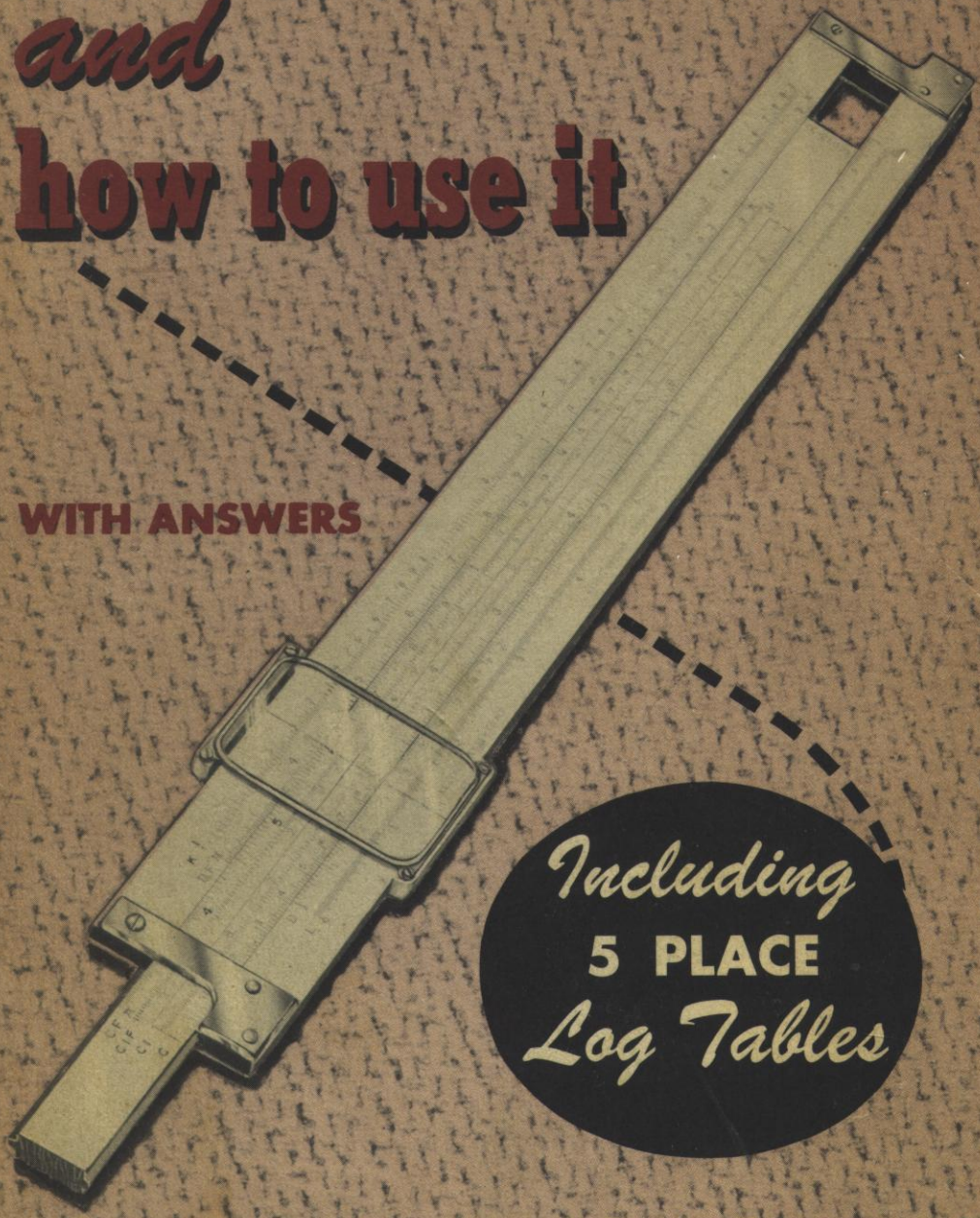
THE SLIDE RULE *and* how to use it

WITH ANSWERS



Including 5 PLACE *Log Tables*

SOMMERS, DRELL AND WALLSCHLAEGER

THE SLIDE RULE
and
How to Use It

A Text-Work Book

by

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PREFACE

The use of the slide rule has become a necessity in many fields of technological and industrial work, not only for the trained engineer but also for the skilled and semi-skilled worker making certain calculations on his job. This text-work book has been designed to fill a need in the teaching material for the training of technical workers and junior engineers, and altho the authors assume that the student beginning the slide rule has had the equivalent of two years of high school mathematics, including a year of algebra, the basal propositions of plane geometry and a knowledge of the simple rules of mensuration, a continuous review of the above material accompanies the introduction of the various scales of the slide rule. Development of the simpler relationships and combinations of the triangle are presented with the introduction of the advanced scales, with the knowledge that little if any study of trigonometry is necessary as a background for the student wishing to learn the application of the slide rule to certain problems of the triangle.

The text-work book has been prepared by the authors to meet the following needs:

a)— A text-work book for adult classes of junior engineers organized for the specific purpose of learning the slide rule.

b)— A work book for all classes in trigonometry and college algebra in colleges and technical schools where the slide rule is used.

c)— A text-work book that may be used as a review of mathematics essentials as well as an introduction to the use of the slide rule with emphasis on the principle of direct teaching.

d)— A text-work book for instruction in the use of the slide rule for groups in large industrial plants where certain specific skills are needed by workers.

e)— A text-work book that may be used by students as supplementary material and followed by them under a teacher's direction without regular class work, thus providing a home study course with suitable exercises.

f)— A text book in which the order of material may be re-arranged by the instructor to suit the needs of the class. For example, the "pn" system for locating the decimal point may be omitted and the scientific notation system may be introduced at once, providing the class understands the theory of exponents.

g)— A work book providing many optional exercises which will allow for individual differences in an adult class.

h)— A text-work book that presents not only graded instruction for the use of the slide rule, but one that also provides a detailed course of study easily followed by an instructor leading to the development of a practical worker.

The authors wish to point out that altho the book has been carefully planned and may be used as supplementary material in some cases, it is not recommended as a substitute for a good teacher. It is suggested that all instructors impress upon their students, college freshman and adult technical workers alike, that the slide rule is not a magic stick that can solve intricate problems practically by itself, but is merely a mechanical device for approximate mathematical computation, with the correctness of the answers dependent entirely

on the care and accuracy of the worker developed thru experience and long practice in handling the rule. To the mathematician or trained engineer this is familiar ground but many new students must be aided in gaining familiarity with the fundamental principles and then led step by step thru the applications of the slide rule to many divisions of mathematics which are themselves often in need of thorough review. Abundant exercises for illustration and practice have been introduced with many of the student questions anticipated and answered simply and directly in phraseology that long experience in adult education has shown to be effective. Whether use will be made of all exercises and material is left entirely to the judgment of the instructor. The book has been arranged so that when work sheets are removed for marking or comparison, many exercises completed by the student will remain with the text material providing valuable future reference.

It is the hope that this book will meet the needs of many colleges, technical and adult education schools for class room material for the presentation of the theory and manipulation of the slide rule, so that this instrument may become more widely used in modern industry.

THE AUTHORS

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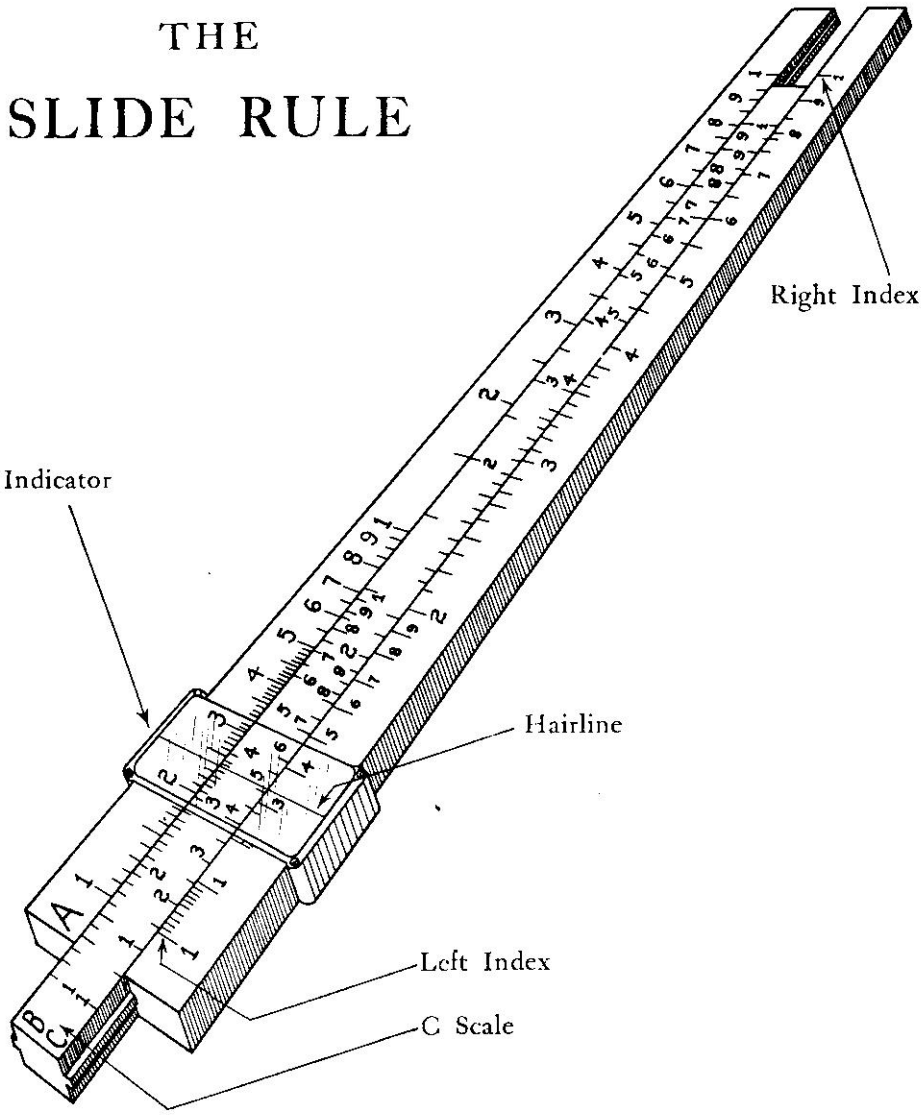


THE STUDY OF THE SLIDE RULE

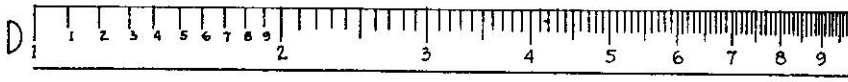
A slide rule is a device for making mathematical calculations. In appearance it is much like a straight edge or ruler with a number of scales or divided sections marked on the faces. There are many types of slide rules depending on the number of scales on the rule.

Each of the different scales will be explained in order. The student should use his own slide rule continuously, in solving examples at the same time they are being read, and in comparing his rule with the figures in the book.

Labeled in the illustration opposite are the names of the parts of the rule which will be mentioned most frequently. The hairline is a straight line marked on the transparent part of the indicator. This is used to aline the marks of the various scales. The number 1 at each end of the scale is called an index: thus, the number 1 at the left is the left index, and the number 1 at the right is the right index. For convenience, the index may be abbreviated in the text as LC, RC, LD, RD, RA. The first letter L or R, refers to the left or right, while the second letters refer to the scales on which the index is being read. While there may be several scales on your rule, it will only be necessary to work with two of them in the beginning. Since multiplication is the first operation to be learned, we will study the C and D scales first.

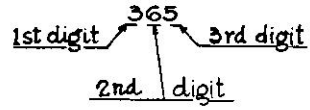
READING THE SCALES

Before the slide rule can be used, it is important to be able to read the scales, since the marks will represent numbers we are to use. The drawings will show only the D-scale, but it can be seen that the C-scale is exactly the same.



First, notice that the whole scale is divided into sections by large numbers, 1 to 10. On most scales the zero of the 10 is omitted. Each of the sections separated by large numbers is divided into ten parts. Further division of the scale will be shown later.

Every number we use is composed of the figures: 1, 2, 3, 4, 5, 6, 7, 8, 9. Each of these is called a digit, or may be called a "significant figure". For example; in the number 365, 3 is the first digit, 6 is the second digit, and 5 is the third digit. (See figure next page).



1245 has four digits; .0012 has two digits, and 4.596 has four digits. Zero is not considered as a digit except when there are digits on each side of it.

EXERCISE

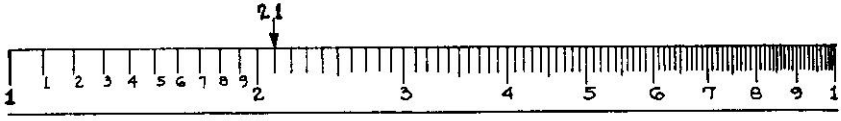
Place in the proper column the first, second and third digits of each number

	1st digit	2nd digit	3rd digit
0.149	1	4	9
479,000			
3876			
5.962			
0.00867			
3,200			
24.91			
845.1			

The large number divisions on the scale are always used for the first digit, and the tenths mark is used for the second digit.

NOTE:

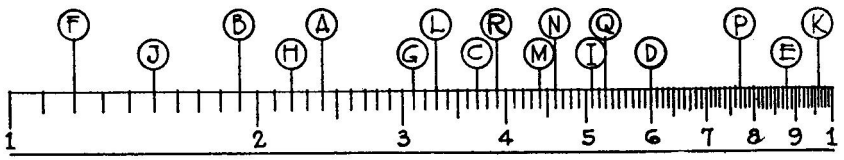
The third digit will be located by an exact mark or by approximation, depending upon the number. The fourth digit is always located by approximation. These cases will be explained in detail subsequently.



The number shown on the scale above is 21. Notice that the rule does not show whether this number is 21 (twenty-one) 210 (two hundred and ten), 2.1 (two and one-tenth), .021 (twenty-one thousandths), .21 (twenty-one hundredths), 21,000 (twenty-one thousand). Thus, a point on the scale of the rule may represent the number, but it will not show the location of the decimal point. For the present only whole numbers will be used and methods for locating the decimal point will be taken up later.

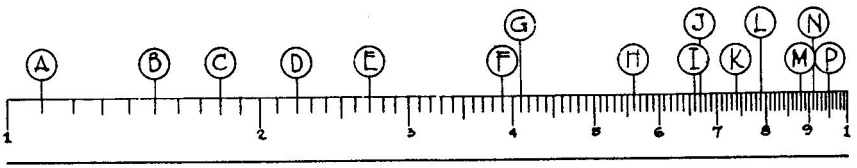
Complete Work Sheet Number 1

WORK SHEET NUMBER 1



Record the readings for the hairlines indicated in the figure.

A) 24	D)____	G)____	J)____	M)____
B)____	E)____	H)____	K)____	N)____
C)____	F)____	I)____	L)____	P)____
Q)____	R)____			



Write in the correct letter with each number listed below:

22 D	41____	67____	95____	15____
79____	18____	74____	56____	39____
88____	27____	91____	11____	66____

Label the figure from the following:

A) 61	D) 26	G) 13	J) 77	M) 82
B) 96	E) 52	H) 14	K) 33	N) 38
C) 21	F) 93	I) 44	L) 63	P) 75

There are three sections of the scales where the subdivisions differ: between 1 and 2; 2 and 4; and from 4 to 10.

Only in the first section, from the large 1 to the large 2, are the tenths marks numbered in small numerals, from 1 to 9. These give the second digit of a number. Care must be taken to remember that these small numerals ALWAYS represent two-digit numbers. Thus, the large 1 or the left index is 1; move the indicator to the right and let the hairline be directly over the small 1, this represents 11; move the hairline to the small 2, this represents 12; move the hairline to the small 6, this represents 16, etc.

Each of the tenths spaces are divided into ten parts, and these new division marks are used to locate three-digit numbers. To locate 162 on the D scale, first note that it is in the first section, between the large 1 and the large 2. Place the hairline of the indicator on the large 1 on the left. This is the first digit or 1; now move the indicator to the right so that the hairline falls directly over the small 6 and you are on the second digit which makes 16; now move your hairline to the right to the second mark between small 6 and small 7 and you are on the third digit, thus completing your reading, 162.

The fourth digit will have to be located approximately. For example: 1535 would lie between 153 and 154, and since the fourth digit is 5, the hairline will be halfway between 153 and 154.

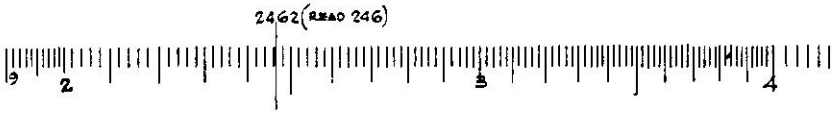
In locating any of these fourth digits, the interval between these small marks can be imagined to be divided into ten parts, then the fourth digit can be estimated.

In the second section, between large 2 and large 4, the tenths marks are not numbered as they are between large 1 and large 2, but the fifth (halfway mark) is slightly longer than the other marks. The tenths here are also subdivided but only into five parts.

If the hairline is on the second long mark between 2 and 3, the reading is 22. If it falls on the first short mark after this, it would be 222. Halfway between this short mark and the next, which would be 224, is 223. We can see then, that for the third digit of a number, in this section, the even digits are the small marks (2, 4, 6, 8), and the odd digits fall halfway between.

As we do not read closer than $\frac{1}{4}$ of the smallest division in this section, one-fourth of the distance between 222 and 223 would be read as 2225. If the hairline seems to show 2223 or 2224, it should be read as 2225. If it appears to indicate 2227 or 2228, it should be read 223. If it appears to read 2462, it should be read 246.

ILLUSTRATION:



The last section lies between large 4 and large 10. Here also, the tenths are not numbered. Each tenth space in this interval is divided into two parts.

If the hairline falls on the third large mark between 5 and 6, the number is read, 53. At the next short mark, the reading is 535. Just beyond this we can estimate 536.

ILLUSTRATION:

"ROUNDING OFF"

Remember that at most, only four digit numbers can be read on the scale, and in the third section (between 4 and 10), only three digit numbers can be read.

If we are to set a number on the rule which has more than three or four digits, it may be "rounded off" until it has the desired number of digits.

RULE

When "rounding off", drop the last digit on the right. If the last digit dropped is 5, 6, 7, 8, or 9, increase the next-to-the-last digit by 1.

ILLUSTRATION:

314159 rounds off to 31416

31416 rounds off to 3142 (four digits)

3142 rounds off to 314 (three digits)

EXERCISE

Round off the following as indicated:

	four-digit	three-digit
489762	4898	490
36923		
743851		
67645		
666666		
134652		

Complete Work Sheets Number 2, 3 and 4

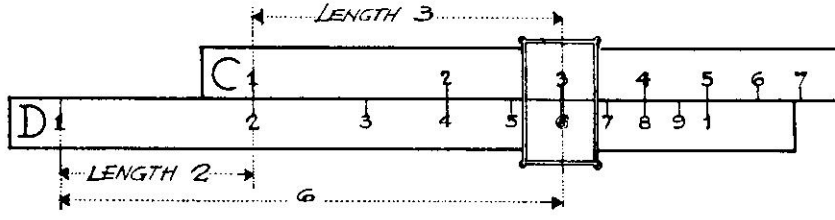
MULTIPLICATION

The C and D scales are used for multiplication. The mathematical theory explaining the operation of these scales will be given in a later chapter. The methods for using the scales will be given in the following sections.

RULE

To multiply numbers, add their respective lengths as represented on the scales.

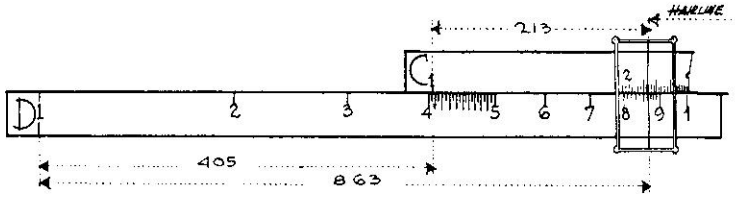
ILLUSTRATION: $2 \times 3 = 6$



Place the left index of the C scale over large 2 on the D scale. Hold the C and D scales in this position firmly between your left thumb and left index finger so that the left index (C1) is directly over 2 on the D scale, forming an exact vertical line (see illustration). Now move indicator to the right until the hairline is directly over 3 on the "C" scale. Under the hairline on the "D" scale is your answer, 6.

The procedure is the same irrespective of the numbers used. For example:

$$405 \times 213 = 86300$$



Following the rule stating that we are to add the lengths which represent these numbers,

a) Place the left index (LC) of the C scale over 405 on the D scale.

b) Move hairline to 213 on the C scale.

c) Under the hairline, find 863 on the D scale.

EXERCISE

Multiply the following using your rule.

1) $16 \times 25 = 400$

2) $215 \times 34 =$

3) $223 \times 167 =$

4) $1265 \times 343 =$

5) $306 \times 184 =$

6) $218 \times 418 =$

7) $1515 \times 542 =$

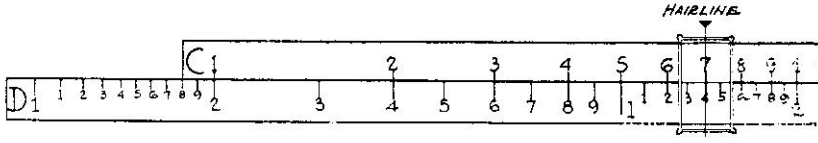
8) $1345 \times 1872 =$

9) $206 \times 1949 =$

10) $2735 \times 1245 =$

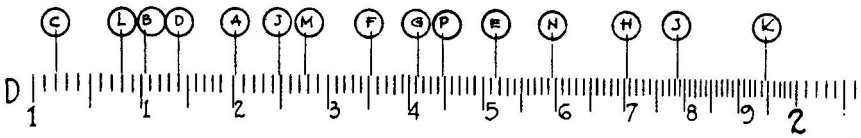
INDEX RULE

If the numbers 2 and 7 are multiplied together it is found that the hairline cannot be moved to 7 on the C scale and the answer is off the rule.



If there were two D scales joined end to end as shown above, then the answer could be read under 7. Thus $2 \times 7 = 14$.

WORK SHEET NUMBER 2



Record the readings for the hairlines indicated in the figure. Also set the hairline on your own slide rule at the same time.

A)_____ D)_____ G)_____ J)_____ M)_____

B)_____ E)_____ H)_____ K)_____ N)_____

C)_____ F)_____ L)_____ P)_____

Draw hairlines on the figure above for the following numbers:

Record the readings on each hairline indicated. Also set the hairline on your own slide rule at the same time.

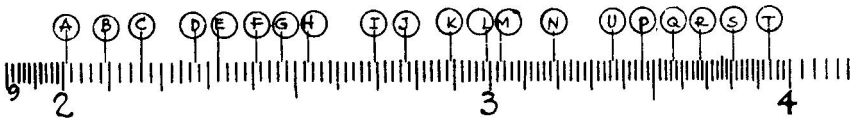
1004_____ 1945_____ 1142_____ 1996_____ 1549_____

1756_____ 1006_____ 1286_____ 1804_____ 1867_____

1819_____ 1473_____ 1507_____ 1001_____ 1243_____

1056_____ 1397_____ 1775_____ 1737_____ 1116_____

WORK SHEET NUMBER 3



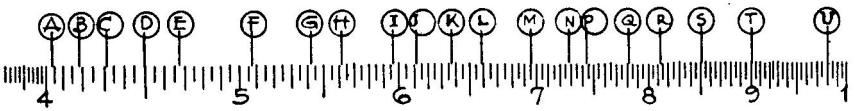
Record the readings for the labeled hairlines in the figure. Also set the hairline on your own slide rule at the same time.

A_____	B_____	C_____	D_____	E_____
F_____	G_____	H_____	I_____	J_____
K_____	L_____	M_____	N_____	P_____
Q_____	R_____	S_____	T_____	U_____

Draw in hairlines on the figure for the following numbers. Label each hairline with its correct value. Set the hairline on your own slide rule at the same time.

247_____	3110_____	3010_____	326_____	2345_____
283_____	3465_____	3225_____	341_____	273_____
3295_____	3775_____	217_____	3985_____	2718_____
2055_____	252_____	288_____	3333_____	3142_____

WORK SHEET NUMBER 4

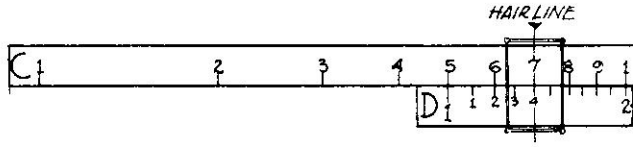


Record the readings for the labeled hairlines in the figure. Also set the hairline on your own slide rule at the same time.

A_____	B_____	C_____	D_____	E_____
F_____	G_____	H_____	I_____	J_____
K_____	L_____	M_____	N_____	P_____
Q_____	R_____	S_____	T_____	U_____

Draw in hairlines on the figure for the following numbers. Label each hairline with its correct value. Set the hairline on your own slide rule at the same time.

456	892	614	932	723
598	943	477	866	998
732	608	555	483	562
655	775	801	616	485



If the left part of the first D scale were cut off at 10, the rule would appear as in the second figure. But this is exactly the same position we would have if we had used the right index instead of the left index. A rule will now be given which will help determine which index to use.

RULE

If the product of the first digit of the numbers being multiplied is less than 10, use the left index. If this product is greater, use the right index. (Note: This rule will work for most cases. If, however, the answer falls off the slide rule, use the other index).

Example: $6 \times 8 = 48$

Applying the rule, the right index must be used.

a) Place right index of C (RC) on 6

b) Move hairline to 8 on C

c) Under hairline (on D) find 48, the answer.

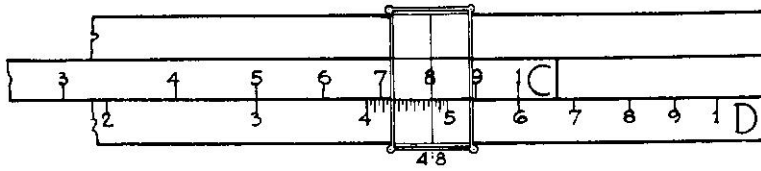


ILLUSTRATION: $214 \times 42 = ?$

The product of the first digits ($2 \times 4 = 8$) is less than 10, therefore use the left index (LC).

ILLUSTRATION: $135 \times 605 = ?$

The product of the first digits is $1 \times 6 = 6$, since this is less than 10, use the left index.

ILLUSTRATION: $435 \times 69 = ?$

The product of the first digits is $4 \times 6 = 24$, since this value is greater than 10, use the right index.

ILLUSTRATION: $342 \times 321 =$

The product of the first digits is $3 \times 3 = 9$, which is less than 10, and the left index is used.

In this last example the answer will be found to fall beyond the rule. Here is a case where Rule 2 does not hold. By "reversing the index", the right index is used (instead of the left) and the answer can be immediately found.

It is well known that the order in multiplication is not important. That is, 3 x 4 gives the same answer as 4 x 3, so that either order of numbers may have been used. As the student becomes more expert, he will avoid having the slide project out too far. As an example, if the following numbers are used, the slide position can be noted.

2×7 the slide projects far out to the left.

7×2 the slide projects to the left only a little.

The second arrangement is preferred.

EXERCISES

Fill in the following table by showing the product of the first digits, and use a check (x) to indicate whether the right or left index is to be used.

	Product of first digits	Left index	Right index
1) 22×63	12		x
2) 415×38			
3) 55×27			
4) 29×687			
5) 864×154			
6) 397×567			
7) 45×12			
8) 832×55			
9) 764×343			
10) 1055×946			

Complete Work Sheet Number 5

WORK SHEET NUMBER 5

Multiply:

1) 576 × 382 =

2) 405 × 365 =

3) 182 × 281 =

4) 314 × 56 =

5) 472 × 845 =

6) 621 × 125 =

7) 793 × 455 =

8) 642 × 1069 =

9) 288 × 1516 =

10) 364 × 1218 =

11) 425 × 405 =

12) 617 × 329 =

13) 1582 × 395 =

14) 454 × 682 =

15) 593 × 647 =

16) 854 × 276 =

17) 356 × 476 =

18) 215 × 268 =

19) 1492 × 312 =

20) 1006 × 451 =

21) 1766 × 433 =

22) 692 × 742 =

23) 1414 × 315 =

24) 277 × 506 =

25) 459 × 594 =

26) 348 × 842 =

27) 676 × 214 =

28) 714 × 314 =

29) 629 × 1562 =

30) 381 × 1056 =

31) 1396 × 478 =

32) 817 × 193 =

33) 726 × 943 =

34) 143 × 861 =

35) 862 × 241 =

36) 932 × 112 =

37) 108 × 709 =

38) 726 × 428 =

39) 520 × 673 =

40) 391 × 568 =

LOCATING THE DECIMAL POINT BY ESTIMATING

The decimal point in multiplication may be estimated, or may be determined by rules. There are several systems for locating the decimal point by rules, but only one will be given here along with the estimating method. The "scientific notation" method, using powers of ten to control the decimal point location will be given in a later chapter because a basic knowledge of exponents is required.

ILLUSTRATION: $42.3 \times 2.13 =$

This can be estimated as $40 \times 2 = 80$, The answer on the slide rule is 902, and therefore must be 90.2.

Similarly, $2.56 \times .0013 =$

This can be estimated as $2 \times .001 = .002$. The answer on the slide rule is 333, and must be .0033.

Complete Work Sheet Number 6

RULE METHOD FOR DETERMINING THE DECIMAL

Each number that we may multiply may be given a "place number" that will tell where the decimal point is. This will be abbreviated as "pn". This number really indicates where the first digit of a number is with respect to the decimal point. The "pn" is positive (+) decimal if any of the digits are to the left of the decimal point.

RULE

For a number which is larger than 1, start with the first digit and count the number of places to the decimal point. This will give you its "pn".

ILLUSTRATION

59.463 has a "pn" of 2, since you count two places from the first digit (5) to the decimal point.

EXERCISE

The student should fill in the blanks in the table below.

Number	"pn"	Number	"pn"
3065.9	4	6.835	1
287,000	6	25.5	2
2,400		29.0	

A number less than 1 is ALWAYS located to the right of the decimal point. The "pn" of such number is ALWAYS either zero or negative. The location of the first significant figure to the right of the decimal point determines its "pn" value. If no zero appears between the decimal point and the first significant figure the "pn" is zero. Thus the "pn" for .69 is zero. If one zero appears between the decimal point and the first significant figure the "pn" is -1; if two zeros appear the "pn" is -2: Thus .086 is -1; .0086 is -2 etc.

RULE

The "pn" for a number less than 1 is numerically equal to the number of zeros which separates the first significant figure to the right from the decimal point and is always negative. If there is no zero between the decimal point and the first significant figure to the right then the "pn" is zero. This is more aptly illustrated on page 29.

WORK SHEET NUMBER 6

In these problems, make the estimated product first, then perform the multiplication on the slide rule.

Problem	Estimated product	Slide rule reading with decimal
1) 6.26 × 182	6 × 200 = 1200	1140.
2) 20.8 × 3.05		
3) 1970 × 386		
4) 547.2 × 3650		
5) 347 × .356		
6) .145 × .346		
7) 25.8 × .0194		
8) 3270 × 45.7		
9) .00488 × .275		
10) .0352 × .0738		
11) 114.8 × .437		
12) 4.96 × 835.		
13) 24500 × 38.3		
14) 67.6 × .984		
15) .0732 × .00046		
16) 12.25 × 35600		
17) .1975 × 0.1066		
18) 8980 × 456		
19) .0598 × 7.04		
20) 305.5 × .0545		

EXERCISE

Fill in the blanks in the table below:

Number	"pn"	Number	"pn"
.0025	−2	.00046	−3
.964	0	.00675	
.0431		1.005	1
.0000354		.675	
75.05		6.000	
.0343		.0075	

It is clear that the "pn" tells how far the **first** digit of a number is from the decimal point. It may be easily pictured in the figure if each dash is to represent one digit place.

$\overline{6}$	$\overline{5}$	$\overline{4}$	$\overline{3}$	$\overline{2}$	$\overline{1}$	.	$\overline{0}$	$\overline{-1}$	$\overline{-2}$	$\overline{-3}$	$\overline{-4}$	$\overline{-5}$	
				4	6	.	3	8					2
						.	0	4	5				−1
				1	.	0	0	6					1
						.	3	8	5				0
						.	0	0	5	5			−2

The first digit of a number would, because of its position, determine the decimal immediately.

RULE METHOD FOR DECIMAL IN MULTIPLICATION

When multiplying numbers, the "pn" of each number is determined, and the following rule is applied:

RULE

For **each** multiplication step, when the slide projects to the left of the rule, add the "pns" of the numbers. Each time it projects to the right, add the "pn" values and subtract 1 from the sum. (An exception is made when the answer is 10 or a multiple thereof, in which case no deduction is made.)

This rule is observed for **each** step in the process, even if the rule continues to project from the same side for two or more successive steps.

ILLUSTRATION: $6 \times 4 = 24$ (rule projects left)
$1 + 1 = 2$

The "pn" values of the two numbers are each 1 and when added, we know the answer must have a "pn" value of 2.

a) $60 \times 4 = 240$
$2 \quad 1 \quad 3$

b) $6 \times 400 = 2400$
$1 \quad 3 \quad 4$

c) $6 \times .4 = 2.4$
$1 \quad 0 \quad 1$

d) $6 \times .004 = .024$
$1 \quad -2 \quad -1$

e) $.6 \times .4 = .24$
$0 \quad 0 \quad 0$

f) $.06 \times .04 = .0024$
$-1 \quad -1 \quad -2$

g) $60 \times .0004 = .024$
$2 \quad -3 \quad -1$

h) $600 \times .004 = 2.4$
$3 \quad -2 \quad 1$

Notice that if we have both signs the same, (either both plus, or both minus), the "pn" values are added and the proper sign used. If the signs are different, the difference of the numbers is taken and the sign will be the same as the larger. (see d and g above).

Example when slide is to the right.

a) $2 \times 4 = 8$
$1 \times 1 \quad -1 = 1$

b) $20 \times 4 = 80$
$2 + 1 \quad -1 = 2$

c) $2 \times 400 = 800$
$1 + 3 \quad -1 = 3$

d) $2 \times .4 = .8$
$1 + 0 \quad -1 = 0$

e) $2 \times .004 = .008$
$1 + \quad -2 \quad -1 = \quad -2$

f) $.2 \times .4 = .08$
$0 + 0 \quad -1 = -1$

g) $.02 \times .04 = .0008$
$-1 + (-1) \quad -1 = -3$

h) $20 \times .0004 = .0024$
$2 + (-3) \quad -1 = \quad -2$

Notice that whatever the sum of the "pn" values one is subtracted whenever the rule projects right.

Complete Work Sheet Number 7 and 8

MULTIPLYING MORE THAN TWO NUMBERS

The rule applying to multiplication can also be applied to the product of more than two numbers and can be read:

RULE

To multiply numbers, add their respective lengths on the scales.
If, for example, we were to multiply longhand

$$4 \times 7 \times 15 = ?$$

we would first multiply $4 \times 7 = 28$, then the new product $28 \times 15 = 420$, the answer.

Applying this to the slide rule, the lengths 4 and 7 are added (using the right index).

WORK SHEET NUMBER 7

In the following problems in addition to the product, write the "pn" value under each number, add for the "pn" value of the product and locate the decimal point. If the rule projects to the right, put a -1 under the equal sign.

Example: $24 \times 5 = 120$ $\qquad$ $260 \times 3 = 780$

"pn" values $2 + 1 = 3$ $\qquad$ $3 + 1 \; -1 \; = 3$

1)	$243 \times 576 =$	11)	$4.96 \times .325 =$
2)	$.495 \times 3.82 =$	12)	$.584 \times .0123 =$
3)	$27.1 \times 456 =$	13)	$45.5 \times 27.6 =$
4)	$.931 \times 3.13 =$	14)	$.457 \times .494 =$
5)	$.043 \times .056 =$	15)	$.387 \times .0042 =$
6)	$54.5 \times 1.05 =$	16)	$.0045 \times .00375 =$
7)	$.297 \times .054 =$	17)	$13.14 \times .194 =$
8)	$3.64 \times 2.87 =$	18)	$4.82 \times 5860 =$
9)	$42.7 \times .179 =$	19)	$146 \times 19600 =$
10)	$.089 \times .0056 =$	20)	$24.5 \times .505 =$

Indicate which index is to be used in following problems (i. e. R. H. or L. H.) and solve using C and D scales.

1)	$135 \times 25.4 =$	11)	$4.92 \times 4.61 =$
2)	$2.43 \times 256 =$	12)	$36.1 \times 2.72 =$
3)	$4.31 \times 1.42 =$	13)	$12.6 \times 5.1 =$
4)	$52.1 \times 3.26 =$	14)	$3.05 \times 42.1 =$
5)	$7.03 \times 2.41 =$	15)	$7.24 \times 3.04 =$
6)	$3.49 \times 8.71 =$	16)	$906 \times 1.005 =$
7)	$9.95 \times 3.41 =$	17)	$5430 \times 2.26 =$
8)	$6.35 \times 4.26 =$	18)	$3.78 \times 2.97 =$
9)	$69.3 \times 1.05 =$	19)	$.972 \times 3.48 =$
10)	$2.16 \times 83.5 =$	20)	$.531 \times 6.98 =$

WORK SHEET NUMBER 8

Multiply the following:

1) $33.1 \times 10.3 =$ _____

2) $145. \times 21. =$ _____

3) $1.52 \times 1475. =$ _____

4) $2.625 \times 3.42 =$ _____

5) $460. \times 279. =$ _____

6) $0.981 \times 0.462 =$ _____

7) $8750. \times 105 =$ _____

8) $935. \times 12.86 =$ _____

9) $0.647 \times 0.0139 =$ _____

10) $0.00352 \times 658. =$ _____

11) $93200 \times 3.42 =$ _____

12) $3.15 \times 0.674 =$ _____

13) $292. \times 935. =$ _____

14) $105. \times 403. =$ _____

15) $0.1006 \times 208. =$ _____

16) $0.653 \times 0.342 =$ _____

17) $73000. \times 33000 =$ _____

18) $0.000521 \times 2.39 =$ _____

19) $18.79 \times 2355. =$ _____

20) $0.785 \times 935. =$ _____

21) $0.785 \times 17.28 =$ _____

22) $0.182 \times 0.401 =$ _____

23) $322. \times 1.89 =$ _____

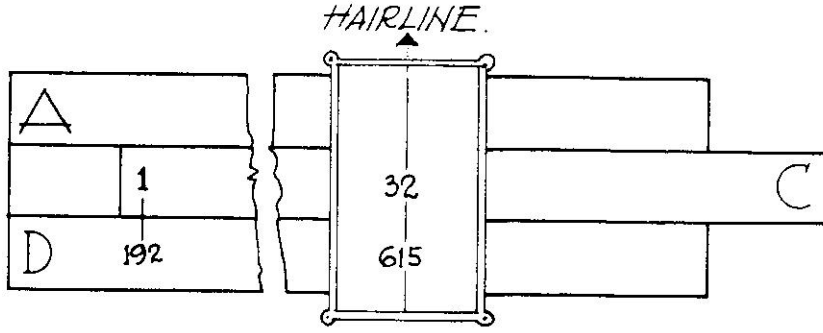
24) $889. \times 973. =$ _____

25) $0.0309 \times 4.07 =$ _____

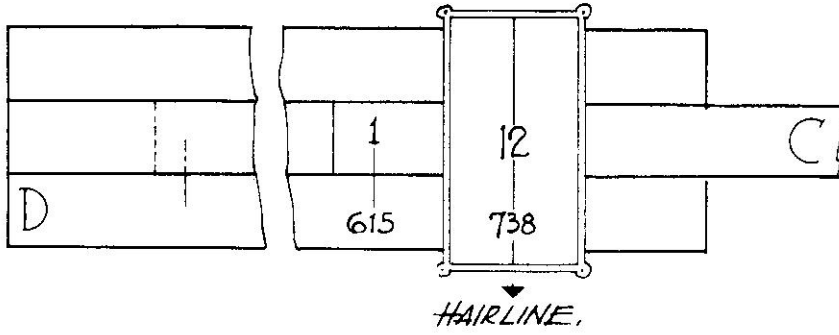
Set hairline on 7; move right index to hairline, move hairline to 4 on C. On D find 28, the product of 4 and 7. It is not necessary to read this number, as we now multiply by 15. Set the left index at the hairline, then move hairline to 15 on C. Read the answer on the D scale as 420.

The decimal point may be estimated, or determined by the "place number" method. In the latter, it is convenient to add the "pn" values as previously described, while making the settings on the slide rule.

ILLUSTRATION: 19.2 x 32 x 12 = ?



First the length 19.2 is added to 32. Set the indicator to 192 on D. Move LC index to hairline. Set the hairline to 32 on C. The product of the first two numbers is under the hairline on D. Since it is not required that this be read, the length 12 is added to it. Move the LC index to the hairline (which is on 615 the first sum). Set hairline to 12 on C. The answer under the hairline on D is 7380.



Estimating the location of the decimal we may say:

$$19.2 \times 32 \times 12 = ?$$

This is approximately

$$20 \times 32 \times 10 = 6000$$

Since we read 738 from the slide rule, we know that the answer is 7380.

Using the Rule Method, the rule is applied at each separate product.

$$\underset{2}{19.2} \times \underset{2}{32} = \underset{3}{615} \qquad \underset{3}{615} \times \underset{2}{12} = \underset{4}{7380.}$$

Because the "pn" of the answer is 4, it must have four digit places before the decimal point. The answer, is, of course, the same as that obtained above.

The student will find that with a little practice, he will carry the "pn" values in mind as each step of the computation is made. Setting the various numbers of the problem can be done at each step and will not interfere with this addition and subtraction.

ILLUSTRATION: $3.14 \times 16.59 \times 3560 \times 0.0562 = ?$

Set indicator to 314 on D. Move LC index to hairline. Set indicator to 1659 on C. (First product is under the hairline on D) Move RC index to hairline. Set indicator to 356 on C (second product is under the hairline on D), move RC index to hairline. Set hairline to 562 on C. Read answer under hairline on D = 1043. By approximation, or by rule, the decimal point may be located and the answer is 10,430.

In estimating the result above, it is not necessary to get an exact value. Instead an approximate value is found $3 \times 16 = 48$, say 50. $50 \times 3500 = 175{,}000$. $175{,}000 \times .05 = 8{,}750$. Apparently the number 1043 read off the rule must be 10,430.

Locating the decimal by the rule method, it is not necessary to observe the results for each step in the multiplications. For convenience in illustrating, the answer will be showin in parenthesis.

$$\underset{1}{3.14} \times \underset{2}{16.59} = \text{Product 1 } (52.0) \quad \underset{-1}{\ } \quad \underset{2}{\ }$$

$$\text{Provuct 1} \times \underset{4}{3560} = \text{Product 2 } (185000) \quad \underset{2}{\ } \quad \underset{6}{\ }$$

$$\text{Product 2} \times \underset{-1}{.0562} = (10{,}400) \text{ The result.} \quad \underset{6}{\ } \quad \underset{5}{\ }$$

ILLUSTRATION:

$$5.64 \times .0038 \times .976 \times .452 = .945$$

$$\underset{1}{5.64} \times \underset{(-2)}{.0038} = \text{Product 1 } (.0214) \quad \underset{-1}{\ }$$

$$\text{Product 1} \times \underset{0}{.097} = \text{Product 2 } (.0209) \quad \underset{-1}{\ } \quad \underset{-1}{\ }$$

$$\text{Product 2} \times \underset{2}{45.2} = \text{Result } (.045) \quad \underset{-1}{\ } \quad \underset{0}{\ }$$

Complete Work Sheet Number 9

DIVISION

Division is just the opposite of multiplication and is done on the C and D scales also.

RULE

To divide one number by another, subtract the length of the divisor from the length of of the dividend.

The student is reminded that the dividend is the number which is to be divided; the divisor is the number doing the dividing, and the quotient is the result of the division.

$$\frac{\text{Dividend}}{\text{Divisor}} = \text{Quotient}$$

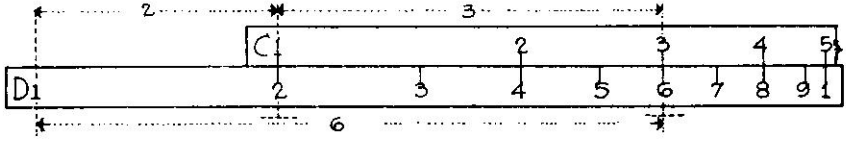
or, Dividend $\div$ Divisor = Quotient

The Rule may then be restated as:

The divisor (on C) is placed over the dividend (on D) and the quotient (answer) is found under the index.

ILLUSTRATION: $\frac{6}{3} = ?$

We subtract the length on the C scale, representing 3, from the length (on the D scale) representing 6. The remaining length on the D scale is 2. (Thus the divisor, 3, has been set over the dividend 6, and under the index is the answer, 2.)



WORK SHEET NUMBER 9

Multiply the following:

1) $7.1 \times 2.3 \times 6 =$ _____

2) $4.92 \times 3.14 \times 330000. =$ _____

3) $0.036 \times 7.95 \times 1.29 =$ _____

4) $0.243 \times 920 \times 1520 \times 6.2 =$ _____

5) $0.0063 \times 0.0519 \times 9.82 \times 14 =$ _____

6) $92. \times 5280. \times 2.65 =$ _____

7) $0.616 \times 24.3 \times 24.3 \times 0.059 =$ _____

8) $3.14 \times 33000 \times 6.25 \times 3. =$ _____

9) $0.785 \times 12.2 \times 12.2 \times 32 =$ _____

10) $0.0054 \times 62.5 \times 87. \times 256. =$ _____

11) $3.4 \times 43.8 \times 10.59 =$ _____

12) $0.542 \times 0.987 \times 32.06 =$ _____

13) $0.250 \times 0.375 \times .625 =$ _____

14) $8.03 \times 436. \times 0.00594 \times 12.16 =$ _____

15) $925 \times 462 \times 3.14 \times 8.49 \times 0.00437 =$ _____

16) $830 \times 412 \times 743 \times 0.0056 \times 0.473 =$ _____

17) $0.3105 \times 740{,}000 \times 6.43 \times 9.12 \times 0.003 =$ _____

18) $269 \times .75 \times 1.2 \times 62.4 \times 0.187 =$ _____

19) $1.40 \times 2.40 \times 3.40 \times 4.40 \times 12 =$ _____

20) $9.07 \times 0.0562 \times 0.349 \times 0.00774 \times 0.3 =$ _____

ILLUSTRATION: $\frac{82}{12} = ?$

Set indicator to 820 on D. Move 12 on C to hairline. Set indicator to LC index. Read answer under hairline on D = 6.83. The decimal point has been located by inspection.

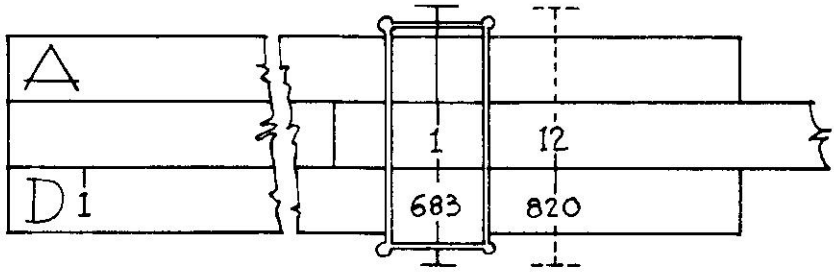
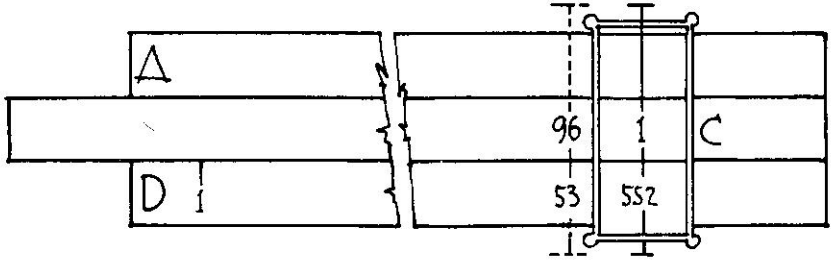


ILLUSTRATION: $\frac{53}{9.6} = ?$

Set indicator to 530 on D. Move 96 on C to hairline. Set indicator to LC index. Read answer under hairline on D = 5.52.



In each case, the decimal point is located by approximation.

$\frac{53}{9.6}$ is approximately $\frac{50}{10}$ or 5 hence answer is 5.52.

Complete Work Sheet Number 10

RULE METHOD FOR DETERMINING THE DECIMAL IN DIVISION

The "pn" of the numbers in a division process will be determined as described previously (in multiplication). The rule for the use of the "pn" numbers is:

RULE

In division, subtract the "pn" of the denominator from the "pn" of the numerator when the rule projects to the left. If the rule projects to the right, make the same subtraction, but add 1. This rule is observed for **each** step in the process even if the scale continues to project from the same side for two or more successive steps.

Notice the similarity between the multiplication and division—shown in the table below.

WORK SHEET NUMBER 10

Divide the following:

1) $\frac{670.}{12.}$ = _____

2) $\frac{4.92}{9.46}$ = _____

3) $\frac{34.9}{2.39}$ = _____

4) $\frac{98.6}{429.}$ = _____

5) $\frac{0.879}{4.21}$ = _____

6) $\frac{0.462}{0.021}$ = _____

7) $\frac{2600}{1.46}$ = _____

8) $\frac{9.86}{97.52}$ = _____

9) $\frac{9.31}{1.005}$ = _____

10) $\frac{17.5}{82300.}$ = _____

11) $\frac{33000.}{2.16}$ = _____

12) $\frac{1}{12.5}$ = _____

13) $\frac{3.14}{5.41}$ = _____

14) $\frac{0.0376}{0.359}$ = _____

15) $\frac{0.0059}{0.000892}$ = _____

16) $\frac{1098.}{987.}$ = _____

17) $\frac{90.2}{0.00363}$ = _____

18) $\frac{0.217}{0.315}$ = _____

19) $\frac{1}{42.1}$ = _____

20) $\frac{1}{3.14}$ = _____

TABLE

	Rule projects left	Rule projects right
multiplication	add "pn"	add "pn" then subtract 1
division	subtract "pn" (denominator from numerator)	subtract "pn" then add 1.

ILLUSTRATION: $\frac{24}{6} = 4$

The rule projects to the left, therefore the difference of the "pn" values is to be taken.

The "pn" of 24 is 2, and of 6 is 1. $(2 - 1 = 1)$. Therefore "pn" of answer is 1. Hence the result is 4. (one digit to the left of the decimal).

ILLUSTRATION: $\frac{275}{24} = ?$

Since the slide projects to the right, then 1 is to be added to the difference of the "pn" values. The difference in this example is $(3 - 2) = 1$, to which we add one. Hence the "pn" value is 2 and the answer read from the rule is 1145; placing the decimal, the answer is 11.45.

If the denominator has a negative "pn" then when the "pn" of the denominator is subtracted, and since it is already negative, the sign will be changed to plus.

Before applying this to an example, the following rule should be learned.

RULE

When subtracting a negative quantity, the sign changes to plus.

$$-(-1) = +1$$

ILLUSTRATION: $\frac{24}{.04} = 600$

From 2 (the "pn" of 24) we will subtract a -1 (the "pn" of .04). This may be represented:

$$\text{"pn"} = 2 - (-1) = 2 + 1 = 3$$

This means that the answer is 600 ("pn" of 3).

ILLUSTRATION: $\frac{.024}{.002} =$

The "pn" values are to be subtracted, and 1 is to be added because the slide projects to the right. $-1 - (-2) = -1 + 2 = 1$, to which we will add 1 because of the slide. This will give a "pn" value of 2 for our answer. Thus 12 is the answer.

Complete Work Sheet Number 11 and 12

WORK SHEET NUMBER 11

Complete the following:

Problem	Answer	Numerator "pn"	Denominator "pn"	Slide	Quotient "pn"
$\frac{156}{25}$	624	3	2		1
$\frac{38.4}{1.38}$	27.8	2	1	+1	2
$\frac{64.8}{.0035}$	18300	2	−2	+1	5
$\frac{386.5}{14.28}$					
$\frac{29.37}{.0564}$					
$\frac{.0796}{.0452}$					
$\frac{23.8}{14.7}$					
$\frac{596.0}{.1125}$					
$\frac{68600}{3.82}$					
$\frac{29.43}{37.64}$					
$\frac{.0473}{26.42}$					
$\frac{79.44}{.067}$					
$\frac{.00463}{.000279}$					
$\frac{.04729}{.0467}$					
$\frac{14.65}{297.5}$					

WORK SHEET NUMBER 12

Write in "pn" value above the values, but try to carry the "pn" addition and subtraction in your mind while the mechanical operation is being performed on the rule.

1) $\dfrac{14 \times 525}{47} =$ _____

2) $\dfrac{24.5 \times 43.4}{3620} =$ _____

3) $\dfrac{1.35 \times 31.6}{0.062} =$ _____

4) $\dfrac{2.56 \times 1.78}{744} =$ _____

5) $\dfrac{4.62 \times 532}{722 \times 6.093} =$ _____

6) $\dfrac{3.26 \times 235}{422 \times 0.953} =$ _____

7) $\dfrac{42.6 \times .054}{48.7 \times 3.80} =$ _____

8) $\dfrac{0.0049 \times 3.05 \times 12}{36.2 \times 7.85} =$ _____

9) $\dfrac{34600 \times 87.3 \times 6}{423 \times 692} =$ _____

10) $\dfrac{792 \times 630}{505 \times 3.79 \times 8.41} =$ _____

11) $\dfrac{34900 \times 4.21 \times 153.1}{62.1} =$ _____

12) $\dfrac{9635}{483 \times 0.00592 \times 206} =$ _____

13) $\dfrac{49.2 \times 0.359}{4.61 \times 98.7 \times 592} =$ _____

14) $\dfrac{541 \times 0.00271 \times 62.4}{4.31 \times 6980 \times 0.00371 \times 98.0} =$ _____

15) $\dfrac{2 \times 3.14 \times 56 \times 1580}{33000 \times 0.85} =$ _____

MULTIPLICATION AND DIVISION:

Problems occasionally contain both multiplication and division, and the so-called "zigzag" method is recommended as being more efficient and convenient than others. For example, the zigzag method will be found preferable to taking the product of the numerators and dividing by the product of the denominators.

A simple problem will be used first to illustrate the method:

$$\frac{8 \times 5 \times 7}{2 \times 3 \times 10}$$

(Note that this problem is intended only to illustrate the "zigzag" method and obviously could be more easily solved by "cancelling" if the solution were directly desired.)

We will remember that numbers in the numerator indicate multiplication, while those in the denominator indicate division.

Take the first number of the numerator (8) and divide by the first number of the denominator (2); multiply this result by 5; divide this new result by 3; multiply by 7; then divide by 10.

Notice that we have alternated with multiplication and division, a process which reduces the number of movements of the slide and thereby reduces the number of errors.

It is not necessary to record the quotients or products at each step.

$$\frac{8}{2} \times 5 \times 7 \qquad \frac{8}{2} = 4$$

$$\frac{(4 \times 5) \times 7}{3 \times 10}$$

$$\frac{20}{3} \times \frac{7}{10}$$

$$\frac{(6.6 \times 7)}{10}$$

$$\frac{46.6}{10} = 4.66$$

Should there be only a few factors in the numerator and many in the denominator, it is convenient to divide as indicated and when zigzaging is no longer possible, the remaining steps are carried out as indicated. (In this case the remaining steps are division). This is also true when the numerator contains more terms than the denominator.

Any results appearing to "fall off" the scale, are to be treated as before;—the other index is to be used.

LOCATING THE DECIMAL POINT.

To determine the decimal point location with the "zigzag" type problem, we may use either the estimation method, or the "pn" method. The following illustrations will show the use of both.

