CONCISE CO., LTD.

Manufacturers of Circular Slide Rules
No.967, 1-chome, Hirai, Edogawa-ku
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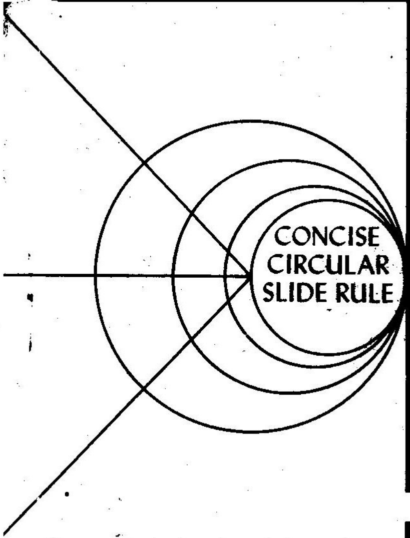

CONCISE

INSTRUCTION MANUAL

NO. 270 N NO. 300

PREFACE

Circular and straight slide rules have been widely used throughout the world as typical calculating instruments. Since each has its own merits and demerits, it is not fair to judge the former superior to the latter and vice versa.

"Concise" Circular Slide Rules based on the principles of logarithms are designed and constructed to facilitate calculations of multiplication, division, proportions, squares and cubes.

The circular slide rule has the following characteristics:

1. As the circumference is furnished with endless graduations, the answer can never be off scale.

2. The circumference of the sliding disc is 3 times longer than the diameter of the disc. The length equivalent to the circumference corresponds to the length of the straight slide rule, so it is available for wide-range calculations.
3. It is handy and pocketable.
4. The operation can be carried out by one-hand manipulation.
5. It is made of highest-quality plastic and all the scales are engraved to ensure a lifetime of accurate readability whereas other similar circular slide rules lack the high precision accuracy.

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1. Scale Reading

As the first step in mastering the slide rule, it is necessary to gain the ability of accurately reading the scales. All the scales are "logarithmic scales", therefore, the graduations on the scales are not measures of length.

Since the C and D scales are the basic logarithmic scales, the explanation on scale reading will be provided using the D scale.

The index mark 1 is called the base-line, and the numbers of the graduations increase clockwise.

(1) There are 9 divisions counting from the base-line on the scale.

(2) The space between the primary divisions 1 and 2 is divided into tenths and these secondary divisions are further sub-divided into tenths, totalling 100

divisions between the primary divisions 1 and 2. Each of the finest sub-divisions, therefore, has the value of 1/100 or 0.01.

(3) Primary divisions 2 and 3, 3 and 4, and 4 and 5 are divided into tenths, but their secondary divisions are sub-divided into fifths, giving each of the finest subdivisions the value of 1/50 or 0.02.

(4) Primary divisions 5 and 6, etc., up to 9 and the base-line are each divided into ten secondary divisions. These secondary divisions are subdivided into two parts giving each of the finest divisions the value of 1/20 or 0.05.

As seen from the above, the decimal point has no bearing upon the position of the number on the slide rule scale. Thus 1.8, 0.18, 18 and 180 etc., are located at the same position on the scales.

2. Decimalization

Calculations by means of slide rules are carried out with significant figures and subsequently the results obtained will also be in the form of significant figures. Accordingly, it is very important to place the decimal point in the proper position, otherwise, correct answers cannot be obtained. For practical calculations, the placing of the decimal point can be conducted according to common sense, and it is convenient to do this according to the rough calculation method, which is used to approximate the values with the required decimal point and compare this to the significant figures obtained by actual calculation.

For example, take the calculation of 565÷7.5 in which, in compliance with the above method,

it is changed to 570÷8 or 570÷7. Hence, the answer of approximately 70 or 80 can be obtained. Actually, the answer 75.3 is obtained by the operation of the slide rule.

In order to simplify explanation of the use of the circular slide rule the following symbols are used in the booklet:

↗ …………	setting of the scales
↑↓ …………	setting of the cursor for reading the graduations
* …………	answer

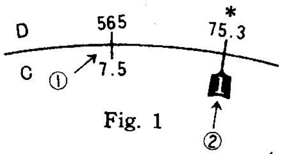


Fig. 1

Procedure: Locate 565 on the D scale and line up 7.5 on the C scale with it. The index mark on the C scale points to answer 75.3 on the D scale.

