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mark-up calculator

Pickett

CIRCULAR SLIDE RULE

YOUR MODEL NO. 103ES INSTRUCTION MANUAL

MARK-UP CALCULATOR

The Mark-Up Calculator can be used to make many different kinds of calculations. One side of the rule has been designed for convenience in computing mark-up problems on either a cost or a selling price basis; the other side has been designed as a circular slide rule for the computation of interest and other problems.

MARK-UP PROBLEMS

On this side of the rule are three scales used in mark-up problems. The outer scale is graduated in dollars and on it are located the cost and/or selling prices. The two inner scales are printed on a moveable disc. These scales are both graduated in percents – one being used for calculations on a cost basis and the other being used for calculations on a selling price basis. For convenience, the cost basis scale will be referred to as the CB scale and the selling price basis as the SB scale.

MARK-UP BASED ON COST

Rule: Set the "cost each" arrow of the CB scale opposite the unit cost on the outer scale. Move the hairline over the percent mark-up based on cost on the CB scale and read the retail price on the outer scale.

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• Example 1.

A certain watch wholesales for $13.00. Find the retail price if the percent mark-up based on cost is 70%.

Set the "cost each" arrow on the CB scale opposite 130 on the outer scale. Move the hairline to 70% on the CB scale and read 221 on the outer scale. Obviously the answer must be $22.10 and not $221.00, or $2.21.

The above rule may also be used to find the percent mark-up based on cost, or the cost price provided that the other necessary information is given.

• Example 2.

If the unit cost of an item is $0.65 and it retails for $0.90; find the percent mark-up based on cost.

Set the "cost each" arrow on the CB scale to 650 on the outer scale. Move the hairline to 900 on the outer scale and read 38½% on the CB scale under the hairline.

If the cost is given as per dozen or per gross, merely use the dozen arrow or gross arrow in place of the cost each arrow.

• Example 3.

A certain ball-pen wholesales for $28.20 per gross. Find the percent mark-up on cost if the pens retail for $0.29 each.

Set the "gross" arrow of the CB scale opposite 282 on the outer scale. Move the hairline to 290 on the outer scale and read the answer — 48% on the CB scale under the hairline.

MARK-UP BASED ON SELLING PRICE

Mark-up based on selling price is done in the same way as mark-up based on cost except the SB scale is used instead of the CB scale.

• Example 1.

Certain chocolate candies wholesale for $17.63 per dozen boxes. What is the retail price per box if a percent mark-up based on selling price is 35%?

Set the dozen arrow of the SB scale opposite 1763 on outer scale. Move hairline to 35% on SB scale and read – $2.26 on outer scale under hairline.

• Example 2.

A fountain pen sells for $12.50. The percent mark-up based on the selling price is 43%. Find the cost of the pen.

Set the hairline to 125 on the outer scale and move 43% on the SB scale under the hairline. Opposite the cost each arrow of the SB scale read $7.13 on the outer scale.

EXERCISES:

Complete the following table:

Cost Price	Selling Price	% Mark-Up based on Cost	% Mark-Up based on Selling Price
	$16.50	57%	
$ 9.20		72%	
$65.50			28%

ANSWERS:

Cost Price	Selling Price	% Mark-Up based on Cost	% Mark-Up based on Selling Price
\$10.51	\$16.50	57%	36.3%
\$ 9.20	\$15.82	72%	41.9%
\$65.50	\$91.00 approx.	39%	28 %

SIMPLE INTEREST

Simple interest may be calculated very easily on the other side of your Mark-Up Calculator. The outer or "C" scale is the only one needed for these calculations. The formula used in simple interest is $I = PRT$ where I is the interest, P is the principal, R is the annual rate of interest, and T is the time in years. (Where one year is considered to be 360 days.)

Rule: (1) Write the time as a fraction of a year $\left(\frac{a}{b}\right)$. (e.g. 3 years as $\frac{3}{1}$ years; 60 days as $\frac{60}{360}$ years; 18 months as $\frac{18}{12}$ years.)

Rule: (2) Move the hairline on the L (lower) indicator over the P (principal) on the outer or "C" scale. Then move the U (upper) indicator until the hairline is over 1 on the "C" scale. Now move the L indicator until the hairline on the U indicator is over R (the rate of interest) on the "C" scale. The hairline on the L indicator is directly over the annual interest on the "C" scale. Now move the U indicator until its hairline is over the denominator b of the fraction shown in Step (1). Finally, move the L indicator until the hairline of the U indicator is over the numerator A of the fraction. Under the hairline on the L indicator read the interest for the period desired. (While this explanation sounds complicated actual calculation is quite easy.)