ILLUSTRATION (Estimating):

$$\frac{3.46 \times 59.2}{12.85 \times 22.3} = 714 \text{ (read from rule)}$$

this is approximately,

$$\frac{3 \times 60}{12 \times 20}$$

cancelling where possible, the estimated result is

3/4, or .75

then our answer to the problem is .714.

(By "pn" Method)

The "pn" values of the various terms may be written into the problem, or may be carried mentally as the student develops skill.

$$\frac{{}^{1}3.46 \times {}^{2}59.2}{{}_{2}12.85 \times {}_{2}22.3}$$

$\frac{3.46}{12.85}$ (division) (slide projects right) 1 −2 2

multiply by 59.2 (slide to left) 0 −2 −2
divide by 22.3 (slide to left) 2 −2 0
Hence "pn" for answer is (0), and answer is .714.

ILLUSTRATION:

$$\frac{23.5 \times .046,\ 693}{156.2} \text{ (read from the rule)}$$

Estimating we have approximately,

$$\frac{25 \times .05}{150} \text{ or } \frac{.05}{6}$$

which is approximately .008. The answer is .00693. By "pn" method:

$\frac{23.5}{156.2}$ = 2 −3 1 0
Multiplied by .046 0 −1 −1 −2

The answer has a "pn" of −2; the answer is .00693.

ILLUSTRATION:

$$\frac{1{,}035}{56.9 \times .0238} = 764 \text{ (read from rule)}$$

(Estimating)

$$\frac{1}{50 \times .02} = \frac{1.}{1} \text{ Hence the answer is .764}$$

(By "pn" method)

$\frac{1.035}{56.9}$ 1 2 −1
divide by .0238 −1 − −1 0

With a "pn" of zero, the answer is .764.

ILLUSTRATION:

$$\frac{.0764}{.00293 \times .0842} = 310 \text{ (read from rule)}$$

(Estimating)

$$\frac{.07}{.003 \times .08} = \frac{.07}{.00024}, \text{ approximately 300.}$$

The answer is thus 310.
(By "pn" Method)

$\frac{.0764}{.00293}$ −1 −2 1 2
divide by .0842 2 − −1 3

The "pn" of the answer is 3, hence the answer is 310.

ILLUSTRATION:

$$\frac{54.6 \times .0035 \times .576}{68.7 \times .0324 \times .00965} = 514 \text{ (read from the rule)}$$

(Estimating)

$$\frac{50 \times .003 \times .5}{70 \times .03 \times .01}$$

by cancelling and multiplication we got,

$$\frac{5 \times .0015}{7 \times .0003}, \text{ or } \frac{5 \times 5}{7}, \text{ which is}$$

approximately 3.
(By "pn" Method)

$\frac{54.6}{68.7}$ 2 −2 0
Multiply by .0035 0 −2 −2
Divide by .0324 −2 − −1 −1
Multiply by .576 −1 0 −1
Divide by .0096 −1 − −2 1

The "pn" of the answer is 1; the answer is 5.14.

SQUARES

In solving problems, there are many occasions when a number must be multiplied by itself.

For example: to find the area of a square 5" on an edge, we multiply the base by the altitude. But because the base equals the altitude, or ($5 \times 5 = 25$), we are multiplying 5 by itself. This is called **squaring.** Thus the square of a number is the result of multiplying that number by itself.

In order to indicate the operation, a small 2 is written to the upper right of a number. (3^2) is the shorthand for showing that the number is to be squared.

$$3 \times 3 = 3^2 = 9$$

Thus 3^2 may be read "three—squared," a^2 is read "a—squared".

It is always possible to square a number using the C and D scales, but it is made in one step by using the A and D scales.

RULE

To square a number, set hairline to number on D scale. Find its square on A scale. (The same result can be attained by going from the C scale to B scale).

ILLUSTRATION

$43.7^2 = ?$

Set hairline to 437 on D.
Read the answer under hairline on "A" scale; it is a little past 19.
Estimate result (thinking of $40^2 = 1600$) as being 1900.
The answer is 1909.
Why must the last digit be 9?
Because the hairline is quite a bit past 1900 but not quite 1910, therefor it must be 1909.

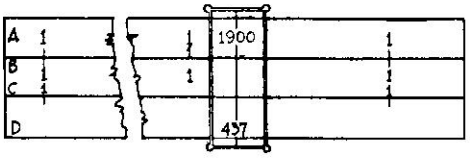
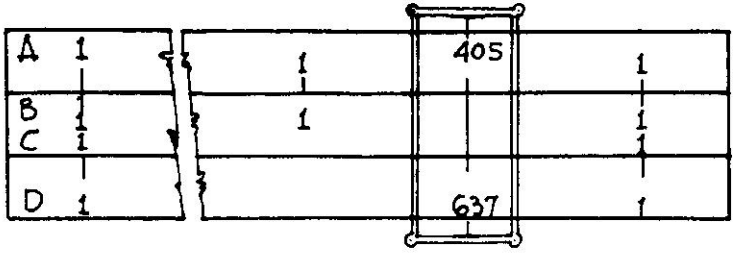


ILLUSTRATION:

$0.0637^2 = ?$

Set indicator to 637 on D.
Read answer under hairline on A = 405.
Estimate result $.06^2 = .0036$.
Therefore the answer is 0.00405.



In some problems it is necessary to square the product of some combination of numbers. For this purpose the parenthesis ( )^2 designates that the value of whatever is within the parenthesis is to be squared.

As examples, consider that:

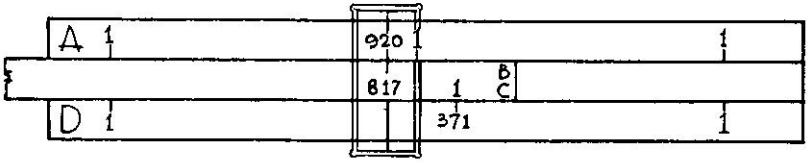
$(2 + 3)^2$ means $(5)^2$, which is equal to 25

$(3 \times 4)^2$, means $(12)^2$, which is equal to 144.

or $\left(\frac{2 \times 6}{3}\right)^2$, means $(4)^2$, which is equal to 16.

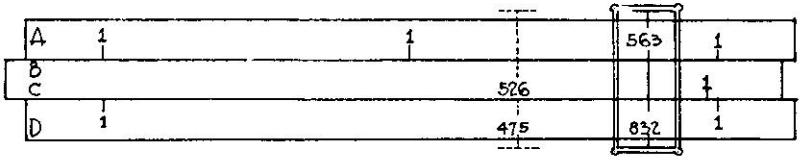
ILLUSTRATION: $(37.1 \times 0.817)^2 = ?$

In problems of this type, the factors are first multiplied on the C and D scales, but instead of looking for the answer under the hairline on the D scale, we look above on the A scale where the square of the product will be found under the hairline.



Move RC index to 371 on D.
Set indicator to 817 on C.
(The product is under hairline on D).
Read answer under hairline on A = 920.
Therefore, answer is 920.

ILLUSTRATION: $\left(\frac{47.5 \times 8.32}{526}\right)^2$



Set indicator to 475 on D.
Move 526 on C to hairline.
Set indicator to 832 on C.
Read answer under hairline on A = 563.
Estimate result $\left(\frac{50 \times 8}{500}\right)^2 = .8^2 = .64$.
Therefore answer = 0.563.

LOCATING THE DECIMAL POINT

RULE

If the square of a number is found in the right section of the A or B scales, the "pn" of the result is twice ($2 \times$ "pn") the "pn" of the number.

RULE

If the square is found in the left section of the A or B scales, multiply the "pn" of the number by 2, then subtract 1. This will give the "pn" of the square.

ILLUSTRATION: $(30)^2 = 900$

The square is found in the left section. "pn" of 30 is 2. Multiplying by 2 and subtracting 1, $(2 \times 2 - 1) = 3$. Hence the "pn" of the square is 3, and the result is 900.

Complete Work Sheet Number 13

SQUARE ROOT

Some problems require that the square root of a number must be found. This is represented by the symbol $\sqrt{\ }$, and should be read as:

$\sqrt{16}$, the square root of 16

$\sqrt{.059}$, the square root of .059

If we are to find the $\sqrt{25}$, for example, we may ask the question:

What number squared (multiplied by itself) will give 25? That number will be the square root of 25.

Thus: $\sqrt{25} = 5$, because $5^2 = 25$

$\sqrt{9} = 3$, because $3^2 = 9$

$\sqrt{64} = 8$, because $8^2 = 64$

On the slide rule, taking the square root is just the opposite of squaring a number.

RULE

To take the square root: set the hairline to the number on A scale, find square root on D scale. (The same result will be obtained by going from B scale to C scale.)

It is noticed however, that there are 2 complete scales on the A scale, and in taking the square root the proper section to be used is determined by the following rule:

RULE

When taking the square root of a number, locate the number on the left A scale if its "pn" is a positive or negative odd number. Locate it on the right A scale if its "pn" is zero or a positive or negative even number.

WORK SHEET NUMBER 13

Complete the following:

Section I

1) $4.2^2 =$ _____ 8) $0.427^2 =$ _____ 15) $0.0198^2 =$ _____

2) $12.1^2 =$ _____ 9) $0.741^2 =$ _____ 16) $3450^2 =$ _____

3) $92.0^2 =$ _____ 10) $98.7^2 =$ _____ 17) $25300^2 =$ _____

4) $69.0^2 =$ _____ 11) $105^2 =$ _____ 18) $0.00391^2 =$ _____

5) $152.^2 =$ _____ 12) $101.6^2 =$ _____ 19) $4090^2 =$ _____

6) $5.17^2 =$ _____ 13) $0.0527^2 =$ _____ 20) $0.000655^2 =$ _____

7) $839.^2 =$ _____ 14) $0.849^2 =$ _____ 21) $0.1006^2 =$ _____

22) $28.7^2 =$ _____ 25) $0.304^2 =$ _____ 28) $0.0495^2 =$ _____

23) $60.2^2 =$ _____ 26) $0.899^2 =$ _____ 29) $0.00874^2 =$ _____

24) $106^2 =$ _____ 27) $48.3^2 =$ _____ 30) $5560^2 =$ _____

Section II

1) $(18 \times 1.28)^2 =$ _____

2) $(42 \times 639.)^2 =$ _____

3) $(6.37 \times 0.017)^2 =$ _____

4) $(91.5 \times 0.758)^2 =$ _____

5) $(0.627 \times 501.)^2 =$ _____

6) $(0.036 \times 7.95 \times 1.29)^2 =$ _____

7) $(4.92 \times 3.14 \times 33000)^2 =$ _____

8) $(3.4 \times 43.8 \times 10.59)^2 =$ _____

9) $\left(\frac{1098}{987}\right)^2 =$ _____

10) $\left(\frac{34.9}{429}\right)^2 =$ _____

11) $\left(\frac{9.71}{5.06}\right)^2 =$ _____

12) $\left(\frac{103.1}{32.1}\right)^2 =$ _____

13) $\left(\frac{42.6}{329.}\right)^2 =$ _____

14) $\left(\frac{0.00352}{0.289}\right)^2 =$ _____

15) $\left(\frac{20.5}{0.0407}\right)^2 =$ _____

16) $\left(\frac{92.1 \times 6.73}{324}\right)^2 =$ _____

17) $\left(\frac{7.29 \times 73. \times 2.06}{485}\right)^2 =$ _____

18) $\left(\frac{24.3 \times 0.987}{3.42 \times 7.31}\right)^2 =$ _____

19) $\left(\frac{873 \times 1.472}{49.6 \times 12}\right)^2 =$ _____

20) $\left(\frac{0.0353 \times 43.2}{0.428}\right)^2 =$ _____

EXCERCISES

Complete the following table:

Number	"pn"		A scale
$\sqrt{496.2}$	3	odd	left
$\sqrt{3.45}$	1	odd	left
$\sqrt{14.2}$	2	even	right
$\sqrt{.0056}$	−2	even	right
$\sqrt{.015}$	−1	odd	left
$\sqrt{.4238}$	0	(Note: "pn" of zero is considered even)	
$\sqrt{148.6}$			
$\sqrt{7930}$			
$\sqrt{.0057}$			
$\sqrt{.0598}$			
$\sqrt{.5641}$			

LOCATING THE DECIMAL POINT

The decimal point may be estimated by squaring the answer.

ILLUSTRATION: $\sqrt{326} = 18.05$

Apparently, 1.805^2; estimated $2^2 = 4$.

18.05^2; estimated as $20^2 = 400$.

Hence, 18.05 is the correct square root.

Using the "pn" notation:

If the "pn" is even, take $\frac{1}{2}$ of it. This will give the "pn" of the square root. If the "pn" is odd, add 1, before dividing by 2.

In the illustration, the "pn" of 326 is 3. Since it is odd, add 1 and divide by 2. The "pn" of the root is 2; hence the result is 18.05.

If the square root sign encloses a product, etc., it is best to determine this before taking the square root.

Thus:

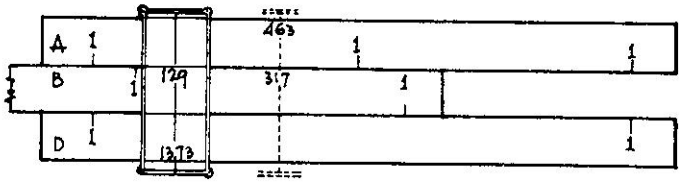
$$\sqrt{4 \times 3} = \sqrt{12}$$

$$\sqrt{\frac{5 \times 8}{2}} = \sqrt{20}$$

$$\sqrt{4 + 3} = \sqrt{7}$$

ILLUSTRATION:

$$\sqrt{\frac{463. \times 12.9}{0.317}} = ?$$



Set indicator to 463 on left portion of A scale. Move 317 on right portion of B to hairline. Set indicator to 129 on right portion of B scale. (Result of multiplication and division is under hairline on A). Read answer under hairline on D = 1373.

Estimate result $\sqrt{\frac{500 \times 12}{.30}} = \sqrt{20{,}000} = 140$

Therefore answer is 137.3.

Complete Work Sheet Number 14

CUBES

Just as 3^2 meant 3×3, so 3^3 (read three—cubed) means $3 \times 3 \times 3$. Thus the small number to the upper right (called an exponent) really tells how many 3's (or whatever number is to be used), must be multiplied together.

ILLUSTRATION:

$$10^3 = 10 \times 10 \times 10$$
$$(3.5)^3 = 3.5 \times 3.5 \times 3.5$$

Of course it always possible to multiply this on the C and D scales, but two somewhat simpler methods may be used. The first is for rules without a K-scale, while the second shows the use of the K-scale.

METHOD ONE

It can be seen that

$$3 \times 3 \times 3 = 3^2 \times 3$$

Hence the number must be first squared, and then multiplied by the original number.

WORK SHEET NUMBER 14

Complete the following:

1) $\sqrt{9.7}$ = _____

2) $\sqrt{12.3}$ = _____

3) $\sqrt{39.1}$ = _____

4) $\sqrt{0.00678}$ = _____

5) $\sqrt{6420.}$ = _____

6) $\sqrt{0.431}$ = _____

7) $\sqrt{873}$ = _____

8) $\sqrt{11740}$ = _____

9) $\sqrt{4460}$ = _____

10) $\sqrt{.00973}$ = _____

11) $\sqrt{0.042}$ = _____

12) $\sqrt{.000205}$ = _____

13) $\sqrt{9870}$ = _____

14) $\sqrt{45900}$ = _____

15) $\sqrt{245.500}$ = _____

16) $\sqrt{152.}$ = _____

17) $\sqrt{839.}$ = _____

18) $\sqrt{0.741}$ = _____

19) $\sqrt{98.7}$ = _____

20) $\sqrt{101.6}$ = _____

21) $\sqrt{0.0527}$ = _____

22) $\sqrt{0.00378}$ = _____

23) $\sqrt{4090.}$ = _____

24) $\sqrt{0.00859}$ = _____

25) $\sqrt{25300.}$ = _____

26) $\sqrt{326000.}$ = _____

27) $\sqrt{7090000.}$ = _____

28) $\sqrt{43.50}$ = _____

29) $\sqrt{0.237}$ = _____

30) $\sqrt{0.00404}$ = _____

1) $\sqrt{\frac{0.987}{0.012}}$ = _____

2) $\sqrt{\frac{3.26 \times 235}{422 \times 0.953}}$ = _____

3) $\sqrt{\frac{5.47 \times 644}{0.0025 \times 12}}$ = _____

4) $\sqrt{\frac{1.35 \times 31.6}{0.062}}$ = _____

5) $\sqrt{\frac{492.}{16.3}}$ = _____

6) $\sqrt{\frac{6560.}{0.159}}$ = _____

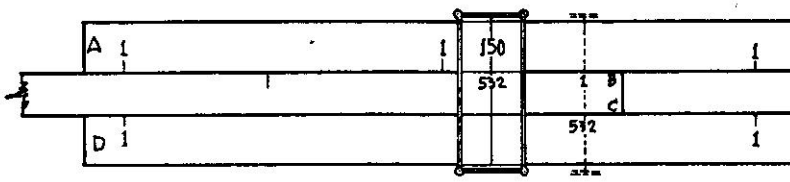
7) $\sqrt{\frac{568. \times 139.}{102.}}$ = _____

8) $\sqrt{\frac{5.63}{12.4 \times 0.787}}$ = _____

9) $\sqrt{\frac{4.98}{563 \times 0.0714 \times 0.135}}$ = _____

10) $\sqrt{\frac{873 \times 3.42 \times 4.2}{7.31 \times 0.455 \times 9.27}}$ = _____

ILLUSTRATION: $53.2^2 = ?$



Set the hairline to 532 on the D scale.

The square is found above on the A scale.

Move the right index of B (RB) to the hairline.

Set hairline to 532 on the B scale and under the hairline on the A scale, find the answer 150.

The decimal is located by approximation.

$$50 \times 50 \times 50 = 125{,}000$$

and the answer is therefore, 150,000.

METHOD TWO

Using the K and D scales, the cube of any number may be found. The K scale is a triple scale, having three sections.

RULE

To cube a number, place hairline over number on D scale, under the hairline on the K scale, find the result.

The decimal point may be located by estimating as in the previous section.

As in the case of squares, the parenthesis $(\ )^3$ means that the result of the calculations within the parenthesis is to be cubed.

Complete Work Sheet Number 15 and 16

CUBE ROOT

METHOD ONE

On slides rules not having K scales, the cube root can be found by a trial method. The procedure is shown below.

$$\sqrt[3]{50600}$$

1. Starting from the decimal point, divide the number into periods of 3.

$$\sqrt[3]{\underline{50}\ \underline{600}.}$$

WORK SHEET NUMBER 15

Complete the following:

1) $4.2^3 =$ _____

2) $16.3^3 =$ _____

3) $92.0^3 =$ _____

4) $09.0^3 =$ _____

5) $51.7^3 =$ _____

6) $8.32^3 =$ _____

7) $0.727^3 =$ _____

8) $98.7^3 =$ _____

9) $10.5^3 =$ _____

10) $0.976^3 =$ _____

11) $0.0397^3 =$ _____

12) $0.0569^3 =$ _____

13) $253^3 =$ _____

14) $4.07^3 =$ _____

15) $16.05^3 =$ _____

16) $0.1005^3 =$ _____

17) $0.0064^3 =$ _____

18) $8390.^3 =$ _____

19) $9.39^3 =$ _____

20) $17.42^3 =$ _____

21) $0.647^3 =$ _____

22) $0.00263^3 =$ _____

23) $27.55^3 =$ _____

24) $10.05^3 =$ _____

25) $171^3 =$ _____

26) $0.0473^3 =$ _____

27) $0.705^3 =$ _____

28) $18.9^3 =$ _____

29) $10.4^3 =$ _____

30) $232.5^3 =$ _____

31) $74.1^3 =$ _____

32) $0.0405^3 =$ _____

33) $13.45^3 =$ _____

34) $9.07^3 =$ _____

35) $0.00482^3 =$ _____

36) $974.^3 =$ _____

37) $.879^3 =$ _____

38) $.1007^3 =$ _____

39) $72.4091^3 =$ _____

40) $.007896^3 =$ _____

WORK SHEET NUMBER 16

Complete the following:

1) $(1.32 \times 6.9)^3 =$ _____

2) $(.056 \times 106.)^3 =$ _____

3) $(10.3 \times 0.198)^3 =$ _____

4) $(98.6 \times 0.407)^3 =$ _____

5) $(4375 \times 0.074)^3 =$ _____

6) $(6.39 \times 12.5)^3 =$ _____

7) $\left(\frac{9.76}{8.42}\right)^3 =$ _____

8) $\left(\frac{5.06}{8.79}\right)^3 =$ _____

9) $\left(\frac{173.4}{47.5}\right)^3 =$ _____

10) $\left(\frac{0.973}{4.24}\right)^3 =$ _____

11) $\left(\frac{1035.}{13.2}\right)^3 =$ _____

12) $\left(\frac{.0593}{.0062}\right)^3 =$ _____

13) $\left(\frac{87.6 \times 5.29}{227.}\right)^3 =$ _____

14) $\left(\frac{6.35 \times 0.972}{305}\right)^3 =$ _____

15) $\left(\frac{545 \times 6.12}{71.9}\right)^3 =$ _____

16) $\left(\frac{877}{7.52 \times 1.73}\right)^3 =$ _____

17) $\left(\frac{9420}{103.5 \times 1.26 \times 4.3}\right)^3 =$ _____

18) $\left(\frac{42.6 \times 167.3}{690 \times 0.202}\right)^3 =$ _____

19) $\left(\frac{807 \times 429 \times 6}{6.34 \times 743.}\right)^3 =$ _____

20) $\left(\frac{489 \times 32}{0.724 \times 7842 \times 0.85}\right)^3 =$ _____

2. The problem is set on the A scale governed by the value of the first period containing digits, reading from the left. This period will contain one, two, or three significant figures ranging in value from 1 to 1000. Values 1 to 10 are set on the left portion of the A scale values from 10 to 100 are set on the right portion, and values from 100 to 1000 are set on the left portion again which now represents values both 1 to 10 and 100 to 1000. In this problem the value is 50, so 506 is set on the right portion of the A scale with the indicator.

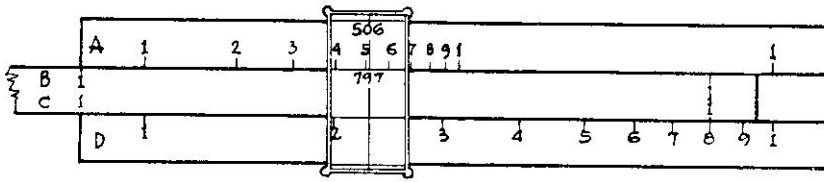
3. The slide is moved until the value of the number on the D scale under the **LC index** is the same as that of the number, under the hairline, on the **left portion** of the B scale. This is shown below. The answer is 370. The principle of this operation may be seen more clearly if the reverse operation of cubing 37.0 were attempted. Looking at diagram on previous page again, note that square of 370 would be directly above on A-scale and that multiplied by 370 on B-scale would result in 506, the desired quantity.

One exception to the procedure of Method One must be noted when the value of the first period is from 100 to 1000. In such cases the number on the D scale under the **right or RC index** instead of LC index, must be the **same** as number under the hairline on the **left portion** of the B scale.

ILLUSTRATION: $\sqrt[3]{506} = ?$

It is not necessary to apply the first step of Method One to number from 1 to 1000 since they are set directly on the scale A. Number 506 is between 100 and 1000 and is set on left portion of A scale with indicator.

The slide is then moved until number on D scale under **RC index** is the same as number under hairline on **left portion** of B. This is shown below. Answer = 7.97.



METHOD TWO

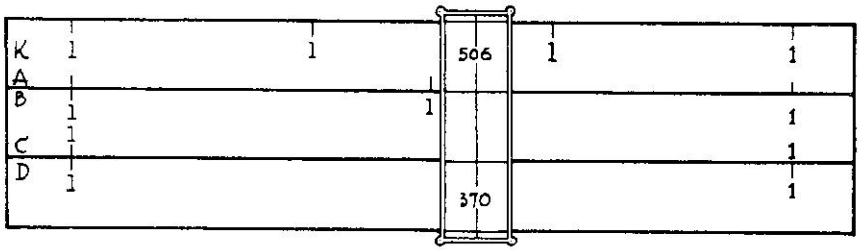
The K scale is a triple scale, consisting of three similar sections, one following the other. In finding cube roots, it is considered a single scale. The portion from left index to left center represents numbers 1 to 10; portion from left center to right center represents numbers 10 to 100; and portion from right center to right index represents numbers 100 to 1000. The procedure for determining on which portion to set the number is shown in example below.

ILLUSTRATION: $\sqrt[3]{50600.}$

1. Starting from the decimal point, divide the number into periods of 3.

$$\sqrt[3]{50\ 600.}$$

2. The problem is then set on the rule governed by the value of the first period containing digits reading from the left. This period will contain one, two, or three significant figures ranging in value from 1 to 1000. In this problem the value is 50, so 506 is set on the center portion of the K scale with indicator.



The answer is found below on the D scale = 370.

The first digit of the answer corresponds to the first group of the number 50 60, and the second digit corresponds to the second group. Each group of the original number is given one of the digits of the answer. So that the decimal point is just brought up into the answer the same way as in long division.

Thus, the decimal may be located and the answer is 37.0.

ILLUSTRATION: $\sqrt[3]{0.00497} =$

Divide number into periods of 3. $\sqrt[3]{0.004\ 97}$

Set 497 on left portion of K since value of first period containing digits is 4.

Read answer under hairline on D = 1706.

Move decimal point to right of first period containing digits and approximate root

$\sqrt[3]{0.004\ 97}$ — approximately $\sqrt[3]{5} = 1.7$ or first answer — 1.706.

Therefore answer = 0.1706.

ILLUSTRATION: $\sqrt[3]{\dfrac{3590. \times 84.6}{0.953}} = ?$

Problems of this type are solved in two steps. First disregarding the radical sign, the result is calculated on the C and D, and the answer found including the decimal point. The cube root of this first result is then found using either Method One or Two. Solving on the C and D, the answer to above — 318500.

Then $\sqrt[3]{318500.}$ — 68.3 using Method One or Two.

Complete Work Sheet Number 17

WORK SHEET NUMBER 17

1) $\sqrt[3]{10.7}$ = _____
2) $\sqrt[3]{12.3}$ = _____
3) $\sqrt[3]{39.1}$ = _____
4) $\sqrt[3]{0.431}$ = _____
5) $\sqrt[3]{0.00687}$ = _____
6) $\sqrt[3]{0.000759}$ = _____
7) $\sqrt[3]{326000.}$ = _____
8) $\sqrt[3]{873}$ = _____
9) $\sqrt[3]{11740}$ = _____
10) $\sqrt[3]{4460}$ = _____
11) $\sqrt[3]{0.00973}$ = _____
12) $\sqrt[3]{9870}$ = _____
13) $\sqrt[3]{0.0527}$ = _____
14) $\sqrt[3]{79.6}$ = _____
15) $\sqrt[3]{0.279}$ = _____
16) $\sqrt[3]{7900}$ = _____
17) $\sqrt[3]{101.6}$ = _____
18) $\sqrt[3]{28.7}$ = _____
19) $\sqrt[3]{805.}$ = _____
20) $\sqrt[3]{43.50}$ = _____
21) $\sqrt[3]{0.237}$ = _____
22) $\sqrt[3]{28750}$ = _____
23) $\sqrt[3]{5660}$ = _____
24) $\sqrt[3]{45900}$ = _____
25) $\sqrt[3]{1001.}$ = _____
26) $\sqrt[3]{94200.}$ = _____
27) $\sqrt[3]{7020.}$ = _____
28) $\sqrt[3]{3.005}$ = _____
29) $\sqrt[3]{77.30}$ = _____
30) $\sqrt[3]{766000000}$ = _____
31) $\sqrt[3]{37850.}$ = _____
32) $\sqrt[3]{245.500}$ = _____
33) $\sqrt[3]{826.000}$ = _____
34) $\sqrt[3]{0.000973}$ = _____
35) $\sqrt[3]{996.000}$ = _____
36) $\sqrt[3]{0.00859}$ = _____

1) $\sqrt[3]{18 \times 1.28}$ = _____
2) $\sqrt[3]{1630 \times 0.290}$ = _____
3) $\sqrt[3]{479. \times 0.0894}$ = _____
4) $\sqrt[3]{\frac{0.987}{0.012}}$ = _____
5) $\sqrt[3]{\frac{6560}{0.159}}$ = _____
6) $\sqrt[3]{\frac{86000}{45.7}}$ = _____
7) $\sqrt[3]{\frac{492}{16.3}}$ = _____
8) $\sqrt[3]{\frac{63.4}{102}}$ = _____
9) $\sqrt[3]{76.8 \times 4500 \times 0.147}$ = _____
10) $\sqrt[3]{8.4 \times 689. \times 0.062 \times 15}$ = _____
11) $\sqrt[3]{\frac{568. \times 1.39}{10.2}}$ = _____
12) $\sqrt[3]{\frac{1.35 \times 31.6}{0.062}}$ = _____
13) $\sqrt[3]{\frac{4.98}{563 \times 0.0714}}$ = _____
14) $\sqrt[3]{\frac{3.26 \times 235}{422 \times 0.953}}$ = _____
15) $\sqrt[3]{\frac{5.47 \times 644}{0.0025 \times 12}}$ = _____
16) $\sqrt[3]{\frac{512 \times 59.3}{497 \times 62.4}}$ = _____
17) $\sqrt[3]{\frac{873 \times 3.42 \times 4.2}{7.31 \times 0.455}}$ = _____
18) $\sqrt[3]{\frac{7.58 \times 0.54 \times 643.}{67.3 \times 69.5}}$ = _____
19) $\sqrt[3]{\frac{1054. \times 78.5}{22.5 \times 304. \times 0.767}}$ = _____
20) $\sqrt[3]{\frac{703. \times 0.00597 \times 4.7 \times 8}{7.59 \times 686. \times 0.483 \times 0.61}}$ = ____

APPLICATION OF THE SLIDE RULE TO THE SOLUTION OF PROBLEMS.

There are many kinds of formulas which are met in applying the slide rule to various problems; in the shops, drafting rooms, and elsewhere. And while you may remember most of them, the following problems will give a review, providing in addition exercises in the use of the slide rule.

Remember first of all, that a formula or equation contains an equal sign. This means that the result on the left side of the sign is the same as that on the right. This may be compared to a balance or scale found in laboratories. In the case of the scales, we know that they will balance if each pan contains an equal amount. Now if either side is changed, the other must be changed in the same way so that the balance (or equality) is maintained.

Then, if the left side is doubled, the right side must be doubled also. If a certain amount is added to the left, the same amount must be added to the right. This is an illustration that:

Equals added to equals, the results are equal.

Equals subtracted from equals, the results are equals.

Equals multiplied by equals, the results are equal.

Equals divided by equals, the results are equal.

(Notice that multiplication (times) is indicated by a dot placed · or "b·a" is "b times a". THIS IS NOT A DECIMAL. If the dot is omitted, the form "b a" would still indicate "b times a".)

Take for example the area of a rectangle. This is given by the formula

$$A = b \cdot a$$

Where b is the base, and a the altitude, the formula is read: "Area equals base times altitude". The multiplication sign is often omitted from the formulas. If values are given for the base and altitude, they may be substituted for the letters in the formula.

ILLUSTRATION:

What is the area of a rectangle having a base of 3″ and an altitude of 4″?

Here b = 3, a = 4, and

$A = 3 \cdot 4$

A = 12 square inches

A	b	h
	12	15
	3.6	14.8
	29.2	18.6
	56.4	5.92
	.30	.456

Some difficulty may be encountered when the area and one other dimension are given, and we are to find, say, the altitude.

ILLUSTRATION:

A rectangle has an Area = 12 square inches and a base of 3 inches. Find the altitude. Substituting in the formula:

$A = b \cdot h \qquad 12 = 3 \cdot a$

The formula must now be changed so that the "a" is alone on one side of the equal sign. We must note what numbers appear with "a" and what they are doing (multiplication) to "a". Since our example shows that 3 is multiplier, if we do the opposite with 3, (i.e. divide), the 3 will cancel from the right side, leaving "a" alone. Because we remember that this is an equality—if we divide the right side by 3, we must divide the left side by 3 also.

$$\frac{12}{3} = \frac{3a}{3}$$

$$a = \frac{12}{3} \text{ or } 4$$

RULE

To remove a number from the side of the equation containing the unknown, perform the OPPOSITE OPERATION with the number.

Addition — opposite operation is subtraction

Subtraction — opposite operation is addition

Multiplication — opposite operation is division

Division — opposite operation is multiplication

EXERCISE: In the formula, $F = M \cdot A$

solve for the letter not designated in the table.

	F	M	A
1	300	5	60
2		27	3
3	34	21	
4	15		6
5	16	9	
6	3		5
7		8	4.7
8	742		121
9	32.3		91.5
10	1560	82.3	

The formula may also have more than a pair of symbols

$$S = P \cdot L \cdot A$$

The procedure of making the substitution for the known letters and solving for the remaining unknown is again followed.

ILLUSTRATION: If $P = 12, L = 5, A = 4$

then $S = P \cdot L \cdot A$

$= 12 \times 5 \times 4$

$= 240$

Or if, $L = 6, S = 1800, P = 5$

To find A, $1800 = 5 \times 6 \times A$

$1800 = 30 \times A$

We note that the operation between A and 30 is one of multiplication. We therefore perform the opposite operation (division) with 30, so that it will be removed from the side containing the unknown A.

$$\frac{1800}{30} = \frac{30\,A}{30}$$

$60 = A$, or $A = 6$

It makes no difference whether the unknown letter appears on the left or right side of the equation, but it is important that the symbol should **only** appear on one side after the various operations have been performed.

Occasionally fractional types of equations are met with, and the same general rules apply.

ILLUSTRATION: $K = \frac{A}{B}$

if $A = 20$, and $B = 4$, then, $K = \frac{20}{4}$

$= 5$

In the same equation, if $B = 20$, and $K = 3$,

$$20 = \frac{A}{3}$$

To solve for A, it is only necessary to multiply both sides of the equation by 3.

This same fractional equation is a slightly more difficult problem when the denominator term contains the unknown.

ILLUSTRATION: $K = \frac{A}{B}$ $K = 25,$ $A = 75$

$$25 = \frac{75}{B}$$

To solve for B, the symbol must be in the numerator, rather than in the denominator. This may be changed by multiplying each side of the equation with the symbol B.

$$25B = 75$$

The change now gives an equation similar to those which have been already solved.

$$B = \frac{75}{25}$$

$$B = 3$$

Formula for Area of a triangle: $A = \frac{1}{2}b.a$ — (A represents area, b represents base, a represents altitude).

Fill in the table:

	A (area)	b (base)	a (altitude)
1		35	21
2		56	83.5
3	28	6	
4	56		12
5		.32	.475
6	4.5	.12	
7	250		128

CIRCLES:

Circumference of a circle: Circumference equals pi times diameter.

$$C = \pi d$$

The symbol π (read "pie"), is a letter of the Greek alphabet which is used to represent the number 3.1416. This is read on the scales as 3.14, or the mark on the scale designated by π is used.

Where d = diameter of circle and π has a certain value 3.14 (read on scale 3.14).

Some scales have π designated so that the value may be located easily.

Fill in the table:

	C	d	C	d
1	49			.0035
2		3		6.05
3		6		12.5
4	35		65.5	
5		1.25	29.7	
6	56		1.38	

$A = \pi r^2$

Where r is the radius of the circle.

ILLUSTRATION: What is the area of a circle having a radius of 5"?

Set hairline to 5 on "D" scale.
Read 5^2 or 25 on A scale.
Move left index of B to the hairline.
Now move hairline to π on B scale.
Find answer under hairline on A scale, 78.5.

NOTE:

The reading is actually 785 on A Scale. The decimal point is located by estimation as follows: $2\times$ Radius $5 = 10$; $10^2 = 100$; hence the decimal must be 78.5.

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	A	r
1		14
2		29.6
3		35.5
4		1.09
5		68.8
6		1500
7		6.87

Finding the radius when the area is known is similar to the previous problems discussed, except that the square root must be taken.

Example: Find the radius of a circle having an area of 30 sq. in. $30 = \pi r^2$

Complete Work Sheet Number 18

WORK SHEET NUMBER 18

Find Area

1) d = 12.7, A = _____

2) d = 98.2, A = _____

3) d = 0.812, A = _____

4) d = 1.312, A = _____

5) d = 3250, A = _____

6) d = 42.3, A = _____

7) d = 0.0626, A = _____

8) d = 837, A = _____

Find diameter

9) A = 126, d = _____

10) A = 0.942, d = _____

11) A = 41.5, d = _____

12) A = 82.9, d = _____

13) A = 5.47, d = _____

14) A = 0.343, d = _____

15) A = 9270, d = _____

16) A = 741, d = _____

Fill in the table:

A	C	r	d
27.6			
	15.5		
		31.7	
			6.8
3.42			
	.05		
		3.05	
		.167	
	19.3		
150			

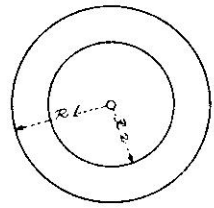
Both sides of the formula are divided by π.

$$\frac{30}{\pi} = \frac{\pi r^2}{\pi}$$

Now we have $r^2 = \frac{30}{\pi}$

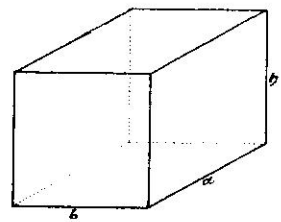
$$r^2 = 9.55$$

We want r, and not r^2, hence we must take the square root, and $r = \sqrt{9.55}$



The area of a ring section may be found by subtracting the inner area (A_2) from the area of the outer circle (A_1).

R_1	R_2	A_1	A_2	$A = A_1 - A_2$
1.25	1.00			
$\frac{1}{2}$	5/16			
$3\frac{1}{4}$	3			
2	$\frac{1}{2}$			
12	11			



Rectangular Prism

Volume of a prism:

$$V = \text{Area of base} \times \text{altitude}$$

A rectangular prism has the indicated dimensions. Fill in the blanks of the table:

$$V = (b.a)h$$

	V	b	a	h
1		5	3	6
2		2.45	3.96	5.5
3		34.5	47.2	12.6
4		3	7.02	9.74

Prisms are solid figures which have parallel edges and uniform cross-sections. They are usually classified by the shape of the cross-section. For example: one with a square base is a square prism and one with a triangle for a base is a triangular prism. This extends through the whole set of geometrical figures. If the base is a circle, the general idea still holds although the figure is called a cylinder.

Two general formulas apply to these figures: The **volume** of a prism is equal to the product of the area of the base and the altitude.

$$\text{Volume} = \text{Area of base} \times \text{altitude}$$

The area of a prism consists of the lateral area which is the area of the side walls only, and the total area which is made up of the lateral area and the area of the upper and the lower bases.

The **lateral area** of a prism is equal to the product of the perimeter of the base and the altitude.

$$\text{Lateral Area} = \text{Perimeter of base} \times \text{altitude.}$$

It is important to remember that prisms may have cross-sections made up of several regular area shapes. The "H" and "I" sections of steel beams are such examples.

EXERCISES:

Fill in the volume and the lateral areas for the table.

	Volume	Lateral Area	Description
5			Rectangular prism: Base is rectangle 12″ × 18″; altitude is 30″.
6			Square prism: base is 2″ on a side; altitude is 10 feet.
7			Triangular prism: legs of triangle are 4″ and 7″; the altitude is 5″.
8			"T" section prism: Cross bar of "T" is 6″; leg of "T" is 5″, width of cross bar and leg is 1″; altitude of prism is 15″.
9			Cylinder: Diameter is 14″, altitude is 24″.
10			Hollow cylinder: Inside radius is 7″, outside radius is 9″; altitude is 18″.
11			"U" section prism: Formed of a 3″ × 7″ rectangle section in which a 1″ × 4″ slot has been cut; prism 8″ altitude.

In the same manner that cylinders and prisms are related, pyramids and cones are also related. That is, the same general formulas apply for volumes and areas.

In both cones and pyramids, the volume is one-third the product of the area of the base and the altitude. This may be seen to be the same as one-third of the volume of the corresponding cylinder or prism, that is, the cylinder or prism having the same base and the same altitude.

$$\text{Volume} = \frac{1}{3} \text{ area of the base} \times \text{altitude.}$$

$$\text{Lateral area} = \frac{1}{2} \text{ perimeter of base} \times \text{slant height.}$$

The slant height is the distance from the apex of the cone or pyramid to the perimeter of the base and is perpendicular to the perimeter at the point of intersection.

EXERCISE

	Description	Volume
1	Cone: Radius is 5″, altitude is 3″.	
2	Cone: Base diameter is 8″; altitude is 20″.	
3	Cone: Base diameter is 18″; altitude is 18″.	
4	Square pyramid: Base is 3″ on side, altitude is 23″.	
5	Triangular pyramid: Base is equilateral triangle 5″ on edge, altitude is 20″.	

WORD PROBLEMS

6. The volume of a square pyramid is 274 inches. If the altitude is 35″, what is the edge of the base?

7. Find the volume of a rectangular pyramid having a base 16″ × 12½″ and an altitude of 5′ 2″.

8. A quantity of sand dumped on the ground has a conical shape with a base 32′ in diameter and a height of 11′. How many cubic yards of sand are there in the pile?

SPHERES

The area and volumes of spheres may be found by the following formulae:

$$\text{Area} = 4 \times \pi \times r^2$$

$$\text{Volume} = 4/3 \times \pi \times r^3$$

Description	Area	Volume
Sphere: Radius of 6″.		
Sphere: 5″ Radius.		
Hollow ball: Outside radius is 8″, wall is 2″.		
Rivet head: Radius 1½ (Half a sphere)		

GENERAL FORMULAS:

Many times the engineer is required to solve equations of varying complexity. It is suggested that the values be substituted directly into the formula, and then using the simplification processes already described, the unknown value may be isolated and thus evaluated.

EXERCISE:

$$T = F + 32s$$

Fill in blanks in the table below:

T	F	s
27		5
43		½
	26	10
39	7	

Complete Work Sheet Number 19

Triangles

Problems which involve triangles and angles may be solved on the slide rule by using the S and T scales.

For convenience, we will name the sides of a right triangle so that there may be no confusion in later work.

"The side opposite", or "the opposite side", mean the same and refer to the side which is opposite the angle. Since a triangle has three sides, two of the sides are used to form the angle, hence this third side is the **opposite** side. The two sides which **form** an angle are

WORK SHEET NUMBER 19

Fill in blank spaces in problems given below by solving for unknown:

I. $PD = M - \frac{.866}{N} + 3\,G$

PD	M	N	G
	.921	10	.077
	.647	8	.077
.816	.905	10	
.647		16	.098

IV. $D = \frac{N + 2}{P}$

D	N	P
.566		27
	10	14.5
.167	28	
	14	21.2

I. $R = \frac{10.4 \times L}{CM}$

R	L	C	M
	24.2	39.6	5.5
	64.79	40.5	1.7
4.5		30.0	8.6
5.9	22.1		14.5
10.5	12.7		.50

V. $V^2 = 2gh$

V	g	h
	32.2	4.56
	32.2	2.81
	32.2	3.96
58.4	32.2	
369	32.2	

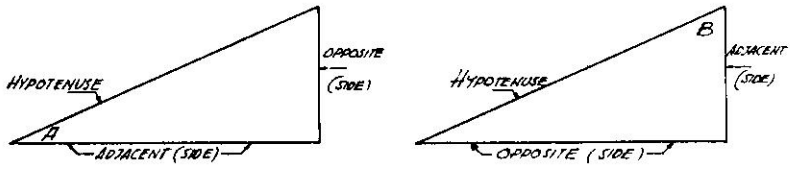
II. $HP = 0.4\,D^2\,N$

HP	D	N
	5	1300
	3.57	1550
35	2.86	
15	1.5	

VI. $OD = \frac{(N + 2)Pc}{\pi}$

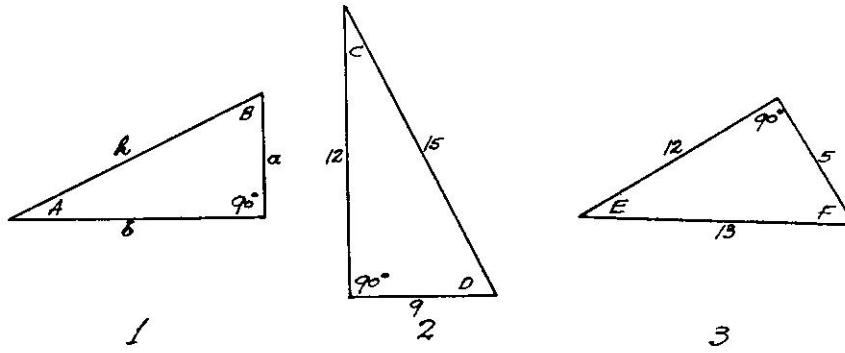
OD	N	P	c
	12	3	.5
	24	7.5	1.37
1.59	26		.043
43.6	54		.096

called **adjacent** sides. In a right triangle, the side opposite the right angle is always called the **hypotenuse.**



Notice in the figures that the side opposite the angle will depend on the angle used. Thus if angle A is used, the side opposite A in the figure will be the altitude of the triangle. But if B is the angle, the side opposite is the base of the triangle.

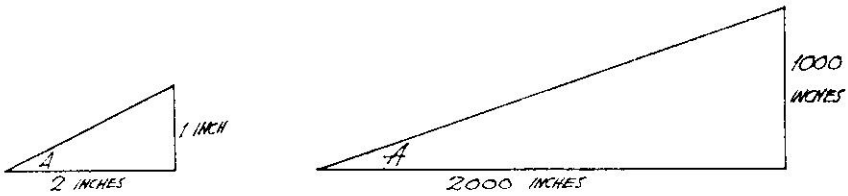
EXERCISE:



Fill in the following:

Triangle	Angle	Opposite Side	Adjacent side	Hypotenuse
1	A	a		
	B			
2	C	9		
	D			
3	E			
	F			

Because of a basic principle of geometry, if the angles are equal, the ratio of any 2 sides of a triangle will be the same. **no matter how large or small the triangles.** This may be pictured as follows:



Thus, the ratio of the altitude to the base — $\frac{\text{altitude}}{\text{base}} = (\frac{1}{2})$ is the same in both triangles because the angles at A are equal, and the figures are right triangles.

We agree to give certain names to these ratios as follows:

$$\text{sine A} = \frac{\text{opposite side}}{\text{hypotenuse}}$$

$$\text{cosine A} = \frac{\text{adjacent side}}{\text{hypotenuse}}$$

$$\text{tangent A} = \frac{\text{opposite side}}{\text{adjacent side}}$$

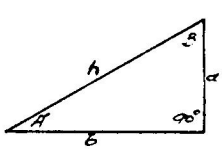
Sine A is abbreviated Sin A
Cosine A is abbreviated Cos A
Tangent A is abbreviated Tan A

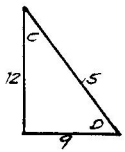
Of course, these are ratios between the **lengths** of the sides. These three relationships should be memorized **immediately,** since all future work will require their use. Remember that the relationships given apply ONLY to **right** triangles. This does not limit the applications which can be made, since most problems can be changed to right triangles by the construction of additional lines.

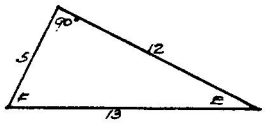
Complete Work Sheet Number 20

WORK SHEET NUMBER 20

Complete the following:





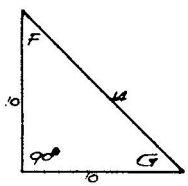


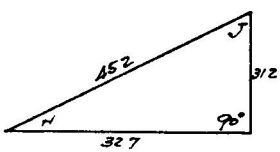
I.

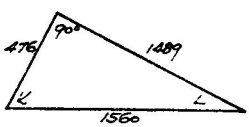
Sin. A = $\frac{a}{h}$	Sin. C = ____	Sin. E = ____
Cos. A = ____	Cos. C = $\frac{12}{15}$	Cos. E = ____
Tan. A = ____	Tan. C = ____	Tan. E = ____
Sin. B = ____	Sin. D = ____	Sin. F = ____
Cos. B = ____	Cos. D = ____	Cos. F = ____
Tan. B = ____	Tan. D = ____	Tan. F = ____

II.

Write the ratios for each of the angles given in the triangles.

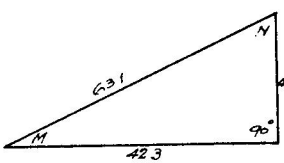


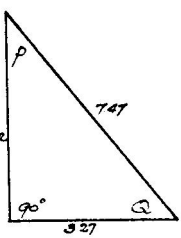


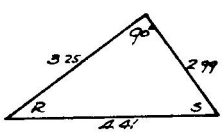


III.

Insert the proper symbol before the letter in the following equations so that the correct relations are given.







Sin M = $\frac{46.8}{63.1}$	N = $\frac{42.3}{46.8}$	R = $\frac{3.25}{4.41}$	S = $\frac{2.99}{3.25}$
M = $\frac{46.8}{42.3}$	P = $\frac{6.72}{7.47}$	Q = $\frac{6.72}{3.27}$	R = $\frac{2.99}{4.41}$
Q = $\frac{6.72}{7.47}$	S = $\frac{3.25}{4.41}$	M = $\frac{56.8}{63.1}$	M = $\frac{42.3}{63.1}$
R = $\frac{3.25}{2.99}$	P = $\frac{3.27}{7.47}$	N = $\frac{42.3}{63.1}$	S = $\frac{2.99}{4.41}$

These relationships are also called trigonometric functions. That is, trigonometry means triangle measurement, while function has the same meaning as relationship. The phrase trigonometric functions merely means then, a triangle relationship used for measurement.

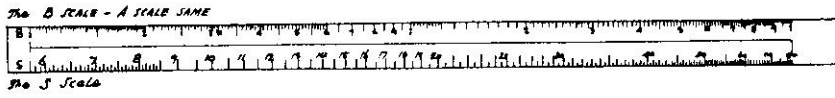
There are six of these fundamental relationships, but the three given above are sufficient for all problems; the others (secant, coscant and cotangent) are only **reciprocals** of those already given, are infrequently used, and need not be learned.

In the exercises which follow, note that the sine of one angle of the right triangle is the same as the cosine of the second angle. In other words,

$$\text{Sin A} = \text{Cos B}, \quad \text{since each is equal to b/h.}$$

The ratios for angles have been found and are given in tables and on the S and T scales of the slide rule. On most rules the S (sine) and T (tangent) scales are on the under side of the rule, and it is necessary either to turn the slide or the slide rule over when using these scales.

The A-B scale must be used with the S scale. The divisions on the S scale vary considerably and should be carefully noted to avoid error. The scale includes angles from 34′ to 90°.



Between 2° and 3° are 6 main divisions, each of 10′ value which in turn are divided into five 2′ sections. Between 10° and 20°, each degree is divided into six parts each of 10′ value. Between 70° and the long mark next to the RS index (denoting 80°), represents 10° and each of the smaller divisions represents 2°. Finally there is a single division between 80° and 90°, representing 10°.

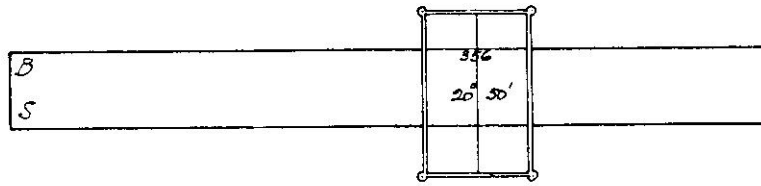
SINE OF AN ANGLE

To find the sine of an angle, set the indicator to the angle on the S scale. Under the hairline on A find the value. On some slide rules the B scale is on the slide, and may be used instead of A.

ILLUSTRATION: Sin 20° 50′ = ?

Set indicator to 20° 50′ on S.

Under the hairline on the A or B scale read the answer = 0.356.



Locating the decimal for the sine.

When reading either the sine or cosine, the left section of the A or B scales gives values between .01 and .1. The right section has values between .1 and 1. In the above illustration, the reading falls in the right section and therefore has a value somewhere between .1 and 1. Since the reading is 356, the value of the sine is 0.356.

COSINES

Cosines of angles cannot be found directly on most rules, but since they have the value of the equivalent sine, they can be readily found. It is remembered that in a right triangle,

$$\text{Cos A} = \text{Sin B}$$

Here, A and B are complementary angles. That is,

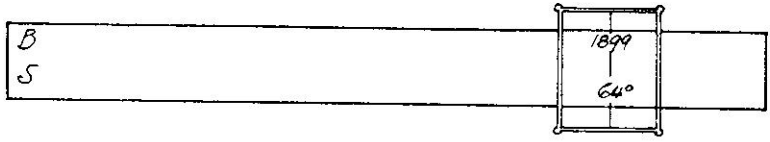
$$A + B = 90°$$

or

$$A = 90° - B$$

In other words, **the cosine of an angle is equal to the sine of its complement.**

ILLUSTRATION: Cos 26° = ?



Complement of 26° is 90° − 26° = 64°.
Cos 26° = Sin 64°
Set hairline to 64° on S.
Read answer on A or B scales = 0.899
Therefore, Cos 26° = 0.899.
The decimal is located in the same manner as for sines.

Due to the fact that there are relatively few graduations on the upper end of the S scale between 70° and 80°, there is a tendency to feel that the accuracy of readings at this end are not as good as those at, say, the 25° section. While it is true that it may be difficult to note the difference between sines of angles between 80° and 90°, it is also a fact that there actually is very little difference in these readings.

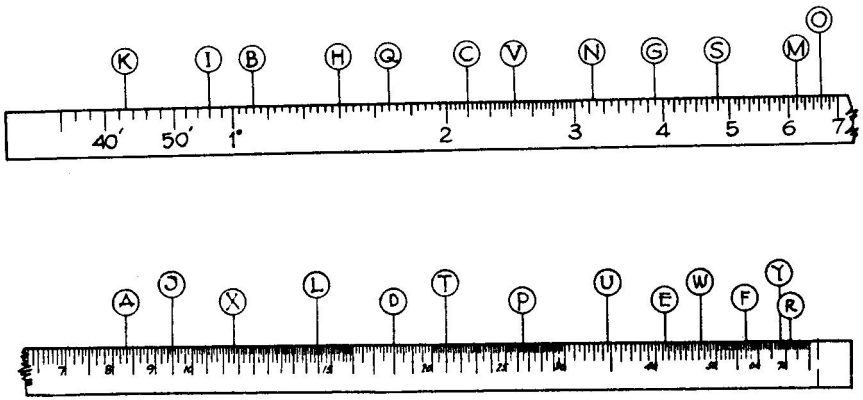
Complete Work Sheet Number 21

Multiplication and Division using Sine and Cosine

If we are to use the Sine and Cosine in problems, the work may be simplified if the value of the sine or cosine of the angle may be set on either the right or left index. Set the angle

WORK SHEET NUMBER 21

SINES AND COSINES



Estimate the readings shown above indicated by hairlines lettered A to Y, and record below:

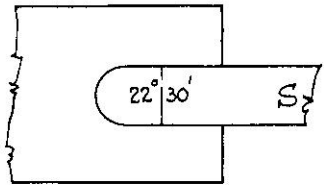
A)_____	F)_____	K)_____	P)_____	U)_____
B)_____	G)_____	L)_____	Q)_____	V)_____
C)_____	H)_____	M)_____	R)_____	W)_____
D)_____	I)_____	N)_____	S)_____	X)_____
E)_____	J)_____	O)_____	T)_____	Y)_____

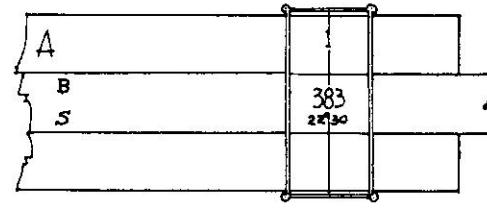
Find the Sin of the Angles below:

1)	45° = _____	11)	8°31′ = _____	21)	75°31′ = _____
2)	30° = _____	12)	67° = _____	22)	59° = _____
3)	21°30′ = _____	13)	15°20′ = _____	23)	20°30′ = _____
4)	54°12′ = _____	14)	38° = _____	24)	14°30′ = _____
5)	44°50′ = _____	15)	47°10′ = _____	25)	36°20′ = _____
6)	47°30′ = _____	16)	18° 5′ = _____	26)	29°10′ = _____
7)	11°20′ = _____	17)	28°30′ = _____	27)	48°55′ = _____
8)	6°35′ = _____	18)	42° = _____	28)	70° = _____
9)	1°22′ = _____	19)	12° = _____	29)	8° 5′ = _____
10)	78°30′ = _____	20)	1°30′ = _____	30)	3°35′ = _____

to the right index, by placing the hairline in position first and moving the slide until the angle is set to the hairline. It can be seen that the value for the sine on the A scale is thus set to the index.