3. Multiplication & Division

3·1 Multiplication

(a) By means of the C and D scales

Example 1 18×25=450

Procedure: Locate 18 on the D scale, and line up the index mark 1 on the C scale with it. Set the cursor to 25 on the C scale. The cursor shows the answer 450 on the D scale.

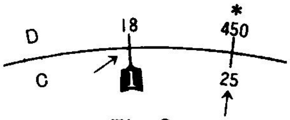


Fig. 2

Example 2

3×2=6
3×5=15
3×7=21

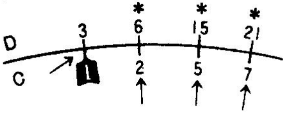


Fig. 3

Procedure: Locate 3 on the D scale, and line up 1 on the C scale with it. Set the cursor to the values 2, 5 and 7 on the C scale, and read the answer 6, 15 and 21 respectively on the D scale.

(b) By means of the CI and D scales

Example 3 150×12=1800

Procedure: Locate 150 on the D scale, and line up 12 on the CI scale with it. The index mark 1 on the C scale points to answer 1800 on the D scale.

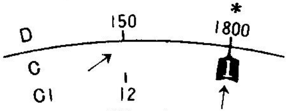


Fig. 4

(c) Successive Multiplication

Example 4 3×4×5=60

Procedure: Locate 3 on the D scale, and line up 4 on the CI scale with it. Move the cursor to 5 on the C scale, which gives the answer 60 on the D scale.

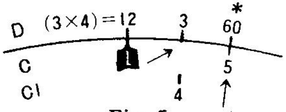


Fig. 5

3·2 Division

(a) By means of the C and D scales

Example 5 850÷25=34

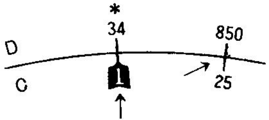


Fig. 6

Procedure: Locate 850 on the D scale, and line up 25 on the C scale with it. The index mark 1 on the C scale points to answer 34 on the D scale.

(b) Successive Division

Example 6 850÷25÷8=4.25

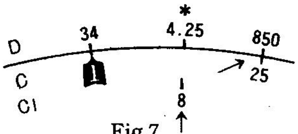


Fig.7

Procedure: Locate 850 on the D scale, and line up 25 on the C scale with it. Move the cursor to 8 on the CI scale and read the answer 4.25 on the D scale.

3·3 Combined Calculations of Multiplication & Division

Example 7 $\frac{3\times 6}{5}=3.6$

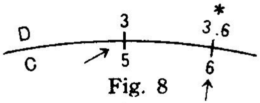


Fig. 8

Procedure: Locate 3 on the D scale and line up 5 on the C scale with it. Set the cursor to 6 on the C scale. Read the answer 3.6 on the D scale.

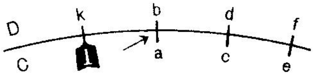
Note: As for the calculation of $\frac{1.32\times 3.2\times 5}{3.6\times 2}$, first obtain the value of $\frac{1.32\times 3.2}{3.6}$, then multiply by $\frac{5}{2}$.

4. Proportions

4·1 Proportion

Values corresponding to each other on the C and D scales are of the same ratio(k), namely, they are in proportion.

$$\frac{b}{a}=\frac{d}{c}=\frac{f}{e}\cdots\cdots=\frac{k}{l}$$



Eig. 9

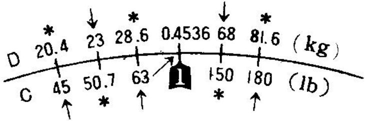
Proportions cover a wide field of computations, such as Conversion, Index, Proportional Allotment and Percentage. Proportions are calculated by "**reference scale method**" using the C and D scales.

