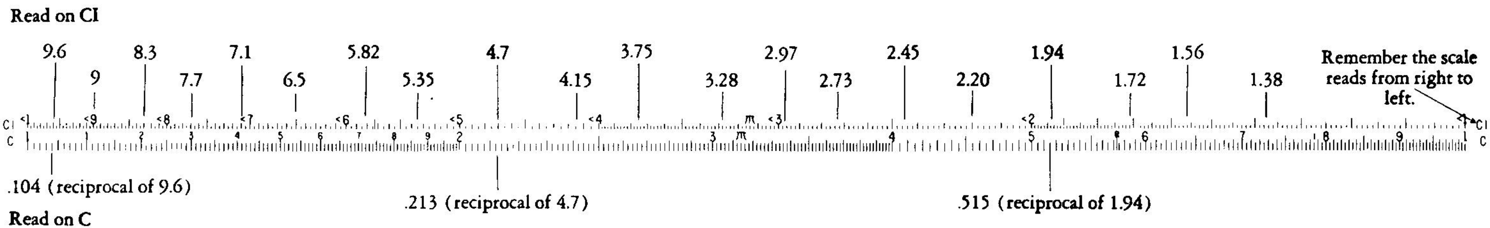
Note .8 on CI is over 1.25 on C, and $.8 \times 1.25 = 1$

Here .4 on CI is opposite 2.5 on C, and $.4 \times 2.5 = 1$

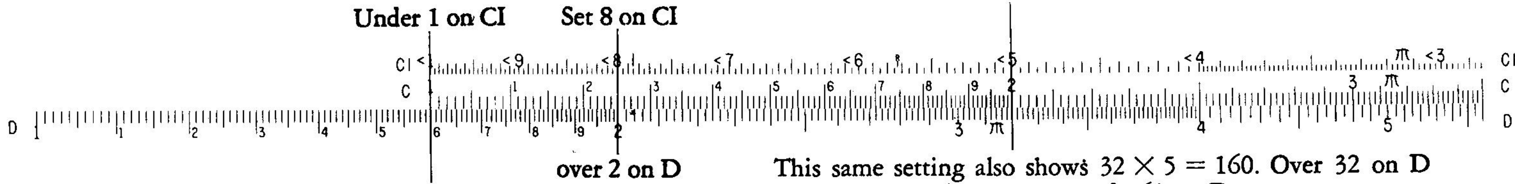
Here .5 on C is under 2 on CI. Notice that $.5 \times 2 = 1$

If the hairline is set over 5 on C, it is also set over $1 \div 5$ or $\frac{1}{5}$ or .2 on CI. At the same time it is over 2 on CI, it is over $\frac{1}{2}$ or .5 on C. When the hairline is over 8 on CI, it is also over $1 \div 8 = .125$ on C.

Summary: If the numbers directly opposite each other on C and CI are multiplied, the result is 1. Numbers opposite on C and CI are called *reciprocals.* Thus 2 and $\frac{1}{2}$ or 2 and .5 are reciprocals.



(b) ***How to use the CI scale in multiplying:*** **Set your slide like the one below. This is set for 2 × 8 using the CI scale. Compare with (f) of part 1.**



This same setting also shows 32 × 5 = 160. Over 32 on D set 5 on CI. Under 1 on CI read 160 on D.

Note: When the CI scale is used, the answer always can be read on the D scale without changing the slide "end-for-end" as was done in Part 1, par. (f).

Rule to multiply using CI: **Set one of the numbers on CI over the other number on D. Read the answer on the D scale under the index of the C scale.**

Examples for practice.

1. Find 204 × 6.62. Set 6.62 on CI over 204 on D. At 1 on CI read 1350 on D.
2. Find 18.7 × 0.384. Set hairline over 18.7 on D. Pull 384 on CI under hairline. At 1 of CI read 7.18 on D.
3. Find 5.38 × 1.92. Set hairline over 5.38 on D. Pull 1.92 on CI under hairline. At 1 of CI read 10.33 on D.
4. Find $1/\pi$. Set hairline over π on C. Read .318 on CI.
5. Find 1/9.05. Set hairline over 9.05 on CI. Read .1105 on C. Or set hairline over 9.05 on C and read .1105 on CI.
6. Find 3.68 × 4.13. Set hairline over 3.68 on D. Set slide so 4.13 on CI is under the hairline. At 1 of C read answer, 15.2, on D.