• EXAMPLE 1.

Find the simple interest charged on a loan of \$3,500 for two years at an annual interest rate of 4½%.

Write the time as $\frac{2}{1}$ years and the rate of interest as 4.5%. Set the L indicator over 35 on the "C" scale and move the U indicator to 1 on the "C" scale. Then move the L indicator until the U indicator is over 45. The hairline of L is over 157, the annual interest. Now move the U indicator until its hairline is over 1 $\left(\text{the denominator of the fraction } \frac{2}{1}\right)$ and then move the L indicator until the hairline of the U indicator is over 2 (the numerator of the fraction $\frac{2}{1}$) read 315 under the hairline on the L indicator. This answer must be \$315.00 as \$31.50 would be too little and \$3,150.00 is too much. Thus the interest is \$315.00.

• EXAMPLE 2.

Find the simple interest charged on a loan of \$240 for 45 days at the rate of 6.8% per annum.

Write the time as $\frac{45}{360}$ years. Set the L indicator over 24 on the "C" scale and the U indicator over 1. Move the L indicator until the hairline on the U indicator is over 68. Then set the U indicator so that its hairline is over 360 (the denominator of the fraction) and move the L indicator until the hairline of the U indicator is over 45 (the numerator of the fraction). Read 204 on the "C" scale under the hairline of the L indicator. The interest is, therefore, \$2.04 not \$0.204 nor \$20.40.

EXERCISES:

A. The amount of a loan is \$4,250 and the annual interest rate is 5.2%. What is the interest due after 2½ years? Answer – \$552.50.

B. A small loan of \$50 is made for 60 days at the annual interest rate of 12%. What is the interest at due date? Answer – \$1.00.

READING THE C AND THE CI SCALES

The C scale is made by separating the circle into 9 parts. The marks or "graduations" have large numerals (1, 2, 3, etc.) near them. These numerals and their marks are used to locate the first digit (from the left) of any number. To locate 259, look first for the large 2. Set the hairline of L over the graduation mark.

The spaces between the large numerals are separated into 10 parts. The graduation marks are used to locate the second digit of any number. For 25, find the fifth long mark that is on around the circle from the 2.

The spaces are again divided into smaller parts, but there is not room to show the numerals. Until you get to the large 2, there are 10 parts. Between the large 2 and 4, there are only 5 subdivisions, so each mark counts as 2. Thus, to locate 359, find the 4th short mark beyond 35. You are now at 358. Halfway between it and the next mark is the setting for 359 (see Figure 2).

Beyond 4 there are only 2 subdivisions, so each counts as 5. There is a short mark for 755 between 75 and 76. Thus 753 is about three-fifths of the way between the mark for 750 and the mark for 755.

The CI scale is read like the C scale but in the opposite direction. Study the readings shown in Figure 2.

In reading or setting numbers on these scales, the decimal point is ignored. For example, 259, and 2.59, and 0.259, and 0.0259 are all set in the same way.

Numbers located on the C scale are reciprocals of the opposite reading on the CI scale, and conversely. For example, 2 on C is opposite ½, or 0.5, on CI.