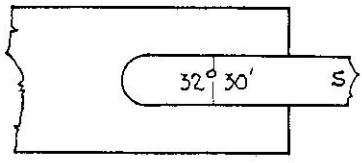
ILLUSTRATION: Sin 22°30′ = ?

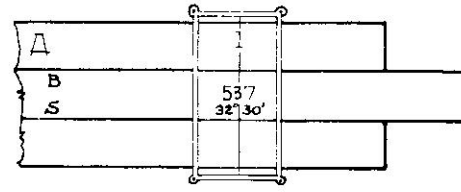




Set 22°30′ on S scale to the right index. The value is on the B scale, and is under both he hairline and the RA index.

ILLUSTRATION: Cos 57°30′ = ?





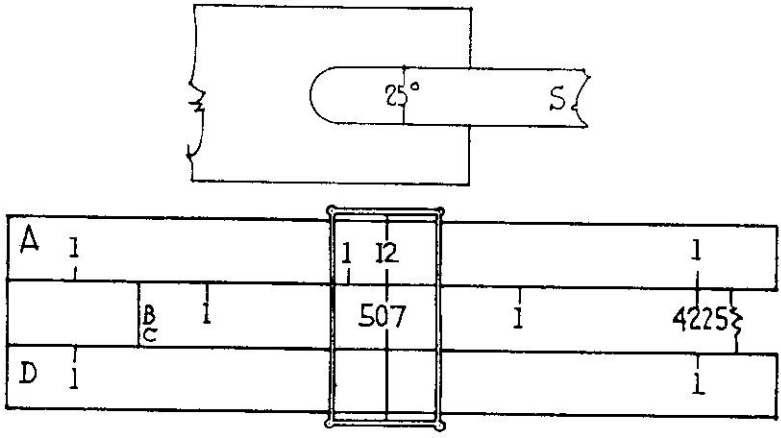
The Cos 57°30′ = Sin (90 − 57°30′)

= Sin 32°30′

Set 32°30′ on S scale to the right index. The value of the angle is under the RA index and is found on the B scale.

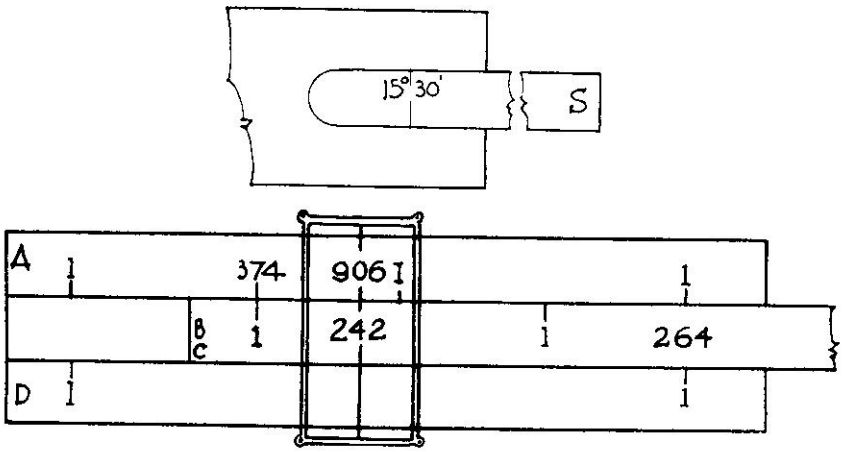
By this method we are able to more readily solve problems.

ILLUSTRATION: $12 \times \text{Sin } 25° = ?$



Set 25 on the S scale to the right index. We have really set the value of the sin 25°, 0.422 to the right index. We set the hairline to 12 on A, and find the answer on the B scale as 507. The decimal may be located by inspection, and the answer is 5.07.

ILLUSTRATION: $\dfrac{242}{\text{Sin } 15° 30'} = ?$



Set 15°30′ on the S scale to the right index. The sine is under the right index on the B scale. The reciprocal of the sine is over the LB index on the A scale.

The problem may now be thought of as

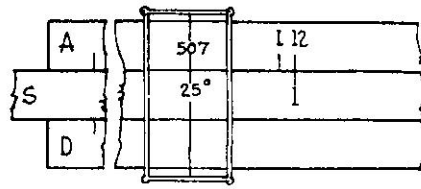
$$242 \times \frac{1}{\text{Sin } 15^\circ\ 30'} \text{ instead of } \frac{242}{\text{Sin } 15^\circ\ 30'}$$

Set the hairline to 242 on the B scale. We will thus multiply the reciprocal of the sin 15° 30′ on the A scale, by 242 on the B scale. Read the answer under the hairline on the A scale as 906. Estimating to locate the decimal point, the answer is 906.

Problems involving cosines are solved in the same manner as above except that the cosine must be replaced by the equivalent sine before proceeding with the solution. This operation may often be done mentally since it is only a matter of subtracting the known angle from 90°.

The order of multiplication may be changed if it is more convenient. Consider the previous illustration of

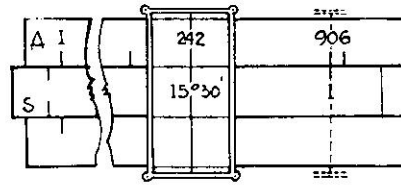
$$12 \times \sin 25^\circ = ?$$



Set the hairline to 12 on the right portion of the A scale. Move the RB index to the hairline. Now reset the hairline to 25° on the S scale, and the answer is found under the hairline on the A scale. It is 507. Estimating the decimal give the correct answer as 5.07.

ILLUSTRATION:

$$\frac{242}{\text{Sin } 15^\circ\ 30'} = ?$$



Set the hairline to 242 on the A scale. Move 15° 30′ on the S scale to the hairline (really the value of the sine on the B scale). Find the answer over the RB index as 906.

FINDING THE ANGLE

In some problems the sine or cosine is given and it is necessary to find the angle itself.

The hairline is set to the given value of the sine or cosine on the B scale and the corresponding angle is found on the S scale. Remember that if the cosine is used, the angle read from the rule must be subtracted from 90°.

Whenever the value of the sine or cosine is set on the scale, it is important, that the correct portion — the left or right — be used. (Values are from .1 to 1 in right portion; .01 to .1 in left portion.)

To find A when $\sin A = .325$

This value lies in the right portion of the B scale, and A = 19°.

In certain rare instances it is necessary to work with angles less than 34° 23′, the smallest value shown on the S scale. In such cases special markings are provided on the S scale. Just to the left of the 2° division is the minute marking, and near the 1°10′ division is the second marking. By placing either of these markings opposite any number on the A scale, the corresponding sine of that number of minutes or seconds is read above the S scale on the A scale.

The sin of 25′ is found by setting minute marking under 25 on A, and reading the answer above the B index on A. This is .00727. The decimal point is set by remembering that 1′ is approximately 0.0003 and sin 1′ is approximately .000005.

Complete Work Sheet Number 21A

SOLUTION OF TRIANGLES

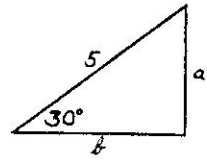
We should now be familiar with the relationships expressed by the sine and cosine, as well as the means of finding the values of the functions of the angles, or, to find the angle when the function is known.

Usually in the solution of triangles by this method, three quantities are involved.

$$\sin A = a/h$$

For example, Sin A, a and h. If we know any two of these, the third can be easily calculated.

ILLUSTRATION:



To find a, the formula involving a, 5 and 30° must be used.

$$\sin 30° = a/5$$

WORK SHEET NUMBER 21 A

1) $32.9 \times \sin 56° 12' =$ _____

2) $187.2 \times \sin 8° 35' =$ _____

3) $\sin 46° \times 0.732 =$ _____

4) $74.3 \times \sin 64° =$ _____

5) $92.3 \times \cos 26° 10' =$ _____

6) $2.54 \times \cos 63° 40' =$ _____

7) $0.269 \times \cos 2° =$ _____

8) $\cos 18° 30' \times 1060 =$ _____

9) $\dfrac{21.5}{\sin 42° 10'} =$ _____

10) $\dfrac{18.3}{\sin 12° 30'} =$ _____

11) $\dfrac{635000}{\sin 36° 10'} =$ _____

12) $\dfrac{0.00406}{\sin 1° 20'} =$ _____

13) $\dfrac{90.1}{\cos 15° 30'} =$ _____

14) $\dfrac{0.427}{\cos 78°} =$ _____

Find the angles corresponding to sines given in table below.

15)

Sin	0.172	0.0683	0.792	0.500	0.0194
Angle					

Find the angles corresponding to cosines given in table below.

16)

Cos	0.787	0.101	0.0523	0.866	0.0866
Angle					

17) Sin 24′ = _____

18) Sin 15′ = _____

19) Sin 16′ = _____

20) Sin 43″ = _____

21) Sin 6′ 12″ = _____

22) Sin 10′ 20″ = _____

Remembering that a must be alone on one side of the equation, both sides are multiplied by 5 (this is the opposite of the division of a by 5, indicated by the equation), giving

$$a = 5 \text{ Sin } 30° = 5 \times .5$$

$$a = 2.5$$

In the same figure, how long is b?

The formula involving b, and the given side and angle is used.

$$\cos 30° = b/5$$

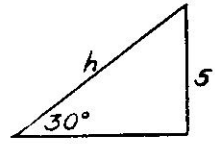
$$\text{or} \quad b = 5 \cos 30°$$

but the cos 30° = sin 60°, so that

$$b = 5 \sin 60° = 5 \times .866$$

$$b = 4.33$$

ILLUSTRATION:



Find the length of h.

$$\sin 30° = 5/h$$

multiply both sides by h, brings h to numerator, divide both sides by sin 30°, leaving h alone on one side of the equal sign.

$$h = \frac{5}{\sin 30°}$$

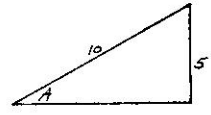
$$h = \frac{5}{.5}$$

$$h = 10$$

The base of the triangle may now be found, using the cosine, but caution should be used since the value of h may be in error from the previous computation. A better method would be to use the function involving 5, 30° and b, but this is the tangent relation and will not be taken up until a later section.

ILLUSTRATION:

If two sides are given, the angles may be found.

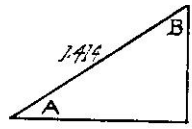


$$\text{Sin A} = 5/10$$

$$\text{Sin A} = .5$$

$$\text{hence,} \qquad A = 30°$$

In another case,



1

$$\cos A = \frac{1}{1.414}$$

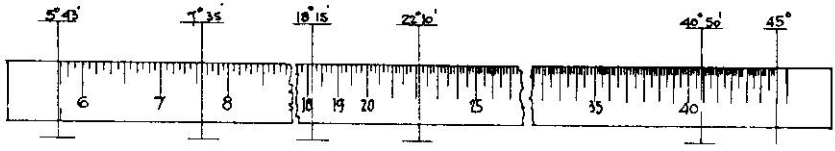
but cos A = sin B, where A and B are complementary.

$$\text{Sin B} = .707$$

$$B = 45°, \text{ and } A = 45°$$

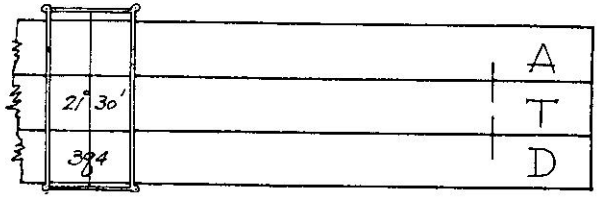
TANGENTS

The tangent scale is marked T and is read on the D (sometimes the C) scale. Some types of rules may require that the slide be reversed.



The tangent scale has values from 5°43′ to 45°. Between the LT index and 20°, the smallest division is a 5′ unit. From 20° to 45° the smallest division is a 10′ unit. To read the tangents, set the indicator to the angle on T and find the value under the hairline on C or D.

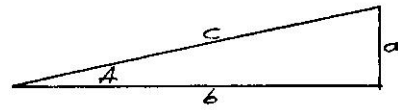
ILLUSTRATION:



Tan 21° = ?

Set the hairline to 21° on T and read the answer under the hairline on the C or D scale, to be .384. To locate the decimal point, remember that the indices of C and the D scales have these values: the left index of either C or D scale is 0.1 and the right index of the C or D scale is 1.0. All tangents read on the T scale will therefore have values ranging from 0.1 to 1.0.

Tangents of angles less than 5°43′ cannot be found on the T scale, but sines of these angles may be used in their place, since sines and tangents of such angles are practically alike differing only in the fourth significant figure. The truth of this fact may be seen in the figure below.



$$\text{Sin A} = \frac{a}{c} \qquad \text{Tan A} = \frac{a}{b}$$

As angle A is decreased, the length of sides b and c becomes more and more alike. Note in the formulas above, that if b is almost equal to c, tan A is almost equal to sin A. To find tangent of any angle smaller than 5°43′, set angle on S scale, and the value read on the A or B scales, will be the required tangent.

Thus tan 2°20′ is approximately equal to sin 2°20′ = 0.0408.

RULE

To find tangents of angles greater than 45°, it is necessary to use the following relationship between complementary angles.

$$\tan A = \frac{1}{\tan (90° - A)}$$

ILLUSTRATION: $\tan 65° = \frac{1}{\tan (90° - 65°)} = \frac{1}{\tan 25°}$

THE SOLUTION OF RIGHT TRIANGLES USING TANGENTS

The calculations using tangents are the same as shown earlier in this section. The problem should be set up as an equation and the equation simplified so that the unknown term may be found.

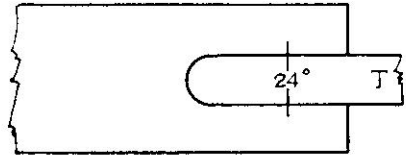
ILLUSTRATION: $28 \times \tan 24° = ?$

It is necessary to have the value corresponding to the Tan 24° set on the C or D scale. In some types of slide rules, the slide must be moved so that the 24° on the tangent scale

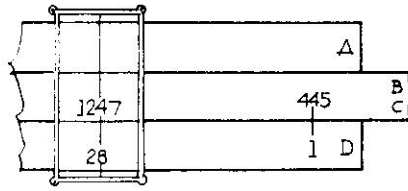
is at either the RD or LD index. On other rules, the hairline may be placed over the 24 mark and the value is read directly on the C scale.

Set the value corresponding to tan 24° to the RD index. Place the hairline to 28 on the D scale and find the answer on the C scale under the hairline, as 1247.

Estimating the result, the answer is 12.47.



It should be noted, that when in doubt as to the procedure to use, the product may be set down on paper. The value for the tangent of the angle as found on the rule is used and the problem is seen to be simple multiplication, which can be performed on the C and D scales.



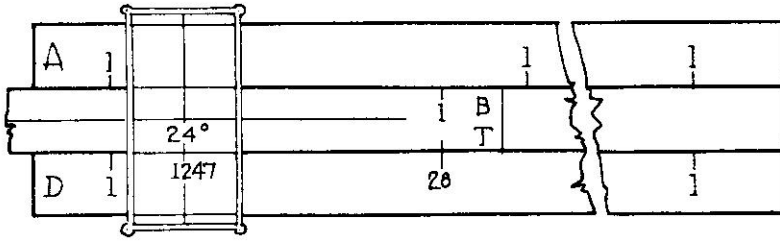
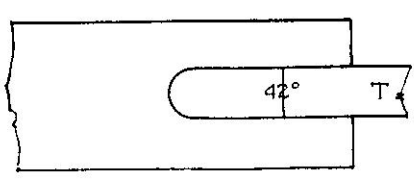
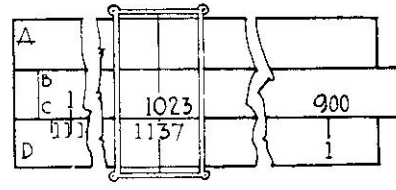


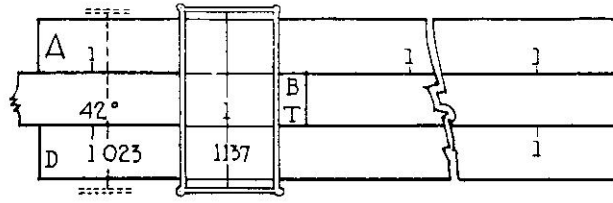
ILLUSTRATION: $\dfrac{102.3}{\text{Tan } 42'} = ?$





This may be thought of as $102.3 \times \dfrac{1}{\tan 42°}$

Set the reading of 42° to the RD index. The value of $\frac{1}{\tan 42^\circ}$ is found under the LC index. Set the hairline to 1023 on the C scale and find the answer under the hairline on the D scale. This is 1137, and estimating the decimal, the answer will be 113.7.



The second method consists of dividing 1023 by the value corresponding to the tangent of 42. This is done by either reversing the slide or if the back of the slide is accessible, of turning over the rule. Set the hairline to 1023, move slide until 42 is at the hairline. Read the answer 113.7 under the right index.

ILLUSTRATION: $93.6 \times \tan 59^\circ = ?$

$$\tan 59^\circ = \frac{1}{\tan (90^\circ - 59^\circ)}$$

$$\tan 59^\circ = \frac{1}{\tan 31^\circ}$$

This is the same form as the previous illustration for we now have $93.6 \times \frac{1}{\tan 31^\circ}$

The answer is 155.6.

ILLUSTRATION: $2.46 \times \tan 4^\circ 15' = ?$

Recalling the previous discussion of small angles, it is seen that

$$\tan 4^\circ 15' = \sin 4^\circ 15'$$

so the problem becomes $2.46 \times \sin 4^\circ 15' =$

and the answer is 0.182.

Complete Work Sheet Number 22

Solution of Problems

There are many practical applications for the use of trigonometry. To deal with some of these cases requires a more thorough knowledge of the subject than we have covered here, but many of the problems may be solved with the few fundamental relationships we have studied thus far.

WORK SHEET NUMBER 22

TANGENTS AND TRIANGLE SOLUTION

Find the tangents of the angles given below:

1) 32° _____

2) 14°30′ _____

3) 26° _____

4) 18°30′ _____

5) 43°10′ _____

6) 8°35′ _____

7) 29°45′ _____

8) 1°42′ _____

9) 3°52′ _____

10) 4°20′ _____

11) 55°20′ _____

12) 68°10′ _____

13) 46°15′ _____

14) 74°30′ _____

15) 83°55′ _____

16) 87°30′ _____

17) 49°10′ _____

18) 86°40′ _____

19) 45°10′ _____

20) 80°30′ _____

21)

tan	0.237	0.684	0.093	0.463	0.292	0.0872
Angle						

Find the angles corresponding to tangents given in table above.

22)

tan	1.325	6.87	2.473	1.947	18.75	4.56
Angle						

Find the angles corresponding to tangents given in table above.

Exercises:

1) $18.4 \times \tan 15° =$ _____

2) $13.2 \times \tan 38° =$ _____

3) $0.095 \times \tan 25°30' =$ _____

4) $63.5 \times \tan 12°20' =$ _____

5) $24.5 \times \tan 31° =$ _____

6) $4690 \times \tan 3°12' =$ _____

7) $2.472 \times \tan 4°30' =$ _____

8) $126.2 \times \tan 43°10' =$ _____

9) $\dfrac{8.53}{\tan 10°30'} =$ _____

10) $\dfrac{186}{\tan 62°12'} =$ _____

11) $\dfrac{12.6}{\tan 36°20'} =$ _____

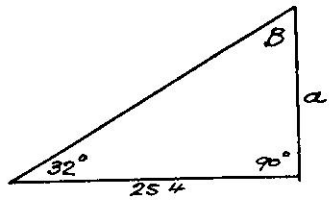
12) $\dfrac{3.58}{\tan 10°} =$ _____

13) $45.5 \times \tan 65°30' =$ _____

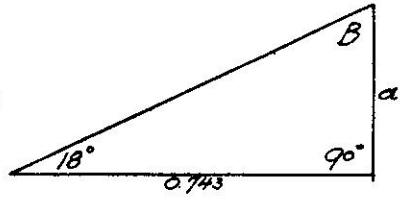
14) $0.808 \times \tan 56° =$ _____

15) $\dfrac{179}{\tan 2°40'} =$ _____

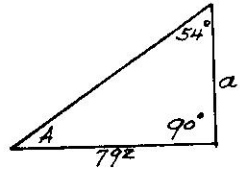
16) $9820 \times \tan 87° =$ _____

17) 

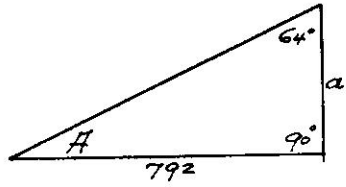
Side a = _____

18) 

Side a = _____

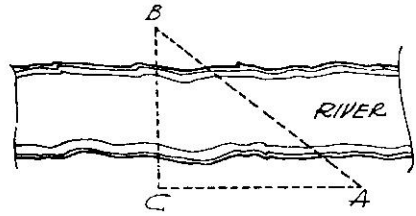
19) 

Side a = _____

20) 

Side a = _____

ILLUSTRATION:



The problem here is to find the width of a river. A transit is set up at point C and a right angle laid out at C. The line CA is then measured off any convenient distance, say 350 feet. The transit is then set up at A, back sighted to C and Angle A then measured. In this problem angle A reads 58°.

$$\tan 58° = \frac{CB}{CA} = \frac{CB}{350}$$

Therefore $CB = 350 \times \tan 58°$

$$= 350 \times \frac{1}{\tan (90° - 58°)}$$

$$= \frac{350}{\tan 32°}$$

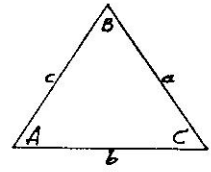
This is solved by methods given in section 26 and CB = 560 ft.

Complete Work Sheet Number 23

SOLVING TRIANGLES OTHER THAN RIGHT TRIANGLES

A triangle which does not have a right angle cannot be readily solved by the methods described in the preceeding sections. For this purpose we will introduce the Sine Law.

SINE LAW



$$\frac{a}{\text{Sin } A} = \frac{b}{\text{Sin } B} = \frac{c}{\text{Sin } C}$$

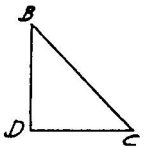
Briefly this says: In a triangle, the ratio of any side to the sine of the angle opposite is equal to the ratio of any other side to the sine of its opposite angle. In setting up a problem any two of these ratios may be used to make up an equation. The selection is made according to the information given in the problem. The solution required will usually only utilize the A scale and the S scale.

While the law is useful especially where the triangle may have an oblique angle, there is no reason why it cannot be applied to right triangles.

WORK SHEET NUMBER 23

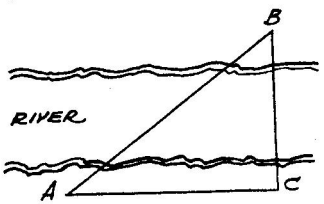
Solve the following:

1)



CD = 5 ft., Angle C = 50°. Height of Building BD = _____

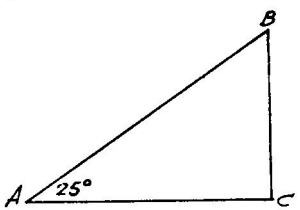
2)



AC = 53.6 ft.
Angle C = 90°
Angle A = 48°

Distance Across River BC = _____

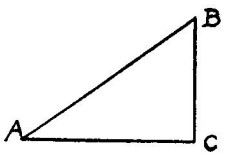
3)



BC = 24.3 ft.
Angle C = 90°

AB = _____ AC = _____

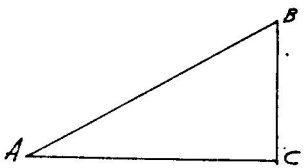
4)



AC = 0.109 ft.
BC = 9.52 ft.
Angle C = 90° AB = _____ Angle A = _____

---

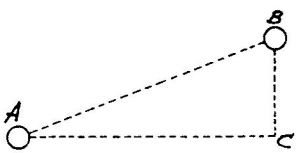
5)



AC = 12.6 ft.
BC = 9.52 ft.
Angle C = 90° AB = _____ Angle A = _____

---

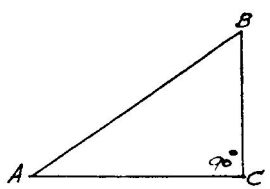
6)



AC = 3.762″
BC = 7.437″
Angle C = 90° Distance between holes AB = _____

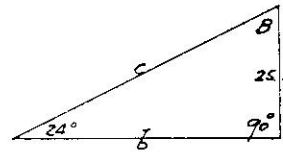
---

7)



AB = 0.959
BC = 0.507 Angle B = _____ AC = _____

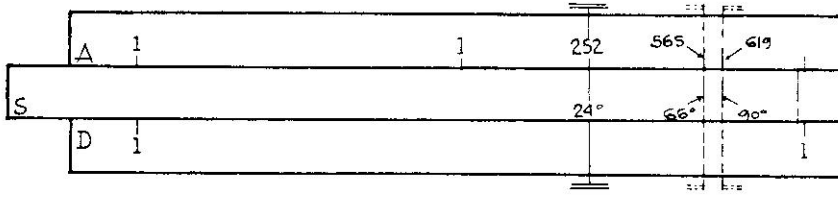
ILLUSTRATION:



Given two angles and a side:

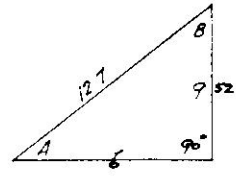
Since the figure is a right triangle the second angle may be found by subtracting from 90°. Thus B is 66°. We will substitute the information in the Sine Law and proceed with the solution.

$$\frac{25.2}{\sin 24^\circ} = \frac{b}{\sin 66^\circ} = \frac{c}{\sin 90^\circ}$$



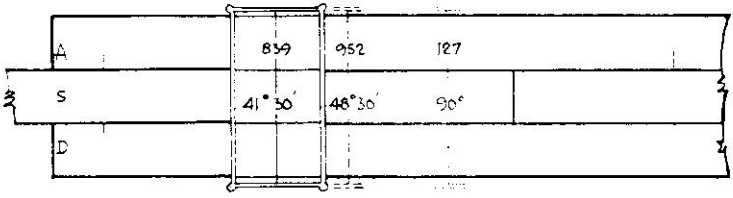
Set 252 on the (right portion) A scale above 24° on the S scale. Set the hairline to 66° on the S scale. Find the answer b under the hairline on the A scale. The answer is 565, or 56.5. Without moving the slide since the ratio is constant, set the hairline to 90°. Find the answer c under the hairline on the A scale to be 61.9.

Given two sides and an angle.



The sine law may be written:

$$\frac{9.52}{\text{Sin A}} = \frac{12.7}{\text{Sin } 90°} = \frac{b}{\text{Sin B}}$$

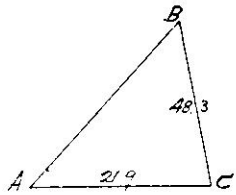


Using the second ratio, set 90° on the S scale under 127 on the A scale. Set the hairline to 952 on the A scale. Under the hairline find 48°30′ on the S scale.

$$\begin{aligned} B &= 90° - A \\ &= 90° - 48°30' \\ &= 41°30' \end{aligned}$$

Without moving the slide, set the hairline to 41°30′ on the S scale and find the value for b on the A scale as 8.39.

ILLUSTRATION:



If C is 90°, one of the acute angles may be found by the use of tangents, and the problem may then be solved as the above.

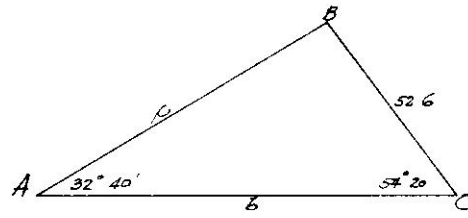
Ordinarily we would solve the triangle for angle B using the tangent, by dividing 21.9 on the D scale by 48.3 on the C scale. The value 0.453 is read as the answer under the RC index on the D scale. This is referred to the tangent scale and the angle 24°22′ is determined.

$$\begin{aligned} A &= 90° - B \\ &= 65°38' \end{aligned}$$

Then $$\frac{48.3}{\sin 65° 38'} = \frac{21.9}{\sin 24° 22'} = \frac{C}{\sin 90°}$$

ILLUSTRATION:

Given: a = 52.6, A = 32°40′, C = 54°20′
Find: B, b, c.



In oblique triangles it is possible for one of the angles to be more than 90° in which, case it is necessary to convert it into an angle less than 90° which has the same sine as the original angle, in order to be able to place it on the S scale.

You will remember that for complementary angles

$$\text{Sin A} = \text{Cos (90} - \text{A)}$$

A somewhat different relation exists between supplementary angles or angles whose sum = 180°.

$$\text{Sin A} = \text{Sin (180°} - \text{A)}$$

In above example, the unknown angle is B

$$\begin{aligned} \text{B} &= 180° - (\text{A} + \text{C}) \\ &= 180° - (32°40' + 54°20') \\ &= 180° - 87° \\ \text{B} &= 93° \end{aligned}$$

Since this is greater than 90°, it must be converted into an equivalent angle before using Sine Law.

$$\text{Sin } 93° = \text{sin } (180° - 93°) = \text{sin } 87°$$

Using Sine Law, $\dfrac{52.6}{\text{sin } 32° 40'} = \dfrac{\text{c}}{\text{sin } 54° 20'} = \dfrac{\text{b}}{\text{sin } 87°}$

Solving as in previous examples, c = 79.0, b = 96.8.

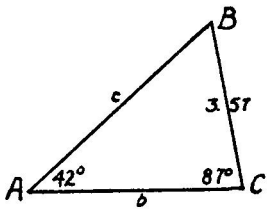
Other oblique triangles in which only one angle is given are solved in a similar fashion, but require a more complete knowledge of trigonometry.

Complete Work Sheet Number 24

WORK SHEET NUMBER 24

SINE LAW

1)

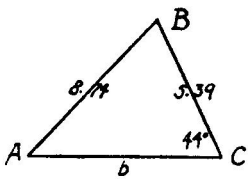


Angle B_____

b_____ c_____

---

2)

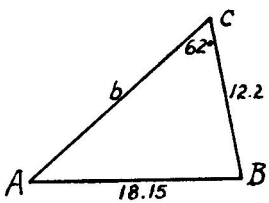


Angle A_____ Angle B_____

b_____

---

3)

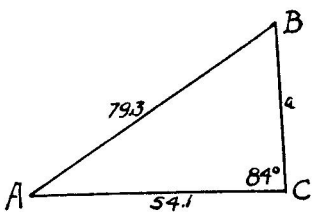


Angle A_____ Angle B_____

b_____

---

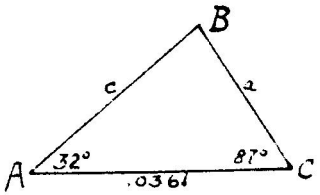
4)



Angle A_____ Angle B_____

a_____

5)

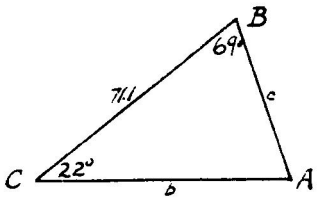


Angle B_____

a_____ c_____

---

6)

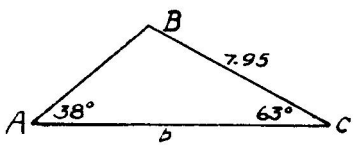


Angle A_____

c_____ b_____

---

7)

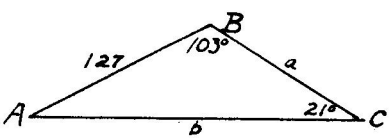


Angle B_____

b_____ c_____

---

8)



Angle A_____

a_____ b_____

EXPONENTS AND LOGARITHMS

In our earlier work, the square, square root, cube and cube roots were taken of numbers by using the A, B, C, D, and K scales. The notation

$$3^2 = 3 \times 3$$

as we have previously mentioned, means that 3 is to be multiplied by itself. This small number to the upper right is commonly called the "exponent", and it is also called the "power" of the number. 3^2 may be read as "three-squared" or "three raised to the second power".

In many fields of engineering it is often necessary to raise a number to a power other than 2 or 3. For this reason a knowledge of exponents and the relation of exponents and logarithms is valuable.

The number being raised to a power is called the "base". Thus

in 3^2, 3 is the base

a^3, a is the base

4^5, 4 is the base

For a better understanding of the relation of exponential quantities, the two following short tables will be used. Here the bases selected are 2 and 10, although any other numbers could have just as conveniently been used.

$$2^1 = 2$$
$$2^2 = 2 \times 2 = 4$$
$$2^3 = 2 \times 2 \times 2 = 8$$
$$2^4 = 2 \times 2 \times 2 \times 2 = 16$$
$$2^5 = 2 \times 2 \times 2 \times 2 \times 2 = 32$$
$$2^6 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 64$$
$$2^7 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 128$$

$$10^1 = 10$$
$$10^2 = 10 \times 10 = 100$$
$$10^3 = 10 \times 10 \times 10 = 1{,}000$$
$$10^4 = 10 \times 10 \times 10 \times 10 = 10{,}000$$
$$10^5 = 10 \times 10 \times 10 \times 10 \times 10 = 100{,}000$$
$$10^6 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 1{,}000{,}000$$

We may see that

$$4 \times 8 = 32$$

but from the table above, $4 = 2^2$, $32 = 2^5$ and $8 = 2^3$. These values may be substituted in the equation, so that

$$2^2 \times 2^3 = 2^5$$

From this example it would appear that adding the exponents of the terms of the product will give the exponent of the result. Products of other numbers in the table will also show this addition relationship.

RULE

When multiplying exponential terms **to the same base,** add the exponents.

It is important to realize that **no** relationship may exist if the bases are different, and have no common factor.

ILLUSTRATION: $2^3 \times 3^2 = ?$

This cannot be simplified by exponential rules since the bases (2 and 3) are different.

DIVISION OF EXPONENTS:

When multiplying exponential terms, the exponents are added. When dividing exponential terms, the exponents are subtracted.

ILLUSTRATION: $$\frac{2^5}{2^2} = \frac{2 \times 2 \times 2 \times 2 \times 2}{2 \times 2} = 2^3, \text{ or } 2^{5-2} = 2^3$$

RULE

When dividing exponential terms, subtract the denominator exponent from the numerator exponent.

Complete Work Sheet Number 25

The operation involving multiplication and division of exponential terms may be extended so that several operations are being performed in one problem. Thus, again we add the exponents when multiplying and subtract when dividing.

ILLUSTRATION: $$\frac{10^4 \times 10^8}{10^2 \times 10^3}$$

Multiplying the numerator and denominator separately, we have

$$\frac{10^{12}}{10^5}$$

Subtracting exponents, the answer is 10^7.

ILLUSTRATION: $$\frac{10^2 \times 10^4 \times 10^6}{10^3 \times 10^5} = \frac{10^{12}}{10^8} = 10^4$$

Complete Work Sheet Number 26

WORK SHEET NUMBER 25

Express the following products as exponential expressions:

1) $10^4 \times 10^5 =$ _____

2) $3^2 \times 3^4 =$ _____

3) $14^5 \times 14^{21} =$ _____

4) $19^2 \times 19^8 =$ _____

5) $2.4^3 \times 2.4^5 =$ _____

6) $8^4 \times 8^5 =$ _____

7) $1^{15} \times 1^{15} =$ _____

8) $11^1 \times 11^1 =$ _____

9) $.02^3 \times .02^{12} =$ _____

10) $4^{122} \times 4^2 =$ _____

11) $9^5 \times 9^6 =$ _____

12) $12^8 \times 12^{12} =$ _____

13) $.004^2 \times .004^8 =$ _____

14) $1.2^4 \times 1.2^9 =$ _____

15) $9.8^2 \times 9.8^{27} =$ _____

16) $20^4 \times 20^5 =$ _____

17) $12.4^2 \times 12.4^2 =$ _____

18) $5^{11} \times 5^{12} =$ _____

19) $84^{14} \times 84^{36} =$ _____

20) $1001^{11} \times 1001^{96} =$ _____

21) $\frac{10^3}{10^4} =$ _____

22) $\frac{10^7}{10^5} =$ _____

23) $\frac{4^4}{4^2} =$ _____

24) $\frac{5^7}{5^4} =$ _____

25) $\frac{8^{17}}{8^4} =$ _____

26) $\frac{9.5^4}{9.5^2} =$ _____

27) $\frac{14.2^{15}}{14.2^{14}} =$ _____

28) $\frac{12.7^5}{12.7^4} =$ _____

29) $\frac{.004^{23}}{.004^{15}} =$ _____

30) $\frac{1.02^{19}}{1.02^4} =$ _____

31) $\frac{17^{26}}{17^{24}} =$ _____

32) $\frac{95.04^8}{95.04^5} =$ _____

33) $\frac{19^{18}}{19^{16}} =$ _____

34) $\frac{48^{12}}{48^4} =$ _____

35) $\frac{11.11^9}{11.11^7} =$ _____

36) $\frac{28^{15}}{28^6} =$ _____

37) $\frac{84.1^{56}}{84.1^{28}} =$ _____

38) $\frac{.102^{11}}{.102^8} =$ _____

39) $\frac{.04503^{14}}{.04503^{11}} =$ _____

40) $\frac{514^7}{514^3} =$ _____

WORK SHEET NUMBER 26

Perform the following combined multiplication and divisions and express as a single exponential expression.

Example $\dfrac{10^7 \times 10^6 \times 10^5}{10^4 \times 10^3 \times 10^2} = \underline{10^9}$

a) $\dfrac{2^2 \times 2^3 \times 2^9}{2^7 \times 2^5} =$ _____

b) $\dfrac{4^4 \times 4^5}{4^3 \times 4^2} =$ _____

c) $\dfrac{9^5 \times 9^6 \times 9^7}{9^3 \times 9^2 \times 9^4} =$ _____

d) $\dfrac{5^{12} \times 5^3}{5^4} =$ _____

e) $\dfrac{10^{14}}{10^2 \times 10^3 \times 10^4} =$ _____

f) $\dfrac{7.2^4 \times 7.2^3}{7.2^2} =$ _____

g) $\dfrac{.004^5 \times .004^7}{.004^4 \times .004^2} =$ _____

h) $\dfrac{12.1^5 \times 12.1^9}{12.1^{12}} =$ _____

i) $\dfrac{409^8 \times 409^2}{409^7} =$ _____

j) $\dfrac{5.15^7 \times 5.15^4}{5.19^9} =$ _____

k) $\dfrac{112^4 \times 112^8 \times 112^3}{112^{12}} =$ _____

l) $\dfrac{2^{147} \times 2^{213} \times 2^2}{2^{158}} =$ _____

m) $\dfrac{47^{81} \times 47^{124}}{47^{140}} =$ _____

n) $\dfrac{706^2 \quad 706^{54}}{706^8} =$ _____

o) $\dfrac{7^{14} \times 7^{11} \times 7^6 \times 7^{54} \times 7^{25} \times 7^{65}}{7^{60} \times 7^{18} \times 7^{50} \times 7^8 \times 7^9 \times 7^{15}} =$ _____

p) $\dfrac{2^4 \times 2^6 \times 2^{11} \times 2^2 \times 2^{1897}}{2^{526} \times 2^{434} \times 2^{601} \times 2^{104} \times 2^2} =$ _____

q) $\dfrac{3^5 \times 3^{10} \times 3^{26} \times 3^2 \times 3^{11}}{3^{24}} =$ _____

r) $\dfrac{9^{856}}{9^{27} \times 9^{27} \times 9^{405} \times 9^{262}} =$ _____

s) $\dfrac{9^2 \times 9^3 \times 9^4 \times 9^5 \times 9^6}{9^6 \times 9^5 \times 9^4 \times 9^3} =$ _____

t) $\dfrac{1.0407^2 \times 1.0407^{14} \times 1.0407^{18}}{1.0407^{24}} =$ _____

NEGATIVE EXPONENTS

So far the problems have only had positive values for exponents. If, for example, we wish to express the result of ten divided by one hundred in exponential form

$$\frac{10}{100} = \frac{1}{10}$$

Expressed in exponents, 10 is 10^1 and 100 is 10^2. Substituting these values in the original problem, we find that both numerator and denominator have the same base, so that we may apply the rule of division of exponential terms (subtracting the exponents).

$$\frac{10^1}{10^2} = 10^{1-2} = 10^{-1}$$

Since this had the same value of the original fraction (1/10th), we know that

$$10^{-1} = \frac{1}{10}$$

This shows that the 10 in the denominator has a plus 1 exponent, but when it is moved into the numerator, the sign of the exponent changes. Thus whether the exponent is positive or negative, or whether the term is in numerator or denominator, the sign will change if the term is moved from the denominator to numerator, or from numerator to denominator.

EXERCISES

Change to a number having positive exponents.

$10^{-1} = \frac{1}{10}$

$10^{-3} = \frac{1}{10^3}$

$\frac{1}{10^{-2}} =$

$\frac{1}{10^{-1}} =$

$\frac{1}{10^{-5}} =$

Change to number having negative exponents.

$10^5 = \frac{1}{10^{-5}}$

$10^3 =$

$\frac{1}{10^2} =$

$10^9 =$

SCIENTIFIC NOTATION

The manipulation of exponents leads to a simple method for the correct location of the decimal point, known as the "Scientific Notation Method".

A number divided by 10 shifts the decimal point one place to the left.

$$\frac{25}{10} = 2.5 \qquad \frac{355}{10} = 35.5 \qquad \frac{3.5}{10} = .35$$

Any multiple of 10 (100, 1000, 10,000) used in division will shift the decimal to the left, the same number of places as the number of zeros.

Similarly, if we wish to move the decimal point to the right we will multiply by 10 (or multiples of 10) and the decimal will be moved to the right a number of places corresponding to the number of zeros. It may also be recalled that the exponent is the same as the number of zeros.

ILLUSTRATION:

	exponent	decimal shift
$25 \times 10 = 250$	1	1
$25 \times 10^3 = 25000$	3	3
$.5 \times 10 = 5.0$	1	1
$.005 \times 10^3 = 5.0$	3	3

RULE

To shift the decimal to the right, multiply by ten with a positive exponent.

To shift the decimal to the left multiply by ten with a negative exponent.

The number of places thru which the decimal point moves is equal to the exponent of ten.

ILLUSTRATION:

If we wish to change any number so that there is only one digit to the left of the decimal point, write the number with multiples of 10 which will return the decimal to its position in the original number.

2500 is original number, we desire it written as 2.5.

To change 2.5 to 2500 would mean to shift the decimal point three places to the right, therefore we multiply by 10^3.

Hence $2500 = 2.5 \times 10^3$

It can be seen that multiplying out the right side of the equation will give back the original term.

ILLUSTRATION:

Rewriting numbers in the left column so that only one digit remains to the left of the decimal point, the result is given in last column.

Number	New decimal place	No. of places shift	Multiply by	Result
564	5.64	2 right	10^2	5.64×10^2
84.2	8.42	1 right	10	8.42×10
5,640	5.64	3 right	10^3	5.64×10^3
0.56	5.6	1 left	10^{-1}	5.6×10^{-1}
.0073	7.3	3 left	10^{-3}	7.3×10^{-3}
567	5.67	2 right	10^2	5.67×10^2

EXERCISE

Rewrite numbers in the left column so that only one digit remains to the left of the decimal point.

Number	New Decimal Place	No. of Places Shift	Multiply	Result
.459				
64,700				
3,850,000				
656				
787				
5,150				
.00015				
.00476				
.0947				
.977				
35,800				
36.5				
776.5				

Complete Work Sheet Number 27

USE OF SCIENTIFIC NOTATION METHOD IN COMPUTATION

If a product is reduced to the scientific notation, the decimal place of the result can be determined by multiplying only the single digits to the left of the decimal point, then combining the exponential terms.

ILLUSTRATION: $324 \times 4560 = ?$

change to scientific notation

$$3.24 \times 10^2 \times 4.56 \times 10^3 =$$
$$3.24 \times 4.56 \times 10^5 =$$

The result may be estimated as

$$3 \times 4 \times 10^5 = 12 \times 10^5$$
or 1,200,000

The answer is 1,475,000.

ILLUSTRATION: $.056 \times 224 = ?$

$$5.6 \times 10^{-2} \times 2.4 \times 10^{-1} =$$
$$5.6 \times 2.4 \times 10^{-3} =$$

this is approximately $6 \times 2 \times 10^{-3} = .012$
The answer is .0134.

Complete Work Sheet Number 28

WORK SHEET NUMBER 27

Convert the following into Scientific Notation:

1) .000004 = _____
2) .00514 = _____
3) .123 = _____
4) .0456 = _____
5) .000078 = _____
6) .000001 = _____
7) .1775 = _____
8) .01861 = _____
9) .000414 = _____
10) .00000112 = _____
11) .32 = _____
12) .0000509 = _____
13) .0000400 = _____
14) .5000000 = _____
15) .029410 = _____
16) .0006543 = _____
17) .000111 = _____
18) .9999000 = _____
19) .026 = _____
20) .0052 = _____

Convert the following into Scientific Notation:

1) 149,000 = _____
2) 1827 = _____
3) 1111 = _____
4) 2905 = _____
5) 40 = _____
6) 26543 = _____
7) 290.5 = _____
8) 409154 = _____
9) 27,000,000 = _____
10) 346.027 = _____
11) 51403 = _____
12) 9 = _____
13) 264.14 = _____
14) 6150.824 = _____
15) 51111.2 = _____
16) 5.0496 = _____
17) 200.00000 = _____
18) 70.0000000 = _____
19) 9000.0000001 = _____
20) 1111.111 = _____

WORK SHEET NUMBER 28

Multiply, using Scientific Notation:

1) $27000 \times .04 =$ _____

2) $840 \times .15 =$ _____

3) $5300 \times 2000 =$ _____

4) $1.25 \times 4000 =$ _____

5) $.000302 \times .02 \times .001 =$ _____

6) $411 \times .003 \times 1.04 =$ _____

7) $86{,}000{,}000 \times 700 =$ _____

8) $512 \times .002 \times 4000 =$ _____

Divide using Scientific Notation:

1) $\frac{4000}{20} =$ _____

2) $\frac{27000}{900} =$ _____

3) $\frac{.0000054}{9000} =$ _____

4) $\frac{.00000000081}{.00000027} =$ _____

5) $\frac{309}{103} =$ _____

6) $\frac{126}{.15} =$ _____

7) $\frac{60{,}200{,}000{,}000}{700} =$ _____

8) $\frac{106{,}000{,}000}{2000} =$ _____

THE LOGARITHMIC SCALES

The log scale may be used for computing all powers and roots of numbers. Because of the somewhat simpler method in reading cubes and squares and their corresponding roots from other scales on the rule, it is not necessary to compute these on the log scale.

A logarithm consists of two parts: the number to the left of the decimal, the characteristic, and the number to the right of the decimal, the mantissa. The characteristic determines the location of the decimal point, and the mantissa determines the value of the log, which corresponds to the number.

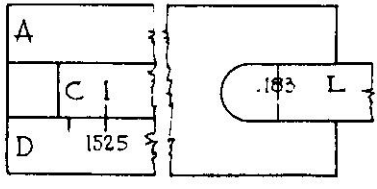
To determine the characteristic:

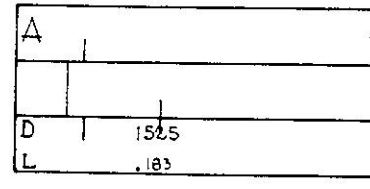
For numbers greater than one, the characteristic is one **less** than the number of digits to the left of the decimal point of the number. For numbers less than one, the characteristic is one more than the number of zeros between the decimal and the first digit, and is **minus** in value.

To determine the mantissa:

The mantissa is found by placing the number on either the C or D scales and finding its value on the log scale. This may mean a simple direct reading if the scales are side by side, or reference to one index or the other if the log scale is not beside either the C or D scales. Thus, if the scales are not side by side, the LC index is placed on the number on the D scale. Turning the rule over the mantissa will be found over the index.

ILLUSTRATION: log 152.5 = ?





Depending on the position of the scales, the hairline is set to the number on D scale, and the log is found under the hairline on the log scale, or set LC index to 1525 on D scale and read the answer from L at the index, as 0.183. Since there are three digits to the left of the decimal, the characteristic is 2 and the log 152.5 = 2.183.

ILLUSTRATION: log .00532 = ?

From the slide rule, the mantissa is .726. The characteristic is a -3. However, we cannot write the log of the number as -3.726, because the mantissa is positive, and only the characteristic is negative. For this reason, the minus sign is placed above the characteristic to show that only the 3 is minus, as

$$\bar{3}.726$$

A second method is to add such a log to 10 -10. Since 10. -10 is zero, such an addition will not change the value of the log, but will change its form. Hence,

$$\begin{array}{r} \bar{3}.726 \\ 10 \quad -10 \\ \hline 7.726 \quad -10 \end{array}$$

We may write the logarithm in either of these two forms.

$$\log .00532 = \bar{3}.726 = 7.726 - 10$$

ILLUSTRATION: log .785 = ?

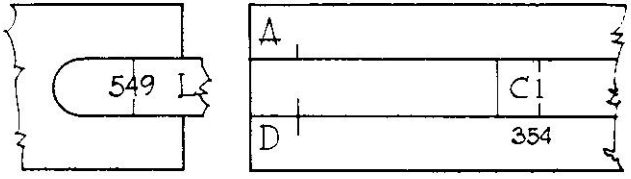
The mantissa is .895 from the slide rule, and the characteristic either -1 or 9. -10. Therefore log 0.785 = $\bar{1}.895$ = 9.895 -10

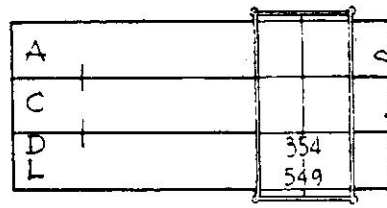
CONVERTING LOGARITHMS TO NUMBERS. (ANTILOGARITHMS)

The process of finding the number itself from the logarithm is known as finding the antilogarithm. In effect, it is just the reverse of finding the logarithm of a number. The mantissa of the log is placed on the L scale, either with the hairline, or by using the index, and its value is read on the C or D scales.

ILLUSTRATION: log A = 2.549

Set either the hairline on 549 on the L scale, or this value (if L scale is on the slide) to the index. The value for A will be found on the D scale.





Since the characteristic is 2, this is one less than the number of digits to the left of the decimal point, and we may place the decimal after the third digit. The answer is 354.

ILLUSTRATION: $\log A = 8.462 - 10$

Set .462 on L scale.

Read number A on D = 290.

Characteristic $8 - 10 = -2$ is 1 more than the number of zeros between decimal and first significant figure, or there is 1 zero between decimal and first significant figure. Therefor answer = .0290.

ILLUSTRATION: $\log A = .073$

Set .073 on L scale.

Read number A on D = 1183.

Characteristic in this case is evidently zero and is 1 less than the number of figures to the left of decimal point, or there is one figure to the left of decimal. Therefore answer = 1.183.

Powers and Roots

Logarithms are especially useful for finding powers and roots of numbers due to the following property of logs.

$$\log A^n = n \times \log A$$

To find the power of any number multiply the exponent n by the log of the number. The result is the log of the desired power. The antilog is then the answer.

The solution of both powers and roots may be made by use of this rule. When the exponent n is equal to 1 or greater it indicates a power of a number, while when n is less than 1 it indicates the root of a number.

$(1.53)^4$

$(126.5)^2$

$(.0543)^7$ are powers of numbers

$\sqrt{6.87} = \left(6.87\right)^{\frac{1}{2}}$

$\sqrt[3]{124.} = \left(124\right)^{\frac{1}{3}}$ are all roots of numbers

$\sqrt[7]{83700} = \left(83700\right)^{\frac{1}{7}}$

In each case 4, 2, 7, $\frac{1}{2}$, $\frac{1}{3}$, or $\frac{1}{7}$ is the exponent n.

ILLUSTRATION: $12.7^5 = ?$

$$\log 12.7^5 = 5 \times \log 12.7$$

Find log 12.7 on slide rule = 1.104.

Multiply 1.104×5 on rule or by inspection = 5.520

Set mantissa .520 on L scale

Read number on D scale = 331

Characteristic 5 is one less than number of places to left of decimal point.

Therefore answer = 331000.

ILLUSTRATION:

$$.0849^{\frac{1}{4}} = \sqrt[4]{.0849}$$

$$\log. \ .0849^{\frac{1}{4}} = \tfrac{1}{4} \times \log. .0849$$

Find log .0849 on slide rule = $8.928 - 10$

The next step is to multiply this log by 1 or divide by 4. If we should now divide $8.928 - 10$ by 4 we would obtain $2.232 - 2.5$ or characteristic equals $2 - 2.5 = -.5$. Since characteristic must be a whole number some modification in the characteristic should be made. A simple change is to add and subtract .5 from the log.

$$\begin{array}{r} 2.232 - 2.5 \\ + .5 \quad - \quad .5 \\ \hline 2.732 - 3 \end{array}$$

Set mantissa .732 on L scale.

Read number on D scale = 539

Characteristic -1 is 1 more than the number of zeros between decimal point and first significant figure. Therefore answer = .539.

ILLUSTRATION: $.741^3 = ?$

$$\log .741^3 = 3 \times \log .741$$

Find log .741 on slide rule = 9.870 − 10

Multiply 9.870 − 10 × 3 = 29.610 − 30

Set mantissa .610 on L scale

Read number on D scale = 407.

Characteristic −1 is one more than the number of zeros between decimal point and first significant figure. Therefore answer = .407.

Complete Work Sheet Number 29 and 30

The CI scale

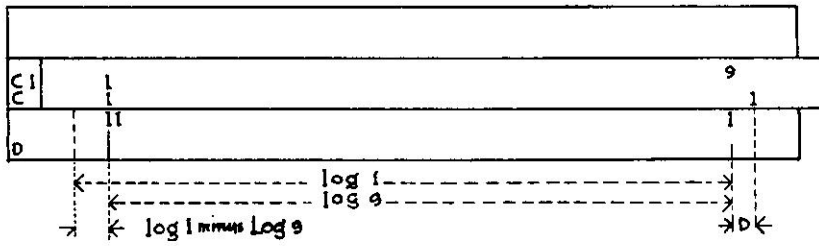
Many rules have a CI scale. It is like the C scale except that it appears in reverse (I stands for inverted) order, and reads from right to left instead of the normal left to right.

The CI scale is used most for finding the value of reciprocals. The reciprocal is defined to be 1 divided by the number.

the reciprocal of 9 is 1/9.

The distance from the nearest index to 9 on the CI scale is the same as on the C or D scale, even if differently placed. We are then able to take the reciprocal of 9 without moving the slide. Ordinarily, to divide 1 by 9, the C and D scales would be used, but the same effect is attained by placing the hairline to 9 on the CI scale and reading the answer from the C or D scale.

Therefore, to find the reciprocal of a number, set the hairline to the number on the CI scale and read its reciprocal below on the C scale.