Continued multiplication: Find 16.3 × 2.14 × 7.35. Move hairline over 16.3 on D. Pull 2.14 on CI under hairline. Move hairline over 7.35 on C. Read answer 256 under hairline on D. Or, set 1 on C over 16.3 on D. Move hairline over 2.14 on C. Pull 7.35 on CI under hairline. Read 256 on D under 1 on C.

Awkward divisions: Find 128 ÷ 85. Here the method of Lesson 1 puts the slide far to the left. But 128 ÷ 85 = 128 × $\frac{1}{85}$. Set 1 of C over 128 on D. Move hairline over 85 on CI. (This is $\frac{1}{85}$ on C.) Read 1.51 on D. Note slide does not extend far outside rule.

For another example, try: 78 ÷ 12 = 6.5; set right-hand index (1) of CI on 78 of D. Under 12 of CI read 6.5 on D.

(c) Finding squares and square roots: Notice the A and B scales. The A and B scales have two parts (left and right) each with numbers from 1 to 10.

D → A Square roots

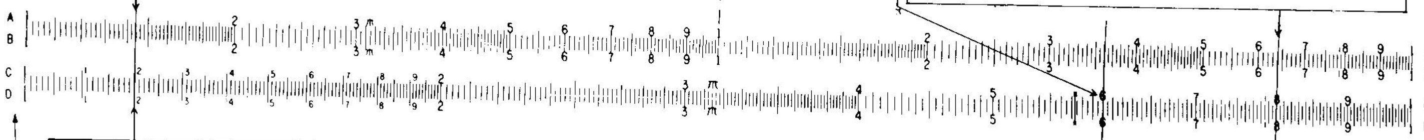
Rule: Numbers on D have their squares on A. Similarly, numbers on C have their squares on B.

When the hairline is over 12 on D, it is also over 12 × 12 = 144, or 12^2 on A. Also $1.2^2 = 1.44$; $.12^2 = .0144$; $120^2 = 14400$, etc. Similarly, opposite 12 on C is 144 on B, etc.

If the left index of A represents 1, this middle index is 10 and the right index is 100. The middle index of A also represents 1000, or 100,000 etc. Also .1 or .001, or .00001, etc.

When the hairline is over 6 on D, it is also over 36 on A. Also $60^2 = 3600$; $.6^2 = .36$, etc. Similarly opposite .06 on C is $(.06)^2$ or .0036 on B.

When the hairline is over 8 on D, it is also over 64 on A. Also $80^2 = 6400$; $.8^2 = .64$, etc. Similarly opposite .08 on C is $(.08)^2$ or .0064 on B.



Squares D to A

When the hairline is over 144 on A, it is also over $\sqrt{144} = 12$ on D. Also $\sqrt{1.44} = 1.2$; $\sqrt{.0144} = .12$; etc. Similarly, opposite 144 on B is 12 on C, etc.

Rule: *Numbers on A have their square roots on D. Similarly, numbers on B have their square roots on C.*

14400 has 5 digits to the left of the decimal point. 144 has 3 digits; 1.44 has 1 digit to left of point. 0.0144 has 1 zero to right of point; 0.000144 has 3 zeroes.

Rule: If the number of digits or zeroes is an odd number use the left-hand part of the A scale to set the number for square roots.

When the hairline is over 36 on A it is over $\sqrt{36} = 6$ on D. Also, $\sqrt{.36} = .6$; $\sqrt{.0036} = .06$; etc. When the hairline is over 64 on A it is over $\sqrt{64} = 8$ on D. Also, $\sqrt{.64} = .8$; $\sqrt{.0064} = .08$; etc. The same relationship is true for the B and C scales.