(a) Conversion

Example 8 Fill the blanks in the following chart with 1 lb = 0.4536 kgs.

kg	(20.4)	23	(28.6)	68	(81.6)
lb	45	(50.7)	63	(150)	180

Fig. 10



"lbs" is set on the C scale and "kgs" on the D scale. It is important that once the scales are established, the specific scales used to represent "lbs" and "kgs" must remain unchanged throughout the operation.

What would be the prices at a pound and 25 lbs of a commodity at \$4.50/kg?

Procedure: 1 kg = 2.205 lbs Locate 4.50 on the D scale and line up 2.205 on the C scale with it. Then answers \$2.04 and \$51 are read on the D scale.

(b) Index

Example 9 Find index in the following chart.

	Output	Index
Jan.	280sets	100
Feb.	245 〃	(87.5)
Mar.	266 〃	(95.0)
Apr.	322 〃	(115)
May	336 〃	(120)
Jun.	350 〃	(125)

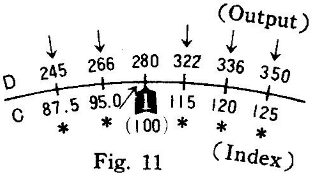


Fig. 11

Procedure: Locate the values of output on the D scale and line up the index **1** (100) on the C scale with them.

(c) Percentage

Example 10 Fill in the percentage columns of the following chart.

	Amount	%
A	$200	(9.5)
B	350	(16.7)
C	450	(21.4)
D	500	(23.8)
E	600	(28.6)
Total	$2100	100

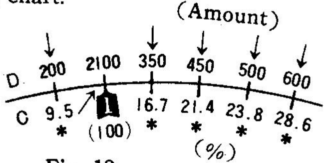


Fig. 12

Procedure: Locate the total sum on the D scale and line up the index **1** on the C scale with it.

(d) Proportional Allotment

Example 11 Allot $3,200.00 at the ratio of 1, 1.5, 2.5 and 3.

	Ratio	Amount
A	1	$ 400
B	1.5	600
C	2.5	1,000
D	3	1,200
Total	8	$ 3,200

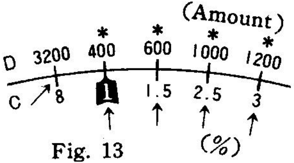


Fig. 13

Procedure: Make the total sum of parts. Locate 400, 600, 1,000 and 1,200 on the D scale and line up 1, 1.5, 2.5, and 3 on the C scale with them.

4·2 Inverse Proportion

The CI and D scales are used for the calculation of inverse proportion.

Example 12 20 men can do a job in 70 days. Fill up blanks of the following table.

Manpowers	(10)	17	28	(40)
Days	140	(82.25)	(50)	35

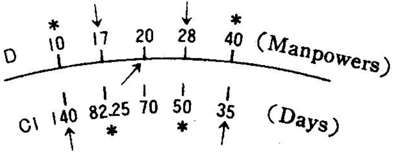


Fig. 14

Procedure: Locate 20 on the D scale, and line up 70 on the CI scale with it, then read answers as per Fig. 14.

It is not necessary to specify scales to represent "man-powers" and "days" in the inverse proportion.

5. Squares & Square Roots

5·1 Square Values & Square Roots

i. To obtain square x^2, set the cursor to x on the D scale, and read the answer against it on the A scale.

ii. To find square root $\sqrt{x}$, set the cursor to x on the A scale, and read the answer against it on the D scale. In calculation of square roots, the given value is divided into two digit groups, counting from the decimal point to the direction of the first significant figure, and if the group including the first significant figure is smaller than 10, the position must be set in between the section of $1 \sim 10$ and if larger than 10, between $10 \sim 100$ on the A scale.

iii. The method of placing decimal point for squares is the same as that for multiplication and division. The decimal point is placed by considering each group as one digit.