WORK SHEET NUMBER 29

Complete:

1) log 52.6 = _____
2) log 3.52 = _____
3) log 105.2 = _____
4) log 256 = _____
5) log 32.6 = _____
6) log 9.71 = _____
7) log 1056. = _____
8) log .147 = _____
9) log .562 = _____
10) log 976 = _____
11) log .0639 = _____
12) log .00823 = _____
13) log .975 = _____
14) log .00419 = _____
15) log .427 = _____
16) log .000431 = _____
17) log 16.5 = _____
18) log 73900 = _____
19) log .174 = _____
20) log 1.943 = _____
21) log 1.202 = _____
22) log 146,000 = _____
23) log 68,000 = _____
24) log 3.211 = _____

25) $\log \frac{62.5}{13.2}$ = _____

26) log 13.2 × 62 = _____

27) log .0732 × .683 = _____

28) $\log \frac{23.5 \times 16}{12}$ = _____

29) $\log \frac{12.6 \times 0.741}{.409}$ = _____

30) $\log \frac{682 \times 32.5}{.755}$ = _____

1) log_____ = .589
2) log_____ = 1.209
3) log_____ = 3.116
4) log_____ = 5.887
5) log_____ = 2.351
6) log_____ = 1.873
7) log_____ = .421
8) log_____ = .973
9) log_____ = 38.473 − 40
10) log_____ = 6.432
11) log_____ = 2.978
12) log_____ = 1.478
13) log_____ = 9.092 − 10
14) log_____ = 7.726 − 10
15) log_____ = 2.442
16) log_____ = 9.793 − 10
17) log_____ = 8.301 − 10
18) log_____ = 7.432 − 10
19) log_____ = 3.043
20) log_____ = .942
21) log_____ = .038
22) log_____ = 8.093 − 10
23) log_____ = .721
24) log_____ = 5.404 − 10

WORK SHEET NUMBER 30

Evaluate by logarithms.

1) 1.63^{3} = _____ Ans.

2) 83.7^{5} = _____ Ans.

3) $.973^{4}$ = _____ Ans.

4) $1085^{.5}$ = _____ Ans.

5) $5800^{1.35}$ = _____ Ans.

6) 46.8^{9} _____ Ans.

7) $.00643^{2.5}$ = _____ Ans.

8) 4890^{4} = _____ Ans.

9 $.545^{4}$ = _____ Ans.

10) $.1047^{.75}$ = _____ Ans.

11) $\sqrt[4]{85.3}$ = _____ Ans.

12) $\sqrt[7]{9420}$ = _____ Ans.

13) $23.5^{.056}$ = _____ Ans.

14) $\left(23.5\right)^{\frac{1}{4}}$ = _____ Ans.

15) $\left(246\right)^{\frac{1}{2}}$ = _____ Ans.

16) $\left(\frac{426}{13}\right)^{5}$ = _____ Ans.

17) $\left(\frac{8.23}{14.63}\right)^{4}$ = _____ Ans.

18) $(23.5 \times .632)^{4}$ = _____ Ans.

19) $(.732 \times .0429)^{.25}$ = _____ Ans.

The CI scale offers further advantages because

a) it permits three multiplication factors to be taken with a single setting of the rule.

b) it allows a series of divisions to be made with a single setting when the dividend remains constant.

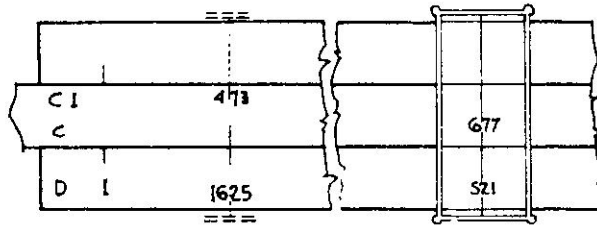
c) it may be used for multiplication to prevent reversing the slide which might be necessary when using the C scale.

When using the CI and D scales, multiplication is performed in the same way as division is performed on the C and D scales, and division in the same way as multiplication is performed.

To multiply 2 × 4, set 4 on CI over 2 on D. Read the answer on the D scale under 2 on the CI index.

To divide 6/3, set the RCI index to 6 on the D scale. Set the hairline to 3 on the CI scale and read the answer under the hairline on the D scale as 2. We are in effect multiplying 6 × 3, which equals 2.

ILLUSTRATION: $162.5 \times 473 \times 0.677 = ?$



Set 473 on CI over 1625 on D. Set the hairline to 677 on C. The answer is under the hairline on D and is 521. Estimating, we then have 52100. The problem was solved with one setting of the rule.

ILLUSTRATION: $\dfrac{2.89}{4.62 \times 1.23} =$

Set 462 on C over 289 on the D scale. Set the hairline to 123 on CI. Read the answer under the hairline on D as 508. Locating the decimal the answer is .508.

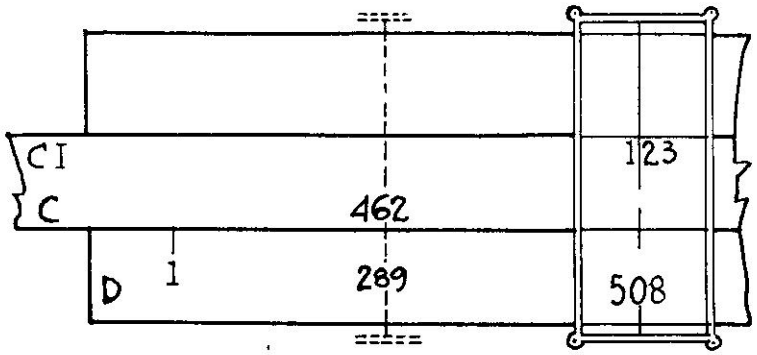
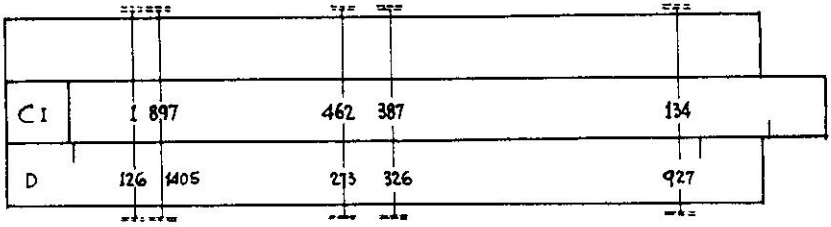


ILLUSTRATION:

$$S = \frac{12.6}{B}$$

B = 1.34, 3.87, 4.62, and 8.97



Set RCI index to 126 on D scale. Set the hairline to 134 on the CI scale. Read the answer under the hairline on the D scale as 9.27.

Set the hairline to 387 on the CI scale and read the answer as 3.26.

In this example what appears to be multiplication is actually division due to use of the CI scale.

There are many other problems in which the CI scale may be used to advantage. Some slide rule users prefer to use the CI and D scales for simple multiplication since it is then unnecessary to worry about which index to use. Like division with the C and D scales, the answer will always fall under whichever CI index is on the D scale.

Complete Work Sheet Number 31

WORK SHEET NUMBER 31

Solve the following problems using CI scale wherever possible to save slide movements.

1) $42.6 \times 12 \times 0.436 =$ _____

2) $87.3 \times 0.072 \times 0.741 =$ _____

3) $42.6 \times 8700 \times 0.071 =$ _____

4) $9350 \times 11.5 \times 0.00431 =$ _____

5) $673 \times 12.1 \times 6.82 =$ _____

6) $0.217 \times 0.053 \times 6 =$ _____

7) $82 \times 0.411 \times 4 \times 905 =$ _____

8) $3.01 \times 755 \times 0.0041 =$ _____

9) $73 \times 6 \times 4.21 \times 8.7 =$ _____

10) $5.71 \times 4.1 \times 0.315 \times 13 \times 0.62 =$ _____

11) $\dfrac{7.31}{5.45 \times 18.1} =$ _____

12) $\dfrac{75400}{6.8 \times 22.9} =$ _____

13) $\dfrac{4.73}{680 \times 0.00401} =$ _____

14) $\dfrac{0.0688}{0.427 \times 0.303} =$ _____

15) $\dfrac{7320}{6 \times 18.1 \times 7.32} =$ _____

16) $\dfrac{3080 \times 6.32 \times 16}{12} =$ _____

17) $\dfrac{0.471 \times 0.420 \times 7.22}{0.0743} =$ _____

18) $\dfrac{848 \times 16 \times 0.142}{92.6} =$ _____

19) $\dfrac{\sqrt{1.36}}{1.85 \times 0.855} =$ _____

20) $\dfrac{\sqrt{173}}{4.92 \times 0.149} =$ _____

21) $I = \dfrac{110}{R}$

R	50	62.1	87.3	2.15	12.6	13.9
I						

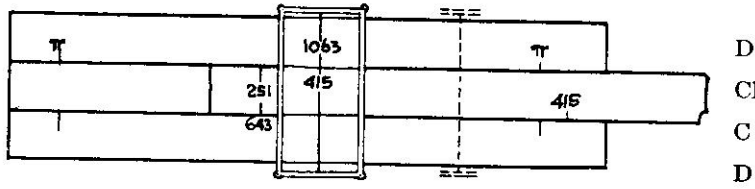
Solve with one setting of the CI scale.

The CF, DF and CIF scales.

These are known as the folded scales and are usually found on the larger and more complex rules. The CF and DF scales are derived from the C and D scales by cutting them at the mark corresponding to π, (pi = 3.1416) and setting the right portion over so that the marking π is over the LC and LD index. By the same arrangement, the CI scale is shifted and becomes the CIF scale.

This is very useful, since it eliminates the necessity of reversing the slide due to a number falling off the scale. Whenever the C scale is moved with respect to the D scale, the CF scale moves the same amount with respect to the DF. Since CF and DF are moved over approximately half a scale length, if a number falls off the scale on the C scale, it can be located upon the CF scale and the answer found under the hairline on DF.

ILLUSTRATION: $\dfrac{6.43 \times 415}{2.51} = ?$



Set 251 on C over 643 on the D scale. If we now attempt to set the hairline to 415 on the C scale it falls off the scale. Set the hairline to 415 on the CF scale and read the answer under the hairline on the DF scale as 10.63.

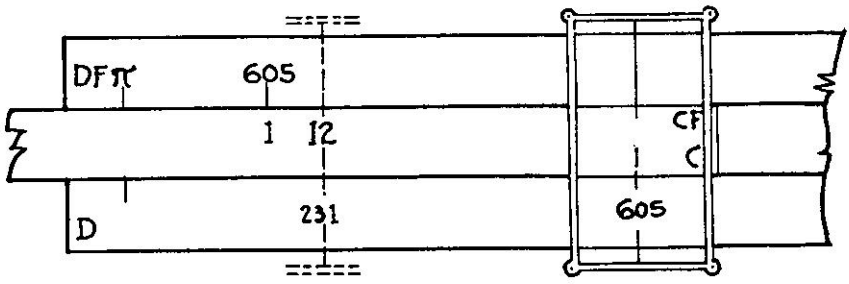
After coming up to the CF and DF scale one may continue to operate on these scales, or go back to the C and D scales. It is possible to move from one set to another **only** AFTER a movement of the slide.

The second advantage of the CF and DF scales is that numbers may be multiplied or divided by π directly without moving the scale. This is due to the fact that the C and D index will always set to π on the CF and DF scales.

To multiply by π, set the number on the D scale and read π times that number on the DF scale.

To divide by π, set the number on the DF scale and read the answer on the D scale.

ILLUSTRATION: $\frac{2.31 \cdot \pi}{12} = ?$



Set the hairline to 231 on the D scale. Set 12 on C scale to hairline. The product of this times π is above on DF, or below the RC index on the D scale. The answer is 0.605.

Complete Work Sheet Number 32

To find tangents of angles 84°17′ to 90°, it will be necessary to find the reciprocal of tan 5°43′ or smaller angles. Since for such small angles we must use the sine scale, in such cases, it will be necessary to find the reciprocal of the sine.

ILLUSTRATION: Tan 86° = ?

$$\tan 86° = \frac{1}{\tan (90° - 86°)} = \frac{1}{\tan 40} = \frac{1}{\sin 4°}$$

$$\sin 4° = 0.0699$$

$$\frac{1}{\sin 4°} = \frac{1}{0.06.99} = 14.3$$

Therefore tan 86° = 14.3

If the tangent of an angle is given, the angle may be found by moving value on C to RD index (or LD index). Read angle under back index on T. Or, set value on C with indicator and read angle under hairline on T.

ILLUSTRATION: tan A = 0.615

Set 615 on C to RD index (or LD index).

Read answer under back index on T = 31°35′

Set indicator to 615 on C

Read answer under hairline on T = 31°35′

If the value of the tangent given is greater than 1 indicating that the angle is greater

WORK SHEET NUMBER 32

Solve using CF and DF to avoid reversing:

1) $\frac{2.16 \times 1.44}{7.21} =$ _____

2) $\frac{619 \times 8.16}{470} =$ _____

3) $\frac{0.373}{5.98 \times 7.12} =$ _____

Hint: Use CIF

4) $\frac{2175}{34.7 \times 6.44} =$ _____

5) $\frac{6.16 \times 3.67}{1.23} =$ _____

6) $\frac{\sqrt{17.6} \times 12.3}{8.66} =$ _____

7) $\frac{7.17 \times \sqrt{3440}}{17.5} =$ _____

8) $\frac{353 \times 0.421}{\sqrt{2.14}} =$ _____

9) $\frac{0.01302 \times 277}{\sqrt{21.5}} =$ _____

10) $\frac{\sqrt{350} \times 1.21}{9.46} =$ _____

11) C = 24.6
M × C = W
Find W

M	0.184	0.358	0.472	8.11	3.06
W					

Solve with one setting of slide:

12) $S = \left(\frac{2.72}{8.64}\right) \times Q$
Find S

Q	12.8	2.71	3.82	8.17	9.95
S					

Solve with one setting of Slide:

13) $4.21 \times 11 \times 9.11 =$ _____

14) $57.1 \times 11 \times 32 =$ _____

15) $\frac{8.32 \times 4.05}{11} =$ _____

16) $\frac{0.0601 \times 11.5}{11} =$ _____

than 45°, it is necessary to first find the reciprocal of the tangent. The angle corresponding to the resulting value is the complement of the desired angle.

ILLUSTRATION: Tan A = 1.43

$$\tan A = \frac{1}{\tan (90\text{-}A)} = 1.43$$

$$\tan (90\text{-}A) = \frac{1}{1.43} = 0.698$$

$$90\text{-}A = 34°55'$$

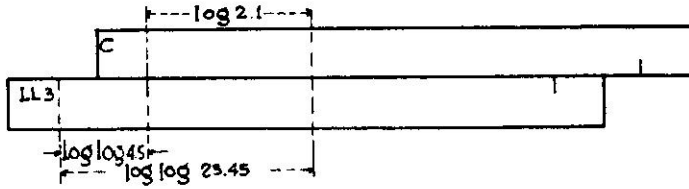
Therefore A = (90° − 34°55′) = 55°5′

LOG-LOG SCALES

If we should take the log of the expression 2.1 × log 45

we would have Log (2.1 × log 4.5) = log 2.1 + log (log 4.5)

If we now construct a scale which is the log log of numbers, we have a simple solution to exponent problems. It is then only necessary to add a length on the log log scale representing the number, to a length on the C scale representing the exponent. The resulting length on the log log scale is the answer to the problem.



In constructing the C and D scales it is possible to represent numbers like 2, 20, 200 and so forth, all by the same marking. (The logs of the same numbers to be base 10 have the same mantissas). The log of the log of these would not have the same mantissa since the figures in the logs will be different; the characteristics will change.

log 2 = .301, log 20 = 1.301, log 200 = 2.301

In order to cover the full practical range of numbers it is therefore necessary to have many scales.

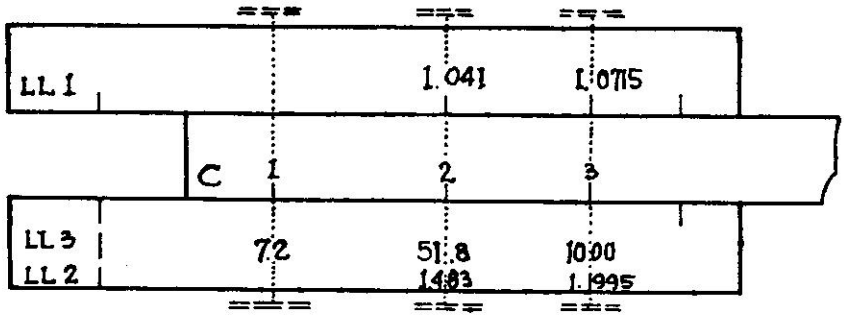
Thus scale LL3 represents numbers from 2.718 to 22026

" " LL2 " " " 1.105 to 2.718

" " LL1 " " " 1.01 to 1.105

" " LL0 " " " .999 to .905

" " LL00 " " " .905 to .0000454



$(7.2)^2 = ?$

To find $(7.2)^2$ set the LC index to 7.2 on LL3. Set the hairline to 2 on the C scale and read the answer under the hairline on LL3 to be 51.8. If the exponent has been .a instead of 2, the answer would be on the LL2 scale. If the exponent had been .02, the answer would be read on LL1.

Any number on LL2 is the root of the number above on LL3.

Any number on LL1 is the root of the number above on LL2.

The answer would have been impossible had the exponent been 20, because it would then have been larger than 22026 the largest number on the scale.

Complete Work Sheet Number 33

WORK SHEET NUMBER 33

1) $6.3^{4.1} =$ _____

2) $72.3^{1.02} =$ _____

3) $823^{.64} =$ _____

4) $624^{.78} =$ _____

5) $1.47^{.113} =$ _____

6) $2.88^{3.51} =$ _____

7) $0.847^{3.1} =$ _____

8) $0.995^{2.6} =$ _____

9) $0.932^{.78} =$ _____

10) $0.652^{.52} =$ _____

11) $2500^{.095} =$ _____

12) $8400^{.795} =$ _____

13) $\left(\frac{826}{12.3}\right)^{3.5} =$ _____

14) $\left(\frac{9.20 \times 6}{18.6}\right)^{.751} =$

15) $(82.3 \times 0.421 \times 1.08)^{2.41} =$ _____

16) $(92.5 \times 16 \times 12)^{.114} =$ _____

17) $\left(\frac{895}{6 \times 32}\right)^{2.5} =$ _____

18) $\left(\frac{9.47}{0.832 \times 0.75}\right)^{.16} =$ _____

19) $\left(\frac{89.5 \times 16}{32.6}\right)^{1.26} =$ _____

20) $\left(\frac{9.05 \times 5.1}{89.1 \times 3.1}\right)^{.85} =$ _____

21) Determine natural logs of these numbers below:

Number	16.3	254	0.873	1.05	3550	87.3
Nat. log						

22) $62.3^{4.5} =$ _____

23) $\left(\frac{92.5}{1.41}\right)^{6.4} =$ _____

24) $0.0155^{3.7} =$ _____

25) $\left(\frac{8.23}{253}\right)^{4.6} =$ _____

TABLE OF LOGARITHMS

FIVE-PLACE LOGARITHMS

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts		
100	00 000	043	087	130	173	217	260	303	346	389		**44**	**43**	**42**
101	432	475	518	561	604	647	689	732	775	817	1	4,4	4,3	4,2
102	860	903	945	988	*030	*072	*115	*157	*199	*242	2	8,8	8,6	8,4
103	01 284	326	368	410	452	494	536	578	620	662	3	13,2	12,9	12,6
104	703	745	787	828	870	912	953	995	*036	*078	4	17,6	17,2	16,8
105	02 119	160	202	243	284	325	366	407	449	490	5	22,0	21,5	21,0
106	531	572	612	653	694	735	776	816	857	898	6	26,4	25,8	25,2
107	938	979	*019	*060	*100	*141	*181	*222	*262	*302	7	30,8	30,1	29,4
108	03 342	383	423	463	503	543	583	623	663	703	8	35,2	34,4	33,6
109	743	782	822	862	902	941	981	*021	*060	*100	9	39,6	38,7	37,8
110	04 139	179	218	258	297	336	376	415	454	493		**41**	**40**	**39**
111	532	571	610	650	689	727	766	805	844	883	1	4,1	4,0	3,9
112	922	961	999	*038	*077	*115	*154	*192	*231	*269	2	8,2	8,0	7,8
113	05 308	346	385	423	461	500	538	576	614	652	3	12,3	12,0	11,7
114	690	729	767	805	843	881	918	956	994	*032	4	16,4	16,0	15,6
115	06 070	108	145	183	221	258	296	333	371	408	5	20,5	20,0	19,5
116	446	483	521	558	595	633	670	707	744	781	6	24,6	24,0	23,4
117	819	856	893	930	967	*004	*041	*078	*115	*151	7	28,7	28,0	27,3
118	07 188	225	262	298	335	372	408	445	482	518	8	32,8	32,0	31,2
119	555	591	628	664	700	737	773	809	846	882	9	36,9	36,0	35,1
120	918	954	990	*027	*063	*099	*135	*171	*207	*243		**38**	**37**	**36**
121	08 279	314	350	386	422	458	493	529	565	600	1	3,8	3,7	3,6
122	636	672	707	743	778	814	849	884	920	955	2	7,6	7,4	7,2
123	991	*026	*061	*096	*132	*167	*202	*237	*272	*307	3	11,4	11,1	10,8
124	09 342	377	412	447	482	517	552	587	621	656	4	15,2	14,8	14,4
125	691	726	760	795	830	864	899	934	968	*003	5	19,0	18,5	18,0
126	10 037	072	106	140	175	209	243	278	312	346	6	22,8	22,2	21,6
127	380	415	449	483	517	551	585	619	653	687	7	26,6	25,9	25,2
128	721	755	789	823	857	890	924	958	992	*025	8	30,4	29,6	28,8
129	11 059	093	126	160	193	227	261	294	327	361	9	34,2	33,3	32,4
130	394	428	461	494	528	561	594	628	661	694		**35**	**34**	**33**
131	727	760	793	826	860	893	926	959	992	*024	1	3,5	3,4	3,3
132	12 057	090	123	156	189	222	254	287	320	352	2	7,0	6,8	6,6
133	385	418	450	483	516	548	581	613	646	678	3	10,5	10,2	9,9
134	710	743	775	808	840	872	905	937	969	*001	4	14,0	13,6	13,2
135	13 033	066	098	130	162	194	226	258	290	322	5	17,5	17,0	16,5
136	354	386	418	450	481	513	545	577	609	640	6	21,0	20,4	19,8
137	672	704	735	767	799	830	862	893	925	956	7	24,5	23,8	23,1
138	988	*019	*051	*082	*114	*145	*176	*208	*239	*270	8	28,0	27,2	26,4
139	14 301	333	364	395	426	457	489	520	551	582	9	31,5	30,6	29,7
140	613	644	675	706	737	768	799	829	860	891		**32**	**31**	**30**
141	922	953	983	*014	*045	*076	*106	*137	*168	*198	1	3,2	3,1	3,0
142	15 229	259	290	320	351	381	412	442	473	503	2	6,4	6,2	6,0
143	534	564	594	625	655	685	715	746	776	806	3	9,6	9,3	9,0
144	836	866	897	927	957	987	*017	*047	*077	*107	4	12,8	12,4	12,0
145	16 137	167	197	227	256	286	316	346	376	406	5	16,0	15,5	15,0
146	435	465	495	524	554	584	613	643	673	702	6	19,2	18,6	18,0
147	732	761	791	820	850	879	909	938	967	997	7	22,4	21,7	21,0
148	17 026	056	085	114	143	173	202	231	260	289	8	25,6	24,8	24,0
149	319	348	377	406	435	464	493	522	551	580	9	28,8	27,9	27,0
150	609	638	667	696	725	754	782	811	840	869				

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
150	17 609	638	667	696	725	754	782	811	840	869
151	898	926	955	984	*013	*041	*070	*099	*127	*156
152	18 184	213	241	270	298	327	355	384	412	441
153	469	498	526	554	583	611	639	667	696	724
154	752	780	808	837	865	893	921	949	977	*005
155	19 033	061	089	117	145	173	201	229	257	285
156	312	340	368	396	424	451	479	507	535	562
157	590	618	645	673	700	728	756	783	811	838
158	866	893	921	948	976	*003	*030	*058	*085	*112
159	20 140	167	194	222	249	276	303	330	358	385
160	412	439	466	493	520	548	575	602	629	656
161	683	710	737	763	790	817	844	871	898	925
162	952	978	*005	*032	*059	*085	*112	*139	*165	*192
163	21 219	245	272	299	325	352	378	405	431	458
164	484	511	537	564	590	617	643	669	696	722
165	748	775	801	827	854	880	906	932	958	985
166	22 011	037	063	089	115	141	167	194	220	246
167	272	298	324	350	376	401	427	453	479	505
168	531	557	583	608	634	660	686	712	737	763
169	789	814	840	866	891	917	943	968	994	*019
170	23 045	070	096	121	147	172	198	223	249	274
171	300	325	350	376	401	426	452	477	502	528
172	553	578	603	629	654	679	704	729	754	779
173	805	830	855	880	905	930	955	980	*005	*030
174	24 055	080	105	130	155	180	204	229	254	279
175	304	329	353	378	403	428	452	477	502	527
176	551	576	601	625	650	674	699	724	748	773
177	797	822	846	871	895	920	944	969	993	*018
178	25 042	066	091	115	139	164	188	212	237	261
179	285	310	334	358	382	406	431	455	479	503
180	527	551	575	600	624	648	672	696	720	744
181	768	792	816	840	864	888	912	935	959	983
182	26 007	031	055	079	102	126	150	174	198	221
183	245	269	293	316	340	364	387	411	435	458
184	482	505	529	553	576	600	623	647	670	694
185	717	741	764	788	811	834	858	881	905	928
186	951	975	998	*021	*045	*068	*091	*114	*138	*161
187	27 184	207	231	254	277	300	323	346	370	393
188	416	439	462	485	508	531	554	577	600	623
189	646	669	692	715	738	761	784	807	830	852
190	875	898	921	944	967	989	*012	*035	*058	*081
191	28 103	126	149	171	194	217	240	262	285	307
192	330	353	375	398	421	443	466	488	511	533
193	556	578	601	623	646	668	691	713	735	758
194	780	803	825	847	870	892	914	937	959	981
195	29 003	026	048	070	092	115	137	159	181	203
196	226	248	270	292	314	336	358	380	403	425
197	447	469	491	513	535	557	579	601	623	645
198	667	688	710	732	754	776	798	820	842	863
199	885	907	929	951	973	994	*016	*038	*060	*081
200	30 103	125	146	168	190	211	233	255	276	298

N.	0	1	2	3	4	5	6	7	8	9

Proportional parts		
	29	**28**
1	2,9	2,8
2	5,8	5,6
3	8,7	8,4
4	11,6	11,2
5	14,5	14,0
6	17,4	16,8
7	20,3	19,6
8	23,2	22,4
9	26,1	25,2

	27	**26**
1	2,7	2,6
2	5,4	5,2
3	8,1	7,8
4	10,8	10,4
5	13,5	13,0
6	16,2	15,6
7	18,9	18,2
8	21,6	20,8
9	24,3	23,4

	25
1	2,5
2	5,0
3	7,5
4	10,0
5	12,5
6	15,0
7	17,5
8	20,0
9	22,5

	24	**23**
1	2,4	2,3
2	4,8	4,6
3	7,2	6,9
4	9,6	9,2
5	12,0	11,5
6	14,4	13,8
7	16,8	16,1
8	19,2	18,4
9	21,6	20,7

	22	**21**
1	2,2	2,1
2	4,4	4,2
3	6,6	6,3
4	8,8	8,4
5	11,0	10,5
6	13,2	12,6
7	15,4	14,7
8	17,6	16,8
9	19,8	18,9

Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts		
200	30 103	125	146	168	190	211	233	255	276	298		**22**	**21**
201	320	341	363	384	406	428	449	471	492	514	1	2,2	2,1
202	535	557	578	600	621	643	664	685	707	728	2	4,4	4,2
203	750	771	792	814	835	856	878	899	920	942	3	6,6	6,3
204	963	984	*006	*027	*048	*069	*091	*112	*133	*154	4	8,8	8,4
205	31 175	197	218	239	260	281	302	323	345	366	5	11,0	10,5
206	387	408	429	450	471	492	513	534	555	576	6	13,2	12,6
207	597	618	639	660	681	702	723	744	765	785	7	15,4	14,7
208	806	827	848	869	890	911	931	952	973	994	8	17,6	16,8
209	32 015	035	056	077	098	118	139	160	181	201	9	19,8	18,9
210	222	243	263	284	305	325	346	366	387	408		**20**	
211	428	449	469	490	510	531	552	572	593	613	1	2,0	
212	634	654	675	695	715	736	756	777	797	818	2	4,0	
213	838	858	879	899	919	940	960	980	*001	*021	3	6,0	
214	33 041	062	082	102	122	143	163	183	203	224	4	8,0	
215	244	264	284	304	325	345	365	385	405	425	5	10,0	
216	445	465	486	506	526	546	566	586	606	626	6	12,0	
217	646	666	686	706	726	746	766	786	806	826	7	14,0	
218	846	866	885	905	925	945	965	985	*005	*025	8	16,0	
219	34 044	064	084	104	124	143	163	183	203	223	9	18,0	
220	242	262	282	301	321	341	361	380	400	420		**19**	
221	439	459	479	498	518	537	557	577	596	616	1	1,9	
222	635	655	674	694	713	733	753	772	792	811	2	3,8	
223	830	850	869	889	908	928	947	967	986	*005	3	5,7	
224	35 025	044	064	083	102	122	141	160	180	199	4	7,6	
225	218	238	257	276	295	315	334	353	372	392	5	9,5	
226	411	430	449	468	488	507	526	545	564	583	6	11,4	
227	603	622	641	660	679	698	717	736	755	774	7	13,3	
228	793	813	832	851	870	889	908	927	946	965	8	15,2	
229	984	003	*021	*040	*059	*078	*097	*116	*135	*154	9	17,1	
230	36 173	192	211	229	248	267	286	305	324	342		**18**	
231	361	380	399	418	436	455	474	493	511	530	1	1,8	
232	549	568	586	605	624	642	661	680	698	717	2	3,6	
233	736	754	773	791	810	829	847	866	884	903	3	5,4	
234	922	940	959	977	996	*014	*033	*051	*070	*088	4	7,2	
235	37 107	125	144	162	181	199	218	236	254	273	5	9,0	
236	291	310	328	346	365	383	401	420	438	457	6	10,8	
237	475	493	511	530	548	566	585	603	621	639	7	12,6	
238	658	676	694	712	731	749	767	785	803	822	8	14,4	
239	840	858	876	894	912	931	949	967	985	*003	9	16,2	
240	38 021	039	057	075	093	112	130	148	166	184		**17**	
241	202	220	238	256	274	292	310	328	346	364	1	1,7	
242	382	399	417	435	453	471	489	507	525	543	2	3,4	
243	561	578	596	614	632	650	668	686	703	721	3	5,1	
244	739	757	775	792	810	828	846	863	881	899	4	6,8	
245	917	934	952	970	987	*005	*023	*041	*058	*076	5	8,5	
246	39 094	111	129	146	164	182	199	217	235	252	6	10,2	
247	270	287	305	322	340	358	375	393	410	428	7	11,9	
248	445	463	480	498	515	533	550	568	585	602	8	13,6	
249	620	637	655	672	690	707	724	742	759	777	9	15,3	
250	794	811	829	846	863	881	898	915	933	950			

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
250	39 794	811	829	846	863	881	898	915	933	950	**18**
251	967	985	*002	*019	*037	*054	*071	*088	*106	*123	1 1,8
252	40 140	157	175	192	209	226	243	261	278	295	2 3,6
253	312	329	346	364	381	398	415	432	449	466	3 5,4
254	483	500	518	535	552	569	586	603	620	637	4 7,2
255	654	671	688	705	722	739	756	773	790	807	5 9,0
256	824	841	858	875	892	909	926	943	960	976	6 10,8
257	993	*010	*027	*044	*061	*078	*095	*111	*128	*145	7 12,6
258	41 162	179	196	212	229	246	263	280	296	313	8 14,4
259	330	347	363	380	397	414	430	447	464	481	9 16,2
260	497	514	531	547	564	581	597	614	631	647	**17**
261	664	681	697	714	731	747	764	780	797	814	1 1,7
262	830	847	863	880	896	913	929	946	963	979	2 3,4
263	996	*012	*029	*045	*062	*078	*095	*111	*127	*144	3 5,1
264	42 160	177	193	210	226	243	259	275	292	308	4 6,8
265	325	341	357	374	390	406	423	439	455	472	5 8,5
266	488	504	521	537	553	570	586	602	619	635	6 10,2
267	651	667	684	700	716	732	749	765	781	797	7 11,9
268	813	830	846	862	878	894	911	927	943	959	8 13,6
269	975	991	*008	*024	*040	*056	*072	*088	*104	*120	9 15,3
270	43 136	152	169	185	201	217	233	249	265	281	**16**
271	297	313	329	345	361	377	393	409	425	441	1 1,6
272	457	473	489	505	521	537	553	569	584	600	2 3,2
273	616	632	648	664	680	696	712	727	743	759	3 4,8
274	775	791	807	823	838	854	870	886	902	917	4 6,4
275	933	949	965	981	996	*012	*028	*044	*059	*075	5 8,0
276	44 091	107	122	138	154	170	185	201	217	232	6 9,6
277	248	264	279	295	311	326	342	358	373	389	7 11,2
278	404	420	436	451	467	483	498	514	529	545	8 12,8
279	560	576	592	607	623	638	654	669	685	700	9 14,4
280	716	731	747	762	778	793	809	824	840	855	**15**
281	871	886	902	917	932	948	963	979	994	*010	1 1,5
282	45 025	040	056	071	086	102	117	133	148	163	2 3,0
283	179	194	209	225	240	255	271	286	301	317	3 4,5
284	332	347	362	378	393	408	423	439	454	469	4 6,0
285	484	500	515	530	545	561	576	591	606	621	5 7,5
286	637	652	667	682	697	712	728	743	758	773	6 9,0
287	788	803	818	834	849	864	879	894	909	924	7 10,5
288	939	954	969	984	*000	*015	*030	*045	*060	*075	8 12,0
289	46 090	105	120	135	150	165	180	195	210	225	9 13,5
290	240	255	270	285	300	315	330	345	359	374	**14**
291	389	404	419	434	449	464	479	494	509	523	1 1,4
292	538	553	568	583	598	613	627	642	657	672	2 2,8
293	687	702	716	731	746	761	776	790	805	820	3 4,2
294	835	850	864	879	894	909	923	938	953	967	4 5,6
295	982	997	*012	*026	*041	*056	*070	*085	*100	*114	5 7,0
296	47 129	144	159	173	188	202	217	232	246	261	6 8,4
297	276	290	305	319	334	349	363	378	392	407	7 9,8
298	422	436	451	465	480	494	509	524	538	553	8 11,2
299	567	582	596	611	625	640	654	669	683	698	9 12,6
300	712	727	741	756	770	784	799	813	828	842	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
300	47 712	727	741	756	770	784	799	813	828	842	
301	857	871	885	900	914	929	943	958	972	986	
302	48 001	015	029	044	058	073	087	101	116	130	
303	144	159	173	187	202	216	230	244	259	273	**15**
304	287	302	316	330	344	359	373	387	401	416	1 | 1,5
305	430	444	458	473	487	501	515	530	544	558	2 | 3,0
306	572	586	601	615	629	643	657	671	686	700	3 | 4,5
307	714	728	742	756	770	785	799	813	827	841	4 | 6,0
308	855	869	883	897	911	926	940	954	968	982	5 | 7,5
309	996	*010	*024	*038	*052	*066	*080	*094	*108	*122	6 | 9,0
											7 | 10,5
310	49 136	150	164	178	192	206	220	234	248	262	8 | 12,0
311	276	290	304	318	332	346	360	374	388	402	9 | 13,5
312	415	429	443	457	471	485	499	513	527	541	
313	554	568	582	596	610	624	638	651	665	679	
314	693	707	721	734	748	762	776	790	803	817	
315	831	845	859	872	886	900	914	927	941	955	**14**
316	969	982	996	*010	*024	*037	*051	*065	*079	*092	1 | 1,4
317	50 106	120	133	147	161	174	188	202	215	229	2 | 2,8
318	243	256	270	284	297	311	325	338	352	365	3 | 4,2
319	379	393	406	420	433	447	461	474	488	501	4 | 5,6
											5 | 7,0
320	515	529	542	556	569	583	596	610	623	637	6 | 8,4
321	651	664	678	691	705	718	732	745	759	772	7 | 9,8
322	786	799	813	826	840	853	866	880	893	907	8 | 11,2
323	920	934	947	961	974	987	*001	*014	*028	*041	9 | 12,6
324	51 055	068	081	095	108	121	135	148	162	175	
325	188	202	215	228	242	255	268	282	295	308	
326	322	335	348	362	375	388	402	415	428	441	
327	455	468	481	495	508	521	534	548	561	574	**13**
328	587	601	614	627	640	654	667	680	693	706	1 | 1,3
329	720	733	746	759	772	786	799	812	825	838	2 | 2,6
											3 | 3,9
330	851	865	878	891	904	917	930	943	957	970	4 | 5,2
331	983	996	*009	*022	*035	*048	*061	*075	*088	*101	5 | 6,5
332	52 114	127	140	153	166	179	192	205	218	231	6 | 7,8
333	244	257	270	284	297	310	323	336	349	362	7 | 9,1
334	375	388	401	414	427	440	453	466	479	492	8 | 10,4
335	504	517	530	543	556	569	582	595	608	621	9 | 11,7
336	634	647	660	673	686	699	711	724	737	750	
337	763	776	789	802	815	827	840	853	866	879	
338	892	905	917	930	943	956	969	982	994	*007	
339	53 020	033	046	058	071	084	097	110	122	135	**12**
											1 | 1,2
340	148	161	173	186	199	212	224	237	250	263	2 | 2,4
341	275	288	301	314	326	339	352	364	377	390	3 | 3,6
342	403	415	428	441	453	466	479	491	504	517	4 | 4,8
343	529	542	555	567	580	593	605	618	631	643	5 | 6,0
344	656	668	681	694	706	719	732	744	757	769	6 | 7,2
345	782	794	807	820	832	845	857	870	882	895	7 | 8,4
346	908	920	933	945	958	970	983	995	*008	*020	8 | 9,6
347	54 033	045	058	070	083	095	108	120	133	145	9 | 10,8
348	158	170	183	195	208	220	233	245	258	270	
349	283	295	307	320	332	345	357	370	382	394	
350	407	419	432	444	456	469	481	494	506	518	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
350	54 407	419	432	444	456	469	481	494	506	518	
351	531	543	555	568	580	593	605	617	630	642	
352	654	667	679	691	704	716	728	741	753	765	
353	777	790	802	814	827	839	851	864	876	888	**13**
354	900	913	925	937	949	962	974	986	998	*011	1 1,3
355	55 023	035	047	060	072	084	096	108	121	133	2 2,6
356	145	157	169	182	194	206	218	230	242	255	3 3,9
357	267	279	291	303	315	328	340	352	364	376	4 5,2
358	388	400	413	425	437	449	461	473	485	497	5 6,5
359	509	522	534	546	558	570	582	594	606	618	6 7,8
											7 9,1
360	630	642	654	666	678	691	703	715	727	739	8 10,4
361	751	763	775	787	799	811	823	835	847	859	9 11,7
362	871	883	895	907	919	931	943	955	967	979	
363	991	*003	*015	*027	*038	*050	*062	*074	*086	*098	
364	56 110	122	134	146	158	170	182	194	205	217	
265	229	241	253	265	277	289	301	312	324	336	**12**
366	348	360	372	384	396	407	419	431	443	455	1 1,2
367	467	478	490	502	514	526	538	549	561	573	2 2,4
368	585	597	608	620	632	644	656	667	679	691	3 3,6
369	703	714	726	738	750	761	773	785	797	808	4 4,8
											5 6,0
370	820	832	844	855	867	879	891	902	914	926	6 7,2
371	937	949	961	972	984	996	*008	*019	*031	*043	7 8,4
372	57 054	066	078	089	101	113	124	136	148	159	8 9,6
373	171	183	194	206	217	229	241	252	264	276	9 10,8
374	287	299	310	322	334	345	357	368	380	392	
375	403	415	426	438	449	461	473	484	496	507	
376	519	530	542	553	565	576	588	600	611	623	
377	634	646	657	669	680	692	703	715	726	738	**11**
378	749	761	772	784	795	807	818	830	841	852	1 1,1
379	864	875	887	898	910	921	933	944	955	967	2 2,2
											3 3,3
380	978	990	*001	*013	*024	*035	*047	*058	*070	*081	4 4,4
381	58 092	104	115	127	138	149	161	172	184	195	5 5 5
382	206	218	229	240	252	263	274	286	297	309	6 6,6
383	320	331	343	354	365	377	388	399	410	422	7 7,7
384	433	444	456	467	478	490	501	512	524	535	8 8,8
385	546	557	569	580	591	602	614	625	636	647	9 9,9
386	659	670	681	692	704	715	726	737	749	760	
387	771	782	794	805	816	827	838	850	861	872	
388	883	894	906	917	928	939	950	961	973	984	
389	995	*006	*017	*028	*040	*051	*062	*073	*084	*095	**10**
											1 1,0
390	59 106	118	129	140	151	162	173	184	195	207	2 2,0
391	218	229	240	251	262	273	284	295	306	318	3 3,0
392	329	340	351	362	373	384	395	406	417	428	4 4,0
393	439	450	461	472	483	494	506	517	528	539	5 5,0
394	550	561	572	583	594	605	616	627	638	649	6 6,0
395	660	671	682	693	704	715	726	737	748	759	7 7,0
396	770	780	791	802	813	824	835	846	857	868	8 8,0
397	879	890	901	912	923	934	945	956	966	977	9 9,0
398	988	999	*010	*021	*032	*043	*054	*065	*076	*086	
399	60 097	108	119	130	141	152	163	173	184	195	
400	206	217	228	239	249	260	271	282	293	304	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

N.	0	1	2	3	4	5	6	7	8	9
400	60 206	217	228	239	249	260	271	282	293	304
401	314	325	336	347	358	369	379	390	401	412
402	423	433	444	455	466	477	487	498	509	520
403	531	541	552	563	574	584	595	606	617	627
404	638	649	660	670	681	692	703	713	724	735
405	746	756	767	778	788	799	810	821	831	842
406	853	863	874	885	895	906	917	927	938	949
407	959	970	981	991	*002	*013	*023	*034	*045	*055
408	61 066	077	087	098	109	119	130	140	151	162
409	172	183	194	204	215	225	236	247	257	268
410	278	289	300	310	321	331	342	352	363	374
411	384	395	405	416	426	437	448	458	469	479
412	490	500	511	521	532	542	553	563	574	584
413	595	606	616	627	637	648	658	669	679	690
414	700	711	721	731	742	752	763	773	784	794
415	805	815	826	836	847	857	868	878	888	899
416	909	920	930	941	951	962	972	982	993	*003
417	62 014	024	034	045	055	066	076	086	097	107
418	118	128	138	149	159	170	180	190	201	211
419	221	232	242	252	263	273	284	294	304	315
420	325	335	346	356	366	377	387	397	408	418
421	428	439	449	459	469	480	490	500	511	521
422	531	542	552	562	572	583	593	603	613	624
423	634	644	655	665	675	685	696	706	716	726
424	737	747	757	767	778	788	798	808	818	829
425	839	849	859	870	880	890	900	910	921	931
426	941	951	961	972	982	992	*002	*012	*022	*033
427	63 043	053	063	073	083	094	104	114	124	134
428	144	155	165	175	185	195	205	215	225	236
429	246	256	266	276	286	296	306	317	327	337
430	347	357	367	377	387	397	407	417	428	438
431	448	458	468	478	488	498	508	518	528	538
432	548	558	568	579	589	599	609	619	629	639
433	649	659	669	679	689	699	709	719	729	739
434	749	759	769	779	789	799	809	819	829	839
435	849	859	869	879	889	899	909	919	929	939
436	949	959	969	979	988	998	*008	*018	*028	*038
437	64 048	058	068	078	088	098	108	118	128	137
438	147	157	167	177	187	197	207	217	227	237
439	246	256	266	276	286	296	306	316	326	335
440	345	355	365	375	385	395	404	414	424	434
441	444	454	464	473	483	493	503	513	523	532
442	542	552	562	572	582	591	301	611	621	631
443	640	650	660	670	680	689	699	709	719	729
444	738	748	758	768	777	787	797	807	816	826
445	836	846	856	865	875	885	895	904	914	924
446	933	943	953	963	972	982	992	*002	*011	*021
447	65 031	040	050	060	070	079	089	099	108	118
448	128	137	147	157	167	176	186	196	205	215
449	225	234	244	254	263	273	283	292	302	312
450	321	331	341	350	360	369	379	389	398	408

Proportional parts	
11	
1	1·1
2	2·2
3	3·3
4	4·4
5	5·5
6	6·6
7	7·7
8	8·8
9	9·9
10	
1	1·0
2	2·0
3	3·0
4	4·0
5	5·0
6	6·0
7	7·0
8	8·0
9	9·0
9	
1	0·9
2	1·8
3	2·7
4	3·6
5	4·5
6	5·4
7	6·3
8	7·2
9	8·1

N. 0 1 2 3 4 5 6 7 8 9 Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
450	65 321	331	341	350	360	369	379	389	398	408
451	418	427	437	447	456	466	475	485	495	504
452	514	523	533	543	552	562	571	581	591	600
453	610	619	629	639	648	658	667	677	686	696
454	706	715	725	734	744	753	763	772	782	792
455	801	811	820	830	839	849	858	868	877	887
456	896	906	916	925	935	944	954	963	973	982
457	992	*001	*011	*020	*030	*039	*049	*058	*068	*077
458	66 087	096	106	115	124	134	143	153	162	172
459	181	191	200	210	219	229	238	247	257	266
460	276	285	295	304	314	323	332	342	351	361
461	370	380	389	398	408	417	427	436	445	455
462	464	474	483	492	502	511	521	530	539	549
463	558	567	577	586	596	605	614	624	633	642
464	652	661	671	680	689	699	708	717	727	736
465	745	755	764	773	783	792	801	811	820	829
466	839	848	857	867	876	885	894	904	913	922
467	932	941	950	960	969	978	987	997	*006	*015
468	67 025	034	043	052	062	071	080	089	099	108
469	117	127	136	145	154	164	173	182	191	201
470	210	219	228	237	247	256	265	274	284	293
471	302	311	321	330	339	348	357	367	376	385
472	394	403	413	422	431	440	449	459	468	477
473	486	495	504	514	523	532	541	550	560	569
474	578	587	596	605	614	624	633	642	651	660
475	669	679	688	697	706	715	724	733	742	752
476	761	770	779	788	797	806	815	825	834	843
477	852	861	870	879	888	897	906	916	925	934
478	943	952	961	970	979	988	997	*006	*015	*024
479	68 034	043	052	061	070	079	088	097	106	115
480	124	133	142	151	160	169	178	187	196	205
481	215	224	233	242	251	260	269	278	287	296
482	305	314	323	332	341	350	359	368	377	386
483	395	404	413	422	431	440	449	458	467	476
484	485	494	502	511	520	529	538	547	556	565
485	574	583	592	601	610	619	628	637	646	655
486	664	673	681	690	699	708	717	726	735	744
487	753	762	771	780	789	797	806	815	824	833
488	842	851	860	869	878	886	895	904	913	922
489	931	940	949	958	966	975	984	993	*002	*011
490	69 020	028	037	046	055	064	073	082	090	099
491	108	117	126	135	144	152	161	170	179	188
492	197	205	214	223	232	241	249	258	267	276
493	285	294	302	311	320	329	338	346	355	364
494	373	381	390	399	408	417	425	434	443	452
495	461	469	478	487	496	504	513	522	531	539
496	548	557	566	574	583	592	601	609	618	627
497	636	644	653	662	671	679	688	697	705	714
498	723	732	740	749	758	767	775	784	793	801
499	810	819	827	836	845	854	862	871	880	888
500	897	906	914	923	932	940	949	958	966	975

Proportional parts	
	10
1	1·0
2	2·0
3	3·0
4	4·0
5	5·0
6	6·0
7	7·0
8	8·0
9	9·0
	9
1	0·9
2	1·8
3	2·7
4	3·6
5	4·5
6	5·4
7	6·3
8	7·2
9	8·1
	8
1	0·8
2	1·6
3	2·4
4	3·2
5	4·0
6	4·8
7	5·6
8	6·4
9	7·2

N. 0 1 2 3 4 5 6 7 8 9 Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
500	69 897	906	914	923	932	940	949	958	966	975
501	984	992	*001	*010	*018	*027	*036	*044	*053	*062
502	70 070	079	088	096	105	114	122	131	140	148
503	157	165	174	183	191	200	209	217	226	234
504	243	252	260	269	278	286	295	303	312	321
505	329	338	346	355	364	372	381	389	398	406
506	415	424	432	441	449	458	467	475	484	492
507	501	509	518	526	535	544	552	561	569	578
508	586	595	603	612	621	629	638	646	655	663
509	672	680	689	697	706	714	723	731	740	749
510	757	766	774	783	791	800	808	817	825	834
511	842	851	859	868	876	885	893	902	910	919
512	927	935	944	952	961	969	978	986	995	*003
513	71 012	020	029	037	046	054	063	071	079	088
514	096	105	113	122	130	139	147	155	164	172
515	181	189	198	206	214	223	231	240	248	257
516	265	273	282	290	299	307	315	324	332	341
517	349	357	366	374	383	391	399	408	416	425
518	433	441	450	458	466	475	483	492	500	508
519	517	525	533	542	550	559	567	575	584	592
520	600	609	617	625	634	642	650	659	667	675
521	684	692	700	709	717	725	734	742	750	759
522	767	775	784	792	800	809	817	825	834	842
523	850	858	867	875	883	892	900	908	917	925
524	933	941	950	958	966	975	983	991	999	*008
525	72 016	024	032	041	049	057	066	074	082	090
526	099	107	115	123	132	140	148	156	165	173
527	181	189	198	206	214	222	230	239	247	255
528	263	272	280	288	296	304	313	321	329	337
529	346	354	362	370	378	387	395	403	411	419
530	428	436	444	452	460	469	477	485	493	501
531	509	518	526	534	542	550	558	567	575	583
532	591	599	607	616	624	632	640	648	656	665
533	673	681	689	697	705	713	722	730	738	746
534	754	762	770	779	787	795	803	811	819	827
535	835	843	852	860	868	876	884	892	900	908
536	916	925	933	941	949	957	965	973	981	989
537	997	*006	*014	*022	*030	*038	*046	*054	*062	*070
538	73 078	086	094	102	111	119	127	135	143	151
539	159	167	175	183	191	199	207	215	223	231
540	239	247	255	263	272	280	288	296	304	312
541	320	328	336	344	352	360	368	376	384	392
542	400	408	416	424	432	440	448	456	464	472
543	480	488	496	504	512	520	528	536	544	552
544	560	568	576	584	592	600	608	616	624	632
545	640	648	656	664	672	679	687	695	703	711
546	719	727	735	743	751	759	767	775	783	791
547	799	807	815	823	830	838	846	854	862	870
548	878	886	894	902	910	918	926	933	941	949
549	957	965	973	981	989	997	*005	*013	*020	*028
550	74 036	044	052	060	068	076	084	092	099	107

Proportional parts	
	9
1	0·9
2	1·8
3	2·7
4	3·6
5	4·5
6	5·4
7	6·3
3	7·2
9	8·1
	8
1	0·8
2	1·6
3	2·4
4	3·2
5	4·0
6	4·8
7	5·6
8	6·4
9	7·2
	7
1	0·7
2	1·4
3	2·1
4	2·8
5	3·5
6	4·2
7	4·9
8	5·6
9	6·3

N. 0 1 2 3 4 5 6 7 8 9 Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
550	74 036	044	052	060	068	076	084	092	099	107
551	115	123	131	139	147	155	162	170	178	186
552	194	202	210	218	225	233	241	249	257	265
553	273	280	288	296	304	312	320	327	335	343
554	351	359	367	374	382	390	398	406	414	421
555	429	437	445	453	461	468	476	484	492	500
556	507	515	523	531	539	547	554	562	570	578
557	586	593	601	609	617	624	632	640	648	656
558	663	671	679	687	695	702	710	718	726	733
559	741	749	757	764	772	780	788	796	803	811
560	819	827	834	842	850	858	865	873	881	889
561	896	904	912	920	927	935	943	950	958	966
562	974	981	989	997	*005	*012	*020	*028	*035	*043
563	75 051	059	066	074	082	089	097	105	113	120
564	128	136	143	151	159	166	174	182	189	197
565	205	213	220	228	236	243	251	259	266	274
566	282	289	297	305	312	320	328	335	343	351
567	358	366	374	381	389	397	404	412	420	427
568	435	442	450	458	465	473	481	488	496	504
569	511	519	526	534	542	549	557	565	572	580
570	587	595	603	610	618	626	633	641	648	656
571	664	671	679	686	694	702	709	717	724	732
572	740	747	755	762	770	778	785	793	800	808
573	815	823	831	838	846	853	861	868	876	884
574	891	899	906	914	921	929	937	944	952	959
575	967	974	982	989	997	*005	*012	*020	*027	*035
576	76 042	050	057	065	072	080	087	095	103	110
577	118	125	133	140	148	155	163	170	178	185
578	193	200	208	215	223	230	238	245	253	260
579	268	275	283	290	298	305	313	320	328	335
580	343	350	358	365	373	380	388	395	403	410
581	418	425	433	440	448	455	462	470	477	485
582	492	500	507	515	522	530	537	545	552	559
583	567	574	582	589	597	604	612	619	626	634
584	641	649	656	664	671	678	686	693	701	708
585	716	723	730	738	745	753	760	768	775	782
586	790	797	805	812	819	827	834	842	849	856
587	864	871	879	886	893	901	908	916	923	930
588	938	945	953	960	967	975	982	989	997	*004
589	77 012	019	026	034	041	048	056	063	070	078
590	085	093	100	107	115	122	129	137	144	151
591	159	166	173	181	188	195	203	210	217	225
592	232	240	247	254	262	269	276	283	291	298
593	305	313	320	327	335	342	349	357	364	371
594	379	386	393	401	408	415	422	430	437	444
595	452	459	466	474	481	488	495	503	510	517
596	525	532	539	546	554	561	568	576	583	590
597	597	605	612	619	627	634	641	648	656	663
598	670	677	685	692	699	706	714	721	728	735
599	743	750	757	764	772	779	786	793	801	808
600	815	822	830	837	844	851	859	866	873	880

Proportional parts	
	8
1	0·8
2	1·6
3	2·4
4	3·2
5	4·0
6	4·8
7	5·6
8	6·4
9	7·2
	7
1	0·7
2	1·4
3	2·1
4	2·8
5	3·5
6	4·2
7	4·9
8	5·6
9	6·3