1440 has 4 digits to the left of the decimal point. 14.4 has 2 digits; .144 has 0 digits; 0.00144 has 2 zeroes to right of point; 0.0000144 has 4 zeroes.

Rule: If the number of digits or zeroes is an even number, use the right-hand part of the A scale to find square roots.

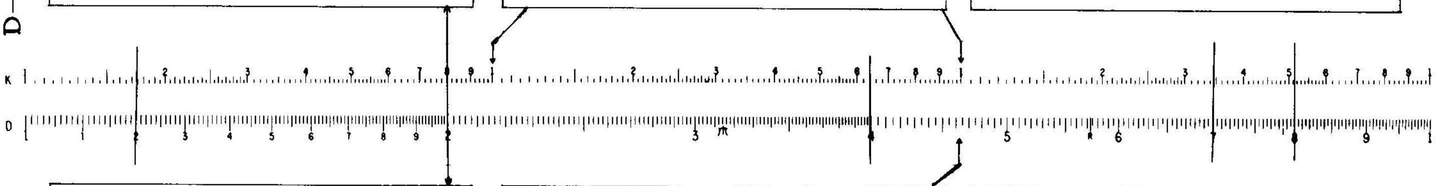
(d) Finding cubes and cube roots: Notice the K scale. The K scale has three parts (left, middle, right) each with numbers 1 to 10. To save space, a K scale and a D scale are shown close together below.

D → K Cubes

When the hairline is over 2 on D, it is also over $2 \times 2 \times 2$ or 2^3, or 8, on K. When it is over 12 on D, it is also over $12 \times 12 \times 12$ or 12^3 or 1728 on K. *Numbers on D have their cubes on K.*

If the left index of K represents 1, then the 1 at the left below represents 10, and the 1 at the right below represents 100. The 1 at the right end of K represents 1000.

When the hairline is over 8 on D, it is also over 512 on K. Observe that $2^3 =$ 8, a one-digit number on left part. 4^3 = 64, a two-digit number on middle part. $8^3 = 512$, a three-digit number on right part.



Cube roots D ← K

When the hairline is over 8 on K, it is also over $\sqrt[3]{8}$ or 2 on D. When it is over 1728 on K, it is over $\sqrt[3]{1728}$ or 12 on D. *Numbers on K have their cube roots on D.*

If the right index of K represents 1, then the 1 at the right above may represent .1. The 1 at the left above may represent .01. The 1 at the left index may represent .001.

When hairline is over 512 on K, it is also over $\sqrt[3]{512} = 8$ on D. When it is over 343 on K, it is also over $\sqrt[3]{343} =$ 7 on D. The parts of the K scale are short and the accuracy is reduced.

Divide the number into groups of three digits. Start from the decimal point and count left when number is greater than 1 and right if number is less than 1.
1,728,000. has 1 digit in first group.
1.728 has 1 digit in first group.
.001,728 has 1 digit in first group.
When the first group has only 1 digit, use left part of K for cube root.

Divide the number into groups of three digits. Start from the decimal point and count left when number is greater than 1 and right if number is less than 1.
64,000. has 2 digits in first group.
64. has 2 digits in first group.
.000,064 has 2 digits in first group.
When the first group has 2 digits, use the middle part of K for cube root.

Divide the number into groups of three digits. Start from the decimal point and count left when number is greater than 1 and right if number is less than 1.
512,000. has 3 digits in the first group.
512. has 3 digits in the first group.
.000,512 has 3 digits in the first group.
When the first group has 3 digits, use the right-hand part of K for cube root.

(e) Decimal Point Location:

For cubes: Use rules for ordinary multiplication.

For cube roots: Separate the figures of the number into groups of three figures going both ways from the decimal point. Supply zeroes as needed. There will be *one* figure in the cube root for each *group* in the original number.

Examples:

1. $\sqrt[3]{348{,}000.000} = 70.3$
2. $\sqrt[3]{34{,}800.000} = 32.6$
3. $\sqrt[3]{3{,}480.000} = 15.2$

Two groups to left of point in number; hence, 2 figures to left of point in cube root.