Example 13 $3^2=9$ $9.48^2=90$

$\sqrt{25}=5$ $\sqrt{250}=15.8$

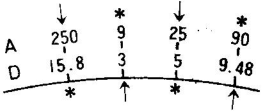


Fig. 15

5·2 Multiplication & Division of Squares & Square Roots

Example 14 $5\times3^2=45$

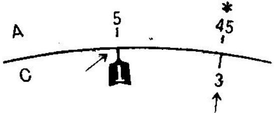


Fig. 16

Example 15 $8\div1.3^2=4.73$

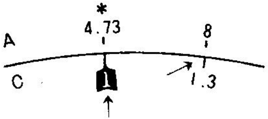


Fig. 17

Example 16 $6^2\div4=9$

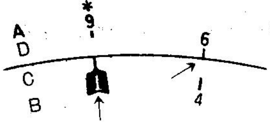


Fig. 18

Note: As shown in the above examples, answers to the calculations involving squares are given on the A scale whereas those to square roots are on the D scale.

Example 17 $\sqrt{20}\times18=80.5$

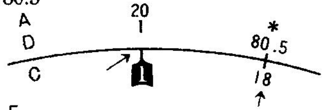


Fig. 19

Example 18 $15\div\sqrt{9}=5$

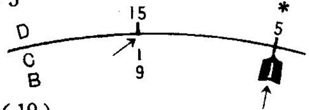


Fig. 20

Use of Gauge Mark "π"

The mark "π" on the C and D scales shows 3.141592···, ratio of circumference of a circle to its diameter. Multiply 3.141592 by diameter, then read the circumference.

5·3 Use of Gauge Mark "c"

The gauge mark "c" at 1.128····· on the C scale is used for problems involving diameters and areas of circles. The position of this mark is derived from the following formula:

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

changing this form

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

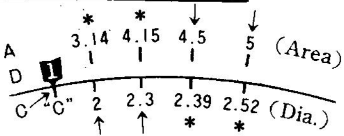
now, $\sqrt{\frac{4}{\pi}} = 1.128\cdots\cdots$, the denominator in the parenthesis above, corresponds to the value of "c".

Answers of circle **diameters** (C scale) and **areas** (A scale) can be read simultaneously by means of the guage mark "c". Volumes of cylinders can also be easily obtained.

Example 19 Fill up the blanks in the followig chart.

Area of circle	(3.14)	(4.15)	4.5	5
Dia. of circle	2	2.3	(2.39)	(2.52)

Fig. 21



Example 20 Find volumes of cylinders, 2.3 in dia., 8m and 15m in length.

Ans. $33.2m^3$

$62.3m^3$

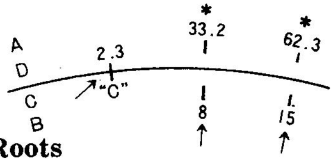


Fig. 22

6. Cubes & Cube Roots

6·1 Cube Values & Cube Roots

i. Cube x^3 is obtained on the K scale against x on the C scale. (D scale of the Model No. 300)

ii. When calculating the cube root of the given value x, x is divided into groups of three digits counting from the decimal point to the direction of the first significant figure, and depending on the number of significant figure, 1, 2 or 3 in the group in which the first significant figure is included, x is set in the section 1~10, 10~100 or 100~1000 of the K scale respectively.

Example 21 $1.5^3 = 3.39$

$2.15^3 = 10$

$4.64^3 = 100$

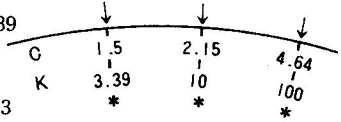


Fig. 23

Example 22 $\sqrt[3]{8} = 2$

$\sqrt[3]{80} = 4.31$

$\sqrt[3]{800} = 9.28$

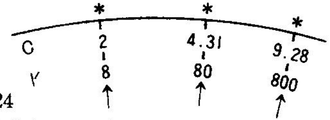


Fig. 24

6·2 Multiplication & Division of Cubes & Cube Roots.

The D (C scale of Model No. 300) and K scales are used for calculations.

Example 23 $5.14 \times 4.33^3 = 418$

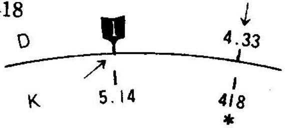
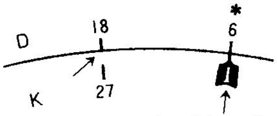


Fig. 25

Example 24 $18 \div \sqrt[3]{27} = 6$

Fig. 26



Note: For calculating $a^3 \div b$, transfer a^3 on the K scale to the D scale and divide it by b.