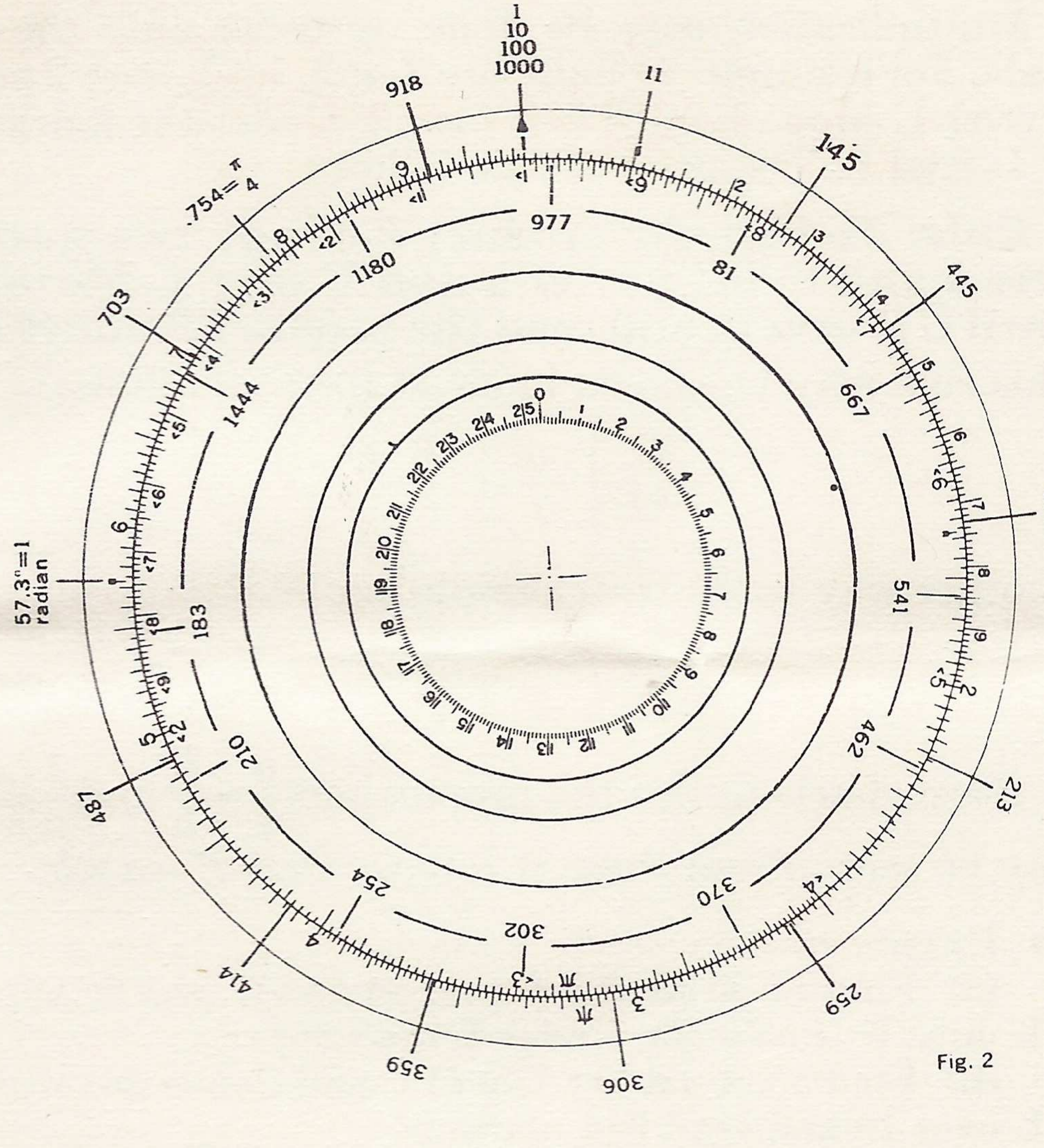

Fig. 2

Similarly, 8 on C is opposite 0.125 on CI. In the same way, 25 on CI is opposite 0.4 on C. Also, 0.6 on CI is opposite 1.667 on C. In each case the product of the two members of the opposite pair is 1. This relation is useful in simplifying computations.

MULTIPLICATION

Multiplication may be done by using only the C scale. For example, to multiply 2 × 3, set L over 2 and U over 1. Move L until U is over 3. Under the hairline of L read 6. The general rule follows.

Rule: **To find the product *P* of any two numbers *a* and *b*, set L over *a* and U over 1. Move L until U is over *b*, and read the product *P* under L.** This rule may be shown in chart form as follows:

$$\begin{array}{c|c|c|} \mathrm{L} & a & P \\ \hline \mathrm{U} & 1 & b \end{array}.$$

Another way to do the example is:

$$\begin{array}{c|c|c|} \mathrm{L} & 1 & b \\ \hline \mathrm{U} & a & P \end{array}.$$

In these charts notice the proportions $\frac{a}{1} = \frac{P}{b}$ and $\frac{1}{a} = \frac{b}{P}$ may be seen. From these it follows that $P = a \times b$.

- Examples:

(a) Find 14 × 23. Set L over 14 and U over 1. Move L until U is over 23. Under L read 322.

(b) Find 36 × 19. Set L over 1, and U over 36. Move L over 19 and read 684 under U.

The decimal point in the answer may be found by estimating. In the example 14 × 23, think "10 × 23 would be 230. The answer will be in the hundreds. It must be 322, not 32.2 or 3220." In the example 36 × 19, think "this is about 36 × 20, which would be 720. Hence the answer is 684."