4. $\sqrt[3]{348.000{,}000} = 7.03$
5. $\sqrt[3]{34.800{,}000} = 3.26$
6. $\sqrt[3]{3.480{,}000} = 1.52$

One group to left of point in number; hence, 1 figure to left of point in cube root.

7. $\sqrt[3]{.348{,}000{,}000} = .703$
8. $\sqrt[3]{.034{,}800{,}000} = .326$
9. $\sqrt[3]{.003{,}480{,}000} = .152$

Three groups to right of point in number; hence, 3 figures to right of point in cube root.

10. $\sqrt[3]{.000{,}348{,}000{,}000} = .0703$
11. $\sqrt[3]{.000{,}034{,}800{,}000} = .0326$
12. $\sqrt[3]{.000{,}003{,}480{,}000} = .0152$

Four groups to right of point in number; hence, 4 figures to right of point in cube root.

(f) Examples for practice:

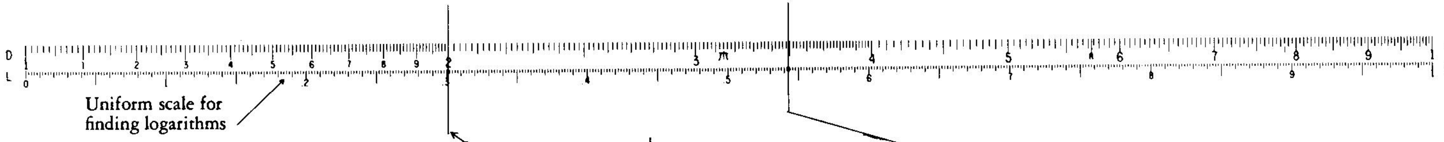
	Answers
1. $\frac{1}{7}$	.143
2. $\frac{1}{35.2}$	.0284
3. $\sqrt{7.3}$	2.7
4. $\sqrt{73}$	8.54
5. $\sqrt{841}$	29
6. $\sqrt{0.062}$	0.249
7. 3.95^2	15.6
8. 48.2^2	2320
9. 2.45^3	14.7
10. 56.1^3	177,000
11. $.738^3$	.402
12. $.0933^3$	.00081
13. $\sqrt[3]{71}$	4.14
14. $\sqrt[3]{5.3}$	1.74
15. $\sqrt[3]{815}$	9.34
16. $\sqrt[3]{.0315}$	.316

PART 3

In Part 3 you will learn how to find logarithms. This part also shows how to find sines, cosines, and tangents of angles, and how to use the slide rule to solve triangles. This lesson is about L, S, and T scales.

If it has been some time since you studied Parts 1 and 2, it may be wise to review them. With the L, S, and T scales, the scales used most are C, D, and CI.

(a) How to find logarithms: **Below is an L scale and D scale.**



The L scale is a uniform scale similar to an ordinary centimeter scale on a "foot-ruler." The decimal points of numbers on the L scale are shown: .1, .2, etc.

When the hairline is over 2 on the D scale, the logarithm of 2, or .301, can be read on the L scale. Thus

Log 2 = .301

Logarithms on L are to base 10. Note above: log 3.49 = .543. The characteristics must be found by rule—they are not read from the scale. See below.

Determining the Characteristic: Count the number of figures from the right of the first non-zero digit toward the decimal point. The characteristic is *positive* if the count is toward the *right,* and *negative* if the count is toward the left.

Determining the Number: When the characteristic is known, use the same rule to place the decimal point in the number. Start at the right of the first non-zero digit and count places as given by the characteristic, supplying zeroes as needed. Use the sign of the characteristic to tell which way you count.