7. Logarithms & Powers

The L and LL scales are used for calculations of logarithms and powers.

7·1 Use of the L scale

The L scale with equal divisions 0~1.0 is used together with the C scale for computations of common logarithms ($\log_{10} x$).

Values on the L scale against X on the C scale are mantissas (decimal fractions) of $\log_{10}X$. Characteristics

can be obtained by the following formula: (number of places above decimal point of a given number) − 1
If X, the given number is of m place below the decimal point, its characteristic is $\overline{m}$ and simply put before or at the left of the decimal point.

Example 25 $\log_{10}4.65 = 0.668$
$\log_{10}46.5 = 1.668$
$\log_{10}0.465 = \overline{1}.668$

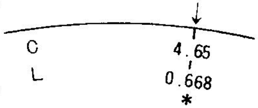


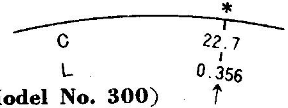
Fig. 27

Note: In $\overline{1}.668$ obtained for $\log_{10}0.465$ of the above example, the characteristic is negative and mantissa positive, therefore, multiplication or division cannot be directly calculated, so $(-1)+0.668=-0.332$ must first be computed.

Anti-logarithm of $\log_{10}^{-1} x = a$ is given by the inverse procedure of the previous example. First take the characteristic out of a given number, then locate the mantissa on the L scale, and read the significant figure of number of logarithm a on the C scale against the mantissa on the L scale. For placing a digit, add 1 to the characteristic of the given number x.

Example 26 $\log_{10}^{-1} 1.356 = 22.7$

Fig. 28



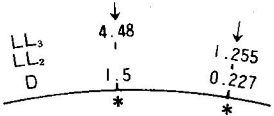
7·2 Use of the LL scale (Model No. 300)

For calculating A^n log log scales ranging from 1.11 to 20000 are given on the Model No.300, divided at the values of "e" which is the base of natural logarithms. The scales are referred to as LL_2 and LL_3 respectively.

(a) Natural Logarithm

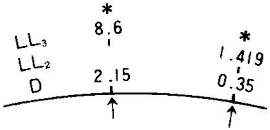
Example 27 $\log_e 4.48 = 1.5$
$\log_e 1.255 = 0.227$

Fig 29



Example 28 $e^{2.15} = 8.6$
$e^{0.35} = 1.419$

Fig. 30



(b) Common Logarithm

In addition to the above, locate 10 on the LL_3 scale and line up the index **1** on the C scale, then read the answer by referring to the LL and C scales.

Example 29
$\log_{10} 1.56 = 0.193$
$\log_{10} 1.155 = 0.0626$

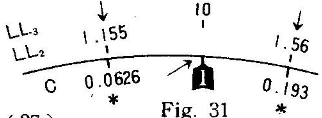


Fig. 31

(c) Powers

The calculation of A^n, $A^{\frac{1}{n}}$ $(A > 1, n > 0)$ can be carried out by the cooperative use of the LL and C scales as follows:

Example 30

$1.255^{1.65} = 1.455$

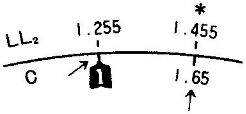


Fig. 32

Example 31 $1.85^{2.47} = 4.57$

$1.85^{0.27} = 1.182$

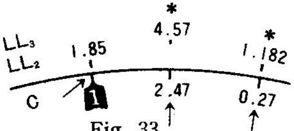


Fig. 33

Example 32 $1.58^{\frac{1}{2.6}} = 1.1922$ (Fig. 34)

Example 33 $8.8^{\frac{1}{3.7}} = 1.8$ (Fig. 35)

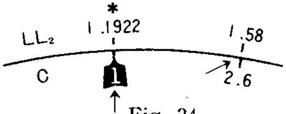


Fig. 34

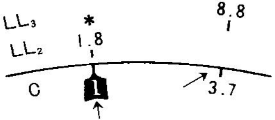


Fig. 35

8. Trigonometric Functions

The S scale is used to determine sines (sinθ) and the T_1 and T_2 scales are used to determine tangents of angles from 6 to 45 degrees, and 45 to 84 degrees. The ST scale is used to determine sines and tangents of angles below 6 degrees.