Multiplication can also be done by using the C and CI scales. For 2×3, set L over 2 and U over 1 on C. Set L over 3 on CI and read product on CI under U. Shown in chart form this is:

	C	CI
L	2	3
U	1	6

The chart for the general case is:

	C	CI
L	a	b
U	1	P

• EXAMPLES:

(a) Find 1.96×45.2. Set L over 1.96 on C and U over 1. Move L over 45.2 on CI and read 88.6 under U on CI. Think: 1.96 is near 2, and $2 \times 45 = 90$, so the answer is 88.6.

(b) Find 714×84.7. Set as in chart:

	C	CI
L	714	847
U	1	P

The product is near 700×80 or 56,000. It is 60,500.

DIVISION

Division may be done using only the C scale. For example, to find the quotient Q = 6 ÷ 3, set L over 6 on C, and U over 3. Move L until U is over 1, and read the answer 2 under L. This is the reverse of the multiplication process. The general rule follows.

***Rule:* To find the quotient $Q = a \div b$ of any two numbers, set L over a on the C scale, and U over b. Move L until U is over 1, and read the quotient under L.**

The chart for this rule is:

$$\begin{array}{c|c|c|}\text{L} & a & Q \\ \hline \text{U} & b & 1\end{array}. \quad \text{Thus} \quad \begin{array}{c|c|c|}\text{L} & 6 & Q \\ \hline \text{U} & 3 & 1\end{array}.$$

In these charts notice the proportions $\frac{a}{b} = \frac{Q}{1}$ and $\frac{6}{3} = \frac{Q}{1}.$

- EXAMPLES:

(a) Find 83 ÷ 7. Set L over 83 on C, and U over 7. Move L until U is over 1 and under L read 11.86.

(b) Find 75 ÷ 92. Set L over 75 on C, and U over 92. Move L until U is over 1 and under L read 0.815. To locate the decimal point, notice that the answer must be near 7/9, or more nearly, 8/10, and in decimal form this is 0.8.

Division can also be done by using the C and CI scales. For 6 ÷ 3, set L over 6 and U over 3 on C. Move L to 1, and under U read 2 on CI. This example and the general case are shown in charts below.

$$\begin{array}{c|c|c|} & \text{C} & \text{CI} \\ \hline \text{L} & 6 & 1 \\ \hline \text{U} & 3 & Q\end{array} \qquad\qquad \begin{array}{c|c|c|} & \text{C} & \text{CI} \\ \hline \text{L} & a & 1 \\ \hline \text{U} & b & Q\end{array}$$

• EXAMPLES:

(a) Find 63.4 ÷ 3.29. Set L over 63.4 on C, and U over 3.29. Move L to 1, and under U read 19.27 on CI. The decimal point is found by noting that the answer must be near 60 ÷ 3, or 20.

(b) Find 26.4 ÷ 47.7. Set L over 264 on C, and U over 477. Move L to 1, and under U read 553 on CI. The decimal point must be at the left, since 26 is about half, or 0.5, of 48. Answer, 0.553.

There is another way to use the CI scale in division. If the CI scale is used first, the settings are as in the charts below.

	CI	C
L	6	1
U	3	Q

	CI	C
L	a	1
U	b	Q

• EXAMPLE:

Find 137 ÷ 513. Set L over 137 on CI, and U over 513 on CI. Move L to 1, and under U read 267 on C. The answer must be somewhere near ¼, so it must be 0.267.

COMBINED OPERATIONS

The C scale can be used to do combined multiplication and division as in the example (6 ÷ 3) × 4, or $\frac{6 \times 4}{3}$. To see how to do this let us combine the first chart shown above for division (page 12) with the first method for multiplication (page 10). Only the C scale needs to be used.

The two charts are shown below, first separately, then combined.

$$\frac{L}{U}\Big|\frac{6}{3}\Big|\frac{2}{1}\Big| \quad \text{with} \quad \frac{L}{U}\Big|\frac{2}{1}\Big|\frac{8}{4}\Big|$$

becomes $\frac{L}{U}\Big|\frac{6}{3}\Big|\frac{\text{answer}}{4}\Big|$.