Rule for logarithms (base 10): **Set the hairline over the number on the D scale. Read the mantissa of the logarithm on the L scale. Supply the correct characteristic of the logarithm, using rule at the left.**

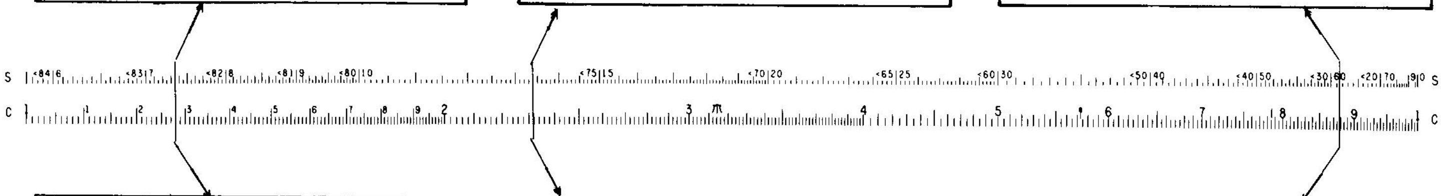
If the logarithm is known and the corresponding number is to be found, use the above rule "backwards." First, pay no attention to the characteristics. Set the mantissa on the L scale and read the number on the D scale. Then use the characteristic to place the decimal point.

(*b*) *How to read the sine scale:* Shown below are a sine scale (S) and a C scale. For sines, the angles on S increase from left to right. Use the numerals on the right side of the marks. The same marks are used for cosines, but the angles increase from right to left. Note the arrows (<), and read numerals on the left.

The mark on S under the line below represents an angle of 7.35°. The value sin 7.35° = .128 is read on the C scale directly below.

The mark on S under the line represents 13.4°. On C read sin 13.4° = .232. For any angle on S, decimal point is at left of value read on C.

Angles larger than 80° can be set only roughly on S. The sines of all these angles are almost 1.



When cosines are wanted the numerals at the left are used (<82). When the mark on S above is read 82.65°, read cos 82.65 = .128.

Reading from right to left the mark on S above is at 76.6°. Then cos 76.6 = .232. For any angle on S, decimal point of cosine is at left of value read on C.

Read cos 28.5° = .879. When angles are given in minutes (28°30′), convert minutes to decimal fractions of a degree before using scales.

Examples for practice:

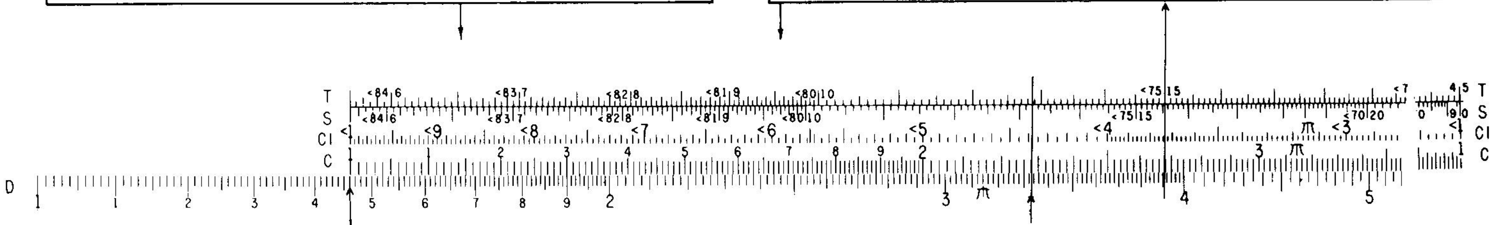
1. Find sin 15.8°. Set hairline over 15.8 on S. Read the value .272 on C.
2. Find the value of cos 62.1°. Set the hairline to the left of <60 on S at 62.1. Read .468 on C.
3. Find sin 59°. Set 59 on the S scale. Read .857 on C.
4. Find cos 31°. Set 31 on the S scale. Read .857 on C.

Examples for you to do:	Answers
1. Find sin 6.7°	.117
2. Find sin 7.6°	.132
3. Find cos 76.3°	.237
4. How large is sin 25.4°?	.429
5. What is the value of cos 54.8°?	.576

(c) ***How to read the tangent scale:*** **The tangent scale (T) is much like the S scale. The scales on the slide shown below are set to multiply 14.6 by the sine, or the cosine, or the tangent of any angle on the S or the T scale.**

Angles on T start at 5.7° and increase toward the right up to 45°. The value of tan 6.75°, or .118, is read on C.