Complementary angles are indicated in red figures next to black figures along the graduations.

8·1 Triangles

i. Locate the index **1** on the D scale and line up the base line **90** on the S scale with it.

ii. To find sinθ and tanθ, apply the cursor operation, and answers are read by referring to the S, T and D scales. Cosθ is found in red figures on the S and D scales.

(Procedures i and ii are not necessary for the operation of the Model No. 300, for calculations can be done by referring to the S, T and Ç scales.)

iii. As for the Model No. 270N, values on the DI scale against θ on the S and T scales are read cosecθ and cotθ and values on the DI scale against red figures on the S scale are read secθ.

iv. Positions of decimal points to be placed on the D scale are read 0.1~1.0 on the S and T_1 scale and 1.0~10 on the T_2 scale.

Example 34

sin32° = 0.53
cosec32° = 1.887
tan30° = 0.577
cot30° = 1.732
tan62° = 1.88
cot62° = 0.532
cos71° = 0.326
sec71° = 3.07

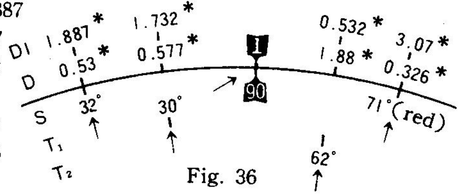


Fig. 36

8·2 Sines & Tangents of Small Angles

sinθ ≑ tanθ is taken for the calculation of angles smaller than 6°.

When the angle is of a smaller value than the range from 6°~40° on the ST scale, the operation is conducted by converting the angle to the unit of radian.

Gauge marks ρ° ρ' ρ'' on the D scale indicate the value of angle of 1 radian by degrees, minutes and seconds.

Locate θ on the C scale and line up gauge marks ρ°, ρ', ρ'' corresponding to the unit of θ (degree, minute or second) with it. The answer is given on the C scale against the index **1** on the D scale. For placing decimal points, the following are taken:

1 minute = 0.0003

1 second = 0.000005

Example 35 $\sin 28' = 0.00814$

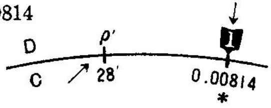


Fig. 37

8·3 Multiplication & Division of Trigonometric Functions

Multiplication and division of trigonometric functions are carried out in the same manner as explained in those of multiplication and division, namely, by the cooperative use of the S, T and D scales.

Example 36 $5.6 \times \sin 35^{\circ} = 3.21$

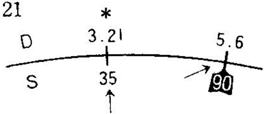


Fig. 38

Example 37 $18.1 \div \tan 25^{\circ} = 38.8$

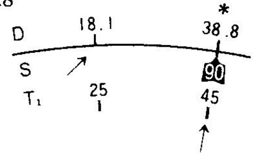
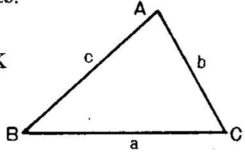


Fig. 39

8·4 Triangles by Sine Proportions

When the opposite sides of the angles A, B and C of a triangle are expressed as *a*, *b* and *c* respectively, the following equation exists:

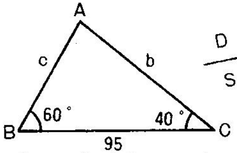
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = K$$



Locate a set of side of the known angle on the D scale, and line up the known angle on the S scale with it, then unknown side (or angle) against the known angle (or side) can be found by the cursor operation.

Example 38 Find b and c in the following triangle with the given B=60°, a=95 , C=40°.