Therefore, set L over 6 on C, and U over 3. Move L until U is over 4, and read the answer 8 under L. You can see that the intermediate setting of U to 1 and the reading of 2 on L can be omitted. The general case is shown below.

$$\frac{a \times b}{c} \qquad \frac{L}{U}\Big|\frac{a}{c}\Big|\frac{\text{answer}}{b}\Big|.$$

- EXAMPLES:

(a) Find $(42 \times 37) \div 65$, or $\frac{42 \times 37}{65}$. Set L over 42 and U over 65. Move L so U is over 37, and read the answer, except for the decimal point, as 239 under L. Note that $42 \div 65$ is about ⅔, and two-thirds of 37 is about 24. Therefore the answer must be 23.9.

(b) Find $\frac{5.17 \times 1.25 \times 9.33}{4.3 \times 6.77}$. Set L over 517, and U over 43. Move L until U is at 125. Move U, leaving L fixed, so U is over 677. Move L until U is over 933. Under L read 207. By using rounded numbers the decimal point may be found and the answer then is 2.07.

Continued multiplication, such as $2 \times 3 \times 4$, can be done several ways. Thus, set L over 2 on C and U over 1. Move L so U is over 3, then keeping L fixed, move U back to 1. Now move L so U is over 4, and read the answer 24 under L. The chart is shown below.

$$\frac{L\quad 2}{U\quad 1}\left|\frac{6}{3\mid 1}\right|\frac{\text{answer}}{4}\Bigg|.$$

Another method uses the CI scale. Set L over 2 on C, and set U over 3 on CI. Move L so U is over 4. Under L read 24. The chart:

$$\frac{L}{U}\left|\frac{2}{3 \text{ on CI}}\right|\frac{\text{answer}}{4}\Bigg|.$$

• Examples:

(a) Find 2.9 × 3.4 × 7.5. Set L over 29 on C, and U over 34 on CI. Move L until U is over 75 on C. Read answer as 739, except for the decimal point, under L on C. The result is near 3 × 3 × 8, or 72, so it must be 73.9.

(b) Find 17.3 × 43 × 9.2. Set L over 173 on C, and U over 43 on CI. Move L until U is over 92 on C. Read the answer as 684, except for the decimal point, on C under L. Round off to 20 × 40 × 10, which gives 8000, so the answer is 6,840.

Note. A set of examples of various types, together with their answers, is given at the end of this booklet. It is suggested that you use them for practice now, before continuing with other scales.

THE A AND A_f SCALES: Squares and Square Roots

The A scale is similar to a C scale which has been reduced to half of its former length. Consequently, as L moves around on the A scale past 2, 3, 4, etc. the graduation mark for 10 is reached after half of a revolution. Continuing on around, the scale is repeated, but now the main divisions may be read as 20, 30, 40, etc.

The outer A scale is subdivided decimally. Thus the length between 1 and 2 is first divided into 10 parts. These are again sub-divided into 5 parts, so each of the shortest marks counts as 2. Between 2 and 5 the shortest marks count as 5. From 5 on around to 10 each short mark represents the second digit of a number set on the scale. There are no sub-divisions of these "tenths."

The inner A scale, or A_f, is subdivided by the common fraction system. Between 1 and 2 the main subdivisions are eighths. A numeral for 1 2/8 or 1 1/4 is printed, and similarly for 1 4/8 or 1 1/2 and 1 6/8 or 1 3/4. No numerals are shown at 1 1/8, at 1 3/8, or at 1 5/8. The shortest marks here are for sixteenths. From 2 on around to 10, the main sub-divisions are fourths. In this part of the scale the shortest marks represent eighths. Sixteenths can be set by splitting the space between the marks for the eighths. However, on continuing around the scale we see that a mark for 7/64 is shown and labelled with the numeral. In this section around as far as 1/2, the short marks are for 64ths. The next one after 7/64 is 8/64 or 1/8; then comes 9/64; 10/64 or 5/32; 11/64 is not labelled, but 12/64 is labelled 3/16. It continues in this way to 32/64, or 1/2. From 1/2 on around to 1, the