N. 0 1 2 3 4 5 6 7 8 9 Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
600	77 815	822	830	837	844	851	859	866	873	880
601	887	895	902	909	916	924	931	938	945	952
602	960	967	974	981	988	996	*003	*010	*017	*025
603	78 032	059	046	053	061	068	075	082	089	097
604	104	111	118	125	132	140	147	154	161	168
605	176	183	190	197	204	211	219	226	233	240
606	247	254	262	269	276	283	290	297	305	312
607	319	326	333	340	347	355	362	369	376	383
608	390	398	405	412	419	426	433	440	447	455
609	462	469	476	483	490	497	504	512	519	526
610	533	540	547	554	561	569	576	583	590	597
611	604	611	618	625	633	640	647	654	661	668
612	675	682	689	696	704	711	718	725	732	739
613	746	753	760	767	774	781	789	796	803	810
614	817	824	831	838	845	852	859	866	873	880
615	888	895	902	909	916	923	930	937	944	951
616	958	965	972	979	986	993	*000	*007	*014	*021
617	79 029	036	043	050	057	064	071	078	085	092
618	099	106	113	120	127	134	141	148	155	162
619	169	176	183	190	197	204	211	218	225	232
620	239	246	253	260	267	274	281	288	295	302
621	309	316	323	330	337	344	351	358	365	372
622	379	386	393	400	407	414	421	428	435	442
623	449	456	463	470	477	484	491	498	505	511
624	518	525	532	539	546	553	560	567	574	581
625	588	595	602	609	616	623	630	637	644	650
626	657	664	671	678	685	692	699	706	713	720
627	727	734	741	748	754	761	768	775	782	789
628	796	803	810	817	824	831	837	844	851	858
629	865	872	879	886	893	900	906	913	920	927
630	934	941	948	955	962	969	975	982	989	996
631	80 003	010	017	024	030	037	044	051	058	065
332	072	079	085	092	099	106	113	120	127	134
633	140	147	154	161	168	175	182	188	195	202
634	209	216	223	229	236	243	250	257	264	271
635	277	284	291	298	305	312	318	325	332	339
636	346	353	359	366	373	380	387	393	400	407
637	414	421	428	434	441	448	455	462	468	475
638	482	489	496	502	509	516	523	530	536	543
639	550	557	564	570	577	584	591	598	604	611
640	618	625	632	638	645	652	659	665	672	679
641	686	693	699	706	713	720	726	733	740	747
642	754	760	767	774	781	787	794	801	808	814
643	821	828	835	841	848	855	862	868	875	882
644	889	895	902	909	916	922	929	936	943	949
645	956	963	969	976	983	990	996	*003	*010	*017
646	81 023	030	037	043	050	057	064	070	077	084
647	090	097	104	111	117	124	131	137	144	151
648	158	164	171	178	184	191	198	204	211	218
649	224	231	238	245	251	258	265	271	278	285
650	291	298	305	311	318	325	331	338	345	351

Proportional parts	
8	
1	0·8
2	1·6
3	2·4
4	3·2
5	4·0
6	4·8
7	5·6
8	6·4
9	7·2
7	
1	0·7
2	1·4
3	2·1
4	2·8
5	3·5
6	4·2
7	4·9
8	5·6
9	6·3
6	
1	0·6
2	1·2
3	1·8
4	2·4
5	3·0
6	3·6
7	4·2
8	4·8
9	5·4

N. 0 1 2 3 4 5 6 7 8 9 Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
650	81 291	298	305	311	318	325	331	338	345	351
651	358	365	371	378	385	391	398	405	411	418
652	425	431	438	445	451	458	465	471	478	485
653	491	498	505	511	518	525	531	538	544	551
654	558	564	571	578	584	591	598	604	611	617
655	624	631	637	644	651	657	664	671	677	684
656	690	697	704	710	717	723	730	737	743	750
657	757	763	770	776	783	790	796	803	809	816
658	823	829	836	842	849	856	862	869	875	882
659	889	895	902	908	915	921	928	935	941	948
660	954	961	968	974	981	987	994	*000	*007	*014
661	82 020	027	033	040	046	053	060	066	073	079
662	086	092	099	105	112	119	125	132	138	145
663	151	158	164	171	178	184	191	197	204	210
664	217	223	230	236	243	249	256	263	269	276
665	282	289	295	302	308	315	321	328	334	341
666	347	354	360	367	373	380	387	393	400	406
667	413	419	426	432	439	445	452	458	465	471
668	478	484	491	497	504	510	517	523	530	536
669	543	549	556	562	569	575	582	588	595	601
670	607	614	620	627	633	640	646	653	659	666
671	672	679	685	692	698	705	711	718	724	730
672	737	743	750	756	763	769	776	782	789	795
673	802	808	814	821	827	834	840	847	853	860
674	866	872	879	885	892	898	905	911	918	924
675	930	937	943	950	956	963	969	975	982	988
676	995	*001	*008	*014	*020	*027	*033	*040	*046	*052
677	83 059	065	072	078	085	091	097	104	110	117
678	123	129	136	142	149	155	161	168	174	181
679	187	193	200	206	213	219	225	232	238	245
680	251	257	264	270	276	283	289	296	302	308
681	315	321	327	334	340	347	353	359	366	372
682	378	385	391	398	404	410	417	423	429	436
683	442	448	455	461	467	474	480	487	493	499
684	506	512	518	525	531	537	544	550	556	563
685	569	575	582	588	594	601	607	613	620	626
686	632	639	645	651	658	664	670	677	683	689
687	696	702	708	715	721	727	734	740	746	753
688	759	765	771	778	784	790	797	803	809	816
689	822	828	835	841	847	853	860	866	872	879
690	885	891	897	904	910	916	923	929	935	942
691	948	954	960	967	973	979	985	992	998	*004
692	84 011	017	023	029	036	042	048	055	061	067
693	073	080	086	092	098	105	111	117	123	130
694	136	142	148	155	161	167	173	180	186	192
695	198	205	211	217	223	230	236	242	248	255
696	261	267	273	280	286	292	298	305	311	317
697	323	330	336	342	348	354	361	367	373	379
698	386	392	398	404	410	417	423	429	435	442
699	448	454	460	466	473	479	485	491	497	504
700	510	516	522	528	535	541	547	553	559	566

Proportional parts	
7	
1	0·7
2	1·4
3	2·1
4	2·8
5	3·5
6	4·2
7	4·9
8	5·6
9	6·3
6	
1	0·6
2	1·2
3	1·8
4	2·4
5	3·0
6	3·6
7	4·2
8	4 8
9	5·4

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
700	84 510	516	522	528	535	541	547	553	559	566
701	572	578	584	590	597	603	609	615	621	628
702	634	640	646	652	658	665	671	677	683	689
703	696	702	708	714	720	726	733	739	745	751
704	757	763	770	776	782	788	794	800	807	813
705	819	825	831	837	844	850	856	862	868	874
706	880	887	893	899	905	911	917	924	930	936
707	942	948	954	960	967	973	979	985	991	997
708	85 003	009	016	022	028	034	040	046	052	058
709	065	071	077	083	089	095	101	107	114	120
710	126	132	138	144	150	156	163	169	175	181
711	187	193	199	205	211	217	224	230	236	242
712	248	254	260	266	272	278	285	291	297	303
713	309	315	321	327	333	339	345	352	358	364
714	370	376	382	388	394	400	406	412	418	425
715	431	437	443	449	455	461	467	473	479	485
716	491	497	503	509	516	522	528	534	540	546
717	552	558	564	570	576	582	588	594	600	606
718	612	618	625	631	637	643	649	655	661	667
719	673	679	685	691	697	703	709	715	721	727
720	733	739	745	751	757	763	769	775	781	788
721	794	800	806	812	818	824	830	836	842	848
722	854	860	866	872	878	884	890	896	902	908
723	914	920	926	932	938	944	950	956	962	968
724	974	980	986	992	998	*004	*010	*016	*022	*028
725	86 034	040	046	052	058	064	070	076	082	088
726	094	100	106	112	118	124	130	136	141	147
727	153	159	165	171	177	183	189	195	201	207
728	213	219	225	231	237	243	249	255	261	267
729	273	279	285	291	297	303	308	314	320	326
730	332	338	344	350	356	362	368	374	380	386
731	392	398	404	410	415	421	427	433	439	445
732	451	457	463	469	475	481	487	493	499	504
733	510	516	522	528	534	540	546	552	558	564
734	570	576	581	587	593	599	605	611	617	623
735	629	635	641	646	652	658	664	670	676	682
736	688	694	700	705	711	717	723	729	735	741
737	747	753	759	764	770	776	782	788	794	800
738	806	812	817	823	829	835	841	847	853	859
739	864	870	876	882	888	894	900	906	911	917
740	923	929	935	941	947	953	958	964	970	976
741	982	988	994	999	*005	*011	*017	*023	*029	*035
742	87 040	046	052	058	064	070	075	081	087	093
743	099	105	111	116	122	128	134	140	146	151
744	157	163	169	175	181	186	192	198	204	210
745	216	221	227	233	239	245	251	256	262	268
746	274	280	286	291	297	303	309	315	320	326
747	332	338	344	349	355	361	367	373	379	384
748	390	396	402	408	413	419	425	431	437	442
749	448	454	460	466	471	477	483	489	495	500
750	506	512	518	523	529	535	541	547	552	558

Proportional parts	
7	
1	0·7
2	1·4
3	2·1
4	2·8
5	3·5
6	4·2
7	4·9
8	5·6
9	6·3
6	
1	0·6
2	1·2
3	1·8
4	2·4
5	3·0
6	3·6
7	4·2
8	4·8
9	5·4
5	
1	0·5
2	1·0
3	1·5
4	2·0
5	2·5
6	3·0
7	3·5
8	4·0
9	4·5

N. 0 1 2 3 4 5 6 7 8 9 Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
750	87 506	512	518	523	529	535	541	547	552	558
751	564	570	576	581	587	593	599	604	610	616
752	622	628	633	639	645	651	656	662	668	674
753	679	685	691	697	703	708	714	720	726	731
754	737	743	749	754	760	766	772	777	783	789
755	795	800	806	812	818	823	829	835	841	846
756	852	858	864	869	875	881	887	892	898	904
757	910	915	921	927	933	938	944	950	955	961
758	967	973	978	984	990	996	*001	*007	*013	*018
759	88 024	030	036	041	047	053	058	064	070	076
760	081	087	093	098	104	110	116	121	127	133
761	138	144	150	156	161	167	173	178	184	190
762	195	201	207	213	218	224	230	235	241	247
763	252	258	264	270	275	281	287	292	298	304
764	309	315	321	326	332	338	343	349	355	360
765	366	372	377	383	389	395	400	406	412	417
766	423	429	434	440	446	451	457	463	468	474
767	480	485	491	497	502	508	513	519	525	530
768	536	542	547	553	559	564	570	576	581	587
769	593	598	604	610	615	621	627	632	638	643
770	649	655	660	666	672	677	683	689	694	700
771	705	711	717	722	728	734	739	745	750	756
772	762	767	773	779	784	790	795	801	807	812
773	818	824	829	835	840	846	852	857	863	868
774	874	880	885	891	897	902	908	913	919	925
775	930	936	941	947	953	958	964	969	975	981
776	986	992	997	*003	*009	*014	*020	*025	*031	*037
777	89 042	048	053	059	064	070	076	081	087	092
778	098	104	109	115	120	126	131	137	143	148
779	154	159	165	170	176	182	187	193	198	204
780	209	215	221	226	232	237	243	248	254	260
781	265	271	276	282	287	293	298	304	310	315
782	321	326	332	337	343	348	354	360	365	371
783	376	382	387	393	398	404	409	415	421	426
784	432	437	443	448	454	459	465	470	476	481
785	487	492	498	504	509	515	520	526	531	537
786	542	548	553	559	564	570	575	581	586	592
787	597	603	609	614	620	625	631	636	642	647
788	653	658	664	669	675	680	686	691	697	702
789	708	713	719	724	730	735	741	746	752	757
790	763	768	774	779	785	790	796	801	807	812
791	818	823	829	834	840	845	851	856	862	867
792	873	878	883	889	894	900	905	911	916	922
793	927	933	938	944	949	955	960	966	971	977
794	982	988	993	998	*004	*009	*015	*020	*026	*031
795	90 037	042	048	053	059	064	069	075	080	086
796	091	097	102	108	113	119	124	129	135	140
797	146	151	157	162	168	173	179	184	189	195
798	200	206	211	217	222	227	233	238	244	249
799	255	260	266	271	276	282	287	293	298	304
800	309	314	320	325	331	336	342	347	352	358

Proportional parts	
	6
1	0·6
2	1·2
3	1·8
4	2·4
5	3·0
6	3·6
7	4·2
8	4·8
9	5·4
	5
1	0·5
2	1·0
3	1·5
4	2·0
5	2·5
6	3·0
7	3·5
8	4·0
9	4·5

N. 0 1 2 3 4 5 6 7 8 9 Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
800	90 309	314	320	325	331	336	342	347	352	358	
801	363	369	374	380	385	390	396	401	407	412	
802	417	423	428	434	439	445	450	455	461	466	
803	472	477	482	488	493	499	504	509	515	520	
804	526	531	536	542	547	553	558	563	569	574	
805	580	585	590	596	601	607	612	617	623	628	
806	634	639	644	650	655	660	666	671	677	682	
807	687	693	698	703	709	714	720	725	730	736	
808	741	747	752	757	763	768	773	779	784	789	
809	795	800	806	811	816	822	827	832	838	843	
810	849	854	859	865	870	875	881	886	891	897	**6**
811	902	907	913	918	924	929	934	940	945	950	1 | 0·6
812	956	961	966	972	977	982	988	993	998	*004	2 | 1·2
813	91 009	014	020	025	030	036	041	046	052	057	3 | 1·8
814	062	068	073	078	084	089	094	100	105	110	4 | 2·4
815	116	121	126	132	137	142	148	153	158	164	5 | 3·0
816	169	174	180	185	190	196	201	206	212	217	6 | 3·6
817	222	228	233	238	243	249	254	259	265	270	7 | 4·2
818	275	281	286	291	297	302	307	312	318	323	8 | 4·8
819	328	334	339	344	350	355	360	365	371	376	9 | 5·4
820	381	387	392	397	403	408	413	418	424	429	
821	434	440	445	450	455	461	466	471	477	482	
822	487	492	498	503	508	514	519	524	529	535	
823	540	545	551	556	561	566	572	577	582	587	
824	593	598	603	609	614	619	624	630	635	640	
825	645	651	656	661	666	672	677	682	687	693	
826	698	703	709	714	719	724	730	735	740	745	
827	751	756	761	766	772	777	782	787	793	798	
828	803	808	814	819	824	829	834	840	845	850	
829	855	861	866	871	876	882	887	892	897	903	
830	908	913	918	924	929	934	939	944	950	955	**5**
831	960	965	971	976	981	986	991	997	*002	*007	1 | 0·5
832	92 012	018	023	028	033	038	044	049	054	059	2 | 1·0
833	065	070	075	080	085	091	096	101	106	111	3 | 1·5
834	117	122	127	132	137	143	148	153	158	163	4 | 2·0
835	169	174	179	184	189	195	200	205	210	215	5 | 2·5
836	221	226	231	236	241	247	252	257	262	267	6 | 3·0
837	273	278	283	288	293	298	304	309	314	319	7 | 3·5
838	324	330	335	340	345	350	355	361	366	371	8 | 4·0
839	376	381	387	392	397	402	407	412	418	423	9 | 4·5
840	428	433	438	443	449	454	459	464	469	474	
841	480	485	490	495	500	505	511	516	521	526	
842	531	536	542	547	552	557	562	567	572	578	
843	583	588	593	598	603	609	614	619	624	629	
844	634	639	645	650	655	660	665	670	675	681	
845	686	691	696	701	706	711	716	722	727	732	
846	737	742	747	752	758	763	768	773	778	783	
847	788	793	799	804	809	814	819	824	829	834	
848	840	845	850	855	860	865	870	875	881	886	
849	891	896	901	906	911	916	921	927	932	937	
850	942	947	952	957	962	967	973	978	983	988	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9
850	92 942	947	952	957	962	967	973	978	983	988
851	993	998	*003	*008	*013	*018	*024	*029	*034	*039
852	93 044	049	054	059	064	069	075	080	085	090
853	095	100	105	110	115	120	125	131	136	141
854	146	151	156	161	166	171	176	181	186	192
855	197	202	207	212	217	222	227	232	237	242
856	247	252	258	263	268	273	278	283	288	293
857	298	303	308	313	318	323	328	334	339	344
858	349	354	359	364	369	374	379	384	389	394
859	399	404	409	414	420	425	430	435	440	445
860	450	455	460	465	470	475	480	485	490	495
861	500	505	510	515	520	526	531	536	541	546
862	551	556	561	566	571	576	581	586	591	596
863	601	606	611	616	621	626	631	636	641	646
864	651	656	661	666	671	676	682	687	692	697
865	702	707	712	717	722	727	732	737	742	747
866	752	757	762	767	772	777	782	787	792	797
867	802	807	812	817	822	827	832	837	842	847
868	852	857	862	867	872	877	882	887	892	897
869	902	907	912	917	922	927	932	937	942	947
870	952	957	962	967	972	977	982	987	992	997
871	94 002	007	012	017	022	027	032	037	042	047
872	052	057	062	067	072	077	082	086	091	096
873	101	106	111	116	121	126	131	136	141	146
874	151	156	161	166	171	176	181	186	191	196
875	201	206	211	216	221	226	231	236	240	245
876	250	255	260	265	270	275	280	285	290	295
877	300	305	310	315	320	325	330	335	340	345
878	349	354	359	364	369	374	379	384	389	394
879	399	404	409	414	419	424	429	433	438	443
880	448	453	458	463	468	473	478	483	488	493
881	498	503	507	512	517	522	527	532	537	542
882	547	552	557	562	567	571	576	581	586	591
883	596	601	606	611	616	621	626	630	635	640
884	645	650	655	660	665	670	675	680	685	689
885	694	699	704	709	714	719	724	729	734	738
886	743	748	753	758	763	768	773	778	783	787
887	792	797	802	807	812	817	822	827	832	836
888	841	846	851	856	861	866	871	876	880	885
889	890	895	900	905	910	915	919	924	929	934
890	939	944	949	954	959	963	968	973	978	983
891	988	993	998	*002	*007	*012	*017	*022	*027	*032
892	95 036	041	046	051	056	061	066	071	075	080
893	085	090	095	100	105	109	114	119	124	129
894	134	139	143	148	153	158	163	168	173	177
895	182	187	192	197	202	207	211	216	221	226
896	231	236	240	245	250	255	260	265	270	274
897	279	284	289	294	299	303	308	313	318	323
898	328	332	337	342	347	352	357	361	366	371
899	376	381	386	390	395	400	405	410	415	419
900	424	429	434	439	444	448	453	458	463	468

Proportional parts	
	6
1	0·6
2	1·2
3	1·8
4	2·4
5	3·0
6	3·6
7	4·2
8	4·8
9	5·4
	5
1	0·5
2	1·0
3	1·5
4	2·0
5	2·5
6	3·0
7	3·5
8	4·0
9	4·5
	4
1	0·4
2	0·8
3	1·2
4	1·6
5	2·0
6	2·4
7	2·8
8	3·2
9	3·6

N. 0 1 2 3 4 5 6 7 8 9 Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
900	95 424	429	434	439	444	448	453	458	463	468	
901	472	477	482	487	492	497	501	506	511	516	
902	521	525	530	535	540	545	550	554	559	564	
903	569	574	578	583	588	593	598	602	607	612	
904	617	622	626	631	636	641	646	650	655	660	
905	665	670	674	679	684	689	694	698	703	708	
906	713	718	722	727	732	737	742	746	751	756	
907	761	766	770	775	780	785	789	794	799	804	
908	809	813	818	823	828	832	837	842	847	852	
909	856	861	866	871	875	880	885	890	895	899	
910	904	909	914	918	923	928	933	938	942	947	**5**
911	952	957	961	966	971	976	980	985	990	995	1 | 0·5
912	999	*004	*009	*014	*019	*023	*028	*033	*038	*042	2 | 1·0
913	96 047	052	057	061	066	071	076	080	085	090	3 | 1·5
914	095	099	104	109	114	118	123	128	133	137	4 | 2·0
915	142	147	152	156	161	166	171	175	180	185	5 | 2·5
916	190	194	199	204	209	213	218	223	227	232	6 | 3·0
917	237	242	246	251	256	261	265	270	275	280	7 | 3·5
918	284	289	294	298	303	308	313	317	322	327	8 | 4·0
919	332	336	341	346	350	355	360	365	369	374	9 | 4·5
920	379	384	388	393	398	402	407	412	417	421	
921	426	431	435	440	445	450	454	459	464	468	
922	473	478	483	487	492	497	501	506	511	515	
923	520	525	530	534	539	544	548	553	558	562	
924	567	572	577	581	586	591	595	600	605	609	
925	614	619	624	628	633	638	642	647	652	656	
926	661	666	670	675	680	685	689	694	699	703	
927	708	713	717	722	727	731	736	741	745	750	
928	755	759	764	769	774	778	783	788	792	797	
929	802	806	811	816	820	825	830	834	839	844	
930	848	853	858	862	867	872	876	881	886	890	**4**
931	895	900	904	909	914	918	923	928	932	937	1 | 0·4
932	942	946	951	956	960	965	970	974	979	984	2 | 0·8
933	988	993	997	*002	*007	*011	*016	*021	*025	*030	3 | 1·2
934	97 035	039	044	049	053	058	063	067	072	077	4 | 1·6
935	081	086	090	095	100	104	109	114	118	123	5 | 2·0
936	128	132	137	142	146	151	155	160	165	169	6 | 2·4
937	174	179	183	188	192	197	202	206	211	216	7 | 2·8
938	220	225	230	234	239	243	248	253	257	262	8 | 3·2
939	267	271	276	280	285	290	294	299	304	308	9 | 3·6
940	313	317	322	327	331	336	340	345	350	354	
941	359	364	368	373	377	382	387	391	396	400	
942	405	410	414	419	424	428	433	437	442	447	
943	451	456	460	465	470	474	479	483	488	493	
944	497	502	506	511	516	520	525	529	534	539	
945	543	548	552	557	562	566	571	575	580	585	
946	589	594	598	603	607	612	617	621	626	630	
947	635	640	644	649	653	658	663	667	672	676	
948	681	685	690	695	699	704	708	713	717	722	
949	727	731	736	740	745	749	754	759	763	768	
950	772	777	782	786	791	795	800	804	809	813	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

FIVE-PLACE LOGARITHMS (Continued)

N.	0	1	2	3	4	5	6	7	8	9	Proportional parts
950	97 772	777	782	786	791	795	800	804	809	813	
951	818	823	827	832	836	841	845	850	855	859	
952	864	868	873	877	882	886	891	896	900	905	
953	909	914	918	923	928	932	937	941	946	950	
954	955	959	964	968	973	978	982	987	991	996	
955	98 000	005	009	014	019	023	028	032	037	041	
956	046	050	055	059	064	068	073	078	082	087	
957	091	096	100	105	109	114	118	123	127	132	
958	137	141	146	150	155	159	164	168	173	177	
959	182	186	191	195	200	204	209	214	218	223	
960	227	232	236	241	245	250	254	259	263	268	**5**
961	272	277	281	286	290	295	299	304	308	313	1 | 0·5
962	318	322	327	331	336	340	345	349	354	358	2 | 1·0
963	363	367	372	376	381	385	390	394	399	403	3 | 1·5
964	408	412	417	421	426	430	435	439	444	448	4 | 2·0
965	453	457	462	466	471	475	480	484	489	493	5 | 2·5
966	498	502	507	511	516	520	525	529	534	538	6 | 3·0
967	543	547	552	556	561	565	570	574	579	583	7 | 3·5
968	588	592	597	601	605	610	614	619	623	628	8 | 4·0
969	632	637	641	646	650	655	659	664	668	673	9 | 4·5
970	677	682	686	691	695	700	704	709	713	717	
971	722	726	731	735	740	744	749	753	758	762	
972	767	771	776	780	784	789	793	798	802	807	
973	811	816	820	825	829	834	838	843	847	851	
974	856	860	865	869	874	878	883	887	892	896	
975	900	905	909	914	918	923	927	932	936	941	
976	945	949	954	958	963	967	972	976	981	985	
977	989	994	998	*003	*007	*012	*016	*021	*025	*029	
978	99 034	038	043	047	052	056	061	065	069	074	
979	078	083	087	092	096	100	105	109	114	118	
980	123	127	131	136	140	145	149	154	158	162	**4**
981	167	171	176	180	185	189	193	198	202	207	1 | 0·4
982	211	216	220	224	229	233	238	242	247	251	2 | 0·8
983	255	260	264	269	273	277	282	286	291	295	3 | 1·2
984	300	304	308	313	317	322	326	330	335	339	4 | 1·6
985	344	348	352	357	361	366	370	374	379	383	5 | 2·0
986	388	392	396	401	405	410	414	419	423	427	6 | 2·4
987	432	436	441	445	449	454	458	463	467	471	7 | 2·8
988	476	480	484	489	493	498	502	506	511	515	8 | 3·2
989	520	524	528	533	537	542	546	550	555	559	9 | 3·6
990	564	568	572	577	581	585	590	594	599	603	
991	607	612	616	621	625	629	634	638	642	647	
992	651	656	660	664	669	673	677	682	686	691	
993	695	699	704	708	712	717	721	726	730	734	
994	739	743	747	752	756	760	765	769	774	778	
995	782	787	791	795	800	804	808	813	817	822	
996	826	830	835	839	843	848	852	856	861	865	
997	870	874	878	883	887	891	896	900	904	909	
998	913	917	922	926	930	935	939	944	948	952	
999	957	961	965	970	974	978	983	987	991	996	
1000	00 000	004	009	013	017	022	026	030	035	039	
N.	0	1	2	3	4	5	6	7	8	9	Proportional parts

TRIGONOMETRIC FUNCTIONS OF ANGLES

0°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.00000	1.0000	.00000	Infinite	1.0000	Infinite	60
1	.00029	.0000	.00029	3437.7	.0000	3437.7	59
2	.00058	.0000	.00058	1718.9	.0000	1718.9	58
3	.00087	.0000	.00087	1145.9	.0000	1145.9	57
4	.00116	.0000	.00116	859.44	.0000	859.44	56
5	.00145	1.0000	.00145	687.55	1.0000	687.55	55
6	.00174	.0000	.00174	572.96	.0000	572.96	54
7	.00204	.0000	.00204	491.11	.0000	491.11	53
8	.00233	.0000	.00233	429.72	.0000	429.72	52
9	.00262	.0000	.00262	381.97	.0000	381.97	51
10	.00291	.99999	.00291	343.77	1.0000	343.77	50
11	.00320	.99999	.00320	312.52	.0000	312.52	49
12	.00349	.99999	.00349	286.48	.0000	286.48	48
13	.00378	.99999	.00378	264.44	.0000	264.44	47
14	.00407	.99999	.00407	245.55	.0000	245.55	46
15	.00436	.99999	.00436	229.18	1.0000	229.18	45
16	.00465	.99999	.00465	214.86	.0000	214.86	44
17	.00494	.99999	.00494	202.22	.0000	202.22	43
18	.00524	.99999	.00524	190.98	.0000	190.99	42
19	.00553	.99998	.00553	180.93	.0000	180.93	41
20	.00582	.99998	.00582	171.88	1.0000	171.89	40
21	.00611	.99998	.00611	163.70	.0000	163.70	39
22	.00640	.99998	.00640	156.26	.0000	156.26	38
23	.00669	.99998	.00669	149.46	.0000	149.47	37
24	.00698	.99997	.00698	143.24	.0000	143.24	36
25	.00727	.99997	.00727	137.51	1.0000	137.51	35
26	.00756	.99997	.00756	132.22	.0000	132.22	34
27	.00785	.99997	.00785	127.32	.0000	127.32	33
28	.00814	.99997	.00814	122.77	.0000	122.78	32
29	.00843	.99996	.00844	118.54	.0000	118.54	31
30	.00873	.99996	.00873	114.59	1.0000	114.59	30
31	.00902	.99996	.00902	110.89	.0000	110.90	29
32	.00931	.99996	.00931	107.43	.0000	107.43	28
33	.00960	.99995	.00960	104.17	.0000	104.17	27
34	.00989	.99995	.00989	101.11	.0000	101.11	26
35	.01018	.99995	.01018	98.218	1.0000	98.223	25
36	.01047	.99994	.01047	95.489	.0000	95.495	24
37	.01076	.99994	.01076	92.908	.0000	92.914	23
38	.01105	.99994	.01105	90.463	.0001	90.469	22
39	.01134	.99993	.01134	88.143	.0001	88.149	21
40	.01163	.99993	.01164	85.940	1.0001	85.946	20
41	.01193	.99993	.01193	83.843	.0001	83.849	19
42	.01222	.99992	.01222	81.847	.0001	81.853	18
43	.01251	.99992	.01251	79.943	.0001	79.950	17
44	.01280	.99992	.01280	78.126	.0001	78.133	16
45	.01309	.99991	.01309	76.390	1.0001	76.396	15
46	.01338	.99991	.01338	74.729	.0001	74.736	14
47	.01367	.99991	.01367	73.139	.0001	73.146	13
48	.01396	.99990	.01396	71.615	.0001	71.622	12
49	.01425	.99990	.01425	70.153	.0001	70.160	11
50	.01454	.99989	.01454	68.750	1.0001	68.757	10
51	.01483	.99989	.01484	67.402	.0001	67.409	9
52	.01512	.99988	.01513	66.105	.0001	66.113	8
53	.01542	.99988	.01542	64.858	.0001	64.866	7
54	.01571	.99988	.01571	63.657	.0001	63.664	6
55	.01600	.99987	.01600	62.499	1.0001	62.507	5
56	.01629	.99987	.01629	61.383	.0001	61.391	4
57	.01658	.99987	.01658	60.306	.0001	60.314	3
58	.01687	.99986	.01687	59.266	.0001	59.274	2
59	.01716	.99985	.01716	58.261	.0001	58.270	1
60	.01745	.99985	.01745	57.290	1.0001	57.299	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