The angle of A is first computed by A =180° − (B+C)



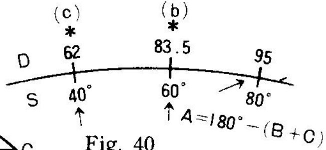
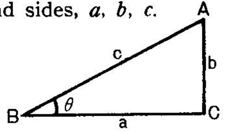


Fig. 40

8·5 Solution of right angles (Model No. 270N)

Solution of right angles can be greatly simplified by use of the S, T and DI scales. The following diagram shows the operation of related base angle θ and sides, *a*, *b*, *c*.



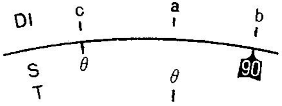
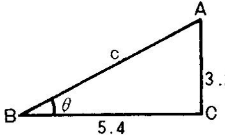


Fig. 41

Example 39 Find θ and c in the below right angle with given $a=5.4$, $b=3.2$



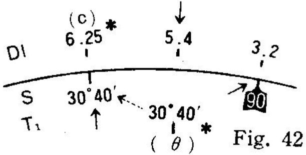


Fig. 42

The above calculation is also applied to that of vectors and the "Pythagorean theorem".

Example 40

$\sqrt{1.8^2+3.5^2}=3.93$

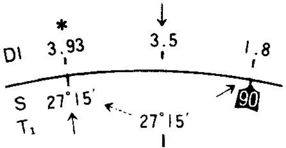
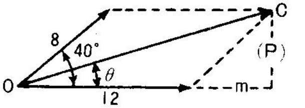
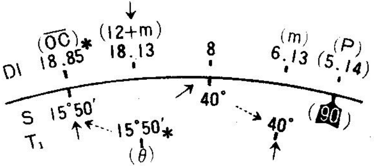


Fig. 43

Example 41 Find $\overline{OC}$ and θ with the given two vectors 8 and 12 when the phase angle difference is 40°.





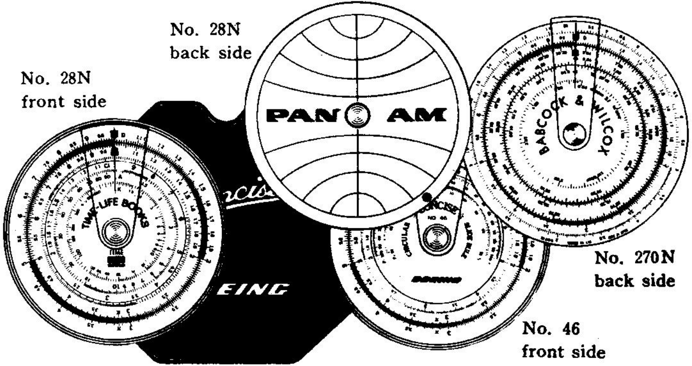
$m = 6.13$
$12+6.13 = 18.13$
$\theta = 15°50'$
$\overline{OC} = 18.25$

Fig. 44

"CONCISE" Circular Slide Rules

	Dia. m/m	Model No.	Scales: Front	Scales: Back	Remarks
Scales on Front Side	84	No.28N	D·C,CI,A,K	Conversion Table	General (pocketable)
	84	No.46	D·C,CI,P_1,P_2	Conversion Table	Profit Calculator
	52	No.32	D·C Perpetual Calendar	Conversion Table	Shoe-horn type, pocketable
	100	No.320	D·C,CI,A,K Perpetual Calendar	Conversion Table	General
Scales on Both Sides	100	No.270N	A,D·C,CI,B,K,L	DI,D·S,T_1,T_2,ST	General & Engineering
	110	No.300	K,A,D·C,CI,B,L	LL_3,LL_2,D·C,S,T_1,T_2,ST	〃

Put your name at the center of the back or the front and use this most attractive give-away to be long remembered.



Use our Circular Slide Rules as give-aways.

Imprinting	Min.q'ty acceptable	Model No.	side
A	100 pcs.	No. 28N	back
		No. 46	front
	200 pcs.	No. 270N No. 300 No. 320	back
B	1000 pcs.	No. 28N No. 270N No. 300 No. 320	front
		No. 28N No. 46	back ※

※ Advertising wordings and technical informations available.

Printing of your name on the vinyl case acceptable.

The plastic-made "Concise" **Circular Slide Rules** are not resistible to the temperature **exceeding 60°C** (140°F).