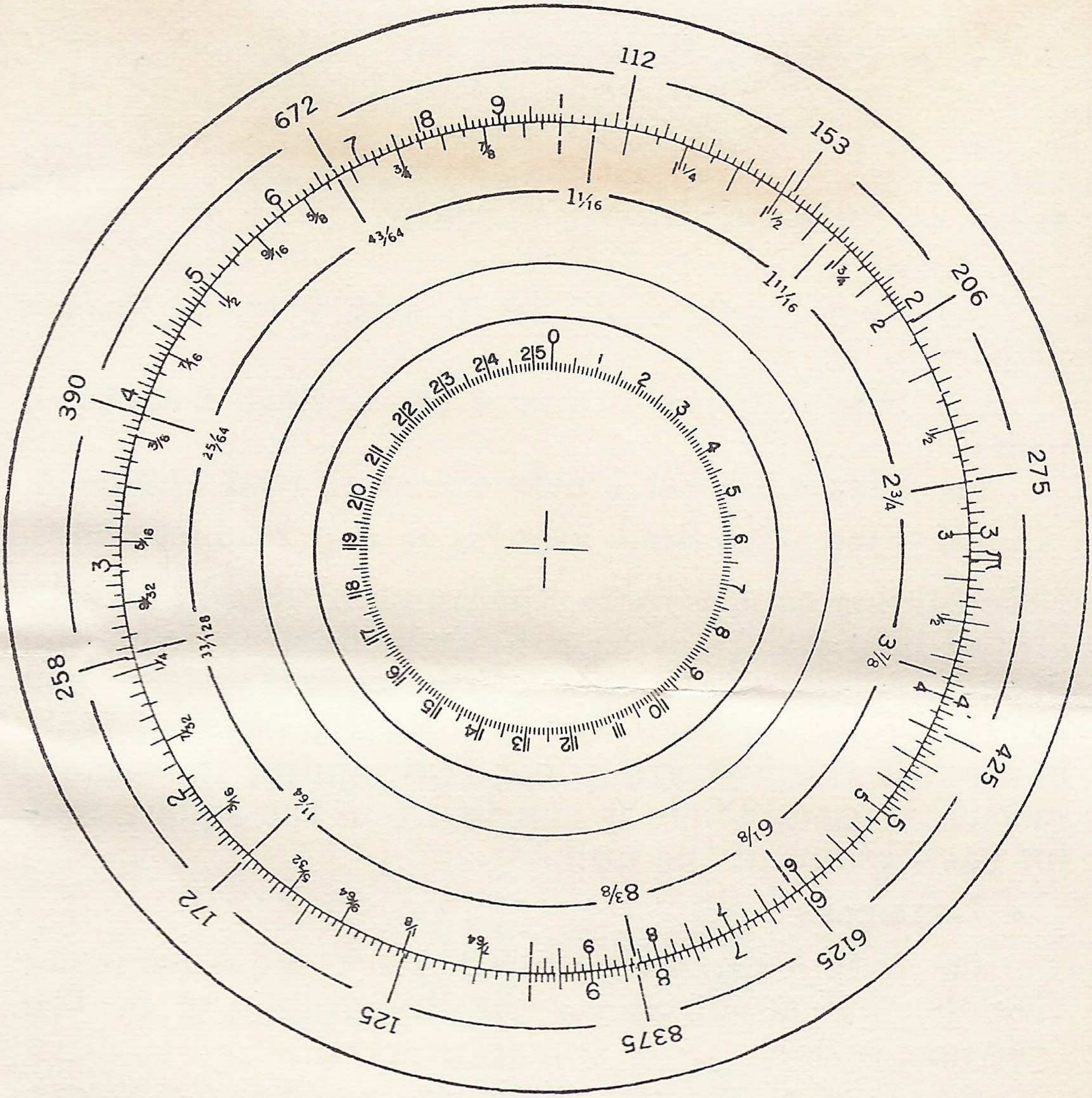

Fig. 3.

short marks are for 32nds. The first is not labelled, but the next, or $^{18}\!/_{32}$ is labelled $^{9}\!/_{16}$. You can count by 32nds on around to 1.

The main use of the A scales is to find squares and square roots.

Rule: When L is set over any value on the C scale, the square of that value is under L on the A scales. Conversely, when L is set over any value on the A scales, the square root of that value is under L on the C scale.

• EXAMPLES:

(a) Find 2×2, or 2^2. Set L over 2 on C. Read 4 under L on A.

(b) Find $\sqrt{4}$. Set L over 4 on A. Read 2 under L on C.

(c) Find 4.23^2. Set L over 423 on C, read 17.9 on A.

(d) Find $\sqrt{9/32}$. Set L over 9/32 on A_f,; read 0.53 on C.

In finding square roots, the numeral should be separated into groups of two figures, starting from the decimal point. If the first group (counting from the left) has only one digit, the first section of the A scale is used. If the first group has two figures, the second section is used. There is one figure in the square root for each group in the number.