89°

1°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.01745	.99985	.01745	57.290	1.0001	57.299	60
1	.01774	.99984	.01775	56.350	.0001	56.359	59
2	.01803	.99984	.01804	55.441	.0001	55.450	58
3	.01832	.99983	.01833	54.561	.0002	54.570	57
4	.01861	.99983	.01862	53.708	.0002	53.718	56
5	.01891	.99982	.01891	52.882	1.0002	52.891	55
6	.01920	.99981	.01920	52.081	.0002	52.090	54
7	.01949	.99981	.01949	51.303	.0002	51.313	53
8	.01978	.99980	.01978	50.548	.0002	50.558	52
9	.02007	.99980	.02007	49.816	.0002	49.826	51
10	.02036	.99979	.02036	49.104	1.0002	49.114	50
11	.02065	.99979	.02066	48.412	.0002	48.422	49
12	.02094	.99978	.02095	47.739	.0002	47.750	48
13	.02123	.99977	.02124	47.085	.0002	47.096	47
14	.02152	.99977	.02153	46.449	.0002	46.460	46
15	.02181	.99976	.02182	45.829	1.0002	45.840	45
16	.02210	.99975	.02211	45.226	.0002	45.237	44
17	.02240	.99975	.02240	44.638	.0002	44.650	43
18	.02269	.99974	.02269	44.066	.0002	44.077	42
19	.02298	.99974	.02298	43.508	.0003	43.520	41
20	.02326	.99973	.02327	42.964	1.0003	42.976	40
21	.02356	.99972	.02357	42.433	.0003	42.445	39
22	.02385	.99971	.02386	41.916	.0003	41.928	38
23	.02414	.99971	.02415	41.410	.0003	41.423	37
24	.02443	.99970	.02444	40.917	.0003	40.930	36
25	.02472	.99969	.02473	40.436	1.0003	40.448	35
26	.02501	.99969	.02502	39.965	.0003	39.978	34
27	.02530	.99968	.02531	39.506	.0003	39.518	33
28	.02559	.99967	.02560	39.057	.0003	39.069	32
29	.02589	.99966	.02589	38.618	.0003	38.631	31
30	.02618	.99966	.02618	38.188	1.0003	38.201	30
31	.02647	.99965	.02648	37.769	.0003	37.782	29
32	.02676	.99964	.02677	37.358	.0003	37.371	28
33	.02705	.99963	.02706	36.956	.0004	36.969	27
34	.02734	.99963	.02735	36.563	.0004	36.576	26
35	.02763	.99962	.02764	36.177	1.0004	36.191	25
36	.02792	.99961	.02793	35.800	.0004	35.814	24
37	.02821	.99960	.02822	35.431	.0004	35.445	23
38	.02850	.99959	.02851	35.069	.0004	35.084	22
39	.02879	.99958	.02880	34.715	.0004	34.729	21
40	.02908	.99958	.02910	34.368	1.0004	34.382	20
41	.02937	.99957	.02939	34.027	.0004	34.042	19
42	.02967	.99956	.02968	33.693	.0004	33.708	18
43	.02996	.99955	.02997	33.366	.0004	33.381	17
44	.03025	.99954	.03026	33.045	.0004	33.060	16
45	.03054	.99953	.03055	32.730	1.0005	32.745	15
46	.03083	.99952	.03084	32.421	.0005	32.437	14
47	.03112	.99951	.03113	32.118	.0005	32.134	13
48	.03141	.99951	.03143	31.820	.0005	31.836	12
49	.03170	.99950	.03172	31.528	.0005	31.544	11
50	.03199	.99949	.03201	31.241	1.0005	31.257	10
51	.03228	.99948	.03230	30.960	.0005	30.976	9
52	.03257	.99947	.03259	30.683	.0005	30.699	8
53	.03286	.99946	.03288	30.411	.0005	30.428	7
54	.03315	.99945	.03317	30.145	.0005	30.161	6
55	.03344	.99944	.03346	29.882	1.0005	29.899	5
56	.03374	.99943	.03375	29.624	.0006	29.641	4
57	.03403	.99942	.03405	29.371	.0006	29.388	3
58	.03432	.99941	.03434	29.122	.0006	29.139	2
59	.03461	.99940	.03463	28.877	.0006	28.894	1
60	.03490	.99939	.03492	28.636	1.0006	28.654	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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2°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.03490	.99939	.03492	28.636	1.0006	28.654	60
1	.03519	.99938	.03521	28.399	.0006	28.417	59
2	.03548	.99937	.03550	28.166	.0006	28.184	58
3	.03577	.99936	.03579	27.937	.0006	27.955	57
4	.03606	.99935	.03608	27.712	.0006	27.730	56
5	.03635	.99934	.03638	27.490	1.0007	27.508	55
6	.03664	.99933	.03667	27.271	.0007	27.290	54
7	.03693	.99932	.03696	27.056	.0007	27.075	53
8	.03722	.99931	.03725	26.845	.0007	26.864	52
9	.03751	.99930	.03754	26.637	.0007	26.655	51
10	.03781	.99928	.03783	26.432	1.0007	26.450	50
11	.03810	.99927	.03812	26.230	.0007	26.249	49
12	.03839	.99926	.03842	26.031	.0007	26.050	48
13	.03868	.99925	.03871	25.835	.0007	25.854	47
14	.03897	.99924	.03900	25.642	.0008	25.661	46
15	.03926	.99923	.03929	25.452	1.0008	25.471	45
16	.03955	.99922	.03958	25.264	.0008	25.284	44
17	.03984	.99921	.03987	25.080	.0008	25.100	43
18	.04013	.99919	.04016	24.898	.0008	24.918	42
19	.04042	.99918	.04045	24.718	.0008	24.739	41
20	.04071	.99917	.04075	24.542	1.0008	24.562	40
21	.04100	.99916	.04104	24.367	.0008	24.388	39
22	.04129	.99915	.04133	24.196	.0008	24.216	38
23	.04158	.99913	.04162	24.026	.0009	24.047	37
24	.04187	.99912	.04191	23.859	.0009	23.880	36
25	.04217	.99911	.04220	23.694	1.0009	23.716	35
26	.04246	.99910	.04249	23.532	.0009	23.553	34
27	.04275	.99908	.04279	23.372	.0009	23.393	33
28	.04304	.99907	.04308	23.214	.0009	23.235	32
29	.04333	.99906	.04337	23.058	.0009	23.079	31
30	.04362	.99905	.04366	22.904	1.0009	22.925	30
31	.04391	.99903	.04395	22.752	.0010	22.774	29
32	.04420	.99902	.04424	22.602	.0010	22.624	28
33	.04449	.99901	.04453	22.454	.0010	22.476	27
34	.04478	.99900	.04483	22.308	.0010	22.330	26
35	.04507	.99898	.04512	22.164	1.0010	22.186	25
36	.04536	.99897	.04541	22.022	.0010	22.044	24
37	.04565	.99896	.04570	21.881	.0010	21.904	23
38	.04594	.99894	.04599	21.742	.0010	21.765	22
39	.04623	.99893	.04628	21.606	.0011	21.629	21
40	.04652	.99892	.04657	21.470	1.0011	21.494	20
41	.04681	.99890	.04687	21.337	.0011	21.360	19
42	.04711	.99889	.04716	21.205	.0011	21.228	18
43	.04740	.99888	.04745	21.075	.0011	21.098	17
44	.04769	.99886	.04774	20.946	.0011	20.970	16
45	.04798	.99885	.04803	20.819	1.0011	20.843	15
46	.04827	.99883	.04832	20.693	.0012	20.717	14
47	.04856	.99882	.04862	20.569	.0012	20.593	13
48	.04885	.99881	.04891	20.446	.0012	20.471	12
49	.04914	.99879	.04920	20.325	.0012	20.350	11
50	.04943	.99878	.04949	20.205	1.0012	20.230	10
51	.04972	.99876	.04978	20.087	.0012	20.112	9
52	.05001	.99875	.05007	19.970	.0012	19.995	8
53	.05030	.99873	.05037	19.854	.0013	19.880	7
54	.05059	.99872	.05066	19.740	.0013	19.766	6
55	.05088	.99870	.05095	19.627	1.0013	19.653	5
56	.05117	.99869	.05124	19.515	.0013	19.541	4
57	.05146	.99867	.05153	19.405	.0013	19.431	3
58	.05175	.99866	.05182	19.296	.0013	19.322	2
59	.05204	.99864	.05212	19.188	.0013	19.214	1
60	.05234	.99863	.05241	19.081	1.0014	19.107	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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3°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.05234	.99863	.05241	19.081	1.0014	19.107	60
1	.05263	.99861	.05270	18.975	.0014	19.002	59
2	.05292	.99860	.05299	18.871	.0014	18.897	58
3	.05321	.99858	.05328	18.768	.0014	18.794	57
4	.05350	.99857	.05357	18.665	.0014	18.692	56
5	.05379	.99855	.05387	18.564	1.0014	18.591	55
6	.05408	.99854	.05416	18.464	.0015	18.491	54
7	.05437	.99852	.05445	18.365	.0015	18.393	53
8	.05466	.99850	.05474	18.268	.0015	18.295	52
9	.05495	.99849	.05503	18.171	.0015	18.198	51
10	.05524	.99847	.05532	18.075	1.0015	18.103	50
11	.05553	.99846	.05562	17.980	.0015	18.008	49
12	.05582	.99844	.05591	17.886	.0016	17.914	48
13	.05611	.99842	.05620	17.793	.0016	17.821	47
14	.05640	.99841	.05649	17.701	.0016	17.730	46
15	.05669	.99839	.05678	17.610	1.0016	17.639	45
16	.05698	.99837	.05707	17.520	.0016	17.549	44
17	.05727	.99836	.05737	17.431	.0016	17.460	43
18	.05756	.99834	.05766	17.343	.0017	17.372	42
19	.05785	.99832	.05795	17.256	.0017	17.285	41
20	.05814	.99831	.05824	17.169	1.0017	17.198	40
21	.05843	.99829	.05853	17.084	.0017	17.113	39
22	.05872	.99827	.05883	16.999	.0017	17.028	38
23	.05902	.99826	.05912	16.915	.0017	16.944	37
24	.05931	.99824	.05941	16.832	.0018	16.861	36
25	.05960	.99822	.05970	16.750	1.0018	16.779	35
26	.05989	.99820	.05999	16.668	.0018	16.698	34
27	.06018	.99819	.06029	16.587	.0018	16.617	33
28	.06047	.99817	.06058	16.507	.0018	16.538	32
29	.06076	.99815	.06087	16.428	.0018	16.459	31
30	.06105	.99813	.06116	16.350	1.0019	16.380	30
31	.06134	.99812	.06145	16.272	.0019	16.303	29
32	.06163	.99810	.06175	16.195	.0019	16.226	28
33	.06192	.99808	.06204	16.119	.0019	16.150	27
34	.06221	.99806	.06233	16.043	.0019	16.075	26
35	.06250	.99804	.06262	15.969	1.0019	16.000	25
36	.06279	.99803	.06291	15.894	.0020	15.926	24
37	.06308	.99801	.06321	15.821	.0020	15.853	23
38	.06337	.99799	.06350	15.748	.0020	15.780	22
39	.06366	.99797	.06279	15.676	.0020	15.708	21
40	.06395	.99795	.06408	15.605	1.0020	15.637	20
41	.06424	.99793	.06437	15.534	.0021	15.566	19
42	.06453	.99791	.06467	15.464	.0021	15.496	18
43	.06482	.99790	.06496	15.394	.0021	15.427	17
44	.06511	.99788	.06525	15.325	.0021	15.358	16
45	.06540	.99786	.06554	15.257	1.0021	15.290	15
46	.06569	.99784	.06583	15.189	.0022	15.222	14
47	.06598	.99782	.06613	15.122	.0022	15.155	13
48	.06627	.99780	.06642	15.056	.0022	15.089	12
49	.06656	.99778	.06671	14.990	.0022	15.023	11
50	.06685	.99776	.06700	14.924	1.0022	14.958	10
51	.06714	.99774	.06730	14.860	.0023	14.893	9
52	.06743	.99772	.06759	14.795	.0023	14.829	8
53	.06772	.99770	.06788	14.732	.0023	14.765	7
54	.06801	.99768	.06817	14.668	.0023	14.703	6
55	.06830	.99766	.06846	14.606	1.0023	14.640	5
56	.06859	.99764	.06876	14.544	.0024	14.578	4
57	.06888	.99762	.06905	14.482	.0024	14.517	3
58	.06918	.99760	.06934	14.421	.0024	14.456	2
59	.06947	.99758	.06963	14.361	.0024	14.395	1
60	.06976	.99756	.06993	14.301	1.0024	14.335	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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4°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.06976	.99756	.06993	14.301	1.0024	14.335	60
1	.07005	.99754	.07022	14.241	.0025	14.276	59
2	.07034	.99752	.07051	14.182	.0025	14.217	58
3	.07063	.99750	.07080	14.123	.0025	14.159	57
4	.07092	.99748	.07110	14.065	.0025	14.101	56
5	.07121	.99746	.07139	14.008	1.0025	14.043	55
6	.07150	.99744	.07168	13.951	.0026	13.986	54
7	.07179	.99742	.07197	13.894	.0026	13.930	53
8	.07208	.99740	.07226	13.838	.0026	13.874	52
9	.07237	.99738	.07256	13.782	.0026	13.818	51
10	.07266	.99736	.07285	13.727	1.0026	13.763	50
11	.07295	.99733	.07314	13.672	.0027	13.708	49
12	.07324	.99731	.07343	13.617	.0027	13.654	48
13	.07353	.99729	.07373	13.563	.0027	13.600	47
14	.07382	.99727	.07402	13.510	.0027	13.547	46
15	.07411	.99725	.07431	13.457	1.0027	13.494	45
16	.07440	.99723	.07460	13.404	.0028	13.441	44
17	.07469	.99721	.07490	13.351	.0028	13.389	43
18	.07498	.99718	.07519	13.299	.0028	13.337	42
19	.07527	.99716	.07548	13.248	.0028	13.286	41
20	.07556	.99714	.07577	13.197	1.0029	13.235	40
21	.07585	.99712	.07607	13.146	.0029	13.184	39
22	.07614	.99710	.07636	13.096	.0029	13.134	38
23	.07643	.99707	.07665	13.046	.0029	13.084	37
24	.07672	.99705	.07694	12.996	.0029	13.034	36
25	.07701	.99703	.07724	12.947	1.0030	12.985	35
26	.07730	.99701	.07753	12.898	1.0030	12.937	34
27	.07759	.99698	.07782	12.849	.0030	12.888	33
28	.07788	.99696	.07812	12.801	.0030	12.840	32
29	.07817	.99694	.07841	12.754	.0031	12.793	31
30	.07846	.99692	.07870	12.706	1.0031	12.745	30
31	.07875	.99689	.07899	12.659	.0031	12.698	29
32	.07904	.99687	.07929	12.612	.0031	12.652	28
33	.07933	.99685	.07958	12.566	.0032	12.606	27
34	.07962	.99682	.07987	12.520	.0032	12.560	26
35	.07991	.99680	.08016	12.474	1.0032	12.514	25
36	.08020	.99678	.08046	12.429	.0032	12.469	24
37	.08049	.99675	.08075	12.384	.0032	12.424	23
38	.08078	.99673	.08104	12.339	.0033	12.379	22
39	.08107	.99671	.08134	12.295	.0033	12.335	21
40	.08136	.99668	.08163	12.250	1.0033	12.291	20
41	.08165	.99666	.08192	12.207	.0033	12.248	19
42	.08194	.99664	.08221	12.163	.0034	12.204	18
43	.08223	.99661	.08251	12.120	.0034	12.161	17
44	.08252	.99659	.08280	12.077	.0034	12.118	16
45	.08281	.99656	.08309	12.035	1.0034	12.076	15
46	.08310	.99654	.08339	11.992	.0035	12.034	14
47	.08339	.99652	.08368	11.950	.0035	11.992	13
48	.08368	.99649	.08397	11.909	.0035	11.950	12
49	.08397	.99647	.08426	11.867	.0035	11.909	11
50	.08426	.99644	.08456	11.826	1.0036	11.868	10
51	.08455	.99642	.08485	11.785	.0036	11.828	9
52	.08484	.99639	.08514	11.745	.0036	11.787	8
53	.08513	.99637	.08544	11.704	.0036	11.747	7
54	.08542	.99634	.08573	11.664	.0037	11.707	6
55	.08571	.99632	.08602	11.625	1.0037	11.668	5
56	.08600	.99629	.08632	11.585	.0037	11.628	4
57	.08629	.99627	.08661	11.546	1.0037	11.589	3
58	.08658	.99624	.08690	11.507	.0038	11.550	2
59	.08687	.99622	.08719	11.468	.0038	11.512	1
60	.08715	.99619	.08749	11.430	1.0038	11.474	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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5°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.08715	.99619	.08749	11.430	1.0038	11.474	60
1	.08744	.99617	.08778	11.392	.0038	11.436	59
2	.08773	.99614	.08807	11.354	.0039	11.398	58
3	.08802	.99612	.08837	11.316	.0039	11.360	57
4	.08831	.99609	.08866	11.279	.0039	11.323	56
5	.08860	.99607	.08895	11.242	1.0039	11.286	55
6	.08889	.99604	.08925	11.205	.0040	11.249	54
7	.08918	.99601	.08954	11.168	.0040	11.213	53
8	.08947	.99599	.08983	11.132	.0040	11.176	52
9	.08976	.99596	.09013	11.095	.0040	11.140	51
10	.09005	.99594	.09042	11.059	1.0041	11.104	50
11	.09034	.99591	.09071	11.024	.0041	11.069	49
12	.09063	.99588	.09101	10.988	.0041	11.033	48
13	.09092	.99586	.09130	10.953	.0041	10.998	47
14	.09121	.99583	.09159	10.918	.0042	10.963	46
15	.09150	.99580	.09189	10.883	1.0042	10.929	45
16	.09179	.99578	.09218	10.848	.0042	10.894	44
17	.09208	.99575	.09247	10.814	.0043	10.860	43
18	.09237	.99572	.09277	10.780	.0043	10.826	42
19	.09266	.99570	.09306	10.746	.0043	10.792	41
20	.09295	.99567	.09335	10.712	1.0043	10.758	40
21	.09324	.99564	.09365	10.678	.0044	10.725	39
22	.09353	.99562	.09394	10.645	.0044	10.692	38
23	.09382	.99559	.09423	10.612	.0044	10.659	37
24	.09411	.99556	.09453	10.579	.0044	10.626	36
25	.09440	.99553	.09482	10.546	1.0045	10.593	35
26	.09469	.99551	.09511	10.514	.0045	10.561	34
27	.09498	.99548	.09541	10.481	.0045	10.529	33
28	.09527	.99545	.09570	10.449	.0046	10.497	32
29	.09556	.99542	.09599	10.417	.0046	10.465	31
30	.09584	.99540	.09629	10.385	1.0046	10.433	30
31	.09613	.99537	.09658	10.354	.0046	10.402	29
32	.09642	.99534	.09688	10.322	.0047	10.371	28
33	.09671	.99531	.09717	10.291	.0047	10.340	27
34	.09700	.99528	.09746	10.260	.0047	10.309	26
35	.09729	.99525	.09776	10.229	1.0048	10.278	25
36	.09758	.99523	.09805	10.199	.0048	10.248	24
37	.09787	.99520	.09834	10.168	.0048	10.217	23
38	.09816	.99517	.09864	10.138	.0048	10.187	22
39	.09845	.99514	.09893	10.108	.0049	10.157	21
40	.09874	.99511	.09922	10.078	1.0049	10.127	20
41	.09903	.99508	.09952	10.048	.0049	10.098	19
42	.09932	.99505	.09981	10.019	.0050	10.068	18
43	.09961	.99503	.10011	9.9893	.0050	10.039	17
44	.09990	.99500	.10040	9.9601	.0050	10.010	16
45	.10019	.99497	.10069	9.9310	1.0050	9.9812	15
46	.10048	.99494	.10099	9.9021	.0051	9.9525	14
47	.10077	.99491	.10128	9.8734	.0051	9.9239	13
48	.10106	.99488	.10158	9.8446	.0051	9.8955	12
49	.10134	.99485	.10187	9.8164	.0052	9.8672	11
50	.10163	.99482	.10216	9.7882	1.0052	9.8391	10
51	.10192	.99479	.10246	9.7601	.0052	9.8112	9
52	.10221	.99476	.10275	9.7322	.0053	9.7834	8
53	.10250	.99473	.10305	9.7044	.0053	9.7558	7
54	.10279	.99470	.10334	9.6768	.0053	9.7283	6
55	.10108	.99467	.10363	9.6493	1.0053	9.7010	5
56	.10337	.99464	.10393	9.6220	.0054	9.6739	4
57	.10366	.99461	.10422	9.5949	.0054	9.6469	3
58	.10395	.99458	.10452	9.5679	.0054	9.6200	2
59	.10424	.99455	.10481	9.5411	.0055	9.5933	1
60	.10453	.99452	.10510	9.5144	1.0055	9.5668	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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6°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.10453	.99452	.10510	9.5144	1.0055	9.5668	60
1	.10482	.99449	.10540	.4878	.0055	.5404	59
2	.10511	.99446	.10569	.4614	.0056	.5141	58
3	.10540	.99443	.10599	.4351	.0056	.4880	57
4	.10568	.99440	.10628	.4090	.0056	.4620	56
5	.10597	.99437	.10657	9.3831	1.0057	9.4362	55
6	.10626	.99434	.10687	.3572	.0057	.4105	54
7	.10655	.99431	.10716	.3315	.0057	.3850	53
8	.10684	.99428	.10746	.3060	.0057	.3596	52
9	.10713	.99424	.10775	.2806	.0058	.3343	51
10	.10742	.99421	.10805	9.2553	1.0058	9.3092	50
11	.10771	.99418	.10834	.2302	.0058	.2842	49
12	.10800	.99415	.10863	.2051	.0059	.2593	48
13	.10829	.99412	.10893	.1803	.0059	.2346	47
14	.10858	.99409	.10922	.1555	.0059	.2100	46
15	.10887	.99406	.10952	9.1309	1.0060	9.1855	45
16	.10916	.99402	.10981	.1064	.0060	.1612	44
17	.10944	.99399	.11011	.0821	.0060	.1370	43
18	.10973	.99396	.11040	.0579	.0061	.1129	42
19	.11002	.99393	.11069	.0338	.0061	.0890	41
20	.11031	.99390	.11099	9.0098	1.0061	9.0651	40
21	.11060	.99386	.11128	8.9860	.0062	.0414	39
22	.11089	.99383	.11158	.9623	.0062	.0179	38
23	.11118	.99380	.11187	.9387	.0062	8.9944	37
24	.11147	.99377	.11217	.9152	.0063	.9711	36
25	.11176	.99373	.11246	8.8918	1.0063	8.9479	35
26	.11205	.99370	.11276	.8686	.0063	.9248	34
27	.11234	.99367	.11305	.8455	.0064	.9018	33
28	.11262	.99364	.11335	.8225	.0064	.8790	32
29	.11291	.99360	.11364	.7996	.0064	.8563	31
30	.11320	.99357	.11393	8.7769	1.0065	8.8337	30
31	.11349	.99354	.11423	.7542	.0065	.8112	29
32	.11378	.99350	.11452	.7317	.0065	.7888	28
33	.11407	.99347	.11482	.7093	.0066	.7665	27
34	.11436	.99344	.11511	.6870	.0066	.7444	26
35	.11465	.99341	.11541	8.8648	1.0066	8.7223	25
36	.11494	.99337	.11570	.6427	.0067	.7004	24
37	.11523	.99334	.11600	.6208	.0067	.6786	23
38	.11551	.99330	.11629	.5989	.0067	.6569	22
39	.11580	.99327	.11659	.5772	.0068	.6353	21
40	.11609	.99324	.11688	8.5555	1.0068	8.6138	20
41	.11638	.99320	.11718	.5340	.0068	.5924	19
42	.11667	.99317	.11747	.5126	.0069	.5711	18
43	.11696	.99314	.11777	.4913	.0069	.5499	17
44	.11725	.99310	.11806	.4701	.0069	.5289	16
45	.11754	.99307	.11836	8.4489	1.0070	8.5079	15
46	.11783	.99303	.11865	.4279	.0070	.4871	14
47	.11811	.99300	.11895	.4070	.0070	.4663	13
48	.11840	.99296	.11924	.3862	.0071	.4457	12
49	.11869	.99293	.11954	.3655	.0071	.4251	11
50	.11898	.99290	.11983	8.3449	1.0071	8.4046	10
51	.11927	.99286	.12013	.3244	.0072	.3843	9
52	.11956	.99283	.12042	.3040	.0072	.3640	8
53	.11985	.99279	.12072	.2837	.0073	.3439	7
54	.12014	.99276	.12101	.2635	.0073	.3238	6
55	.12042	.99272	.12131	8.2434	1.0073	8.3039	5
56	.12071	.99269	.12160	.2234	.0074	.2840	4
57	.12100	.99265	.12190	.2035	.0074	.2642	3
58	.12129	.99262	.12219	.1837	.0074	.2446	2
59	.12158	.99258	.12249	.1640	.0075	.2250	1
60	.12187	.99255	.12278	8.1443	1.0075	8.2055	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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7°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.12187	.99255	.12278	8.1443	1.0075	8.2055	60
1	.12216	.99251	.12308	.1248	.0075	.1861	59
2	.12245	.99247	.12337	.1053	.0076	.1668	58
3	.12273	.99244	.12367	.0860	.0076	.1476	57
4	.12302	.99240	.12396	.0667	.0076	.1285	56
5	.12331	.99237	.12426	8.0476	1.0077	8.1094	55
6	.12360	.99233	.12456	.0285	.0077	.0905	54
7	.12389	.99229	.12485	.0095	.0078	.0717	53
8	.12418	.99226	.12515	7.9906	.0078	.0529	52
9	.12447	.99222	.12544	.9717	.0078	.0342	51
10	.12476	.99219	.12574	7.9530	1.0079	8.0156	50
11	.12504	.99215	.12603	.9344	.0079	7.9971	49
12	.12533	.99211	.12633	.9158	.0079	.9787	48
13	.12562	.99208	.12662	.8973	.0080	.9604	47
14	.12591	.99204	.12692	.8789	.0080	.9421	46
15	.12620	.99200	.12722	7.8606	1.0080	7.9240	45
16	.12649	.99197	.12751	.8424	.0081	.9059	44
17	.12678	.99193	.12781	.8243	.0081	.8879	43
18	.12706	.99189	.12810	.8062	.0082	.8700	42
19	.12735	.99186	.12840	.7882	.0082	.8522	41
20	.12764	.99182	.12869	7.7703	1.0082	7.8344	40
21	.12793	.99178	.12899	.7525	.0083	.8168	39
22	.12822	.99174	.12928	.7348	.0083	.7992	38
23	.12851	.99171	.12958	.7171	.0084	.7817	37
24	.12879	.99167	.12988	.6996	.0084	.7642	36
25	.12908	.99163	.13017	7.6821	1.0084	7.7469	35
26	.12937	.99160	.13047	.6646	.0085	.7296	34
27	.12966	.99156	.13076	.6473	.0085	.7124	33
28	.12995	.99152	.13106	.6300	.0085	.6953	32
29	.13024	.99148	.13136	.6129	.0086	.6783	31
30	.13053	.99144	.13165	7.5957	1.0086	7.6613	30
31	.13081	.99141	.13195	.5787	.0087	.6444	29
32	.13110	.99137	.13224	.5617	.0087	.6276	28
33	.13139	.99133	.13254	.5449	.0087	.6108	27
34	.13168	.99129	.13284	.5280	.0088	.5942	26
35	.13197	.99125	.13313	7.5113	1.0088	7.5776	25
36	.13226	.99121	.13343	.4946	.0089	.5611	24
37	.13254	.99118	.13372	.4780	.0089	.5446	23
38	.13283	.99114	.13402	.4615	.0089	.5282	22
39	.13312	.99110	.13432	.4451	.0090	.5119	21
40	.13341	.99106	.13461	7.4287	1.0090	7.4957	20
41	.13370	.99102	.13491	.4124	.0090	.4795	19
42	.13399	.99098	.13520	.3961	.0091	.4634	18
43	.13427	.99094	.13550	.3800	.0091	.4474	17
44	.13456	.99090	.13580	.3639	.0092	.4315	16
45	.13485	.99086	.13609	7.3479	1.0092	7.4156	15
46	.13514	.99083	.13639	.3319	.0092	.3998	14
47	.13543	.99079	.13669	.3160	.0093	.3840	13
48	.13571	.99075	.13698	.3002	.0093	.3683	12
49	.13600	.99071	.13728	.2844	.0094	.3527	11
50	.13629	.99067	.13757	7.2687	1.0094	7.3372	10
51	.13658	.99063	.13787	.2531	.0094	.3217	9
52	.13687	.99059	.13817	.2375	.0095	.3063	8
53	.13716	.99055	.13846	.2220	.0095	.2909	7
54	.13744	.99051	.13876	.2066	.0096	.2757	6
55	.13773	.99047	.13906	7.1912	1.0096	7.2604	5
56	.13802	.99043	.13935	.1759	.0097	.2453	4
57	.13831	.99039	.13965	.1607	.0097	.2302	3
58	.13860	.99035	.13995	.1455	.0097	.2152	2
59	.13888	.99031	.14024	.1304	.0098	.2002	1
60	.13917	.99027	.14054	7.1154	1.0098	7.1853	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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8°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.13917	.99027	.14054	7.1154	1.0098	7.1853	60
1	.13946	.99023	.14084	.1004	.0099	.1704	59
2	.13975	.99019	.14113	.0854	.0099	.1557	58
3	.14004	.99015	.14143	.0706	.0099	.1409	57
4	.14032	.99010	.14173	.0558	.0100	.1263	56
5	.14061	.99006	.14202	7.0410	1.0100	7.1117	55
6	.14090	.99002	.14232	.0264	.0101	.0972	54
7	.14119	.98998	.14262	.0117	.0101	.0827	53
8	.14148	.98994	.14291	6.9972	.0102	.0683	52
9	.14176	.98990	.14321	.9827	.0102	.0539	51
10	.14205	.98986	.14351	6.9682	1.0102	7.0396	50
11	.14234	.98982	.14380	.9538	.0103	.0254	49
12	.14263	.98978	.14410	.9395	.0103	.0112	48
13	.14292	.98973	.14440	.9252	.0104	6.9971	47
14	.14320	.98969	.14470	.9110	.0104	.9830	46
15	.14349	.98965	.14499	6.8969	1.0104	6.9690	45
16	.14378	.98961	.14529	.8828	.0105	.9550	44
17	.14407	.98957	.14559	.8687	.0105	.9411	43
18	.14436	.98952	.14588	.8547	.0106	.9273	42
19	.14464	.98948	.14618	.8408	.0106	.9135	41
20	.14493	.98944	.14648	6.8269	1.0107	6.8998	40
21	.14522	.98940	.14677	.8131	.0107	.8861	39
22	.14551	.98936	.14707	.7993	.0107	.8725	38
23	.14579	.98931	.14737	.7856	.0108	.8589	37
24	.14608	.98927	.14767	.7720	.0108	.8454	36
25	.14637	.98923	.14796	6.7584	1.0109	6.8320	35
26	.14666	.98919	.14826	.7448	.0109	.8185	34
27	.14695	.98914	.14856	.7313	.0110	.8052	33
28	.14723	.98910	.14886	.7179	.0110	.7919	32
29	.14752	.98906	.14915	.7045	.0111	.7787	31
30	.14781	.98901	.14945	6.6911	1.0111	6.7655	30
31	.14810	.98897	.14975	.6779	.0111	.7523	29
32	.14838	.98893	.15004	.6646	.0112	.7392	28
33	.14867	.98889	.15034	.6514	.0112	.7262	27
34	.14896	.98884	.15064	.6383	.0113	.7132	26
35	.14925	.98880	.15094	6.6252	1.0113	6.7003	25
36	.14953	.98876	.15123	.6122	.0114	.6874	24
37	.14982	.98871	.15153	.5992	.0114	.6745	23
38	.15011	.98867	.15183	.5863	.0115	.6617	22
39	.15040	.98862	.15213	.5734	.0115	.6490	21
40	.15068	.98858	.15243	6.5605	1.0115	6.6363	20
41	.15097	.98854	.15272	.5478	.0116	.6237	19
42	.15126	.98849	.15302	.5350	.0116	.6111	18
43	.15155	.98845	.15332	.5223	.0117	.5985	17
44	.15183	.98840	.15362	.5097	.0117	.5860	16
45	.15212	.98836	.15391	6.4971	1.0118	6.5736	15
46	.15241	.98832	.15421	.4845	.0118	.5612	14
47	.15270	.98827	.15451	.4720	.0119	.5488	13
48	.15298	.98823	.15481	.4596	.0119	.5365	12
49	.15328	.98818	.15511	.4472	.0119	.5243	11
50	.15356	.98814	.15540	6.4348	1.0120	6.5121	10
51	.15385	.98809	.15570	.4225	.0120	.4999	9
52	.15413	.98805	.15600	.4103	.0121	.4878	8
53	.15442	.98800	.15630	.3980	.0121	.4757	7
54	.15471	.98796	.15659	.3859	.0122	.4637	6
55	.15500	.98791	.15689	6.3737	1.0122	6.4517	5
56	.15528	.98787	.15719	.3616	.0123	.4398	4
57	.15557	.98782	.15749	.3496	.0123	.4279	3
58	.15586	.98778	.15779	.3376	.0124	.4160	2
59	.15615	.98773	.15809	.3257	.0124	.4042	1
60	.15643	.98769	.15838	6.3137	1.0125	6.3924	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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9°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.15643	.98769	.15838	6.3137	1.0125	6.3924	60
1	.15672	.98764	.15868	.3019	.0125	.3807	59
2	.15701	.98760	.15898	.2901	.0125	.3690	58
3	.15730	.98755	.15928	.2783	.0126	.3574	57
4	.15758	.98750	.15958	.2665	.0126	.3458	56
5	.15787	.98746	.15987	6.2548	1.0127	6.3343	55
6	.15816	.98741	.16017	.2432	.0127	.3228	54
7	.15844	.98737	.16047	.2316	.0128	.3113	53
8	.15873	.98732	.16077	.2200	.0128	.2999	52
9	.15902	.98727	.16107	.2085	.0129	.2885	51
10	.15931	.98723	.16137	6.1970	1.0129	6.2772	50
11	.15959	.98718	.16167	.1856	.0130	.2659	49
12	.15988	.98714	.16196	.1742	.0130	.2546	48
13	.16017	.98709	.16226	.1628	.0131	.2434	47
14	.16045	.98704	.16256	.1515	.0131	.2322	46
15	.16074	.98700	.16286	6.1402	1.0132	6.2211	45
16	.16103	.98695	.16316	.1290	.0132	.2100	44
17	.16132	.98690	.16346	.1178	.0133	.1990	43
18	.16160	.98685	.16376	.1066	.0133	.1880	42
19	.16189	.98681	.16405	.0955	.0134	.1770	41
20	.16218	.98676	.16435	6.0844	1.0134	6.1661	40
21	.16246	.98671	.16465	.0734	.0135	.1552	39
22	.16275	.98667	.16495	.0624	.0135	.1443	38
23	.16304	.98662	.16525	.0514	.0136	.1335	37
24	.16333	.98657	.16555	.0405	.0136	.1227	36
25	.16361	.98652	.16585	6.0296	1.0136	6.1120	35
26	.16390	.98648	.16615	.0188	.0137	.1013	34
27	.16419	.98643	.16644	.0080	.0137	.0906	33
28	.16447	.98638	.16674	5.9972	.0138	.0800	32
29	.16476	.98633	.16704	.9865	.0138	.0694	31
30	.16505	.98628	.16734	5.9758	1.0139	6.0588	30
31	.16533	.98624	.16764	.9651	.0139	.0483	29
32	.16562	.98619	.16794	.9545	.0140	.0379	28
33	.16591	.98614	.16824	.9439	.0140	.0274	27
34	.16619	.98609	.16854	.9333	.0141	.0170	26
35	.16648	.98604	.16884	5.9228	1.0141	6.0066	25
36	.16677	.98600	.16914	.9123	.0142	5.9963	24
37	.16705	.98595	.16944	.9019	.0142	.9860	23
38	.16734	.98590	.16973	.8915	.0143	.9756	22
39	.16763	.98585	.17003	.8811	.0143	.9655	21
40	.16791	.98580	.17033	5.8708	1.0144	5.9554	20
41	.16820	.98575	.17063	.8605	.0144	.9452	19
42	.16849	.98570	.17093	.8502	.0145	.9351	18
43	.16878	.98565	.17123	.8400	.0145	.9250	17
44	.16906	.98560	.17153	.8298	.0146	.9150	16
45	.16935	.98556	.17183	5.8196	1.0146	5.9049	15
46	.16964	.98551	.17213	.8095	.0147	.8950	14
47	.16992	.98546	.17243	.7994	.0147	.8850	13
48	.17021	.98541	.17273	.7894	.0148	.8751	12
49	.17050	.98536	.17303	.7794	.0148	.8652	11
50	.17078	.98531	.17333	5.7694	1.0149	5.8554	10
51	.17107	.98526	.17363	.7594	.0150	.8456	9
52	.17136	.98521	.17393	.7495	.0150	.8358	8
53	.17164	.98516	.17423	.7396	.0151	.8261	7
54	.17193	.98511	.17453	.7297	.0151	.8163	6
55	.17221	.98506	.17483	5.7199	1.0152	5.8067	5
56	.17250	.98501	.17513	.7101	.0152	.7970	4
57	.17279	.98496	.17543	.7004	.0153	.7874	3
58	.17307	.98491	.17573	.6906	.0153	.7778	2
59	.17336	.98486	.17603	.6809	.0154	.7683	1
60	.17365	.98481	.17633	5.6713	1.0154	5.7588	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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10°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.17365	.98481	.17633	5.6713	1.0154	5.7588	60
1	.17393	.98476	.17663	.6616	.0155	.7493	59
2	.17422	.98471	.17693	.6520	.0155	.7398	58
3	.17451	.98465	.17723	.6425	.0156	.7304	57
4	.17479	.98460	.17753	.6329	.0156	.7210	56
5	.17508	.98455	.17783	5.6234	1.0157	5.7117	55
6	.17537	.98450	.17813	.6140	.0157	.7023	54
7	.17565	.98445	.17843	.6045	.0158	.6930	53
8	.17594	.98440	.17873	.5951	.0158	.6838	52
9	.17622	.98435	.17903	.5857	.0159	.6745	51
10	.17651	.98430	.17933	5.5764	1.0159	5.6653	50
11	.17680	.98425	.17963	.5670	.0160	.6561	49
12	.17708	.98419	.17993	.5578	.0160	.6470	48
13	.17737	.98414	.18023	.5485	.0161	.6379	47
14	.17766	.98409	.18053	.5393	.0162	.6288	46
15	.17794	.98404	.18083	5.5301	1.0162	5.6197	45
16	.17823	.98399	.18113	.5209	.0163	.6107	44
17	.17852	.98394	.18143	.5117	.0163	.6017	43
18	.17880	.98388	.18173	.5026	.0164	.5928	42
19	.17909	.98383	.18203	.4935	.0164	.5838	41
20	.17937	.98378	.18233	5.4845	1.0165	5.5749	40
21	.17966	.98373	.18263	.4755	.0165	.5660	39
22	.17995	.98368	.18293	.4665	.0166	.5572	38
23	.18023	.98362	.18323	.4575	.0166	.5484	37
24	.18052	.98357	.18353	.4486	.0167	.5396	36
25	.18080	.98352	.18383	5.4396	1.0167	5.5308	35
26	.18109	.98347	.18413	.4308	.0168	.5221	34
27	.18138	.98341	.18444	.4219	.0169	.5134	33
28	.18166	.98336	.18474	.4131	.0169	.5047	32
29	.18195	.98331	.18504	.4043	.0170	.4960	31
30	.18223	.98325	.18534	5.3955	1.0170	5.4874	30
31	.18252	.98320	.18564	.3868	.0171	.4788	29
32	.18281	.98315	.18594	.3780	.0171	.4702	28
33	.18309	.98309	.18624	.3694	.0172	.4617	27
34	.18338	.98304	.18654	.3607	.0172	.4532	26
35	.18366	.98299	.18684	5.3521	1.0173	5.4447	25
36	.18395	.98293	.18714	.3434	.0174	.4362	24
37	.18424	.98288	.18745	.3349	.0174	.4278	23
38	.18452	.98283	.18775	.3263	.0175	.4194	22
39	.18481	.98277	.18805	.3178	.0175	.4110	21
40	.18509	.98272	.18835	5.3093	1.0176	5.4026	20
41	.18538	.98267	.18865	.3008	.0176	.3943	19
42	.18567	.98261	.18895	.2923	.0177	.3860	18
43	.18595	.98256	.18925	.2839	.0177	.3777	17
44	.18624	.98250	.18955	.2755	.0178	.3695	16
45	.18652	.98245	.18985	5.2671	1.0179	5.3612	15
46	.18681	.98240	.19016	.2588	.0179	.3530	14
47	.18709	.98234	.19046	.2505	.0180	.3449	13
48	.18738	.98229	.19076	.2422	.0180	.3367	12
49	.18767	.98223	.19106	.2339	.0181	.3286	11
50	.18795	.98218	.19136	5.2257	1.0181	5.3205	10
51	.18824	.98212	.19166	.2174	.0182	.3124	9
52	.18852	.98207	.19197	.2092	.0182	.3044	8
53	.18881	.98201	.19227	.2011	.0183	.2963	7
54	.18909	.98196	.19257	.1929	.0184	.2883	6
55	.18938	.98190	.19287	5.1848	1.0184	5.2803	5
56	.18967	.98185	.19317	.1767	.0185	.2724	4
57	.18995	.98179	.19347	.1686	.0185	.2645	3
58	.19024	.98174	.19378	.1606	.0186	.2565	2
59	.19052	.98168	.19408	.1525	.0186	.2487	1
60	.19081	.98163	.19438	5.1445	1.0187	5.2408	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.19081	.98163	.19438	5.1445	1.0187	5.2408	60
1	.19109	.98157	.19468	.1366	.0188	.2330	59
2	.19138	.98152	.19498	.1285	.0188	.2252	58
3	.19166	.98146	.19529	.1207	.0189	.2174	57
4	.19195	.98140	.19559	.1128	.0189	.2097	56
5	.19224	.98135	.19589	5.1049	1.0190	5.2019	55
6	.19252	.98129	.19619	.0970	.0191	.1942	54
7	.19281	.98124	.19649	.0892	.0191	.1865	53
8	.19309	.98118	.19680	.0814	.0192	.1788	52
9	.19338	.98112	.19710	.0736	.0192	.1712	51
10	.19366	.98107	.19740	5.0658	1.0193	5.1636	50
11	.19395	.98101	.19770	.0581	.0193	.1560	49
12	.19423	.98095	.19800	.0504	.0194	.1484	48
13	.19452	.98090	.19831	.0427	.0195	.1409	47
14	.19480	.98084	.19861	.0350	.0195	.1333	46
15	.19509	.98078	.19891	5.0273	1.0196	5.1258	45
16	.19537	.98073	.19921	.0197	.0196	.1183	44
17	.19566	.98067	.19952	.0121	.0197	.1109	43
18	.19595	.98061	.19982	.0045	.0198	.1034	42
19	.19623	.98056	.20012	4.9969	.0198	.0960	41
20	.19652	.98050	.20042	4.9894	1.0199	5.0886	40
21	.19680	.98044	.20073	.9819	.0199	.0812	39
22	.19709	.98039	.20103	.9744	.0200	.0739	38
23	.19737	.98033	.20133	.9669	.0201	.0666	37
24	.19766	.98027	.20163	.9594	.0201	.0593	36
25	.19794	.98021	.20194	4.9520	1.0202	5.0520	35
26	.19823	.98016	.20224	.9446	.0202	.0447	34
27	.19851	.98010	.20254	.9372	.0203	.0375	33
28	.19880	.98004	.20285	.9298	.0204	.0302	32
29	.19908	.97998	.20315	.9225	.0204	.0230	31
30	.19937	.97992	.20345	4.9151	1.0205	5.0158	30
31	.19965	.97987	.20375	.9078	.0205	.0087	29
32	.19994	.97981	.20406	.9006	.0206	.0015	28
33	.20022	.97975	.20436	.8933	.0207	4.9944	27
34	.20051	.97969	.20466	.8860	.0207	.9873	26
35	.20079	.97963	.20497	4.8788	1.0208	4.9802	25
36	.20108	.97957	.20527	.8716	.0208	.9732	24
37	.20136	.97952	.20557	.8644	.0209	.9661	23
38	.20165	.97946	.20588	.8573	.0210	.9591	22
39	.20193	.97940	.20618	.8501	.0210	.9521	21
40	.20222	.97934	.20648	4.8430	1.0211	4.9452	20
41	.20250	.97928	.20679	.8359	.0211	.9382	19
42	.20279	.97922	.20709	.8288	.0212	.9313	18
43	.20307	.97916	.20739	.8217	.0213	.9243	17
44	.20336	.97910	.20770	.8147	.0213	.9175	16
45	.20364	.97904	.20800	4.8077	1.0214	4.9106	15
46	.20393	.97899	.20830	.8007	.0215	.9037	14
47	.20421	.97893	.20861	.7937	.0215	.8969	13
48	.20450	.97887	.20891	.7867	.0216	.8901	12
49	.20478	.97881	.20921	.7798	.0216	.8833	11
50	.20506	.97875	.20952	4.7728	1.0217	4.8765	10
51	.20535	.97869	.20982	.7659	.0218	.8697	9
52	.20563	.97863	.21012	.7591	.0218	.8630	8
53	.20592	.97857	.21043	.7522	.0219	.8563	7
54	.20620	.97851	.21073	.7453	.0220	.8496	6
55	.20649	.97845	.21104	4.7385	1.0220	4.8429	5
56	.20677	.97839	.21134	.7317	.0221	.8362	4
57	.20706	.97833	.21164	.7249	.0221	.8296	3
58	.20734	.97827	.21195	.7181	.0222	.8229	2
59	.20763	.97821	.21225	.7114	.0223	.8163	1
60	.20791	.97815	.21256	4.7046	1.0222	4.8097	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.20791	.97815	.21256	4.7046	1.0223	4.8097	60
1	.20820	.97809	.21286	.6979	.0224	.8032	59
2	.20848	.97803	.21316	.6912	.0225	.7966	58
3	.20876	.97797	.21347	.6845	.0225	.7901	57
4	.20905	.97790	.21377	.6778	.0226	.7835	56
5	.20933	.97784	.21408	4.6712	1.0226	4.7770	55
6	.20962	.97778	.21438	.6646	.0227	.7706	54
7	.20990	.97772	.21468	.6580	.0228	.7641	53
8	.21019	.97766	.21499	.6514	.0228	.7576	52
9	.21047	.97760	.21529	.6448	.0229	.7512	51
10	.21076	.97754	.21560	4.6382	1.0230	4.7448	50
11	.21104	.97748	.21590	.6317	.0230	.7384	49
12	.21132	.97741	.21621	.6252	.0231	.7320	48
13	.21161	.97735	.21651	.6187	.0232	.7257	47
14	.21189	.97729	.21682	.6122	.0232	.7193	46
15	.21218	.97723	.21712	4.6057	1.0233	4.7130	45
16	.21246	.97717	.21742	.5993	.0234	.7067	44
17	.21275	.97711	.21773	.5928	.0234	.7004	43
18	.21303	.97704	.21803	.5864	.0235	.6942	42
19	.21331	.97698	.21834	.5800	.0235	.6879	41
20	.21360	.97692	.21864	4.5736	1.0236	4.6817	40
21	.21388	.97686	.21895	.5673	.0237	.6754	39
22	.21417	.97680	.21925	.5609	.0237	.6692	38
23	.21445	.97673	.21956	.5546	.0238	.6631	37
24	.21473	.97667	.21986	.5483	.0239	.6569	36
25	.21502	.97661	.22017	4.5420	1.0239	4.6507	35
26	.21530	.97655	.22047	.5357	.0240	.6446	34
27	.21559	.97648	.22078	.5294	.0241	.6385	33
28	.21587	.97642	.22108	.5232	.0241	.6324	32
29	.21615	.97636	.22139	.5169	.0242	.6263	31
30	.21644	.97630	.22169	4.5107	1.0243	4.6201	30
31	.21672	.97623	.22200	.5045	.0243	.6142	29
32	.21701	.97617	.22230	.4983	.0244	.6081	28
33	.21729	.97611	.22261	.4921	.0245	.6021	27
34	.21757	.97604	.22291	.4860	.0245	.5961	26
35	.21786	.97598	.22322	4.4799	1.0246	4.5901	25
36	.21814	.97592	.22353	.4737	.0247	.5841	24
37	.21843	.97585	.22383	.4676	.0247	.5782	23
38	.21871	.97579	.22414	.4615	.0248	.5722	22
39	.21899	.97573	.22444	.4555	.0249	.5663	21
40	.21928	.97566	.22475	4.4494	1.0249	4.5604	20
41	.21956	.97560	.22505	.4434	.0250	.5545	19
42	.21985	.97553	.22536	.4373	.0251	.5486	18
43	.22013	.97547	.22566	.4313	.0251	.5428	17
44	.22041	.97541	.22597	.4253	.0252	.5369	16
45	.22070	.97534	.22628	4.4194	1.0253	4.5311	15
46	.22098	.97528	.22658	.4134	.0253	.5253	14
47	.22126	.97521	.22689	.4074	.0254	.5195	13
48	.22155	.97515	.22719	.4015	.0255	.5137	12
49	.22183	.97508	.22750	.3956	.0255	.5079	11
50	.22211	.97502	.22781	4.3897	1.0256	4.5021	10
51	.22240	.97495	.22811	.3838	.0257	.4964	9
52	.22268	.97489	.22842	.3779	.0257	.4907	8
53	.22297	.97483	.22872	.3721	.0258	.4850	7
54	.22325	.97476	.22903	.3662	.0259	.4793	6
55	.22353	.97470	.22934	4.3604	1.0260	4.4736	5
56	.22382	.97463	.22964	.3546	.0260	.4679	4
57	.22410	.97457	.22995	.3488	.0261	.4623	3
58	.22438	.97450	.23025	.3430	.0262	.4566	2
59	.22467	.97443	.23056	.3372	.0262	.4510	1
60	.22495	.97437	.23087	4.3315	1.0263	4.4454	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.22495	.97437	.23087	4.3315	1.0263	4.4454	60
1	.22523	.97430	.23117	.3257	.0264	.4398	59
2	.22552	.97424	.23148	.3200	.0264	.4342	58
3	.22580	.97417	.23179	.3143	.0265	.4287	57
4	.22608	.97411	.23209	.3086	.0266	.4231	56
5	.22637	.97404	.23240	4.3029	1.0266	4.4176	55
6	.22665	.97398	.23270	.2972	.0267	.4121	54
7	.22693	.97391	.23301	.2916	.0268	.4065	53
8	.22722	.97384	.23332	.2859	.0268	.4011	52
9	.22750	.97378	.23363	.2803	.0269	.3956	51
10	.22778	.97371	.23393	4.2747	1.0270	4.3901	50
11	.22807	.97364	.23424	.2691	.0271	.3847	49
12	.22835	.97358	.23455	.2635	.0271	.3792	48
13	.22863	.97351	.23485	.2579	.0272	.3738	47
14	.22892	.97344	.23516	.2524	.0273	.3684	46
15	.22920	.97338	.23547	4.2468	1.0273	4.3630	45
16	.22948	.97331	.23577	.2413	.0274	.3576	44
17	.22977	.97324	.23608	.2358	.0275	.3523	43
18	.23005	.97318	.23639	.2303	.0276	.3469	42
19	.23033	.97311	.23670	.2248	.0276	.3415	41
20	.23061	.97304	.23700	4.2193	1.0277	4.3362	40
21	.23090	.97298	.23731	.2139	.0278	.3309	39
22	.23118	.97291	.23762	.2084	.0278	.3256	38
23	.23146	.97284	.23793	.2030	.0279	.3203	37
24	.23175	.97277	.23823	.1976	.0280	.3150	36
25	.23203	.97271	.23854	4.1921	1.0280	4.3098	35
26	.23231	.97264	.23885	.1867	.0281	.3045	34
27	.23260	.97257	.23916	.1814	.0282	.2993	33
28	.23288	.97250	.23946	.1760	.0283	.2941	32
29	.23316	.97244	.23977	.1706	.0283	.2888	31
30	.23344	.97237	.24008	4.1653	1.0284	4.2836	30
31	.23373	.97230	.24039	.1600	.0285	.2785	29
32	.23401	.97223	.24069	.1546	.0285	.2733	28
33	.23429	.97216	.24100	.1493	.0286	.2681	27
34	.23458	.97210	.24131	.1440	.0287	.2630	26
35	.23486	.97203	.24162	4.1388	1.0288	4.2579	25
36	.23514	.97196	.24192	.1335	.0288	.2527	24
37	.23542	.97189	.24223	.1282	.0289	.2476	23
38	.23571	.97182	.24254	.1230	.0290	.2425	22
39	.23599	.97175	.24285	.1178	.0291	.2375	21
40	.23627	.97169	.24316	4.1126	1.0291	4.2324	20
41	.23655	.97162	.24346	.1073	.0292	.2273	19
42	.23684	.97155	.24377	.1022	.0293	.2223	18
43	.23712	.97148	.24408	.0970	.0293	.2173	17
44	.23740	.97141	.24439	.0918	.0294	.2122	16
45	.23768	.97134	.24470	4.0867	1.0295	4.2072	15
46	.23797	.97127	.24501	.0815	.0296	.2022	14
47	.23825	.97120	.24531	.0764	.0296	.1972	13
48	.23853	.97113	.24562	.0712	.0297	.1923	12
49	.23881	.97106	.24593	.0662	.0298	.1873	11
50	.23910	.97099	.24624	4.0611	1.0299	4.1824	10
51	.23938	.97092	.24655	.0560	.0299	.1774	9
52	.23966	.97086	.24686	.0509	.0300	.1725	8
53	.23994	.97079	.24717	.0458	.0301	.1676	7
54	.24023	.97072	.24747	.0408	.0302	.1627	6
55	.24051	.97065	.24778	4.0358	1.0302	4.1578	5
56	.24079	.97058	.24809	.0307	.0303	.1529	4
57	.24107	.97051	.24840	.0257	.0304	.1481	3
58	.24136	.97044	.24871	.0207	.0305	.1432	2
59	.24164	.97037	.24902	.0157	.0305	.1384	1
60	.24192	.97029	.24933	4.0108	1.0306	4.1336	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.24192	.97029	.24933	4.0108	1.0306	4.1336	60
1	.24220	.97022	.24964	.0058	.0307	.1287	59
2	.24249	.97015	.24995	.0009	.0308	.1239	58
3	.24277	.97008	.25025	3.9959	.0308	.1191	57
4	.24305	.97001	.25056	.9910	.0309	.1144	56
5	.24333	.96994	.25087	3.9861	1.0310	4.1096	55
6	.24361	.96987	.25118	.9812	.0311	.1048	54
7	.24390	.96980	.25149	.9763	.0311	.1001	53
8	.24418	.96973	.25180	.9714	.0312	.0953	52
9	.24446	.96966	.25211	.9665	.0313	.0906	51
10	.24474	.96959	.25242	3.9616	1.0314	4.0859	50
11	.24502	.96952	.25273	.9568	.0314	.0812	49
12	.24531	.96944	.25304	.9520	.0315	.0765	48
13	.24559	.96937	.25335	.9471	.0316	.0718	47
14	.24587	.96930	.25366	.9423	.0317	.0672	46
15	.24615	.96923	.25397	3.9375	1.0317	4.0625	45
16	.24643	.96916	.25428	.9327	.0318	.0579	44
17	.24672	.96909	.25459	.9279	.0319	.0532	43
18	.24700	.96901	.25490	.9231	.0320	.0486	42
19	.24728	.96894	.25521	.9184	.0320	.0440	41
20	.24756	.96887	.25552	3.9136	1.0321	4.0394	40
21	.24784	.96880	.25583	.9089	.0322	.0348	39
22	.24813	.96873	.25614	.9042	.0323	.0302	38
23	.24841	.96865	.25645	.8994	.0323	.0256	37
24	.24869	.96858	.25676	.8947	.0324	.0211	36
25	.24897	.96851	.25707	3.8900	1.0325	4.0165	35
26	.24925	.96844	.25738	.8853	.0326	.0120	34
27	.24953	.96836	.25769	.8807	.0327	.0074	33
28	.24982	.96829	.25800	.8760	.0327	.0029	32
29	.25010	.96822	.25831	.8713	.0328	3.9984	31
30	.25038	.96815	.25862	3.8667	1.0329	3.9939	30
31	.25066	.96807	.25893	.8621	.0330	.9894	29
32	.25094	.96800	.25924	.8574	.0330	.9850	28
33	.25122	.96793	.25955	.8528	.0331	.9805	27
34	.25151	.96785	.25986	.8482	.0332	.9760	26
35	.25179	.96778	.26017	3.8436	1.0333	3.9716	25
36	.25207	.96771	.26048	.8390	.0334	.9672	24
37	.25235	.96763	.26079	.8345	.0334	.9627	23
38	.25263	.96756	.26110	.8299	.0335	.9583	22
39	.25291	.96749	.26141	.8254	.0336	.9539	21
40	.25319	.96741	.26172	3.8208	1.0337	3.9495	20
41	.25348	.96734	.26203	.8163	.0338	.9451	19
42	.25376	.96727	.26234	.8118	.0338	.9408	18
43	.25404	.96719	.26266	.8073	.0339	.9364	17
44	.25432	.96712	.26297	.8027	.0340	.9320	16
45	.25460	.96704	.26328	3.7983	1.0341	3.9277	15
46	.25488	.96697	.26359	.7938	.0341	.9234	14
47	.25516	.96690	.26390	.7893	.0342	.9190	13
48	.25544	.96682	.26421	.7848	.0343	.9147	12
49	.25573	.96675	.26452	.7804	.0344	.9104	11
50	.25601	.96667	.26483	3.7759	1.0345	3.9061	10
51	.25629	.96660	.26514	.7715	.0345	.9018	9
52	.25657	.96652	.26546	.7671	.0346	.8976	8
53	.25685	.96645	.26577	.7627	.0347	.8933	7
54	.25713	.96638	.26608	.7583	.0348	.8890	6
55	.25741	.96630	.26639	3.7539	1.0349	3.8848	5
56	.25769	.96623	.26670	.7495	.0349	.8805	4
57	.25798	.96615	.26701	.7451	.0350	.8763	3
58	.25826	.96608	.26732	.7407	.0351	.8721	2
59	.25854	.96600	.26764	.7364	.0352	.8679	1
60	.25882	.96592	.26795	3.7320	1.0353	3.8637	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

75°

15°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.25882	.96592	.26795	3.7320	1.0353	3.8637	60
1	.25910	.96585	.26826	.7277	.0353	.8595	59
2	.25938	.96577	.26857	.7234	.0354	.8553	58
3	.25966	.96570	.26888	.7191	.0355	.8512	57
4	.25994	.96562	.26920	.7147	.0356	.8470	56
5	.26022	.96555	.26951	3.7104	1.0357	3.8428	55
6	.26050	.96547	.26982	.7062	.0358	.8387	54
7	.26078	.96540	.27013	.7019	.0358	.8346	53
8	.26107	.96532	.27044	.6976	.0359	.8304	52
9	.26135	.96524	.27076	.6933	.0360	.8263	51
10	.26163	.96517	.27107	3.6891	1.0361	3.8222	50
11	.26191	.96509	.27138	.6848	.0362	.8181	49
12	.26219	.96502	.27169	.6806	.0362	.8140	48
13	.26247	.96494	.27201	.6764	.0363	.8100	47
14	.26275	.96186	.27232	.6722	.0364	.8059	46
15	.26303	.96479	.27263	3.6679	1.0365	3.8018	45
16	.26331	.96471	.27294	.6637	.0366	.7978	44
17	.26359	.96463	.27326	.6596	.0367	.7937	43
18	.26387	.96456	.27357	.6554	.0367	.7897	42
19	.26415	.96448	.27388	.6512	.0368	.7857	41
20	.26443	.96440	.27419	3.6470	1.0369	3.7816	40
21	.26471	.96433	.27451	.6429	.0370	.7776	39
22	.26499	.96425	.27482	.6387	.0371	.7736	38
23	.26527	.96417	.27513	.6346	.0371	.7697	37
24	.26556	.96409	.27544	.6305	.0372	.7657	36
25	.26584	.96402	.27576	3.6263	1.0373	3.7617	35
26	.26612	.96394	.27607	.6222	.0374	.7577	34
27	.26640	.96386	.27638	.6181	.0375	.7538	33
28	.26668	.96378	.27670	.6140	.0376	.7498	32
29	.26696	.96371	.27701	.6100	.0376	.7459	31
30	.26724	.96363	.27732	3.6059	1.0377	3.7420	30
31	.26752	.96355	.27764	.6018	.0378	.7380	29
32	.26780	.96347	.27795	.5977	.0379	.7341	28
33	.26808	.96340	.27826	.5937	.0380	.7302	27
34	.26836	.96332	.27858	.5896	.0381	.7263	26
35	.26864	.96324	.27889	3.5856	1.0382	3.7224	25
36	.26892	.96316	.27920	.5816	.0382	.7186	24
37	.26920	.96308	.27952	.5776	.0383	.7147	23
38	.26948	.96301	.27983	.5736	.0384	.7108	22
39	.26976	.96293	.28014	.5696	.0385	.7070	21
40	.27004	.96285	.28046	3.5656	1.0386	3.7031	20
41	.27032	.96277	.28077	.5616	.0387	.6993	19
42	.27060	.96269	.28109	.5576	.0387	.6955	18
43	.27088	.96261	.28140	.5536	.0388	.6917	17
44	.27116	.96253	.28171	.5497	.0389	.6879	16
45	.27144	.96245	.28203	3.5457	1.0390	3.6840	15
46	.27172	.96238	.28234	.5418	.0391	.6802	14
47	.27200	.96230	.28266	.5378	.0392	.6765	13
48	.27228	.96222	.28297	.5339	.0393	.6727	12
49	.27256	.96214	.28328	.5300	.0393	.6689	11
50	.27284	.96206	.28360	3.5261	1.0394	3.6651	10
51	.27312	.96198	.28391	.5222	.0395	.6614	9
52	.27340	.96190	.28423	.5183	.0396	.6576	8
53	.27368	.96182	.28454	.5144	1.0397	.6539	7
54	.27396	.96174	.28486	.5105	.0398	.6502	6
55	.27424	.96166	.28517	3.5066	1.0399	3.6464	5
56	.27452	.96158	.28549	.5028	.0399	.6427	4
57	.27480	.96150	.28580	.4989	.0400	.6390	3
58	.27508	.96142	.28611	.4951	.0401	.6353	2
59	.27536	.96134	.28643	.4913	.0402	.6316	1
60	.27564	.96126	.28674	3.4874	1.0403	3.6279	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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16°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.27564	.96126	.28674	3.4874	1.0403	3.6279	60
1	.27592	.96118	.28706	.4836	.0404	.6243	59
2	.27620	.96110	.28737	.4798	.0405	.6206	58
3	.27648	.96102	.28769	.4760	.0406	.6169	57
4	.27675	.96094	.28800	.4722	.0406	.6133	56
5	.27703	.96086	.28832	3.4684	1.0407	3.6096	55
6	.27731	.96078	.28863	.4646	.0408	.6060	54
7	.27759	.96070	.28895	.4608	.0409	.6024	53
8	.27787	.96062	.28926	.4570	.0410	.5987	52
9	.27815	.96054	.28958	.4533	.0411	.5951	51
10	.27843	.96045	.28990	3.4495	1.0412	3.5915	50
11	.27871	.96037	.29021	.4458	.0413	.5879	49
12	.27899	.96029	.29053	.4420	.0413	.5843	48
13	.27927	.96021	.29084	.4383	.0414	.5807	47
14	.27955	.96013	.29116	.4346	.0415	.5772	46
15	.27983	.96005	.29147	3.4308	1.0416	3.5736	45
16	.28011	.95997	.29179	.4271	.0417	.5700	44
17	.28039	.95989	.29210	.4234	.0418	.5665	43
18	.28067	.95980	.29242	.4197	.0419	.5629	42
19	.28094	.95972	.29274	.4160	.0420	.5594	41
20	.28122	.95964	.29305	3.4124	1.0420	3.5559	40
21	.28150	.95956	.29337	.4087	.0421	.5523	39
22	.28178	.95948	.29368	.4050	.0422	.5488	38
23	.28206	.95940	.29400	.4014	.0423	.5453	37
24	.28234	.95931	.29432	.3977	.0424	.5418	36
25	.28262	.95923	.29463	3.3941	1.0425	3.5383	35
26	.28290	.95915	.29495	.3904	.0426	.5348	34
27	.28318	.95907	.29526	.3868	.0427	.5313	33
28	.28346	.95898	.29558	.3832	.0428	.5279	32
29	.28374	.95890	.29590	.3795	.0428	.5244	31
30	.28401	.95882	.29621	3.3759	1.0429	3.5209	30
31	.28429	.95874	.29653	.3723	.0430	.5175	29
32	.28457	.95865	.29685	.3687	.0431	.5140	28
33	.28485	.95857	.29716	.3651	.0432	.5106	27
34	.28513	.95849	.29748	.3616	.0433	.5072	26
35	.28541	.95840	.29780	3.3580	1.0434	3.5037	25
36	.28569	.95832	.29811	.3544	.0435	.5003	24
37	.28597	.95824	.29843	.3509	.0436	.4969	23
38	.28624	.95816	.29875	.3473	.0437	3.4935	22
39	.28652	.95807	.29906	.3438	.0438	.4901	21
40	.28680	.95799	.29938	3.3402	1.0438	3.4867	20
41	.28708	.95791	.29970	.3367	.0439	.4833	19
42	.28736	.95782	.30001	.3332	.0440	.4799	18
43	.28764	.95774	.30033	.3296	.0441	.4766	17
44	.28792	.95765	.30065	.3261	.0442	.4732	16
45	.28820	.95757	.30096	3.3226	1.0443	3.4698	15
46	.28847	.95749	.30128	.3191	.0444	.4665	14
47	.28875	.95740	.30160	.3156	.0445	.4632	13
48	.28903	.95732	.30192	.3121	.0446	.4598	12
49	.28931	.95723	.30223	.3087	.0447	.4565	11
50	.28959	.95715	.30255	3.3052	1.0448	3.4532	10
51	.28987	.95707	.30287	.3017	.0448	.4498	9
52	.29014	.95698	.30319	3.2983	.0449	.4465	8
53	.29042	.95690	.30350	.2948	.0450	.4432	7
54	.29070	.95681	.30382	.2914	.0451	.4399	6
55	.29098	.95673	.30414	3.2879	1.0452	3.4366	5
56	.29126	.95664	.30446	.2845	.0453	.4334	4
57	.29154	.95656	.30478	.2811	.0454	.4301	3
58	.29181	.95647	.30509	.2777	.0455	.4268	2
59	.29209	.95639	.30541	.2742	.0456	.4236	1
60	.29237	.95630	.30573	3.2708	1.0457	3.4203	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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17°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.29237	.95630	.30573	3.2708	1.0457	3.4203	60
1	.29265	.95622	.30605	.2674	.0458	.4170	59
2	.29293	.95613	.30637	.2640	.0459	.4138	58
3	.29321	.95605	.30668	.2607	.0460	.4106	57
4	.29348	.95596	.30700	.2573	.0461	.4073	56
5	.29376	.95588	.30732	3.2539	1.0461	3.4041	55
6	.29404	.95579	.30764	.2505	.0462	.4009	54
7	.29432	.95571	.30796	.2472	.0463	.3977	53
8	.29460	.95562	.30828	.2438	.0464	.3945	52
9	.29487	.95554	.30859	.2405	.0465	.3913	51
10	.29515	.95545	.30891	3.2371	1.0466	3.3881	50
11	.29543	.95536	.30923	.2338	.0467	.3849	49
12	.29571	.95528	.30955	.2305	.0468	.3817	48
13	.29598	.95519	.30987	.2271	.0469	.3785	47
14	.29626	.95511	.31019	.2238	.0470	.3754	46
15	.29654	.95502	.31051	3.2205	1.0471	3.3722	45
16	.29682	.95493	.31083	.2172	.0472	.3690	44
17	.29710	.95485	.31115	.2139	.0473	.3659	43
18	.29737	.95476	.31146	.2106	.0474	.3627	42
19	.29765	.95467	.31178	.2073	.0475	.3596	41
20	.29793	.95459	.31210	3.2041	1.0476	3.3565	40
21	.29821	.95450	.31242	.2008	.0477	.3534	39
22	.29848	.95441	.31274	.1975	.0478	.3502	38
23	.29876	.95433	.31306	.1942	.0478	.3471	37
24	.29904	.95424	.31338	.1910	.0479	.3440	36
25	.29932	.95415	.31370	3.1877	1.0480	3.3409	35
26	.29959	.95407	.31402	.1845	.0481	.3378	34
27	.29987	.95398	.31434	.1813	.0482	.3347	33
28	.30015	.95389	.31466	.1780	.0483	.3316	32
29	.30043	.95380	.31498	.1748	.0484	.3285	31
30	.30070	.95372	.31530	3.1716	1.0485	3.3255	30
31	.30098	.95363	.31562	.1684	.0486	.3224	29
32	.30126	.95354	.31594	.1652	.0487	.3194	28
33	.30154	.95345	.31626	.1620	.0488	.3163	27
34	.30181	.95337	.31658	.1588	.0489	.3133	26
35	.30209	.95328	.31690	3.1556	1.0490	3.3102	25
36	.30237	.95319	.31722	.1524	.0491	.3072	24
37	.30265	.95310	.31754	.1492	.0492	.3042	23
38	.30292	.95301	.31786	.1460	.0493	.3011	22
39	.30320	.95293	.31818	.1429	.0494	.2981	21
40	.30348	.95284	.31850	3.1397	1.0495	3.2951	20
41	.30375	.95275	.31882	.1366	.0496	.2921	19
42	.30403	.95266	.31914	.1334	.0497	.2891	18
43	.30431	.95257	.31946	.1303	.0498	.2861	17
44	.30459	.95248	.31978	.1271	.0499	.2831	16
45	.30486	.95239	.32010	3.1240	1.0500	3.2801	15
46	.30514	.95231	.32042	.1209	.0501	.2772	14
47	.30542	.95222	.32074	.1177	.0502	.2742	13
48	.30569	.95213	.32106	.1146	.0503	.2712	12
49	.30597	.95204	.32138	.1115	.0504	.2683	11
50	.30625	.95195	.32171	3.1084	1.0505	3.2653	10
51	.30653	.95186	.32203	.1053	.0506	.2624	9
52	.30680	.95177	.32235	.1022	.0507	.2594	8
53	.30708	.95168	.32267	.0991	.0508	.2565	7
54	.30736	.95159	.32299	.0960	.0509	.2535	6
55	.30763	.95150	.32331	3.0930	1.0510	3.2506	5
56	.30791	.95141	.32363	.0899	.0511	.2477	4
57	.30819	.95132	.32395	.0868	.0512	.2448	3
58	.30846	.95124	.32428	.0838	.0513	.2419	2
59	.30874	.95115	.32460	.0807	.0514	.2390	1
60	.30902	.95106	.32492	3.0777	1.0515	3.2361	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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18°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.30902	.95106	.32492	3.0777	1.0515	3.2361	60
1	.30929	.95097	.32524	.0746	.0516	.2332	59
2	.30957	.95088	.32556	.0716	.0517	.2303	58
3	.30985	.95079	.32588	.0686	.0518	.2274	57
4	.31012	.95070	.32621	.0655	.0519	.2245	56
5	.31040	.95061	.32653	3.0625	1.0520	3.2216	55
6	.31068	.95051	.32685	.0595	.0521	.2188	54
7	.31095	.95042	.32717	.0565	.0522	.2159	53
8	.31123	.95033	.32749	.0535	.0523	.2131	52
9	.31150	.95024	.32782	.0505	.0524	.2102	51
10	.31178	.95015	.32814	3.0475	1.0525	3.2074	50
11	.31206	.95006	.32846	.0445	.0526	.2045	49
12	.31233	.94997	.32878	.0415	.0527	.2017	48
13	.31261	.94988	.32910	.0385	.0528	.1989	47
14	.31289	.94979	.32943	.0356	.0529	.1960	46
15	.31316	.94970	.32975	3.0326	1.0530	3.1932	45
16	.31344	.94961	.33007	.0296	.0531	.1904	44
17	.31372	.94952	.33039	.0267	.0532	.1876	43
18	.31399	.94942	.33072	.0237	.0533	.1848	42
19	.31427	.94933	.33104	.0208	.0534	.1820	41
20	.31454	.94924	.33136	3.0178	1.0535	3.1792	40
21	.31482	.94915	.33169	.0149	.0536	.1764	39
22	.31510	.94906	.33201	.0120	.0537	.1736	38
23	.31537	.94897	.33233	.0090	.0538	.1708	37
24	.31565	.94888	.33265	.0061	.0539	.1681	36
25	.31592	.94878	.33298	3.0032	1.0540	3.1653	35
26	.31620	.94869	.33330	.0003	.0541	.1625	34
27	.31648	.94860	.33362	2.9974	.0542	.1598	33
28	.31675	.94851	.33395	.9945	.0543	.1570	32
29	.31703	.94841	.33427	.9916	.0544	.1543	31
30	.31730	.94832	.33459	2.9887	1.0545	3.1515	30
31	.31758	.94823	.33492	.9858	.0546	.1488	29
32	.31786	.94814	.33524	.9829	.0547	.1461	28
33	.31813	.94805	.33557	.9800	.0548	.1433	27
34	.31841	.94795	.33589	.9772	.0549	.1406	26
35	.31868	.94786	.33621	2.9743	1.0550	3.1379	25
36	.31896	.94777	.33654	.9714	.0551	.1352	24
37	.31923	.94767	.33686	.9686	.0552	.1325	23
38	.31951	.94758	.33718	.9657	.0553	.1298	22
39	.31978	.94749	.33751	.9629	.0554	.1271	21
40	.32006	.94740	.33783	2.9600	1.0555	3.1244	20
41	.32034	.94730	.33816	.9572	.0556	.1217	19
42	.32061	.94721	.33848	.9544	.0557	.1190	18
43	.32089	.94712	.33880	.9515	.0558	.1163	17
44	.32116	.94702	.33913	.9487	.0559	.1137	16
45	.32144	.94693	.33945	2.9459	1.0560	3.1110	15
46	.32171	.94684	.33978	.9431	.0561	.1083	14
47	.32199	.94674	.34010	.9403	.0562	.0157	13
48	.32226	.94665	.34043	.9375	.0563	.1030	12
49	.32254	.94655	.34075	.9347	.0565	.1004	11
50	.32282	.94646	.34108	2.9319	1.0566	3.0977	10
51	.32309	.94637	.34140	.9291	.0567	.0951	9
52	.32337	.94627	.34173	.9263	.0568	.0925	8
53	.32364	.94618	.34205	.9235	.0569	.0898	7
54	.32392	.94608	.34238	.9208	.0570	.0872	6
55	.32419	.94599	.34270	2.9180	1.0571	3.0846	5
56	.32447	.94590	.34303	.9152	.0572	.0820	4
57	.32474	.94580	.34335	.9125	.0573	.0793	3
58	.32502	.94571	.34368	.9097	.0574	.0767	2
59	.32529	.94561	.34400	.9069	.0575	.0741	1
60	.32557	.94552	.34433	2.9042	1.0576	3.0715	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