Angles on T from 45° to 84.3° begin at the right index and increase toward the left. Tan 75° = 3.73, is read on CI.



Note that 1 of C is over 14.6 of D

14.6 × sin 13.2° = 3.33 on D

Rule: Read tangents of angles from 5.7° to 45° on C; place decimal point at left of first figure. Read tangents of angles from 45° to 84.3° on CI; place decimal point at right of first figure.

Finding cotangents. Remember that, for any angle A, cot A = 1/tan A. The tangent and cotangent of the same angle are reciprocals. (See Lesson 2, parts *(a)* and *(b)*.)

Rule: Read cotangents of angles from 5.7° to 45° on CI; place decimal point at right of first figure. Read cotangents of angles from 45° to 84.3° on C; place decimal point at left of first figure.

Computing with sines and tangents:

Rule: Remember that when an angle is set on S or on T, the value of the sine (or of the tangent) is automatically set on the C scale.

When a sine (or a tangent) occurs as a factor, set the angle on S (or on T), and proceed as in ordinary multiplication.

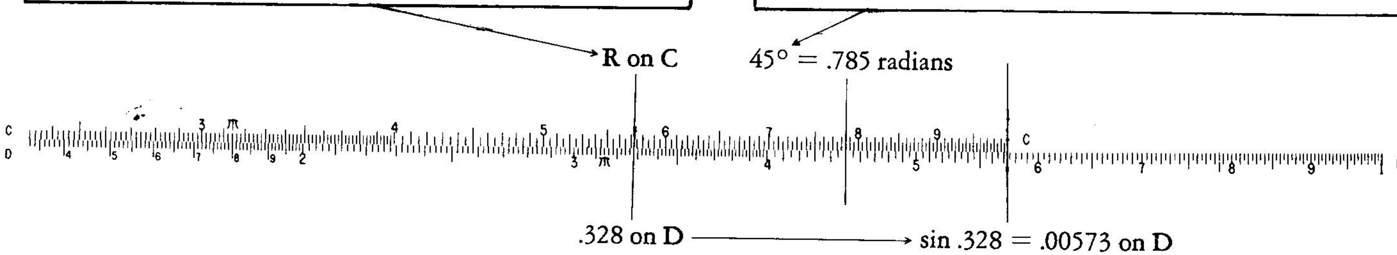
Similarly, you can divide a number by the sine (or by the tangent) by setting the number on D and moving the slide so the angle on S (or on T) is under the hairline. Read the result as usual on D.

(*d*) ***Small angles:*** The sines and tangents of angles smaller than 5.7° are nearly equal. Notice the special mark on the C scale at 5.7 with R above it.

(*e*) ***Radian measure:*** Sometimes it is necessary to change from angle measure in degrees to angle measure in radians. Remember that 1 radian = 57.3 degrees.

Rule for small angles: **Set R on C over the angle on D. At 1 of C read the value of the sine or the tangent on D. For angles between .57° and 5.7° supply a zero at the left of the first digit read, then the decimal point. For angles between .057 and .57 supply two zeroes, then point.**

Rule: **To change from degrees to radians, set 1 of the C scale over R (57.3) on D. Set hairline over angle in degrees on D. Read radian measure on C. To change radians to degrees, set radians on C and read value in degrees on D.**



(*f*) ***Logarithms, base e:*** **In some kinds of scientific and engineering work it is convenient to use logarithms for which the base is *e*, or 2.718 approximately.**

Note: $\log_{10} x = (\log_{10} e)(\log_e x)$ or $\log_e x = (\log_{10} x)/(\log_{10} e) = (1/\log_{10} e)(\log_{10} x) = 2.30 \log_{10} x$.

Example. Find $\log_e 20$. Since $\log_{10} 20 = 1.30$, $\log_e 20 = 1.30 \times 2.30 = 3.00$, approximately.

Rule: **To find $\log_e x$, first find $\log_{10} x$, then multiply by 2.30 or divide by .434.**

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