• EXAMPLES:

(a) Find $\sqrt{84,100}$. Write 8′41′00. There is one figure in the first group, so use the first section of A. The answer is 290.

(b) Find $\sqrt{0.000094}$. Write the number 0.00′00′94. The group 94 has 2 digits. Use the second part of A. The answer is 0.0097.

If a number is set on an A scale, the reciprocal of the square root may be read on the CI scale. Also, the A scales convert common fractions to decimals (for example, 3/16 on A_f is opposite 0.1875 on A), but there is a set of such conversions on the back of the rule.

LOGARITHMS AND ADDING FRACTIONS

The mantissa of a logarithm may be found by using the L scale. Do not confuse the L *scale* with the L *indicator* in the discussion that follows. The L scale is a uniform scale; that is, the graduation marks are all the same distance apart. The main divisions are labelled 1, 2, 3, etc. The main subdivisions are tenths and give the second digit of the mantissa. The shortest subdivisions are fifths, and are counted as 2. The decimal point is always on the left of the mantissa. The characteristic of the logarithm must be found by one of the usual methods.

***Rule:* To find the mantissa, set the L *indicator* over the number on the C scale, and read the mantissa on the L *scale*. Conversely, if the mantissa is known, set the L indicator over it on the L scale, and the number is under the hairline on the C scale.**

• EXAMPLES:

(a) Find log 2. Set L indicator over 2 on C. Read 0.301 on L scale.

(b) Given that log $n = 2.477$, find n. Set the L indicator over 477 on the L scale, read 300 on the C scale. The characteristic is 2, so the number is 300.

The F_a is a uniform scale on which the graduations represent 64ths. It is used to add fractional values shown on the scale.

***Rule:* To add any two fractions on the F_a scale, set L over one of the fractions and U over 1. Move L until U is over the other fraction, and read the sum under L.**

EXAMPLES:

(a) Find $\frac{19}{64} + \frac{3}{8}$. Set L over $\frac{19}{64}$, and U over 1. Move L until U is over $\frac{3}{8}$. Read $\frac{43}{64}$ under L.

(b) Add $\frac{27}{32}$ and $\frac{13}{64}$. Set L over $\frac{27}{32}$ and U over 1. Move L until U is over $\frac{13}{64}$. Note the sum is more than 1. Read $1\frac{3}{64}$ under U on L.

One fraction can also be subtracted from another by reversing the above process. Thus to find $1\frac{3}{64} - \frac{13}{64}$, set L over $1\frac{3}{64}$ on F_a, and U over $\frac{13}{64}$. Move L until U is over 1. Under L read the result $\frac{27}{32}$. In the general case, the charts below show how to find $a + b$ and $a - b$.

L	a	Sum
U	1	b

L	a	Difference
U	b	1

MIXED PROBLEMS

1. 143 X 0.387
2. 168 X 0.324
3. 18.9 X 132 X 0.0481
4. 22.9 X 116 X 0.524
5. 832 ÷ 6.41
6. 716 ÷ 8.32
7. $\frac{643 \times 8.12}{5.19}$
8. $\frac{469 \times 757}{5.13}$
9. $\frac{9 \times 3.2}{7}$
10. $\frac{11 \times 6.8}{5}$
11. 1 ÷ 3.43
12. 1 ÷ 2.78
13. 29.8 X 4.87
14. 68.3 X 2.91
15. 79.1 X 3.62 X 5.55
16. 93.2 X 22.1 X 0.625
17. 16.35 ÷ 8.02
18. 14.62 ÷ 7.03
19. $\frac{11.95 \times 9.12}{3.40}$
20. $\frac{16.28 \times 5.37}{4.60}$
21. $\frac{2.81 \times 8.11}{6.02}$
22. $\frac{3.74 \times 8.81}{7.08}$
23. .0642 X 80.6
24. 0.0824 X 60.3

ANSWERS

1. 55.3	**5.** 130	**9.** 4.12	**13.** 145	**17.** 2.04	**21.** 3.79
2. 54.4	**6.** 86.1	**10.** 14.96	**14.** 198.8	**18.** 2.080	**22.** 4.65
3. 120	**7.** 1006.	**11.** 0.292	**15.** 1589	**19.** 32.1	**23.** 5.17
4. 1391	**8.** 69,200	**12.** 0.360	**16.** 1287	**20.** 19.00	**24.** 4.97