71°

19°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.32557	.94552	.34433	2.9042	1.0576	3.0715	60
1	.32584	.94542	.34465	.9015	.0577	.0690	59
2	.32612	.94533	.34498	.8987	.0578	.0664	58
3	.32639	.94523	.34530	.8960	.0579	.0638	57
4	.32667	.94514	.34563	.8933	.0580	.0612	56
5	.32694	.94504	.34595	2.8905	1.0581	3.0586	55
6	.32722	.94495	.34628	.8878	.0582	.0561	54
7	.32749	.94485	.34661	.8851	.0584	.0535	53
8	.32777	.94476	.34693	.8824	.0585	.0509	52
9	.32804	.94466	.34726	.8797	.0586	.0484	51
10	.32832	.94457	.34758	2.8770	1.0587	3.0458	50
11	.32859	.94447	.34791	.8743	.0588	.0433	49
12	.32887	.94438	.34824	.8716	.0589	.0407	48
13	.32914	.94428	.34856	.8689	.0590	.0382	47
14	.32942	.94418	.34889	.8662	.0591	.0357	46
15	.32969	.94409	.34921	2.8636	1.0592	3.0331	45
16	.32996	.94399	.34954	.8609	.0593	.0306	44
17	.33024	.94390	.34987	.8583	.0594	.0281	43
18	.33051	.94380	.35019	.8555	.0595	.0256	42
19	.33079	.94370	.35052	.8529	.0596	.0231	41
20	.33106	.94361	.35085	2.8502	1.0598	3.0206	40
21	.33134	.94351	.35117	.8476	.0599	.0181	39
22	.33161	.94341	.35150	.8449	.0600	.0156	38
23	.33189	.94332	.35183	.8423	.0601	.0131	37
24	.33216	.94322	.35215	.8396	.0602	.0106	36
25	.33243	.94313	.35248	2.8370	1.0603	3.0081	35
26	.33271	.94303	.35281	.8344	.0604	.0056	34
27	.33298	.94293	.35314	.8318	.0605	.0031	33
28	.33326	.94283	.35346	.8291	.0606	.0007	32
29	.33353	.94274	.35379	.8265	.0607	2.9982	31
30	.33381	.94264	.35412	2.8239	1.0608	2.9957	30
31	.33408	.94254	.35445	.8213	.0609	.9933	29
32	.33435	.94245	.35477	.8187	.0611	.9908	28
33	.33463	.94235	.35510	.8161	.0612	.9884	27
34	.33490	.94225	.35543	.8135	.0613	.9859	26
35	.33518	.94215	.35576	2.8109	1.0614	2.9835	25
36	.33545	.94206	.35608	.8083	.0615	.9810	24
37	.33572	.94196	.35641	.8057	.0616	.9786	23
38	.33600	.94186	.35674	.8032	.0617	.9762	22
39	.33627	.94176	.35707	.8006	.0618	.9738	21
40	.33655	.94167	.35739	2.7980	1.0619	2.9713	20
41	.33682	.94157	.35772	.7954	.0620	.9689	19
42	.33709	.94147	.35805	.7929	.0622	.9665	18
43	.33737	.94137	.35838	.7903	.0623	.9641	17
44	.33764	.94127	.35871	.7878	.0624	.9617	16
45	.33792	.94118	.35904	2.7852	1.0625	2.9593	15
46	.33819	.94108	.35936	.7827	.0626	.9569	14
47	.33846	.94098	.35969	.7801	.0627	.9545	13
48	.33874	.94088	.36002	.7776	.0628	.9521	12
49	.33901	.94078	.36035	.7751	.0629	.9497	11
50	.33928	.94068	.36068	2.7725	1.0630	2.9474	10
51	.33956	.94058	.36101	.7700	.0632	.9450	9
52	.33983	.94049	.36134	.7675	.0633	.9426	8
53	.34011	.94039	.36167	.7650	.0634	.9402	7
54	.34038	.94029	.36199	.7625	.0635	.9379	6
55	.34065	.94019	.36232	2.7600	1.0636	2.9355	5
56	.34093	.94009	.36265	.7575	.0637	.9332	4
57	.34120	.93999	.36298	.7550	.0638	.9308	3
58	.34147	.93989	.36331	.7525	.0639	.9285	2
59	.34175	.93979	.36364	.7500	.0641	.9261	1
60	.34202	.93969	.36397	2.7475	1.0642	2.9238	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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20°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.34202	.93969	.36397	2.7475	1.0642	2.9238	60
1	.34229	.93959	.36430	.7450	.0643	.9215	59
2	.34257	.93949	.36463	.7425	.0644	.9191	58
3	.34284	.93939	.36496	.7400	.0645	.9168	57
4	.34311	.93929	.36529	.7376	.0646	.9145	56
5	.34339	.93919	.36562	2.7351	1.0647	2.9122	55
6	.34366	.93909	.36595	.7326	.0648	.9098	54
7	.34393	.93899	.36628	.7302	.0650	.9075	53
8	.34421	.93889	.36661	.7277	.0651	.9052	52
9	.34448	.93879	.36694	.7252	.0652	.9029	51
10	.34475	.93869	.36727	2.7228	1.0653	2.9006	50
11	.34502	.93859	.36760	.7204	.0654	.8983	49
12	.34530	.93849	.36793	.7179	.0655	.8960	48
13	.34557	.93839	.36826	.7155	.0656	.8937	47
14	.34584	.93829	.36859	.7130	.0658	.8915	46
15	.34612	.93819	.36892	2.7106	1.0659	2.8892	45
16	.34639	.93809	.36925	.7082	.0660	.8869	44
17	.34666	.93799	.36958	.7058	.0661	.8846	43
18	.34693	.93789	.36991	.7033	.0662	.8824	42
19	.34721	.93779	.37024	.7009	.0663	.8801	41
20	.34748	.93769	.37057	2.6985	1.0664	2.8778	40
21	.34775	.93758	.37090	.6961	.0666	.8756	39
22	.34803	.93748	.37123	.6937	.0667	.8733	38
23	.34830	.93738	.37156	.6913	.0668	.8711	37
24	.34857	.93728	.37190	.6889	.0669	.8688	36
25	.34884	.93718	.37223	2.6865	1.0670	2.8666	35
26	.34912	.93708	.37256	.6841	.0671	.8644	34
27	.34939	.93698	.37289	.6817	.0673	.8621	33
28	.34966	.93687	.37322	.6794	.0674	.8599	32
29	.34993	.93677	.37355	.6770	.0675	.8577	31
30	.35021	.93667	.37388	2.6746	1.0676	2.8554	30
31	.35048	.93657	.37422	.6722	.0677	.8532	29
32	.35075	.93647	.37455	.6699	.0678	.8510	28
33	.35102	.93637	.37488	.6675	.0679	.8488	27
34	.35130	.93626	.37521	.6652	.0681	.8466	26
35	.35157	.93616	.37554	2.6628	1.0682	2.8444	25
36	.35184	.93606	.37587	.6604	.0683	.8422	24
37	.35211	.93596	.37621	.6581	.0684	.8400	23
38	.35239	.93585	.37654	.6558	.0685	.8378	22
39	.35266	.93575	.37687	.6534	.0686	.8356	21
40	.35293	.93565	.37720	2.6511	1.0688	2.8334	20
41	.35320	.93555	.37754	.6487	.0689	.8312	19
42	.35347	.93544	.37787	.6464	.0690	.8290	18
43	.35375	.93534	.37820	.6441	.0691	.8269	17
44	.35402	.93524	.37853	.6418	.0692	.8247	16
45	.35429	.93513	.37887	2.6394	1.0694	2.8225	15
46	.35456	.93503	.37920	.6371	.0695	.8204	14
47	.35483	.93493	.37953	.6348	.0696	.8182	13
48	.35511	.93482	.37986	.6325	.0697	.8160	12
49	.35538	.93472	.38020	.6302	.0698	.8139	11
50	.35565	.93462	.38053	2.6279	1.0699	2.8117	10
51	.35592	.93451	.38086	.6256	.0701	.8096	9
52	.35619	.93441	.38120	.6233	.0702	.8074	8
53	.35647	.93431	.38153	.6210	.0703	.8053	7
54	.35674	.93420	.38186	.6187	.0704	.8032	6
55	.35701	.93410	.38220	2.6164	1.0705	2.8010	5
56	.35728	.93400	.38253	.6142	.0707	.7989	4
57	.35755	.93389	.38286	.6119	.0708	.7968	3
58	.35782	.93379	.38320	.6096	.0709	.7947	2
59	.35810	.93368	.38353	.6073	.0710	.7925	1
60	.35837	.93358	.38386	2.6051	1.0711	2.7904	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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21°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.35837	.93358	.38386	2.6051	1.0711	2.7904	60
1	.35864	.93348	.38420	.6028	.0713	.7883	59
2	.35891	.93337	.38453	.6006	.0714	.7862	58
3	.35918	.93327	.38486	.5983	.0715	.7841	57
4	.35945	.93316	.38520	.5960	.0716	.7820	56
5	.35972	.93306	.38553	2.5938	1.0717	2.7799	55
6	.36000	.93295	.38587	.5916	.0719	.7778	54
7	.36027	.93285	.38620	.5893	.0720	.7757	53
8	.36054	.93274	.38654	.5871	.0721	.7736	52
9	.36081	.93264	.38687	.5848	.0722	.7715	51
10	.36108	.93253	.38720	2.5826	1.0723	2.7694	50
11	.36135	.93243	.38754	.5804	.0725	.7674	49
12	.36162	.93232	.38787	.5781	.0726	.7653	48
13	.36189	.93222	.38821	.5759	.0727	.7632	47
14	.36217	.93211	.38854	.5737	.0728	.7611	46
15	.36244	.93201	.38888	2.5715	1.0729	2.7591	45
16	.36271	.93190	.38921	.5693	.0731	.7570	44
17	.36298	.93180	.38955	.5671	.0732	.7550	43
18	.36325	.93169	.38988	.5649	.0733	.7529	42
19	.36352	.93158	.39022	.5627	.0734	.7509	41
20	.36379	.93148	.39055	2.5605	1.0736	2.7488	40
21	.36406	.93137	.39089	.5583	.0737	.7468	39
22	.36433	.93127	.39122	.5561	.0738	.7447	38
23	.36460	.93116	.39156	.5539	.0739	.7427	37
24	.36488	.93105	.39189	.5517	.0740	.7406	36
25	.36515	.93095	.39223	2.5495	1.0742	2.7386	35
26	.36542	.93084	.39257	.5473	.0743	.7366	34
27	.36569	.93074	.39290	.5451	.0744	.7346	33
28	.36596	.93063	.39324	.5430	.0745	.7325	32
29	.36623	.93052	.39357	.5408	.0747	.7305	31
30	.36650	.93042	.39391	2.5386	1.0748	2.7285	30
31	.36677	.93031	.39425	.5365	.0749	.7265	29
32	.36704	.93020	.39458	.5343	.0750	.7245	28
33	.36731	.93010	.39492	.5322	.0751	.7225	27
34	.36758	.92999	.39525	.5300	.0753	.7205	26
35	.36785	.92988	.39559	2.5278	1.0754	2.7185	25
36	.36812	.92978	.39593	.5257	.0755	.7165	24
37	.36839	.92967	.39628	.5236	.0756	.7145	23
38	.36866	.92956	.39660	.5214	.0758	.7125	22
39	.36893	.92945	.39694	.5193	.0759	.7105	21
40	.36921	.92935	.39727	2.5171	1.0760	2.7085	20
41	.36948	.92924	.39761	.5150	.0761	.7065	19
42	.36975	.92913	.39795	.5129	.0763	.7045	18
43	.37002	.92902	.39828	.5108	.0764	.7026	17
44	.37029	.92892	.39862	.5086	.0765	.7006	16
45	.37056	.92881	.39896	2.5065	1.0766	2.6986	15
46	.37083	.92870	.39930	.5044	.0768	.6967	14
47	.37110	.92859	.39963	.5023	.0769	.6947	13
48	.37137	.92848	.39997	.5002	.0770	.6927	12
49	.37164	.92838	.40031	.4981	.0771	.6908	11
50	.37191	.92827	.40065	2.4960	1.0773	2.6888	10
51	.37218	.92816	.40098	.4939	.0774	.6869	9
52	.37245	.92805	.40132	.4918	.0775	.6849	8
53	.37272	.92794	.40166	.4897	.0776	.6830	7
54	.37299	.92784	.40200	.4876	.0778	.6810	6
55	.37326	.92773	.40233	2.4855	1.0779	2.6791	5
56	.37353	.92762	.40267	.4834	.0780	.6772	4
57	.37380	.92751	.40301	.4813	.0781	.6752	3
58	.37407	.92740	.40335	.4792	.0783	.6733	2
59	.37434	.92729	.40369	.4772	.0784	.6714	1
60	.37461	.92718	.40403	2.4751	1.0785	2.6695	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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22°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.37461	.92718	.40403	2.4751	1.0785	2.6695	60
1	.37488	.92707	.40436	.4730	.0787	.6675	59
2	.37514	.92696	.40470	.4709	.0788	.6656	58
3	.37541	.92686	.40504	.4689	.0789	.6637	57
4	.37568	.92675	.40538	.4668	.0790	.6618	56
5	.37595	.92664	.40572	2.4647	1.0792	2.6599	55
6	.37622	.92653	.40606	.4627	.0793	.6580	54
7	.37649	.92642	.40640	.4606	.0794	.6561	53
8	.37676	.92631	.40673	.4586	.0795	.6542	52
9	.37703	.92620	.40707	.4565	.0797	.6523	51
10	.37730	.92609	.40741	2.4545	1.0798	2.6504	50
11	.37757	.92598	.40775	.4525	.0799	.6485	49
12	.37784	.92587	.40809	.4504	.0801	.6466	48
13	.37811	.92576	.40843	.4484	.0802	.6447	47
14	.37838	.92565	.40877	.4463	.0803	.6428	46
15	.37865	.92554	.40911	2.4443	1.0804	2.6410	45
16	.37892	.92543	.40945	.4423	.0806	.6391	44
17	.37919	.92532	.40979	.4403	.0807	.6372	43
18	.37946	.92521	.41013	.4382	.0808	.6353	42
19	.37972	.92510	.41047	.4362	.0810	.6335	41
20	.37999	.92499	.41081	2.4342	1.0811	2.6316	40
21	.38026	.92488	.41115	.4322	.0812	.6297	39
22	.38053	.92477	.41149	.4302	.0813	.6279	38
23	.38080	.92466	.41183	.4282	.0815	.6260	37
24	.38107	.92455	.41217	.4262	.0816	.6242	36
25	.38134	.92443	.41251	2.4242	1.0817	2.6223	35
26	.38161	.92432	.41285	.4222	.0819	.6205	34
27	.38188	.92421	.41319	.4202	.0820	.6186	33
28	.38214	.92410	.41353	.4182	.0821	.6168	32
29	.38241	.92399	.41387	.4162	.0823	.6150	31
30	.38268	.92388	.41421	2.4142	1.0824	2.6131	30
31	.38295	.92377	.41455	.4122	.0825	.6113	29
32	.38322	.92366	.41489	.4102	.0826	.6095	28
33	.38349	.92354	.41524	.4083	.0828	.6076	27
34	.38376	.92343	.41558	.4063	.0829	.6058	26
35	.38403	.92332	.41592	2.4043	1.0830	2.6040	25
36	.38429	.92321	.41626	.4023	.0832	.6022	24
37	.38456	.92310	.41660	.4004	.0833	.6003	23
38	.38483	.92299	.41694	.3984	.0834	.5985	22
39	.38510	.92287	.41728	.3964	.0836	.5967	21
40	.38537	.92276	.41762	2.3945	1.0837	2.5949	20
41	.38564	.92265	.41797	.3925	.0838	.5931	19
42	.38591	.92254	.41831	.3906	.0840	.5913	18
43	.38617	.92242	.41865	.3886	.0841	.5895	17
44	.38644	.92231	.41899	.3867	.0842	.5877	16
45	.38671	.92220	.41933	2.3847	1.0844	2.5859	15
46	.38698	.92209	.41968	.3828	.0845	.5841	14
47	.38725	.92197	.42002	.3808	.0846	.5823	13
48	.38751	.92186	.42036	.3789	.0847	.5805	12
49	.38778	.92175	.42070	.3770	.0849	.5787	11
50	.38805	.92164	.42105	2.3750	1.0850	2.5770	10
51	.38832	.92152	.42139	.3731	.0851	.5752	9
52	.38859	.92141	.42173	.3712	.0853	.5734	8
53	.38886	.92130	.42207	.3692	.0854	.5716	7
54	.38912	.92118	.42242	.3673	.0855	.5699	6
55	.38939	.92107	.42276	2.3654	1.0857	2.5681	5
56	.38966	.92096	.42310	.3635	.0858	.5663	4
57	.38993	.92084	.42344	.3616	.0859	.5646	3
58	.39019	.92073	.42379	.3597	.0861	.5628	2
59	.39046	.92062	.42413	.3577	.0862	.5610	1
60	.39073	.92050	.42447	2.3558	1.0864	2.5593	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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23°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.39073	.92050	.42447	2.3558	1.0864	2.5593	60
1	.39100	.92039	.42482	.3539	.0865	.5575	59
2	.39126	.92028	.42516	.3520	.0866	.5558	58
3	.39153	.92016	.42550	.3501	.0868	.5540	57
4	.39180	.92005	.42585	.3482	.0869	.5523	56
5	.39207	.91993	.42619	2.3463	1.0870	2.5506	55
6	.39234	.91982	.42654	.3445	.0872	.5488	54
7	.39260	.91971	.42688	.3426	.0873	.5471	53
8	.39287	.91959	.42722	.3407	.0874	.5453	52
9	.39314	.91948	.42757	.3388	.0876	.5436	51
10	.39341	.91936	.42791	2.3369	1.0877	2.5419	50
11	.39367	.91925	.42826	.3350	.0878	.5402	49
12	.39394	.91913	.42860	.3332	.0880	.5384	48
13	.39421	.91902	.42894	.3313	.0881	.5367	47
14	.39448	.91891	.42929	.3294	.0882	.5350	46
15	.39474	.91879	.42963	2.3276	1.0884	2.5333	45
16	.39501	.91868	.42998	.3257	.0885	.5316	44
17	.39528	.91856	.43032	.3238	.0886	.5299	43
18	.39554	.91845	.43067	.3220	.0888	.5281	42
19	.39581	.91833	.43101	.3201	.0889	.5264	41
20	.39508	.91822	.43136	2.3183	1.0891	2.5247	40
21	.39635	.91840	.43170	.3164	.0892	.5230	39
22	.39661	.91798	.43205	.3145	.0893	.5213	38
23	.39688	.91787	.43239	.3127	.0895	.5196	37
24	.39715	.91775	.43274	.3109	.0896	.5179	36
25	.39741	.91764	.43308	2.3090	1.0897	2.5163	35
26	.39768	.91752	.43343	.3072	.0899	.5146	34
27	.39795	.91741	.43377	.3053	.0900	.5129	33
28	.39821	.91729	.43412	.3035	.0902	.5112	32
29	.39848	.91718	.43447	.3017	.0903	.5095	31
30	.39875	.91706	.43481	2.2998	1.0904	2.5078	30
31	.39901	.91694	.43516	.2980	.0906	.5062	29
32	.39928	.91683	.43550	.2962	.0907	.5045	28
33	.39955	.91671	.43585	.2944	.0908	.5028	27
34	.39981	.91659	.43620	.2925	.0910	.5011	26
35	.40008	.91648	.43654	2.2907	1.0911	2.4995	25
36	.40035	.91636	.43689	.2889	.0913	.4978	24
37	.40061	.91625	.43723	.2871	.0914	.4961	23
38	.40088	.91613	.43758	.2853	.0915	.4945	22
39	.40115	.91601	.43793	.2835	.0917	.4928	21
40	.40141	.91590	.43827	2.2817	1.0918	2.4912	20
41	.40168	.91578	.43862	.2799	.0920	.4895	19
42	.40195	.91566	.43897	.2781	.0921	.4879	18
43	.40221	.91554	.43932	.2763	.0922	.4862	17
44	.40248	.91543	.43966	.2745	.0924	.4846	16
45	.40275	.91531	.44001	2.2727	1.0925	2.4829	15
46	.40301	.91519	.44036	.2709	.0927	.4813	14
47	.40328	.91508	.44070	.2691	.0928	.4797	13
48	.40354	.91496	.44105	.2673	.0929	.4780	12
49	.40381	.91484	.44140	.2655	.0931	.4764	11
50	.40408	.91472	.44175	2.2637	1.0932	2.4748	10
51	.40434	.91461	.44209	.2619	.0934	.4731	9
52	.40461	.91449	.44244	.2602	.0935	.4715	8
53	.40487	.91437	.44279	.2584	.0936	.4699	7
54	.40514	.91425	.44314	.2566	.0938	.4683	6
55	.40541	.91414	.44349	2.2548	1.0939	2.4666	5
56	.40567	.91402	.44383	.2531	.0941	.4650	4
57	.40594	.91390	.44418	.2513	.0942	.4634	3
58	.40620	.91378	.44453	.2495	.0943	.4618	2
59	.40647	.91366	.44488	.2478	.0945	.4602	1
60	.40674	.91354	.44523	2.2460	1.0946	2.4586	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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24°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.40674	.91354	.44523	2.2460	1 0946	2.4586	60
1	.40700	.91343	.44558	.2443	.0948	.4570	59
2	.40727	.91331	.44593	.2425	.0949	.4554	58
3	.40753	.91319	.44627	.2408	.0951	.4538	57
4	.40780	.91307	.44662	.2390	.0952	.4522	56
5	.40806	.91295	.44697	2.2373	1.0953	2.4506	55
6	.40833	.91283	.44732	.2355	.0955	.4490	54
7	.40860	.91271	.44767	.2338	.0956	.4474	53
8	.40886	.91260	.44802	.2320	.0958	.4458	52
9	.40913	.91248	.44837	.2303	.0959	.4442	51
10	.40939	.91236	.44872	2.2286	1.0961	2.4426	50
11	.40966	.91224	.44907	.2268	.0962	.4411	49
12	.40992	.91212	.44942	.2251	.0963	.4395	48
13	.41019	.91200	.44977	.2234	.0965	.4379	47
14	.41045	.91188	.45012	.2216	.0966	.4363	46
15	.41072	.91176	.45047	2.2199	1.0968	2.4347	45
16	.41098	.91164	.45082	.2182	.0969	.4332	44
17	.41125	.91152	.45117	.2165	.0971	.4316	43
18	.41151	.91140	.45152	.2147	.0972	.4300	42
19	.41178	.91128	.45187	.2130	.0973	.4285	41
20	.41204	.91116	.45222	2.2113	1.0975	2.4269	40
21	.41231	.91104	.45257	.2096	.0976	.4254	39
22	.41257	.91092	.45292	.2079	.0978	.4238	38
23	.41284	.91080	.45327	.2062	.0979	.4222	37
24	.41310	.91068	.45362	.2045	.0981	.4207	36
25	.41337	.91056	.45397	2.2028	1.0982	2.4191	35
26	.41363	.91044	.45432	.2011	.0984	.4176	34
27	.41390	.91032	.45467	.1994	.0985	.4160	33
28	.41416	.91020	.45502	.1977	.0986	.4145	32
29	.41443	.91008	.45537	.1960	.0988	.4130	31
30	.41469	.90996	.45573	2.1943	1.0989	2.4114	30
31	.41496	.90984	.45608	.1926	.0991	.4099	29
32	.41522	.90972	.45643	.1909	.0992	.4083	28
33	.41549	.90960	.45678	.1892	.0994	.4068	27
34	.41575	.90948	.45713	.1875	.0995	.4053	26
35	.41602	.90936	.45748	2.1859	1.0997	2.4037	25
36	.41628	.90924	.45783	.1842	.0998	.4022	24
37	.41654	.90911	.45819	.1825	.1000	.4007	23
38	.41681	.90899	.45854	.1808	.1001	.3992	22
39	.41707	.90887	.45889	.1792	.1003	.3976	21
40	.41734	.90875	.45924	2.1775	1.1004	2.3961	20
41	.41760	.90863	.45960	.1758	.1005	.3946	19
42	.41787	.90851	.45995	.1741	.1007	.3931	18
43	.41813	.90839	.46030	.1725	.1008	.3916	17
44	.41839	.90826	.46065	.1708	.1010	.3901	16
45	.41866	.90814	.46101	2.1692	1.1011	2.3886	15
46	.41892	.90802	.46136	.1675	.1013	.3871	14
47	.41919	.90790	.46171	.1658	.1014	.3856	13
48	.41945	.90778	.46206	.1642	.1016	.3841	12
49	.41972	.90765	.46242	.1625	.1017	.3826	11
50	.41998	.90753	.46277	2.1609	1.1019	2.3811	10
51	.42024	.90741	.46312	.1592	.1020	.3796	9
52	.42051	.90729	.46348	.1576	.1022	.3781	8
53	.42077	.90717	.46383	.1559	.1023	.3766	7
54	.42103	.90704	.46418	.1543	.1025	.3751	6
55	.42130	.90692	.46454	2.1527	1.1026	2.3736	5
56	.42156	.90680	.46489	.1510	.1028	.3721	4
57	.42183	.90668	.46524	.1494	.1029	.3706	3
58	.42209	.90655	.46560	.1478	.1031	.3691	2
59	.42235	.90643	.46595	.1461	.1032	.3677	1
60	.42262	.90631	.46631	2.1445	1.1034	2.3662	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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25°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.42262	.90631	.46631	2.1445	1.1034	2.3662	60
1	.42288	.90618	.46666	.1429	.1035	.3647	59
2	.42314	.90606	.46702	.1412	.1037	.3632	58
3	.42341	.90594	.46737	.1396	.1038	.3618	57
4	.42367	.90581	.46772	.1380	.1040	.3603	56
5	.42394	.90569	.46808	2.1264	1.1041	2.3588	55
6	.42420	.90557	.46843	.1348	.1043	.3574	54
7	.42446	.90544	.46879	.1331	.1044	.3559	53
8	.42473	.90532	.46914	.1315	.1046	.3544	52
9	.42499	.90520	.46950	.1299	.1047	.3530	51
10	.42525	.90507	.46985	2.1283	1.1049	2.3515	50
11	.42552	.90495	.47021	.1267	.1050	.3501	49
12	.42578	.90483	.47056	.1251	.1052	.3486	48
13	.42604	.90470	.47092	.1235	.1053	.3472	47
14	.42630	.90458	.47127	.1219	.1055	.3457	46
15	.42657	.90445	.47163	2.1203	1.1056	2.3443	45
16	.42683	.90433	.47199	.1187	.1058	.3428	44
17	.42709	.90421	.47234	.1171	.1059	.3414	43
18	.42736	.90408	.47270	.1155	.1061	.3399	42
19	.42762	.90396	.47305	.1139	.1062	.3385	41
20	.42788	.90383	.47341	2.1123	1.1064	2.3371	40
21	.42815	.90371	.47376	.1107	.1065	.3356	39
22	.42841	.90358	.47412	.1092	.1067	.3342	38
23	.42867	.90346	.47448	.1076	.1068	.3328	37
24	.42893	.90333	.47483	.1060	.1070	.3313	36
25	.42920	.90321	.47519	2.1044	1.1072	2.3299	35
26	.42946	.90308	.47555	.1028	.1073	.3285	34
27	.42972	.90296	.47590	.1013	.1075	.3271	33
28	.42998	.90283	.47628	.0997	.1076	.3256	32
29	.43025	.90271	.47662	.0981	.1078	.3242	31
30	.43051	.90258	.47697	2.0965	1.1079	2.3228	30
31	.43077	.90246	.47733	.0950	.1081	.3214	29
32	.43104	.90233	.47769	.0934	.1082	.3200	28
33	.43130	.90221	.47805	.0918	.1084	.3186	27
34	.43156	.90208	.47840	.0903	.1085	.3172	26
35	.43182	.90196	.47876	2.0887	1.1087	2.3158	25
36	.43209	.90183	.47912	.0872	.1088	.3143	24
37	.43235	.90171	.47948	.0856	.1090	.3129	23
38	.43261	.90158	.47983	.0840	.1092	.3115	22
39	.43287	.90145	.48019	.0825	.1093	.3101	21
40	.43313	.90133	.48055	2.0809	1.1095	2.3087	20
41	.43340	.90120	.48091	.0794	.1096	.3073	19
42	.43366	.90108	.48127	.0778	.1098	.3059	18
43	.43392	.90095	.48162	.0763	.1099	.3046	17
44	.43418	.90082	.48198	.0747	.1101	.3032	16
45	.43444	.90070	.48234	2.0732	1.1102	2.3018	15
46	.43471	.90057	.48270	.0717	.1104	.3004	14
47	.43497	.90044	.48306	.0701	.1106	.2990	13
48	.43523	.90032	.48342	.0686	.1107	.2976	12
49	.43549	.90019	.48378	.0671	.1109	.2962	11
50	.43575	.90006	.48414	2.0655	1.1110	2.2949	10
51	.43602	.89994	.48449	.0640	.1112	.2935	9
52	.43628	.89981	.48485	.0625	.1113	.2921	8
53	.43654	.89968	.48521	.0609	.1115	.2907	7
54	.43680	.89956	.48557	.0594	.1116	.2894	6
55	.43706	.89943	.48593	2.0579	1.1118	2.2880	5
56	.43732	.89930	.48629	.0564	.1120	.2866	4
57	.43759	.89918	.48665	.0548	.1121	.2853	3
58	.43785	.89905	.48701	.0533	.1123	.2839	2
59	.43811	.89892	.48737	.0518	.1124	.2825	1
60	.43837	.89879	.48773	2.0503	1.1126	2.2812	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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26°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.43837	.89879	.48773	2.0503	1.1126	2.2812	60
1	.43863	.89867	.48809	.0488	.1127	.2798	59
2	.43889	.89854	.48845	.0473	.1129	.2784	58
3	.43915	.89841	.48881	.0458	.1131	.2771	57
4	.43942	.89828	.48917	.0443	.1132	.2757	56
5	.43968	.89815	.48953	2.0427	1.1134	2.2744	55
6	.43994	.89803	.48989	.0412	.1135	.2730	54
7	.44020	.89790	.49025	.0397	.1137	.2717	53
8	.44046	.89777	.49062	2.0382	.1139	.2703	52
9	.44072	.89764	.49098	.0367	.1140	.2690	51
10	.44098	.89751	.49134	2.0352	1.1142	2.2676	50
11	.44124	.89739	.49170	.0338	.1143	.2663	49
12	.44150	.89726	.49206	.0323	.1145	.2650	48
13	.44177	.89713	.49242	.0308	.1147	.2636	47
14	.44203	.89700	.49278	.0293	.1148	.2623	46
15	.44229	.89687	.49314	2.0278	1.1150	2.2610	45
16	.44255	.89674	.49351	.0263	.1151	.2596	44
17	.44281	.89661	.49387	.0248	.1153	.2583	43
18	.44307	.89649	.49423	.0233	.1155	.2570	42
19	.44333	.89636	.49459	.0219	.1156	.2556	41
20	.44385	.89623	.49495	2.0204	1.1158	2.2543	40
21	.44385	.89610	.49532	.0189	.1159	.2530	39
22	.44411	.89597	.49568	.0174	.1161	.2517	38
23	.44437	.89584	.49604	.0159	.1163	.2503	37
24	.44463	.89571	.49640	.0145	.1164	.2490	36
25	.44489	.89558	.49677	2.0130	1.1166	2.2477	35
26	.44516	.89545	.49713	.0115	.1167	.2464	34
27	.44542	.89532	.49749	.0101	.1169	.2451	33
28	.44568	.89519	.49785	.0086	.1171	.2438	32
29	.44594	.89506	.49822	.0071	.1172	.2425	31
30	.44620	.89493	.49858	2.0057	1.1174	2.2411	30
31	.44646	.89480	.49894	.0042	.1176	.2398	29
32	.44672	.89467	.49931	.0028	.1177	.2385	28
33	.44698	.89454	.49967	.0013	.1179	.2372	27
34	.44724	.89441	.50003	1.9998	.1180	.2359	26
35	.44750	.89428	.50040	1.9984	1.1182	2.2348	25
36	.44776	.89415	.50076	.9969	.1184	.2333	24
37	.44802	.89402	.50113	.9955	.1185	.2320	23
38	.44828	.89389	.50149	.9940	.1187	.2307	22
39	.44854	.89376	.50185	.9926	.1189	.2294	21
40	.44880	.89363	.50222	1.9912	1.1190	2.2282	20
41	.44906	.89350	.50258	.9897	.1192	.2269	19
42	.44932	.89337	.50295	.9883	.1193	.2256	18
43	.44958	.89324	.50331	.9868	.1195	.2243	17
44	.44984	.89311	.50368	.9854	.1197	.2230	16
45	.45010	.89298	.50404	1.9840	1.1198	2.2217	15
46	.45036	.89285	.50441	.9825	.1200	.2204	14
47	.45062	.89272	.50477	.9811	.1202	.2192	13
48	.45088	.89258	.50514	.9797	.1203	.2179	12
49	.45114	.89245	.50550	.9782	.1205	.2166	11
50	.45140	.89232	.50587	1.9768	1.1207	2.2153	10
51	.45166	.89219	.50623	.9754	.1208	.2141	9
52	.45191	.89206	.50660	.9739	.1210	.2128	8
53	.45217	.89193	.50696	.9725	.1212	.2115	7
54	.45243	.89180	.50733	.9711	.1213	.2103	6
55	.45269	.89166	.50769	1.9697	1.1215	2.2090	5
56	.45295	.89153	.50806	.9683	.1217	.2077	4
57	.45321	.89140	.50843	.9668	.1218	.2065	3
58	.45347	.89127	.50879	.9654	.1220	.2052	2
59	.45373	.89114	.50916	.9640	.1222	.2039	1
60	.45399	.89101	.50952	1.9626	1.1223	2.2027	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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27°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.45399	.89101	.50952	1.9626	1.1223	2.2027	60
1	.45425	.89087	.50989	.9612	.1225	.2014	59
2	.45451	.89074	.51026	.9598	.1226	.2002	58
3	.45477	.89061	.51062	.9584	.1228	.1989	57
4	.45503	.89048	.51099	.9570	.1230	.1977	56
5	.45528	.89034	.51136	1.9556	1.1231	2.1964	55
6	.45554	.89021	.51172	.9542	.1233	.1952	54
7	.45580	.89008	.51209	.9528	.1235	.1939	53
8	.45606	.88995	.51246	.9514	.1237	.1927	52
9	.45632	.88981	.51283	.9500	.1238	.1914	51
10	.45658	.88968	.51319	1.9486	1.1240	2.1902	50
11	.45684	.88955	.51356	.9472	.1242	.1889	49
12	.45710	.88942	.51393	.9458	.1243	.1877	48
13	.45736	.88928	.51430	.9444	.1245	.1865	47
14	.45761	.88915	.51466	.9430	.1247	.1852	46
15	.45787	.88902	.51503	1.9416	1.1248	2.1840	45
16	.45813	.88888	.51540	.9402	.1250	.1828	44
17	.45839	.88875	.51577	.9388	.1252	.1815	43
18	.45865	.88862	.51614	.9375	.1253	.1803	42
19	.45891	.88848	.51651	.9361	.1255	.1791	41
20	.45917	.88835	.51687	1.9347	1.1257	2.1778	40
21	.45942	.88822	.51724	.9333	.1258	.1766	39
22	.45968	.88808	.51761	.9319	.1260	.1754	38
23	.45994	.88795	.51798	.9306	.1262	.1742	37
24	.46020	.88781	.51835	.9292	.1264	.1730	36
25	.46046	.88768	.51872	1.9278	1.1265	2.1717	35
26	.46072	.88755	.51909	.9264	.1267	.1705	34
27	.46097	.88741	.51946	.9251	.1269	.1693	33
28	.46123	.88728	.51983	.9237	.1270	.1681	32
29	.46149	.88714	.52020	.9223	.1272	.1669	31
30	.46175	.88701	.52057	1.9210	1.1274	2.1657	30
31	.46201	.88688	.52094	.9196	.1275	.1645	29
32	.46226	.88674	.52131	.9182	.1277	.1633	28
33	.46252	.88661	.52168	.9169	.1279	.1620	27
34	.46278	.88647	.52205	.9155	.1281	.1608	26
35	.46304	.88634	.52242	1.9142	1.1282	2.1596	25
36	.46330	.88620	.52279	.9128	.1284	.1584	24
37	.46355	.88607	.52318	.9115	.1286	.1572	23
38	.46381	.88593	.52353	.9101	.1287	.1560	22
39	.46407	.88580	.52390	.9088	.1289	.1548	21
40	.46433	.88566	.52427	1.9074	1.1291	2.1536	20
41	.46458	.88553	.52464	.9061	.1293	.1525	19
42	.46484	.88539	.52501	.9047	.1294	.1513	18
43	.46510	.88526	.52538	.9034	.1296	.1501	17
44	.46536	.88512	.52575	.9020	.1298	.1489	16
45	.46561	.88499	.52612	1.9007	1.1299	2.1477	15
46	.46587	.88485	.52650	.8993	.1301	.1465	14
47	.46613	.88472	.52687	.8980	.1303	.1453	13
48	.46639	.88458	.52724	.8967	.1305	.1441	12
49	.46664	.88444	.52761	.8953	.1306	.1430	11
50	.46690	.88431	.52798	1.8940	1.1308	2.1418	10
51	.46716	.88417	.52836	.8927	.1310	.1406	9
52	.46741	.88404	.52873	.8913	.1312	.1394	8
53	.46767	.88390	.52910	.8900	.1313	.1382	7
54	.46793	.88376	.52947	.8887	.1315	.1371	6
55	.46819	.88363	.52984	1.8873	1.1317	2.1359	5
56	.46844	.88349	.53022	.8860	.1319	.1347	4
57	.46870	.88336	.53059	.8847	.1320	.1335	3
58	.46896	.88322	.53096	.8834	.1322	.1324	2
59	.46921	.88308	.53134	.8820	.1324	.1312	1
60	.46947	.88295	.53171	1.8807	1.1326	2.1300	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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28°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.46947	.88295	.53171	1.8807	1.1326	2.1300	60
1	.46973	.88281	.53208	.8794	.1327	.1289	59
2	.46998	.88267	.53245	.8781	.1329	.1277	58
3	.47024	.88254	.53283	.8768	.1331	.1266	57
4	.47050	.88240	.53320	.8754	.1333	.1254	56
5	.47075	.88226	.53358	1.8741	1.1334	2.1242	55
6	.47101	.88213	.53395	.8728	.1336	.1231	54
7	.47127	.88199	.53432	.8715	.1338	.1219	53
8	.47152	.88185	.53470	.8702	.1340	.1208	52
9	.47178	.88171	.53507	.8689	.1341	.1196	51
10	.47204	.88158	.53545	1.8676	1.1343	2.1185	50
11	.47229	.88144	.53582	.8663	.1345	.1173	49
12	.47255	.88130	.53619	.8650	.1347	.1162	48
13	.47281	.88117	.53657	.8637	.1349	.1150	47
14	.47306	.88103	.53694	.8624	.1350	.1139	46
15	.47332	.88089	.53732	1.8611	1.1352	2.1127	45
16	.47357	.88075	.53769	.8598	.1354	.1116	44
17	.47383	.88061	.53807	.8585	.1356	.1104	43
18	.47409	.88048	.53844	.8572	.1357	.1093	42
19	.47434	.88034	.53882	.8559	.1359	.1082	41
20	.47460	.88020	.53919	1.8546	1.1361	2.1070	40
21	.47486	.88006	.53957	.8533	.1363	.1059	39
22	.47511	.87992	.53995	.8520	.1365	.1048	38
23	.47537	.87979	.54032	.8507	.1366	.1036	37
24	.47562	.87965	.54070	.8495	.1368	.1025	36
25	.47588	.87951	.54107	1.8482	1.1370	2.1014	35
26	.47613	.87937	.54145	.8469	.1372	.1002	34
27	.47639	.87923	.54183	.8456	.1373	.0991	33
28	.47665	.87909	.54220	.8445	.1375	.0980	32
29	.47690	.87895	.54258	.8430	.1377	.0969	31
30	.47716	.87882	.54295	1.8418	1.1379	2.0957	30
31	.47741	.87868	.54333	.8405	.1381	.0946	29
32	.47767	.87854	.54371	.8392	.1382	.0935	28
33	.47792	.87840	.54409	.8379	.1384	.0924	27
34	.47818	.87826	.54446	.8367	.1386	.0912	26
35	.47844	.87812	.54484	1.8354	1.1388	2.0901	25
36	.47869	.87798	.54522	.8341	.1390	.0890	24
37	.47895	.87784	.54559	.8329	.1391	.0879	23
38	.47920	.87770	.54597	.8316	.1393	.0868	22
39	.47946	.87756	.54635	.8303	.1395	.0857	21
40	.47971	.87742	.54673	1.8291	1.1397	2.0846	20
41	.47997	.87728	.54711	.8278	.1399	.0835	19
42	.48022	.87715	.54748	.8265	.1401	.0824	18
43	.48048	.87701	.54786	.8253	.1402	.0812	17
44	.48073	.87687	.54824	.8240	.1404	.0801	16
45	.48099	.87673	.54862	1.8227	1.1406	2.0790	15
46	.48124	.87659	.54900	.8215	.1408	.0779	14
47	.48150	.87645	.54937	.8202	.1410	.0768	13
48	.48175	.87631	.54975	.8190	.1411	.0757	12
49	.48201	.87617	.55013	.8177	.1413	.0746	11
50	.48226	.87603	.55051	1.8165	1.1415	2.0735	10
51	.48252	.87588	.55089	.8152	.1417	.0725	9
52	.48277	.87574	.55127	.8140	.1419	.0714	8
53	.48303	.87560	.55165	.8127	.1421	.0703	7
54	.48328	.87546	.55203	.8115	.1422	.0692	6
55	.48354	.87532	.55241	1.8102	1.1424	2.0681	5
56	.48379	.87518	.55279	.8090	.1426	.0670	4
57	.48405	.87504	.55317	.8078	.1428	.0659	3
58	.48430	.87490	.55355	.8065	.1430	.0648	2
59	.48455	.87476	.55393	.8053	.1432	.0637	1
60	.48481	.87462	.55431	1.8040	1.1433	2.0627	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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29°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.48481	.87462	.55431	1.8040	1.1433	2.0627	60
1	.48506	.87448	.55469	.8028	.1435	.0616	59
2	.48532	.87434	.55507	.8016	.1437	.0605	58
3	.48557	.87420	.55545	.8003	.1439	.0594	57
4	.48583	.87405	.55583	.7991	.1441	.0583	56
5	.48608	.87391	.55621	1.7979	1.1443	2.0573	55
6	.48633	.87377	.55659	.7966	.1445	.0562	54
7	.48659	.87363	.55697	.7954	.1446	.0551	53
8	.48684	.87349	.55735	.7942	.1448	.0540	52
9	.48710	.87335	.55774	.7930	.1450	.0530	51
10	.48735	.87320	.55812	1.7917	1.1452	2.0519	50
11	.48760	.87306	.55850	.7905	.1454	.0508	49
12	.48786	.87292	.55888	.7893	.1456	.0498	48
13	.48811	.87278	.55926	.7881	.1458	.0487	47
14	.48837	.87264	.55964	.7868	.1459	.0476	46
15	.48862	.87250	.56003	1.7856	1.1461	2.0466	45
16	.48887	.87235	.56041	.7844	.1463	.0455	44
17	.48913	.87221	.56079	.7832	.1465	.0444	43
18	.48938	.87207	.56117	.7820	.1467	.0434	42
19	.48964	.87193	.56156	.7808	.1469	.0423	41
20	.48989	.87178	.56194	1.7795	1.1471	2.0413	40
21	.49014	.87164	.56232	.7783	.1473	.0402	39
22	.49040	.87150	.56270	.7771	.1474	.0392	38
23	.49065	.87136	.56309	.7759	.1476	.0381	37
24	.49090	.87121	.56347	.7747	.1478	.0370	36
25	.49116	.87107	.56385	1.7735	1.1480	2.0360	35
26	.49141	.87093	.56424	.7723	.1482	.0349	34
27	.49166	.87078	.56462	.7711	.1484	.0339	33
28	.49192	.87064	.56500	.7699	.1486	.0329	32
29	.49217	.87050	.56539	.7687	.1488	.0318	31
30	.49242	.87035	.56577	1.7675	1.1489	2.0308	30
31	.49268	.87021	.56616	.7663	.1491	.0297	29
32	.49293	.87007	.56654	.7651	.1493	.0287	28
33	.49318	.86992	.56692	.7639	.1495	.0276	27
34	.49343	.86978	.56731	.7627	.1497	.0266	26
35	.49369	.86964	.56769	1.7615	1.1499	2.0256	25
36	.49394	.86949	.56808	.7603	.1501	.0245	24
37	.49419	.86935	.56846	.7591	.1503	.0235	23
38	.49445	.86921	.56885	.7579	.1505	.0224	22
39	.49470	.86906	.56923	.7567	.1507	.0214	21
40	.49495	.86892	.56962	1.7555	1.1508	2.0204	20
41	.49521	.86877	.57000	.7544	.1510	.0194	19
42	.49546	.86863	.57039	.7532	.1512	.0183	18
43	.49571	.86849	.57077	.7520	.1514	.0173	17
44	.49596	.86834	.57116	.7508	.1516	.0163	16
45	.49622	.86820	.57155	1.7496	1.1518	2.0152	15
46	.49647	.86805	.57193	.7484	.1520	.0142	14
47	.49672	.86791	.57232	.7473	.1522	.0132	13
48	.49697	.86776	.57270	.7461	.1524	.0122	12
49	.49723	.86762	.57309	.7449	.1526	.0111	11
50	.49748	.86748	.57348	1.7437	1.1528	2.0101	10
51	.49773	.86733	.57386	.7426	.1530	.0091	9
52	.49798	.86719	.57425	.7414	.1531	.0081	8
53	.49823	.86704	.57464	.7402	.1533	.0071	7
54	.49849	.86690	.57502	.7390	.1535	.0061	6
55	.49874	.86675	.57541	1.7379	1.1537	2.0050	5
56	.49899	.86661	.57580	.7367	.1539	.0040	4
57	.49924	.86646	.57619	.7355	.1541	.0030	3
58	.49950	.86632	.57657	.7344	.1543	.0020	2
59	.49975	.86617	.57696	.7332	.1545	.0010	1
60	.50000	.86603	.57735	1.7320	1.1547	2.0000	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

60°

30°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.50000	.86603	.57735	1.7320	1.1547	2.0000	60
1	.50025	.86588	.57774	.7309	.1549	1.9990	59
2	.50050	.86573	.57813	.7297	.1551	.9980	58
3	.50075	.86559	.57851	.7286	.1553	.9970	57
4	.50101	.86544	.57890	.7274	.1555	.9960	56
5	.50126	.86530	.57929	1.7262	1.1557	1.9950	55
6	.50151	.86515	.57968	.7251	.1559	.9940	54
7	.50176	.86500	.58007	.7239	.1561	.9930	53
8	.50201	.86486	.58046	.7228	.1562	.9920	52
9	.50226	.86471	.58085	.7216	.1564	.9910	51
10	.50252	.86457	.58123	1.7205	1.1566	1.9900	50
11	.50277	.86442	.58162	.7193	.1568	.9890	49
12	.50302	.86427	.58201	.7182	.1570	.9880	48
13	.50327	.86413	.58240	.7170	.1572	.9870	47
14	.50352	.86398	.58279	.7159	.1574	.9860	46
15	.50377	.86383	.58318	1.7147	1.1576	1.9850	45
16	.50402	.86369	.58357	.7136	.1578	.9840	44
17	.50428	.86354	.58396	.7124	.1580	.9830	43
18	.50453	.86339	.58435	.7113	.1582	.9820	42
19	.50478	.86325	.58474	.7101	.1584	.9811	41
20	.50503	.86310	.58513	1.7090	1.1586	1.9801	40
21	.50528	.86295	.58552	.7079	.1588	.9791	39
22	.50553	.86281	.58591	.7067	.1590	.9781	38
23	.50578	.86266	.58630	.7056	.1592	.9771	37
24	.50603	.86251	.58670	.7044	.1594	.9761	36
25	.50628	.86237	.58709	1.7033	1.1596	1.9752	35
26	.50653	.86222	.58748	.7022	.1598	.9742	34
27	.50679	.86207	.58787	.7010	.1600	.9732	33
28	.50704	.86192	.58826	.6999	.1602	.9722	32
29	.50729	.86178	.58865	.6988	.1604	.9713	31
30	.50754	.86163	.58904	1.6977	1.1606	1.9703	30
31	.50779	.86148	.58944	.6965	.1608	.9693	29
32	.50804	.86133	.58983	.6954	.1610	.9683	28
33	.50829	.86118	.59022	.6943	.1612	.9674	27
34	.50854	.86104	.59061	.6931	.1614	.9664	26
35	.50879	.86089	.59100	1.6920	1.1616	1.9654	25
36	.50904	.86074	.59140	.6909	.1618	.9645	24
37	.50929	.86059	.59179	.6898	.1620	.9635	23
38	.50954	.86044	.59218	.6887	.1622	.9625	22
39	.50979	.86030	.59258	.6875	.1624	.9616	21
40	.51004	.86015	.59297	1.6864	1.1626	1.9606	20
41	.51029	.86000	.59336	.6853	.1628	.9596	19
42	.51054	.85985	.59376	.6842	.1630	.9587	18
43	.51079	.85970	.59415	.6831	.1632	.9577	17
44	.51104	.85955	.59454	.6820	.1634	.9568	16
45	.51129	.85941	.59494	1.6808	1.1636	1.9558	15
46	.51154	.85926	.59533	.6797	.1638	.9549	14
47	.51179	.85911	.59572	.6786	.1640	.9539	13
48	.51204	.85896	.59612	.6775	.1642	.9530	12
49	.51229	.85881	.59651	.6764	.1644	.9520	11
50	.51254	.85866	.59691	1.6753	1.1646	1.9510	10
51	.51279	.85851	.59730	.6742	.1648	.9501	9
52	.51304	.85836	.59770	.6731	.1650	.9491	8
53	.51329	.85821	.59809	.6720	.1652	.9482	7
54	.51354	.85806	.59849	.6709	.1654	.9473	6
55	.51379	.85791	.59888	1.6698	1.1656	1.9463	5
56	.51404	.85777	.59928	.6687	.1658	.9454	4
57	.51429	.85762	.59967	.6676	.1660	.9444	3
58	.51454	.85747	.60007	.6665	.1662	.9435	2
59	.51479	.85732	.60046	.6654	.1664	.9425	1
60	.51504	.85717	.60086	1.6643	1.1666	1.9416	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

31°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.51504	.85717	.60086	1.6643	1.1666	1.9416	60
1	.51529	.85702	.60126	.6632	.1668	.9407	59
2	.51554	.85687	.60165	.6621	.1670	.9397	58
3	.51578	.85672	.60205	.6610	.1672	.9388	57
4	.51603	.85657	.60244	.6599	.1674	.9378	56
5	.51628	.85642	.60284	1.6588	1.1676	1.9369	55
6	.51653	.85627	.60324	.6577	.1678	.9360	54
7	.51678	.85612	.60363	.6566	.1681	.9350	53
8	.51703	.85597	.60403	.6555	.1683	.9341	52
9	.51728	.85582	.60443	.6544	.1685	.9332	51
10	.51753	.85566	.60483	1.6534	1.1687	1.9322	50
11	.51778	.85551	.60522	.6523	.1689	.9313	49
12	.51803	.85536	.60562	.6512	.1691	.9304	48
13	.51827	.85521	.60602	.6501	.1693	.9295	47
14	.51852	.85506	.60642	.6490	.1695	.9285	46
15	.51877	.85491	.60681	1.6479	1.1697	1.9276	45
16	.51902	.85476	.60721	.6469	.1699	.9267	44
17	.51927	.85461	.60761	.6458	.1701	.9258	43
18	.51952	.85446	.60801	.6447	.1703	.9248	42
19	.51977	.85431	.60841	.6436	.1705	.9239	41
20	.52002	.85416	.60881	1.6425	1.1707	1.9230	40
21	.52026	.85400	.60920	.6415	.1709	.9221	39
22	.52051	.85385	.60960	.6404	.1712	.9212	38
23	.52076	.85370	.61000	.6393	.1714	.9203	37
24	.52101	.85355	.61040	.6383	.1716	.9193	36
25	.52126	.85340	.61080	1.6372	1.1718	1.9184	35
26	.52151	.85325	.61120	.6361	.1720	.9175	34
27	.52175	.85309	.61160	.6350	.1722	.9166	33
28	.52200	.85294	.61200	.6340	.1724	.9157	32
29	.52225	.85279	.61240	.6329	.1726	.9148	31
30	.52250	.85264	.61280	1.6318	1.1728	1.9139	30
31	.52275	.85249	.61320	.6308	.1730	.9130	29
32	.52299	.85234	.61360	.6297	.1732	.9121	28
33	.52324	.85218	.61400	.6286	.1734	.9112	27
34	.52349	.85203	.61440	.6276	.1737	.9102	26
35	.52374	.85188	.61480	1.6265	1.1739	1.9093	25
36	.52398	.85173	.61520	.6255	.1741	.9084	24
37	.52423	.85157	.61560	.6244	.1743	.9075	23
38	.52448	.85142	.61601	.6233	.1745	.9066	22
39	.52473	.85127	.61641	.6223	.1747	.9057	21
40	.52498	.85112	.61681	1.6212	1.1749	1.9048	20
41	.52522	.85096	.61721	.6202	.1751	.9039	19
42	.52547	.85081	.61761	.6191	.1753	.9030	18
43	.52572	.85066	.61801	.6181	.1756	.9021	17
44	.52597	.85050	.61842	.6170	.1758	.9013	16
45	.52621	.85035	.61882	1.6160	1.1760	1.9004	15
46	.52646	.85020	.61922	.6149	.1762	.8995	14
47	.52671	.85004	.61962	.6139	.1764	.8986	13
48	.52695	.84989	.62003	.6128	.1766	.8977	12
49	.52720	.84974	.62043	.6118	.1768	.8968	11
50	.52745	.84959	.62083	1.6107	1.1770	1.8959	10
51	.52770	.84943	.62123	.6097	.1772	.8950	9
52	.52794	.84928	.62164	.6086	.1775	.8941	8
53	.52819	.84912	.62204	.6076	.1777	.8932	7
54	.52844	.84897	.62244	.6066	.1779	.8924	6
55	.52868	.84882	.62285	1.6055	1.1781	1.8915	5
56	.52893	.84866	.62325	.6045	.1783	.8906	4
57	.52918	.84851	.62366	.6034	.1785	.8897	3
58	.52942	.84836	.62406	.6024	.1787	.8888	2
59	.52967	.84820	.62446	.6014	.1790	.8879	1
60	.52992	.84805	.62487	1.6003	1.1792	1.8871	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.52992	.84805	.62487	1.6003	1.1792	1.8871	60
1	.53016	.84789	.62527	.5993	.1794	.8862	59
2	.53041	.84774	.62568	.5983	.1796	.8853	58
3	.53066	.84758	.62608	.5972	.1798	.8844	57
4	.53090	.84743	.62649	.5962	.1800	.8835	56
5	.53115	.84728	.62689	1.5952	1.1802	1.8827	55
6	.53140	.84712	.62730	.5941	.1805	.8818	54
7	.53164	.84697	.62770	.5931	.1807	.8809	53
8	.53189	.84681	.62811	.5921	.1809	.8801	52
9	.53214	.84666	.62851	.5910	.1811	.8792	51
10	.53238	.84650	.62892	1.5900	1.1813	1.8783	50
11	.53263	.84635	.62933	.5890	.1815	.8775	49
12	.53288	.84619	.62973	.5880	.1818	.8766	48
13	.53312	.84604	.63014	.5869	.1820	.8757	47
14	.53337	.84588	.63055	.5859	.1822	.8749	46
15	.53361	.84573	.63095	1.5849	1.1824	1.8740	45
16	.53386	.84557	.63136	.5839	.1826	.8731	44
17	.53411	.84542	.63177	.5829	.1828	.8723	43
18	.53435	.84526	.63217	.5818	.1831	.8714	42
19	.53460	.84511	.63258	.5808	.1833	.8706	41
20	.53484	.84495	.63299	1.5798	1.1835	1.8697	40
21	.53509	.84479	.63339	.5788	.1837	.8688	39
22	.53533	.84464	.63380	.5778	.1839	.8680	38
23	.53558	.84448	.63421	.5768	.1841	.8671	37
24	.53583	.84433	.63462	.5757	.1844	.8663	36
25	.53607	.84417	.63503	1.5747	1.1846	1.8654	35
26	.53632	.84402	.63543	.5737	.1848	.8646	34
27	.53656	.84386	.63584	.5727	.1850	.8637	33
28	.53681	.84370	.63625	.5717	.1852	.8629	32
29	.53705	.84355	.63666	.5707	.1855	.8620	31
30	.53730	.84339	.63707	1.5697	1.1857	1.8611	30
31	.53754	.84323	.63748	.5687	.1859	.8603	29
32	.53779	.84308	.63789	.5677	.1861	.8595	28
33	.53803	.84292	.63830	.5667	.1863	.8586	27
34	.53828	.84276	.63871	.5657	.1866	.8578	26
35	.53852	.84261	.63912	1.5646	1.1868	1.8569	25
36	.53877	.84245	.63953	.5636	.1870	.8561	24
37	.53901	.84229	.63994	.5626	.1872	.8552	23
38	.53926	.84214	.64035	.5616	.1874	.8544	22
39	.53950	.84198	.64076	.5606	.1877	.8535	21
40	.53975	.84182	.64117	1.5596	1.1879	1.8527	20
41	.53999	.84167	.64158	.5586	.1881	.8519	19
42	.54024	.84151	.64199	.5577	.1883	.8510	18
43	.54048	.84135	.64240	.5567	.1886	.8502	17
44	.54073	.84120	.64281	.5557	.1888	.8493	16
45	.54097	.84104	.64322	1.5547	1.1890	1.8485	15
46	.54122	.84088	.64363	.5537	.1892	.8477	14
47	.54146	.84072	.64404	.5527	.1894	.8468	13
48	.54171	.84057	.64446	.5517	.1897	.8460	12
49	.54195	.84041	.64487	.5507	.1899	.8452	11
50	.54220	.84025	.64528	1.5497	1.1901	1.8443	10
51	.54244	.84009	.64569	.5487	.1903	.8435	9
52	.54268	.83993	.64610	.5477	.1906	.8427	8
53	.54293	.83978	.64652	.5467	.1908	.8418	7
54	.54317	.83962	.64693	.5458	.1910	.8410	6
55	.54342	.83946	.64734	1.5448	1.1912	1.8402	5
56	.54366	.83930	.64775	.5438	.1915	.8394	4
57	.54391	.83914	.64817	.5428	.1917	.8385	3
58	.54415	.83899	.64858	.5418	.1919	.8377	2
59	.54439	.83883	.64899	.5408	.1921	.8369	1
60	.54464	.83867	.64941	1.5399	1.1924	1.8361	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.54464	.83867	.64941	1.5399	1.1924	1.8361	60
1	.54488	.83851	.64982	.5389	.1926	.8352	59
2	.54513	.83835	.65023	.5379	.1928	.8344	58
3	.54537	.83819	.65065	.5369	.1930	.8336	57
4	.54561	.83804	.65106	.5359	.1933	.8328	56
5	.54586	.83788	.65148	1.5350	1.1935	1.8320	55
6	.54610	.83772	.65189	.5340	.1937	.8311	54
7	.54634	.83756	.65231	.5330	.1939	.8303	53
8	.54659	.83740	.65272	.5320	.1942	.8295	52
9	.54683	.83724	.65314	.5311	.1944	.8287	51
10	.54708	.83708	.65355	1.5301	1.1946	1.8279	50
11	.54732	.83692	.65397	.5291	.1948	.8271	49
12	.54756	.83676	.65438	.5282	.1951	.8263	48
13	.54781	.83660	.65480	.5272	.1953	.8255	47
14	.54805	.83644	.65521	.5262	.1955	.8246	46
15	.54829	.83629	.65563	1.5252	1.1958	1.8238	45
16	.54854	.83613	.65604	.5243	.1960	.8230	44
17	.54878	.83597	.65646	.5233	.1962	.8222	43
18	.54902	.83581	.65688	.5223	.1964	.8214	42
19	.54926	.83565	.65729	.5214	.1967	.8206	41
20	.54951	.83549	.65771	1.5204	1.1969	1.8198	40
21	.54975	.83533	.65813	.5195	.1971	.8190	39
22	.54999	.83517	.65854	.5185	.1974	.8182	38
23	.55024	.83501	.65896	.5175	.1976	.8174	37
24	.55048	.83485	.65938	.5166	.1978	.8166	36
25	.55072	.83469	.65980	1.5156	1.1980	1.8158	35
26	.55097	.83453	.66021	.5147	.1983	.8150	34
27	.55121	.83437	.66063	.5137	.1985	.8142	33
28	.55145	.83421	.66105	.5127	.1987	.8134	32
29	.55169	.83405	.66147	.5118	.1990	.8126	31
30	.55194	.83388	.66188	1.5108	1.1992	1.8118	30
31	.55218	.83372	.66230	.5099	.1994	.8110	29
32	.55242	.83356	.66272	.5089	.1997	.8102	28
33	.55266	.83340	.66314	.5080	.1999	.8094	27
34	.55291	.83324	.66356	.5070	.2001	.8086	26
35	.55315	.83308	.66398	1.5061	1.2004	1.8078	25
36	.55339	.83292	.66440	.5051	.2006	.8070	24
37	.55363	.83276	.66482	.5042	.2008	.8062	23
38	.55388	.83260	.66524	.5032	.2010	.8054	22
39	.55412	.83244	.66566	.5023	.2013	.8047	21
40	.55436	.83228	.66608	1.5013	1.2015	1.8039	20
41	.55460	.83211	.66650	.5004	.2017	.8031	19
42	.55484	.83195	.66692	.4994	.2020	.8023	18
43	.55509	.83179	.66734	.4985	.2022	.8015	17
44	.55533	.83163	.66776	.4975	.2024	.8007	16
45	.55557	.83147	.66818	1.4966	1.2027	1.7999	15
46	.55581	.83131	.66860	.4957	.2029	.7992	14
47	.55605	.83115	.66902	.4947	.2031	.7984	13
48	.55629	.83098	.66944	.4938	.2034	.7976	12
49	.55654	.83082	.66986	.4928	.2036	.7968	11
50	.55678	.83066	.67028	1.4919	1.2039	1.7960	10
51	.55702	.83050	.67071	.4910	.2041	.7953	9
52	.55726	.83034	.67113	.4900	.2043	.7945	8
53	.55750	.83017	.67155	.4891	.2046	.7937	7
54	.55774	.83001	.67197	.4881	.2048	.7929	6
55	.55799	.82985	.67239	1.4872	1.2050	1.7921	5
56	.55823	.82969	.67282	.4863	.2053	.7914	4
57	.55847	.82952	.67324	.4853	.2055	.7906	3
58	.55871	.82936	.67366	.4844	.2057	.7898	2
59	.55895	.82920	.67408	.4835	.2060	.7891	1
60	.55919	.82904	.67451	1.4826	1.2062	1.7883	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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34°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.55919	.82904	.67451	1.4826	1.2062	1.7883	60
1	.55943	.82887	.67493	.4816	.2064	.7875	59
2	.55967	.82871	.67535	.4807	.2067	.7867	58
3	.55992	.82855	.67578	.4798	.2069	.7860	57
4	.56016	.82839	.67620	.4788	.2072	.7852	56
5	.56040	.82822	.67663	1.4779	1.2074	1.7844	55
6	.56064	.82806	.67705	.4770	.2076	.7837	54
7	.56088	.82790	.67747	.4761	.2079	.7829	53
8	.56112	.82773	.67790	.4751	.2081	.7821	52
9	.56136	.82757	.67832	.4742	.2083	.7814	51
10	.56160	.82741	.67875	1.4733	1.2086	1.7806	50
11	.56184	.82724	.67917	.4724	.2088	.7798	49
12	.56208	.82708	.67960	.4714	.2091	.7791	48
13	.56232	.82692	.68002	.4705	.2093	.7783	47
14	.56256	.82675	.68045	.4696	.2095	.7776	46
15	.56280	.82659	.68087	1.4687	1.2098	1.7768	45
16	.56304	.82643	.68130	.4678	.2100	.7760	44
17	.56328	.82626	.68173	.4669	.2103	.7753	43
18	.56353	.82610	.68215	.4659	.2105	.7745	42
19	.56377	.82593	.68258	.4650	.2107	.7738	41
20	.56401	.82577	.68301	1.4641	1.2110	1.7730	40
21	.56425	.82561	.68343	.4632	.2112	.7723	39
22	.56449	.82544	.68386	.4623	.2115	.7715	38
23	.56473	.82528	.68429	.4614	.2117	.7708	37
24	.56497	.82511	.68471	.4605	.2119	.7700	36
25	.56521	.82495	.68514	1.4595	1.2122	1.7693	35
26	.56545	.82478	.68557	.4586	.2124	.7685	34
27	.56569	.82462	.68600	.4577	.2127	.7678	33
28	.56593	.82445	.68642	.4568	.2129	.7670	32
29	.56617	.82429	.68685	.4559	.2132	.7663	31
30	.56641	.82413	.68728	1.4550	1.2134	1.7655	30
31	.56664	.82396	.68771	.4541	.2136	.7648	29
32	.56688	.82380	.68814	.4532	.2139	.7640	28
33	.56712	.82363	.68857	.4523	.2141	.7633	27
34	.56736	.82347	.68899	.4514	.2144	.7625	26
35	.56760	.82330	.68942	1.4505	1.2146	1.7618	25
36	.56784	.82314	.68985	.4496	.2149	.7610	24
37	.56808	.82297	.69028	.4487	.2151	.7603	23
38	.56832	.82280	.69071	.4478	.2153	.7596	22
39	.56856	.82264	.69114	.4469	.2156	.7588	21
40	.56880	.82247	.69157	1.4460	1.2158	1.7581	20
41	.56904	.82231	.69200	.4451	.2161	.7573	19
42	.56928	.82214	.69243	.4442	.2163	.7566	18
43	.56952	.82198	.69286	.4433	.2166	.7559	17
44	.56976	.82181	.69329	.4424	.2168	.7551	16
45	.57000	.82165	.69372	1.4415	1.2171	1.7544	15
46	.57023	.82148	.69415	.4406	.2173	.7537	14
47	.57047	.82131	.69459	.4397	.2175	.7529	13
48	.57071	.82115	.69502	.4388	.2178	.7522	12
49	.57095	.82098	.69545	.4379	.2180	.7514	11
50	.57119	.82082	.69588	1.4370	1.2183	1.7507	10
51	.57143	.82065	.69631	.4361	.2185	.7500	9
52	.57167	.82048	.69674	.4352	.2188	.7493	8
53	.57191	.82032	.69718	.4343	.2190	.7485	7
54	.57214	.82015	.69761	.4335	.2193	.7478	6
55	.57238	.81998	.69804	1.4326	1.2195	1.7471	5
56	.57262	.81982	.69847	.4317	.2198	.7463	4
57	.57286	.81965	.69891	.4308	.2200	.7456	3
58	.57310	.81948	.69934	.4299	.2203	.7449	2
59	.57334	.81932	.69977	.4290	.2205	.7442	1
60	.57358	.81915	.70021	1.4281	1.2208	1.7434	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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35°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.57358	.81915	.70021	1.4281	1.2208	1.7434	60
1	.57381	.81898	.70064	.4273	.2210	.7427	59
2	.57405	.81882	.70107	.4264	.2213	.7420	58
3	.57429	.81865	.70151	.4255	.2215	.7413	57
4	.57453	.81848	.70194	.4246	.2218	.7405	56
5	.57477	.81832	.70238	1.4237	1.2220	1.7398	55
6	.57500	.81815	.70281	.4228	.2223	.7391	54
7	.57524	.81798	.70325	.4220	.2225	.7384	53
8	.57548	.81781	.70368	.4211	.2228	.7377	52
9	.57572	.81765	.70412	.4202	.2230	.7369	51
10	.57596	.81748	.70455	1.4193	1.2233	1.7362	50
11	.57619	.81731	.70499	.4185	.2235	.7355	49
12	.57643	.81714	.70542	.4176	.2238	.7348	48
13	.57667	.81698	.70586	.4167	.2240	.7341	47
14	.57691	.81681	.70629	.4158	.2243	.7334	46
15	.57714	.81664	.70673	1.4150	1.2245	1.7327	45
16	.57738	.81647	.70717	.4141	.2248	.7319	44
17	.57762	.81630	.70760	.4132	.2250	.7312	43
18	.57786	.81614	.70804	.4123	.2253	.7305	42
19	.57809	.81597	.70848	.4115	.2255	.7298	41
20	.57833	.81580	.70891	1.4106	1.2258	1.7291	40
21	.57857	.81563	.70935	.4097	.2260	.7284	39
22	.57881	.81546	.70979	.4089	.2263	.7277	38
23	.57904	.81530	.71022	.4080	.2265	.7270	37
24	.57928	.81513	.71066	.4071	.2268	.7263	36
25	.57952	.81496	.71110	1.4063	1.2270	1.7256	35
26	.57975	.81479	.71154	.4054	.2273	.7249	34
27	.57999	.81462	.71198	.4045	.2276	.7242	33
28	.58023	.81445	.71241	1.4037	.2278	.7234	32
29	.58047	.81428	.71285	.4028	.2281	.7227	31
30	.58070	.81411	.71329	1.4019	1.2283	1.7220	30
31	.58094	.81395	.71373	.4011	.2286	.7213	29
32	.58118	.81378	.71417	.4002	.2288	.7206	28
33	.58141	.81361	.71461	.3994	.2291	.7199	27
34	.58165	.81344	.71505	.3985	.2293	.7192	26
35	.58189	.81327	.71549	1.3976	1.2296	1.7185	25
36	.58212	.81310	.71593	.3968	.2298	.7178	24
37	.58236	.81293	.71637	.3959	1.2301	.7171	23
38	.58259	.81276	.71681	.3951	.2304	.7164	22
39	.58283	.81259	.71725	.3942	.2306	.7157	21
40	.58307	.81242	.71769	1.3933	1.2309	1.7151	20
41	.58330	.81225	.71813	.3925	.2311	.7144	19
42	.58354	.81208	.71857	.3916	.2314	.7137	18
43	.58378	.81191	.71901	.3908	.2316	.7130	17
44	.58401	.81174	.71945	.3899	.2319	.7123	16
45	.58425	.81157	.71990	1.3891	1.2322	1.7116	15
46	.58448	.81140	.72034	.3882	.2324	.7109	14
47	.58472	.81123	.72078	.3874	.2327	.7102	13
48	.58496	.81106	.72122	.3865	.2329	.7095	12
49	.58519	.81089	.72166	.3857	.2332	.7088	11
50	.58543	.81072	.72211	1.3848	1.2335	1.7081	10
51	.58566	.81055	.72255	.3840	.2337	.7075	9
52	.58590	.81038	.72299	1.3831	.2340	.7068	8
53	.58614	.81021	.72344	.3823	.2342	.7061	7
54	.58637	.81004	.72388	.3814	.2345	.7054	6
55	.58661	.80987	.72432	1.3806	1.2348	1.7047	5
56	.58684	.80970	.72477	.3797	.2350	.7040	4
57	.58708	.80953	.72521	.3789	.2353	.7033	3
58	.58731	.80936	.72565	.3781	.2355	.7027	2
59	.58755	.80919	.72610	.3772	.2358	.7020	1
60	.58778	.80902	.72654	1.3764	1.2361	1.7013	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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36°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.58778	.80902	.72654	1.3764	1.2361	1.7013	60
1	.58802	.80885	.72699	.3755	.2363	.7006	59
2	.58825	.80867	.72743	.3747	.2366	.6999	58
3	.58849	.80850	.72788	.3738	.2368	.6993	57
4	.58873	.80833	.72832	1.3730	.2371	.6986	56
5	.58896	.80816	.72877	1.3722	1.2374	1.6979	55
6	.58920	.80799	.72921	.3713	.2376	.6972	54
7	.58943	.80782	.72966	.3705	.2379	.6965	53
8	.58967	.80765	.73010	.3697	.2382	.6959	52
9	.58990	.80747	.73055	.3688	.2384	.6952	51
10	.59014	.80730	.73100	1.3680	1.2387	1.6945	50
11	.59037	.80713	.73144	.3672	.2389	.6938	49
12	.59060	.80696	.73189	.3663	.2392	.6932	48
13	.59084	.80679	.73234	.3655	.2395	.6925	47
14	.59107	.80662	.73278	.3647	.2397	.6918	46
15	.59131	.80644	.73323	1.3638	1.2400	1.6912	45
16	.59154	.80627	.73368	.3630	.2403	.6905	44
17	.59178	.80610	.73412	.3622	.2405	.6898	43
18	.59201	.80593	.73457	.3613	.2408	.6891	42
19	.59225	.80576	.73502	.3605	.2411	.6885	41
20	.59248	.80558	.73547	1.3597	1.2413	1.6878	40
21	.59272	.80541	.73592	.3588	.2416	.6871	39
22	.59295	.80524	.73637	.3580	.2419	.6865	38
23	.59318	.80507	.73681	.3572	.2421	.6858	37
24	.59342	.80489	.73726	.3564	.2424	.6851	36
25	.59365	.80472	.73771	1.3555	1.2427	1.6845	35
26	.59389	.80455	.73816	.3547	.2479	1.6838	34
27	.59412	.80437	.73861	.3539	.2432	.6831	33
28	.59435	.80420	.73906	.3531	.2435	.6825	32
29	.59459	.80403	.73951	.3522	.2437	.6818	31
30	.59482	.80386	.73996	1.3514	1.2440	1.6812	30
31	.59506	.80368	.74041	.3506	.2443	.6805	29
32	.59529	.80351	.74086	.3498	.2445	.6798	28
33	.59552	.80334	.74131	.3489	.2448	.6792	27
34	.59576	.80316	.74176	.3481	.2451	.6785	26
35	.59599	.80299	.74221	1.3473	1.2453	1.6779	25
36	.59622	.80282	.74266	.3465	.2456	.6772	24
37	.59646	.80264	.74312	.3457	.2459	.6766	23
38	.59669	.80247	.74357	.3449	.2461	.6759	22
39	.59692	.80230	.74402	.3440	.2464	.6752	21
40	.59716	.80212	.74447	1.3432	1.2467	1.6746	20
41	.59739	.80195	.74492	.3424	.2470	.6739	19
42	.59762	.80177	.74538	.3416	.2472	.6733	18
43	.59786	.80160	.74583	.3408	.2475	.6726	17
44	.59809	.80143	.74628	.3400	.2478	.6720	16
45	.59832	.80125	.74673	1.3392	1.2480	1.6713	15
46	.59856	.80108	.74719	1.3383	.2483	.6707	14
47	.59879	.80090	.74764	.3375	.2486	.6700	13
48	.59902	.80073	.74809	.3367	.2488	.6694	12
49	.59926	.80056	.74855	.3359	.2491	.6687	11
50	.59949	.80038	.74900	1.3351	1.2494	1.6681	10
51	.59972	.80021	.74946	.3343	.2497	.6674	9
52	.59995	.80003	.74991	.3335	.2499	.6668	8
53	.60019	.79986	.75037	.3327	.2502	.6661	7
54	.60042	.79968	.75082	.3319	.2505	.6655	6
55	.60065	.79951	.75128	1.3311	1.2508	1.6648	5
56	.60088	.79933	.75173	.3303	.2510	.6642	4
57	.60112	.79916	.75219	.3294	.2513	.6636	3
58	.60135	.79898	.75264	.3286	.2516	.6629	2
59	.60158	.79881	.75310	.3278	.2519	.6623	1
60	.60181	.79863	.75355	1.3270	1.2521	1.6616	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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37°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.60181	.79863	.75355	1.3270	1.2521	1.6616	60
1	.60205	.79846	.75401	.3262	.2524	.6610	59
2	.60228	.79828	.75447	.3254	.2527	.6603	58
3	.60251	.79811	.75492	.3246	.2530	.6597	57
4	.60274	.79793	.75538	.3238	.2532	.6591	56
5	.60298	.79776	.75584	1.3230	1.2535	1.6584	55
6	.60320	.79758	.75629	.3222	.2538	.6578	54
7	.60344	.79741	.75675	.3214	.2541	.6572	53
8	.60367	.79723	.75721	.3206	.2543	.6565	52
9	.60390	.79706	.75767	.3198	.2546	.6559	51
10	.60413	.79688	.75812	1.3190	1.2549	1.6552	50
11	.60437	.79670	.75858	.3182	.2552	.6546	49
12	.60460	.79653	.75904	.3174	.2554	.6540	48
13	.60483	.79635	.75950	.3166	.2557	.6533	47
14	.60506	.79618	.75996	.3159	.2560	.6527	46
15	.60529	.79600	.76042	1.3151	1.2563	1.6521	45
16	.60552	.79582	.76088	.3143	.2565	.6514	44
17	.60576	.79565	.76134	.3135	.2568	.6508	43
18	.60599	.79547	.76179	.3127	.2571	.6502	42
19	.60622	.79530	.76225	.3119	.2574	.6496	41
20	.60645	.79512	.76271	1.3111	1.2577	1.6489	40
21	.60668	.79494	.76317	.3103	.2579	.6483	39
22	.60691	.79477	.76364	.3095	.2582	.6477	38
23	.60714	.79459	.76410	.3087	.2585	.6470	37
24	.60737	.79441	.76456	.3079	.2588	.6464	36
25	.60761	.79424	.76502	1.3071	1.2591	1.6458	35
26	.60784	.79406	.76548	.3064	.2593	.6452	34
27	.60807	.79388	.76594	.3056	.2596	.6445	33
28	.60830	.79371	.76640	.3048	.2599	.6439	32
29	.60853	.79353	.76686	.3040	.2602	.6433	31
30	.60876	.79335	.76733	1.3032	1.2605	1.6427	30
31	.60899	.79318	.76779	.3024	.2607	.6420	29
32	.60922	.79300	.76825	.3016	.2610	.6414	28
33	.60945	.79282	.76871	.3009	.2613	.6408	27
34	.60968	.79264	.76918	.3001	.2616	.6402	26
35	.60991	.79247	.76964	1.2993	1.2619	1.6396	25
36	.61014	.79229	.77010	.2985	.2622	1.6389	24
37	.61037	.79211	.77057	.2977	.2624	1.6383	23
38	.61061	.79193	.77103	.2970	.2627	.6377	22
39	.61084	.79176	.77149	.2962	.2630	.6371	21
40	.61107	.79158	.77196	1.2954	1.2633	1.6365	20
41	.61130	.79140	.77242	.2946	.2636	.6359	19
42	.61153	.79122	.77289	.2938	.2639	.6352	18
43	.61176	.79104	.77335	.2931	.2641	.6346	17
44	.61199	.79087	.77382	.2923	.2644	.6340	16
45	.61222	.79069	.77428	1.2915	1.2647	1.6334	15
46	.61245	.79051	.77475	.2907	.2650	.6328	14
47	.61268	.79033	.77521	.2900	.2653	.6322	13
48	.61290	.79015	.77568	.2892	.2656	.6316	12
49	.61314	.78998	.77614	.2884	.2659	.6309	11
50	.61337	.78980	.77661	1.2876	1.2661	1.6303	10
51	.61360	.78962	.77708	.2869	.2664	.6297	9
52	.61383	.78944	.77754	.2861	.2667	.6291	8
53	.61405	.78926	.77801	.2853	.2670	.6285	7
54	.61428	.78908	.77848	.2845	.2673	.6279	6
55	.61451	.78890	.77895	1.2838	1.2676	1.6273	5
56	.61474	.78873	.77941	.2830	.2679	.6267	4
57	.61497	.78855	.77988	.2822	.2681	.6261	3
58	.61520	.78837	.78035	.2815	.2684	.6255	2
59	.61543	.78819	.78082	.2807	.2687	.6249	1
60	.61566	.78801	.78128	1.2799	1.2690	1.6243	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.61566	.78801	.78128	1.2799	1.2690	1.6243	60
1	.61589	.78783	.78175	.2792	.2693	.6237	59
2	.61612	.78765	.78222	.2784	.2696	.6231	58
3	.61635	.78747	.78269	.2776	.2699	.6224	57
4	.61658	.78729	.78316	.2769	.2702	.6218	56
5	.61681	.78711	.78363	1.2761	1.2705	1.6212	55
6	.61703	.78693	.78410	.2753	.2707	.6206	54
7	.61726	.78675	.78457	.2746	.2710	.6200	53
8	.61749	.78657	.78504	.2738	.2713	.6194	52
9	.61772	.78640	.78551	.2730	.2716	.6188	51
10	.61795	.78622	.78598	1.2723	1.2719	1.6182	50
11	.61818	.78604	.78645	.2715	.2722	.6176	49
12	.61841	.78586	.78692	.2708	.2725	.6170	48
13	.61864	.78568	.78739	.2700	.2728	.6164	47
14	.61886	.78550	.78786	.2692	.2731	.6159	46
15	.61909	.78532	.78834	1.2685	1.2734	1.6153	45
16	.61932	.78514	.78881	.2677	.2737	.6147	44
17	.61955	.78496	.78928	.2670	.2739	.6141	43
18	.61978	.78478	.78975	.2662	.2742	.6135	42
19	.62001	.78460	.79022	.2655	.2745	.6129	41
20	.62023	.78441	.79070	1.2647	1.2748	1.6123	40
21	.62046	.78423	.79117	.2639	.2751	.6117	39
22	.62069	.78405	.79164	.2632	.2754	.6111	38
23	.62092	.78387	.79212	.2624	.2757	.6105	37
24	.62115	.78369	.79259	.2617	.2760	.6099	36
25	.62137	.78351	.79306	1.2609	1.2763	1.6093	35
26	.62160	.78333	.79354	.2602	.2766	.6087	34
27	.62183	.78315	.79401	.2594	.2769	.6081	33
28	.62206	.78297	.79449	.2587	.2772	.6077	32
29	.62229	.78279	.79496	.2579	.2775	.6070	31
30	.62251	.78261	.79543	1.2572	1.2778	1.6064	30
31	.62274	.78243	.79591	.2564	.2781	.6058	29
32	.62297	.78224	.79639	.2557	.2784	.6052	28
33	.62320	.78206	.79686	.2549	.2787	.6046	27
34	.62342	.78188	.79734	.2542	.2790	.6040	26
35	.62365	.78170	.79781	1.2534	1.2793	1.6034	25
36	.62388	.78152	.79829	.2527	.2795	.6029	24
37	.62411	.78134	.79876	.2519	.2798	.6023	23
38	.62433	.78116	.79924	.2512	.2801	.6017	22
39	.62456	.78097	.79972	.2504	.2804	.6011	21
40	.62479	.78079	.80020	1.2497	1.2807	1.6005	20
41	.62501	.78061	.80067	.2489	.2810	.6000	19
42	.62524	.78043	.80115	.2482	.2813	.5994	18
43	.62547	.78025	.80163	.2475	.2816	.5988	17
44	.62570	.78007	.80211	.2467	.2819	.5982	16
45	.62592	.77988	.80258	1.2460	1.2822	1.5976	15
46	.62615	.77970	.80306	.2452	.2825	.5971	14
47	.62638	.77952	.80354	.2445	.2828	.5965	13
48	.62660	.77934	.80402	.2437	.2831	.5959	12
49	.62683	.77915	.80450	.2430	.2834	.5953	11
50	.62706	.77897	.80498	1.2423	1.2837	1.5947	10
51	.62728	.77879	.80546	.2415	.2840	.5942	9
52	.62751	.77861	.80594	.2408	.2843	.5936	8
53	.62774	.77842	.80642	.2400	.2846	.5930	7
54	.62796	.77824	.80690	.2393	.2849	.5924	6
55	.62819	.77806	.80738	1.2386	1.2852	1.5919	5
56	.62841	.77788	.80786	.2378	.2855	.5913	4
57	.62864	.77769	.80834	.2371	.2858	.5907	3
58	.62887	.77751	.80882	.2364	.2861	.5901	2
59	.62909	.77733	.80930	.2356	.2864	.5898	1
60	.62932	.77715	.80978	1.2349	1.2867	1.5890	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.62932	.77715	.80978	1.2342	1.2867	1.5890	60
1	.62955	.77696	.81026	.2342	.2871	.5884	59
2	.62977	.77678	.81075	.2334	.2874	.5879	58
3	.63000	.77660	.81123	.2327	.2877	.5873	57
4	.63022	.77641	.81171	.2320	.2880	.5867	56
5	.63045	.77623	.81219	1.2312	1.2883	1.5862	55
6	.63067	.77605	.81268	.2305	.2886	.5856	54
7	.63090	.77586	.81316	.2297	.2889	.5850	53
8	.63113	.77568	.81364	.2290	.2892	.5845	52
9	.63135	.77549	.81413	.2283	.2895	.5839	51
10	.63158	.77531	.81461	1.2276	1.2898	1.5833	50
11	.63180	.77513	.81509	.2268	.2901	.5828	49
12	.63203	.77494	.81558	.2261	.2904	.5822	48
13	.63225	.77476	.81606	.2254	.2907	.5816	47
14	.63248	.77458	.81655	.2247	.2910	.5811	46
15	.63270	.77439	.81703	1.2239	1.2913	1.5805	45
16	.63293	.77421	.81752	.2232	.2916	.5799	44
17	.63315	.77402	.81800	.2225	.2919	.5794	43
18	.63338	.77384	.81849	.2218	.2922	.5788	42
19	.63360	.77365	.81898	.2210	.2926	.5783	41
20	.63383	.77347	.81946	1.2203	1.2929	1.5777	40
21	.63405	.77329	.81995	.2196	.2932	.5771	39
22	.63428	.77310	.82043	.2189	.2935	.5766	38
23	.63450	.77292	.82092	.2181	.2939	.5760	37
24	.63473	.77273	.82141	.2174	.2941	.5755	36
25	.63495	.77255	.82190	1.2167	1.2944	1.5749	35
26	.63518	.77236	.82238	.2160	.2947	.5743	34
27	.63540	.77218	.82287	.2152	.2950	.5738	33
28	.63563	.77199	.82336	.2145	.2953	.5732	32
29	.63585	.77181	.82385	.2138	.2956	.5727	31
30	.63608	.77162	.82434	1.2131	1.2960	1.5721	30
31	.63630	.77144	.82482	.2124	.2963	.5716	29
32	.63653	.77125	.82531	.2117	.2966	.5710	28
33	.63675	.77107	.82580	.2109	.2969	.5705	27
34	.63697	.77088	.82629	.2102	.2972	.5699	26
35	.63720	.77070	.82678	1.2095	1.2975	1.5694	25
36	.63742	.77051	.82727	.2088	.2978	.5688	24
37	.63765	.77033	.82776	.2081	.2981	.5683	23
38	.63787	.77014	.82825	.2074	.2985	.5677	22
39	.63810	.76996	.82874	.2066	.2988	.5672	21
40	.63832	.76977	.82923	1.2059	1.2991	1.5666	20
41	.63854	.76958	.82972	.2052	.2994	.5661	19
42	.63877	.76940	.83022	.2045	.2997	.5655	18
43	.63899	.76921	.83071	.2038	.3000	.5650	17
44	.63921	.76903	.83120	.2031	.3003	.5644	16
45	.63944	.76884	.83169	1.2024	1.3006	1.5639	15
46	.63966	.76865	.83218	.2016	.3010	.5633	14
47	.63989	.76847	.83267	.2009	.3013	.5628	13
48	.64011	.76828	.83317	.2002	.3016	.5622	12
49	.64033	.76810	.83366	.1995	.3019	.5617	11
50	.64056	.76791	.83415	1.1988	1.3022	1.5611	10
51	.64078	.76772	.83465	.1981	.3025	.5606	9
52	.64100	.76754	.83514	.1974	.3029	.5600	8
53	.64123	.76735	.83563	.1967	.3032	.5595	7
54	.64145	.76716	.83613	.1960	.3035	.5590	6
55	.64167	.76698	.83662	1.1953	1.3038	1.5584	5
56	.64189	.76679	.83712	.1946	.3041	.5579	4
57	.64212	.76660	.83761	.1939	.3044	.5573	3
58	.64234	.76642	.83811	.1932	.3048	.5568	2
59	.64256	.76623	.83860	.1924	.3051	.5563	1
60	.64279	.76604	.83910	1.1917	1.3054	1.5557	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.64279	.76604	.83910	1.1917	1.3054	1.5557	60
1	.64301	.76586	.83959	.1910	.3057	.5552	59
2	.64323	.76567	.84009	.1903	.3060	.5546	58
3	.64345	.76548	.84059	.1896	.3064	.5541	57
4	.64368	.76530	.84108	.1889	.3067	.5536	56
5	.64390	.76511	.84158	1.1882	1.3070	1.5530	55
6	.64412	.76492	.84208	.1875	.3073	.5525	54
7	.64435	.76473	.84257	.1868	.3076	.5520	53
8	.64457	.76455	.84307	.1861	.3080	.5514	52
9	.64479	.76436	.84357	.1854	.3083	.5509	51
10	.64501	.76417	.84407	1.1847	1.3086	1.5503	50
11	.64523	.76398	.84457	.1840	.3089	.5498	49
12	.64546	.76380	.84506	.1833	.3092	.5493	48
13	.64568	.76361	.84556	.1826	.3096	.5487	47
14	.64590	.76342	.84606	.1819	.3099	.5482	46
15	.64612	.76323	.84656	1.1812	1.3102	1.5477	45
16	.64635	.76304	.84706	.1805	.3105	.5471	44
17	.64657	.76286	.84756	.1798	.3109	.5466	43
18	.64679	.76267	.84806	.1791	.3112	.5461	42
19	.64701	.76248	.84856	.1785	.3115	.5456	41
20	.64723	.76229	.84906	1.1778	1.3118	1.5450	40
21	.64745	.76210	.84956	.1771	.3121	.5445	39
22	.64768	.76191	.85006	.1764	.3125	.5440	38
23	.64790	.76173	.85056	.1757	.3128	.5434	37
24	.64812	.76154	.85107	.1750	.3131	.5429	36
25	.64834	.76135	.85157	1.1743	1.3134	1.5424	35
26	.64856	.76116	.85207	.1736	.3138	.5419	34
27	.64878	.76097	.85257	.1729	.3141	.5413	33
28	.64900	.76078	.85307	.1722	.3144	.5408	32
29	.64923	.76059	.85358	.1715	.3148	.5403	31
30	.64945	.76041	.85408	1.1708	1.3151	1.5398	30
31	.64967	.76022	.85458	.1702	.3154	.5392	29
32	.64989	.76003	.85509	.1695	.3157	.5387	28
33	.65011	.75984	.85559	.1688	.3161	.5382	27
34	.65033	.75965	.85609	.1681	.3164	.5377	26
35	.65055	.75946	.85660	1.1674	1.3167	1.5371	25
36	.65077	.75927	.85710	.1667	.3170	.5366	24
37	.65100	.75908	.85761	.1660	.3174	.5361	23
38	.65121	.75889	.85811	.1653	.3177	.5356	22
39	.65141	.75870	.85862	.1647	.3180	.5351	21
40	.65166	.75851	.85912	1.1640	1.3184	1.5345	20
41	.65188	.75832	.85963	.1633	.3187	.5340	19
42	.65210	.75813	.86013	.1626	.3190	.5335	18
43	.65232	.75794	.86064	.1619	.3193	.5330	17
44	.65254	.75775	.86115	.1612	.3197	.5325	16
45	.65276	.75756	.86165	1.1605	1.3200	1.5319	15
46	.65298	.75737	.86216	.1599	.3203	.5314	14
47	.65320	.75718	.86267	.1592	.3207	.5309	13
48	.65342	.75700	.86318	.1585	.3210	.5304	12
49	.65364	.75680	.86368	.1578	.3213	.5299	11
50	.65386	.75661	.86419	1.1571	1.3217	1.5294	10
51	.65408	.75642	.86470	.1565	.3220	.5289	9
52	.65430	.75623	.86521	.1558	.3223	.5283	8
53	.65452	.75604	.86572	.1551	.3227	.5278	7
54	.65474	.75585	.86623	.1544	.3230	.5273	6
55	.65496	.75566	.86674	1.1537	1.3233	1.5268	5
56	.65518	.75547	.86725	.1531	.3237	.5263	4
57	.65540	.75528	.86775	.1524	.3240	.5258	3
58	.65562	.75509	.86826	.1517	.3243	.5253	2
59	.65584	.75490	.86878	.1510	.3247	.5248	1
60	.65606	.75471	.86929	1.1504	1.3250	1.5242	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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41°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.65606	.75471	.86929	1.1504	1.3250	1.5242	60
1	.65628	.75452	.86980	.1497	.3253	.5237	59
2	.65650	.75433	.87031	.1490	.3257	.5232	58
3	.65672	.75414	.87082	.1483	.3260	.5227	57
4	.65694	.75394	.87133	.1477	.3263	.5222	56
5	.65716	.75375	.87184	1.1470	1.3267	1.5217	55
6	.65737	.75356	.87235	.1463	.3270	.5212	54
7	.65759	.75337	.87287	.1456	.3274	.5207	53
8	.65781	.75318	.87338	.1450	.3277	.5202	52
9	.65803	.75299	.87389	.1443	.3280	.5197	51
10	.65825	.75280	.87441	1.1436	1.3284	1.5192	50
11	.65847	.75261	.87492	.1430	.3287	.5187	49
12	.65869	.75241	.87543	.1423	.3290	.5182	48
13	.65891	.75222	.87595	.1416	.3294	.5177	47
14	.65913	.75203	.87646	.1409	.3297	.5171	46
15	.65934	.75184	.87698	1.1403	1.3301	1.5166	45
16	.65956	.75165	.87749	.1396	.3304	.5161	44
17	.65978	.75146	.87801	.1389	.3307	.5156	43
18	.66000	.75126	.87852	.1383	.3311	.5151	42
19	.66022	.75107	.87904	.1376	.3314	.5146	41
20	.66044	.75088	.87955	1.1369	1.3318	1.5141	40
21	.66066	.75069	.88007	.1363	.3321	.5136	39
22	.66087	.75049	.88058	.1356	.3324	.5131	38
23	.66109	.75030	.88110	.1249	.3328	.5126	37
24	.66131	.75011	.88162	.1343	.3331	.5121	36
25	.66153	.74992	.88213	1.1336	1.3335	1.5116	35
26	.66175	.74973	.88265	.1329	.3338	.5111	34
27	.66197	.74953	.88317	.1323	.3342	.5106	33
28	.66218	.74934	.88369	.1316	.3345	.5101	32
29	.66240	.74915	.88421	.1309	.3348	.5096	31
30	.66262	.74895	.88472	1.1303	1.3352	1.5092	30
31	.66284	.74876	.88524	.1296	.3355	.5087	29
32	.66305	.74857	.88576	.1290	.3359	.5082	28
33	.66327	.74838	.88628	.1283	.3362	.5077	27
34	.66349	.74818	.88680	.1276	.3366	.5072	26
35	.66371	.74799	.88732	1.1270	1.3369	1.5067	25
36	.66393	.74780	.88784	.1263	.3372	.5062	24
37	.66414	.74760	.88836	.1257	.3376	.5057	23
38	.66436	.74741	.88888	.1250	.3379	.5052	22
39	.66458	.74722	.88940	.1243	.3383	.5047	21
40	.66479	.74702	.88992	1.1237	1.3386	1.5042	20
41	.66501	.74683	.89044	.1230	.3390	.5037	19
42	.66523	.74664	.89097	.1224	.3393	.5032	18
43	.66545	.74644	.89149	.1217	.3397	.5027	17
44	.66566	.74625	.89201	.1211	.3400	.5022	16
45	.66588	.74606	.89253	1.1204	1.3404	1.5018	15
46	.66610	.74586	.89306	.1197	.3407	.5013	14
47	.66631	.74567	.89358	.1191	.3411	.5008	13
48	.66653	.74548	.89410	.1184	.3414	.5003	12
49	.66675	.74528	.89463	.1178	.3418	.4998	11
50	.66697	.74509	.89515	1.1171	1.3421	1.4993	10
51	.66718	.74489	.89567	.1165	.3425	.4988	9
52	.66740	.74470	.89620	.1158	.3428	.4983	8
53	.66762	.74450	.89672	.1152	.3432	.4979	7
54	.66783	.74431	.89725	.1145	.3435	.4974	6
55	.66805	.74412	.89777	1.1139	1.3439	1.4969	5
56	.66826	.74392	.89830	.1132	.3442	.4964	4
57	.66848	.74373	.89882	.1126	.3446	.4959	3
58	.66870	.74353	.89935	.1119	.3449	.4954	2
59	.66891	.74334	.89988	.1113	.3453	.4949	1
60	.66913	.74314	.90040	1.1106	1.3456	1.4945	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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42°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.66913	.74314	.90040	1.1106	1.3456	1.4945	60
1	.66935	.74295	.90093	.1100	.3460	.4940	59
2	.66956	.74275	.90146	.1093	.3463	.4935	58
3	.66978	.74256	.90198	.1088	.3467	.4930	57
4	.66999	.74236	.90251	.1080	.3470	.4925	56
5	.67021	.74217	.90304	1.1074	1.3474	1.4921	55
6	.67043	.74197	.90357	.1067	.3477	.4916	54
7	.67064	.74178	.90410	.1061	.3481	.4911	53
8	.67086	.74158	.90463	.1054	.3485	.4906	52
9	.67107	.74139	.90515	.1048	.3488	.4901	51
10	.67129	.74119	.90568	1.1041	1.3492	1.4897	50
11	.67150	.74100	.90621	.1035	.3495	.4892	49
12	.67172	.74080	.90674	.1028	.3499	.4887	48
13	.67194	.74061	.90727	.1022	.3502	.4882	47
14	.67215	.74041	.90780	.1015	.3506	.4877	46
15	.67237	.74022	.90834	1.1009	1.3509	1.4873	45
16	.67258	.74002	.90887	.1003	.3513	.4868	44
17	.67280	.73983	.90940	.0996	.3517	.4863	43
18	.67301	.73963	.90993	.0990	.3520	.4858	42
19	.67323	.73943	.91046	.0983	.3524	.4854	41
20	.67344	.73924	.91099	1.0977	1.3527	1.4849	40
21	.67366	.73904	.91153	.0971	.3531	.4844	39
22	.67387	.73885	.91206	.0964	.3534	.4839	38
23	.67409	.73865	.91259	.0958	.3538	.4835	37
24	.67430	.73845	.91312	.0951	.3542	.4830	36
25	.67452	.73826	.91366	1.0945	1.3545	1.4825	35
26	.67473	.73806	.91419	.0939	.3549	.4821	34
27	.67495	.73787	.91473	.0932	.3552	.4816	33
28	.67516	.73767	.91526	.0926	.3556	.4811	32
29	.67537	.73747	.91580	.0919	.3560	.4806	31
30	.67559	.73728	.91633	1.0913	1.3563	1.4802	30
31	.67580	.73708	.91687	.0907	.3567	.4797	29
32	.67602	.73688	.91740	.0900	.3571	.4792	28
33	.67623	.73669	.91794	.0894	.3574	.4788	27
34	.67645	.73649	.91847	.0888	.3578	.4783	26
35	.67666	.73629	.91901	1.0881	1.3581	1.4778	25
36	.67688	.73610	.91955	.0875	.3585	.4774	24
37	.67709	.73590	.92008	.0868	.3589	.4769	23
38	.67730	.73570	.92062	.0862	.3592	.4764	22
39	.67752	.73551	.92116	.0856	.3596	.4760	21
40	.67773	.73531	.92170	1.0849	1.3600	1.4755	20
41	.67794	.73511	.92223	.0843	.3603	.4750	19
42	.67816	.73491	.92277	.0837	.3607	.4746	18
43	.67837	.73472	.92331	.0830	.3611	.4741	17
44	.67859	.73452	.92385	.0824	.3614	.4736	16
45	.67880	.73432	.92439	1.0818	1.3618	1.4732	15
46	.67901	.73412	.92493	.0812	.3622	.4727	14
47	.67923	.73393	.92547	.0805	.3625	.4723	13
48	.67944	.73373	.92601	.0799	.3629	.4718	12
49	.67965	.73353	.92655	.0793	.3633	.4713	11
50	.67987	.73333	.92709	1.0786	1.3636	1.4709	10
51	.68008	.73314	.92763	.0780	.3640	.4704	9
52	.68029	.73294	.92817	.0774	.3644	.4699	8
53	.68051	.73274	.92871	.0767	.3647	.4695	7
54	.68072	.73254	.92926	.0761	.3651	.4690	6
55	.68093	.73234	.92980	1.0755	1.3655	1.4686	5
56	.68115	.73215	.93034	.0749	.3658	.4681	4
57	.68136	.73195	.93088	.0742	.3662	.4676	3
58	.68157	.73175	.93143	.0736	.3666	.4672	2
59	.68178	.73155	.93197	.0730	.3669	.4667	1
60	.68200	.73135	.93251	1.0724	1.3673	1.4663	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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43°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.68200	.73135	.93251	1.0724	1.3673	1.4663	60
1	.68221	.73115	.93306	.0717	.3677	.4658	59
2	.68242	.73096	.93360	.0711	.3681	.4654	58
3	.68264	.73076	.93415	.0705	.3684	.4649	57
4	.68285	.73056	.93469	.0699	.3688	.4644	56
5	.68306	.73036	.93524	1.0692	1.3692	1.4640	55
6	.68327	.73016	.93578	.0686	.3695	.4635	54
7	.68349	.72996	.93633	.0680	.3699	.4631	53
8	.68370	.72976	.93687	.0674	.3703	.4626	52
9	.68391	.72956	.93742	.0667	.3707	.4622	51
10	.68412	.72937	.93797	1.0661	1.3710	1.4617	50
11	.68433	.72917	.93851	.0655	.3714	.4613	49
12	.68455	.72897	.93906	.0649	.3718	.4608	48
13	.68476	.72877	.93961	.0643	.3722	.4604	47
14	.68497	.72857	.94016	.0636	.3725	.4599	46
15	.68518	.72837	.94071	1.0630	1.3729	1.4595	45
16	.68539	.72817	.94125	.0624	.3733	.4590	44
17	.68561	.72797	.94180	.0618	.3737	.4586	43
18	.68582	.72777	.94235	.0612	.3740	.4581	42
19	.68603	.72757	.94290	.0605	.3744	.4577	41
20	.68624	.72737	.94345	1.0599	1.3748	1.4572	40
21	.68645	.72717	.94400	.0593	.3752	.4568	39
22	.68666	.72697	.94455	.0587	.3756	.4563	38
23	.68688	.72677	.94510	.0581	.3759	.4559	37
24	.68709	.72657	.94565	.0575	.3763	.4554	36
25	.68730	.72637	.94620	1.0568	1.3767	1.4550	35
26	.68751	.72617	.94675	.0562	.3771	.4545	34
27	.68772	.72597	.94731	.0556	.3774	.4541	33
28	.68793	.72577	.94786	.0550	.3778	.4536	32
29	.68814	.72557	.94841	.0544	.3782	.4532	31
30	.68835	.72537	.94896	1.0538	1.3786	1.4527	30
31	.68856	.72517	.94952	.0532	.3790	.4523	29
32	.68878	.72497	.95007	.0525	.3794	.4518	28
33	.68899	.72477	.95062	.0519	.3797	.4514	27
34	.68920	.72457	.95118	.0513	.3801	.4510	26
35	.68941	.72437	.95173	.10507	1.3805	1.4505	25
36	.68962	.72417	.95229	.0501	.3809	.4501	24
37	.68983	.72397	.95284	.0495	.3813	.4496	23
38	.69004	.72377	.95340	.0489	.3816	.4492	22
39	.69025	.72357	.95395	.0483	.3820	.4487	21
40	.69046	.72337	.95451	1.0476	1.3824	1.4483	20
41	.69067	.72317	.95506	.0470	.3828	.4479	19
42	.69088	.72297	.95562	.0464	.3832	.4474	18
43	.69109	.72277	.95618	.0458	.3836	.4470	17
44	.69130	.72256	.95673	.0452	.3839	.4465	16
45	.69151	.72236	.95729	1.0446	1.3843	1.4461	15
46	.69172	.72216	.95785	.0440	.3847	.4457	14
47	.69193	.72196	.95841	.0434	.3851	.4452	13
48	.69214	.72176	.95896	.0428	.3855	.4448	12
49	.69235	.72156	.95952	.0422	.3859	.4443	11
50	.69256	.72136	.96008	1.0416	1.3863	1.4439	10
51	.69277	.72115	.96064	.0410	.3867	.4435	9
52	.69298	.72095	.96120	.0404	.3870	.4430	8
53	.69319	.72075	.96176	.0397	.3874	.4426	7
54	.69340	.72055	.96232	.0391	.3878	.4422	6
55	.69361	.72035	.96288	1.0385	1.3882	1.4417	5
56	.69382	.72015	.96344	.0379	.3886	.4413	4
57	.69403	.71994	.96400	.0373	.3890	.4408	3
58	.69424	.71974	.96456	.0367	.3894	.4404	2
59	.69445	.71954	.96513	.0361	.3898	.4400	1
60	.69466	.71934	.96569	1.0355	1.3902	1.4395	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

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44°

M	Sine	Cosine	Tan.	Cotan.	Secant	Cosec.	M
0	.69466	.71934	.96569	1.0355	1.3902	1.4395	60
1	.69487	.71914	.96625	.0349	.3905	.4391	59
2	.69508	.71893	.96681	.0343	.3909	.4387	58
3	.69528	.71873	.96738	.0337	.3913	.4382	57
4	.69549	.71853	.96794	.0331	.3917	.4378	56
5	.69570	.71833	.96850	1.0325	1.3921	1.4374	55
6	.69591	.71813	.96907	.0319	.3925	.4370	54
7	.69612	.71792	.96963	.0313	.3929	.4365	53
8	.69633	.71772	.97020	.0307	.3933	.4361	52
9	.69654	.71752	.97076	.0301	.3937	.4357	51
10	.69675	.71732	.97133	1.0295	1.3941	1.4352	50
11	.69696	.71711	.97189	.0289	.3945	.4348	49
12	.69716	.71691	.97246	.0283	.3949	.4344	48
13	.69737	.71671	.97302	.0277	.3953	.4339	47
14	.69758	.71650	.97359	.0271	.3957	.4335	46
15	.69779	.71630	.97416	1.0265	1.3960	1.4331	45
16	.69800	.71610	.97472	.0259	.3964	.4327	44
17	.69821	.71589	.97529	.0253	.3968	.4322	43
18	.69841	.71569	.97586	.0247	.3972	.4318	42
19	.69862	.71549	.97643	.0241	.3976	.4314	41
20	.69883	.71529	.97700	1.0235	1.3980	1.4310	40
21	.69904	.71508	.97756	.0229	.3984	.4305	39
22	.69925	.71488	.97813	.0223	.3988	.4301	38
23	.69945	.71468	.97870	.0218	.3992	.4297	37
24	.69966	.71447	.97927	.0212	.3996	.4292	36
25	.69987	.71427	.97984	1.0206	1.4000	1.4288	35
26	.70008	.71406	.98041	.0200	.4004	.4284	34
27	.70029	.71386	.98098	.0194	.4008	.4280	33
28	.70049	.71366	.98155	.0188	.4012	.4276	32
29	.70070	.71345	.98212	.0182	.4016	.4271	31
30	.70091	.71325	.98270	1.0176	1.4020	1.4267	30
31	.70112	.71305	.98327	.0170	.4024	.4263	29
32	.70132	.71284	.98384	.0164	.4028	.4259	28
33	.70153	.71264	.98441	.0158	.4032	.4254	27
34	.70174	.71243	.98499	.0152	.4036	.4250	26
35	.70194	.71223	.98556	1.0146	1.4040	1.4246	25
36	.70215	.71203	.98613	.0141	.4044	.4242	24
37	.70236	.71182	.98671	.0135	.4048	.4238	23
38	.70257	.71162	.98728	.0129	.4052	.4233	22
39	.70277	.71141	.98786	.0123	.4056	.4229	21
40	.70298	.71121	.98843	1.0117	1.4060	1.4225	20
41	.70319	.71100	.98901	.0111	.4065	.4221	19
42	.70339	.71080	.98958	.0105	.4069	.4217	18
43	.70360	.71059	.99016	.0099	.4073	.4212	17
44	.70381	.71039	.99073	.0093	.4077	.4208	16
45	.70401	.71018	.99131	1.0088	1.4081	1.4204	15
46	.70422	.70998	.99189	.0082	.4085	.4200	14
47	.70443	.70977	.99246	.0076	.4089	.4196	13
48	.70463	.70957	.99304	.0070	.4093	.4192	12
49	.70484	.70936	.99362	.0064	.4097	.4188	11
50	.70505	.70916	.99420	1.0058	1.4101	1.4183	10
51	.70525	.70895	.99478	.0052	.4105	.4179	9
52	.70546	.70875	.99536	.0047	.4109	.4175	8
53	.70566	.70854	.99593	.0041	.4113	.4171	7
54	.70587	.70834	.99651	.0035	.4117	.4167	6
55	.70608	.70813	.99709	1.0029	1.4122	1.4163	5
56	.70628	.70793	.99767	.0023	.4126	.4159	4
57	.70649	.70772	.99826	.0017	.4130	.4154	3
58	.70669	.70752	.99884	.0012	.4134	.4150	2
59	.70690	.70731	.99942	.0006	.4138	.4146	1
60	.70711	.70711	1.0000	1.0000	1.4142	1.4142	0
M	Cosine	Sine	Cotan.	Tan.	Cosec.	Secant	M

45°

Decimal Parts of an Inch

1/64 .01563	33/64 .51563
1/32 .08125	17/32 .53125
3/64 .04688	35/64 .54688
1/16 .0625	9/16 .5625
5/64 .07813	37/64 .57813
3/32 .09375	19/32 .59375
7/64 .10938	39/64 .60938
1/8 .125	5/8 .625
9/64 .14063	41/64 .64063
5/32 .15625	21/32 .65625
11/64 .17188	43/64 .67188
3/16 .1875	11/16 .6875
13/64 .20313	45/64 .70313
7/32 .21875	23/32 .71875
15/64 .23438	47/64 .73438
1/4 .250	3/4 .750
17/64 .26563	49/64 .76563
9/32 .28125	25/32 .78125
19/64 .29688	51/64 .79688
5/16 .3125	13/16 .8125
21/64 .32813	53/64 .82813
11/32 .34375	27/32 .84375
23/64 .35938	55/64 .85938
3/8 .375	7/8 .875
25/64 .39063	57/64 .89063
13/32 .40625	29/32 .90625
27/64 .42188	59/64 .92188
7/16 .4375	15/16 .9375
29/64 .45313	61/64 .95313
15/32 .46875	31/32 .96875
31/64 .48438	63/64 .98438
1/2 .500	1 1.00000

ANSWERS TO "THE SLIDE RULE AND HOW TO USE IT"

By Sommers, Drell and Wallschlaeger

Answers to these problems have in most cases been solved by the use of a slide rule and are limited in accuracy to the slide rule errors.

The Publisher

Work Sheet No. 1,

A. 24, B. 19, C. 37, D. 60, E. 88, F. 12, G. 31, H. 22, I. 51, J. 15, K. 96, L. 33, M. 44, N. 46, P. 77, Q. 53, R. 39

1. D, 2. L, 3. M, 4. G, 5. C, 6. E, 7. J, 8. K, 9. N, 10. P, 11. H, 12. A, 13. B, 14. F, 15. I

Work Sheet No. 2

A. 1202, B. 1105, C. 102, D. 114, E. 1515, F. 1351, G. 1412, H. 1705, J. 1785, K. 1945, L. 108, M. 1276, N. 1595, P. 1448

Work Sheet No. 3

A. 2004, B. 209, C. 216, D. 226, E. 232, F. 241, G. 247, H. 252, I. 269, J. 277, K. 289, L. 299, M. 303, N. 319, P. 346, Q. 357, R. 367, S. 381, T. 394 , U. 337

Work Sheet No. 4

A. 404, B. 418, C. 431, D. 450, E. 467, F. 507, G. 542, H. 562, I. 597, J. 611, K. 637, L. 659, M. 696, N. 728, P. 743, Q. 782, R. 813, S. 851, T. 901. U. 98

Exercise Page 14

1. 12 Right index, 2. 12 Right index, 3. 10 Right index, 4. 12 Right index, 5. 8 Left index, 6. 15 Right index, 7. 4 Left index, 8. 40 Right index, 9. 21 Right index, 10. 9 Left index

Work Sheet No. 5

1. 220,000 2. 148,000 3. 51,000 4. 17,600 5. 399,000 6. 77,700 7. 361,000 8. 686,000
9. 437,000 10. 443,500 11. 172,000 12. 203,000 13. 625,000 14. 309,500 15. 383,700 16. 235,700
17. 169,500 18. 57,600 19. 465,500 20. 453,700 21. 764,700 22. 513,000 23. 445,400 24. 140,300
25. 272,600 26. 293,000 27. 144,100 28. 224,200 29. 982,500 30. 402,300 31. 667,300 32. 157,700
33. 685,000 34. 123,100 35. 207,700 36. 104,400 37. 76,500 38. 310,700 39. 350,000 40. 222,100

Work Sheet No. 6

1. 1140, 2. 63.5, 3. 760,400, 4. 1,997,300, 5. 123.5, 6. .0502, 7. .51, 8. 149,500, 9. .001341 10. .0026, 11. 50.2, 12. 4140, 13. 938,300, 14. 66.5, 15. .0000336, 16. 436,000, 17. .02135, 18. 4,095,000, 19. .421, 20. 16.65

Work Sheet No. 7

1. 139,500, 2. 1.880, 3. 12,350, 4. 2.91, 5. .002405, 6. 57.2, 7. .01605, 8. 10.45, 9. 7.65, 10. .000498, 11. 1.61, 12. .00718, 13. 1255, 14. 226, 15. .001625, 16. .00001688, 17. 2.55, 18. 28,200, 19. 2,861,600, 20. 12.37

1. 3430, 2. 622, 3. 6.12, 4. 169.5, 5. 16.92, 6. 30.4, 7. 33.9, 8. 27.05, 9. 72.8, 10. 180.3, 11. 22.7, 12. 98.2, 13. 64.3, 14. 128.4, 15. 22.0, 16. 910.5, 17. 12,260, 18. 11.22, 19. 3.38, 20. 3.71

Work Sheet No. 8

1. 341, 2. 3045, 3. 2240, 4. 8.975, 5. 128,300, 6. .453, 7. 919,000, 8. 12,000, 9. .009, 10. 2.32, 11. 318,700, 12. 2.12, 13. 273,000, 14. 42,400, 15. 20.92, 16. .223, 17. 2,410,000,000, 18. .001245, 19. 44,200, 20. 734, 21. 13.55, 22. .073, 23. 609, 24. 865,000, 25. .1258

Work Sheet No. 9

1. 97.9, 2. 5,100,000, 3. .3695, 4. 2,105,000, 5. .045, 6. 1,288,000, 7. 21.45, 8. 1,945,000, 9. 3740, 10. 7525, 11. 1575, 12. 17.15, 13. .0585, 14. 253, 15. 49,800, 16. 672,000, 17. 40,400, 18. 2825, 19. 604, 20. .000413

Work Sheet No. 10

1. 55.8, 2. .520, 3. 14.6, 4. .230, 5. .2085, 6. 22.0, 7. 1780, 8. .1001, 9. 9.26, 10. .000213, 11. 15,250, 12. .080, 13. .580, 14. .1045, 15. 6.62, 16. 1.111, 17. 24,800, 18. .689, 19. .0238, 20. .3185

Work Sheet No. 11

1. 624, 2. 27.8, 3. 18300, 4. 27.1, 5. 520, 6. 1.76, 7. 1.62, 8. 5300, 9. 17900, 10. .782, 11. .00179, 12. 1185, 13. 16.6, 14. 1.012, 15. .0493

ANSWERS

Work Sheet No. 12

1. 156.3, 2. .294, 3. 688, 4. .00612, 5. .559, 6. 1.905, 7. .01245, 8. .000632, 9. 61.9,
10. 31.0, 11. 362,236, 12. 16.3, 13. .0000656, 14. .00836, 15. 19.8,

Work Sheet No. 13

1. 17.6, 2. 146, 3. 8480, 4. 4760, 5. 23100, 6. 26.7, 7. 703,000, 8. .182, 9. .549, 10. 9720,
11. 11,000, 12. 10,300, 13. .00278, 14. .720, 15. .000392, 16. 11,900,000, 17. 640,000,000,
18. .0000153, 19. 16,730,000, 20. .000000428, 21. .0101, 22. 823, 23. 3,620, 24. 11,250,
25. .0923, 26. .809, 27. 2,330, 28. .00245, 29. .0000763, 30. 30,900,000

1. 530, 2. 720,000,000, 3. .01173, 4. 4,820, 5. 98,500, 6. .136, 7. 260,100,000,000,
8. 2,480,000, 9. 1.24, 10. .0065, 11. 3.67, 12. 10.3, 13. .0157, 14. .000865, 15. 253,500,
16. 3.65, 17. 5.11, 18. .920, 19. 4.65, 20. .286.

Work Sheet No. 14

1. 3.12, 2. 3.51, 3. 6.26, 4. .0823, 5. 80.125, 6. .657, 7. 29.5, 8. 108.35, 9. 66.8, 10. .0986,
11. .205, 12. .0143, 13. 99.3, 14. 214, 15. 15.68, 16. 12.3, 17. 28.9, 18. .861, 19. 9.93,
20. 10.08, 21. .229, 22. .0615, 23. 63.9, 24. .0927, 25. 159, 26. 571, 27. 2,663, 28. 6.60,
29. .487, 30. .0636.

1. 9.08, 2. 1.37, 3. 342.7, 4. 26.2, 5. 5.53, 6. 203.12, 7. 27.8, 8. .760, 9. .096, 10. 20.15

Work Sheet No. 15

1. 74.2, 2. 4,340, 3. 780,000, 4. 732, 5. 138,000, 6. 580, 7. .385, 8. 960,000, 9. 1,160,
10. .932, 11. .0000628, 12. .000184, 13. 16,200,000, 14. 67.2, 15. 4,120, 16. 0.1002,
17. 0.000000263, 18. 590,000,000,000, 19. 830, 20. 5,300, 21. .271, 22. .000,000,0182, 23. 20,900,
24. 1,002, 25. 5,000,000, 26. .000106, 27. .352, 28. 6,750, 29. 1,125, 30. 12,600,000
31. 409,000, 32. 0.000665, 33. 2,430, 34. 749, 35. 0.000000122, 36. 928,000,000, 37. .680,
38. .122, 39. 380,000, 40. 0.000,000,493

Work Sheet No. 16

1. 760, 2. 210, 3. 8.50, 4. 65,000, 5. 34,100,000, 6. 512,000, 7. 1.64, 8. .191, 9. 48.8,
10. .0121, 11. 482,000, 12. 880, 13. 8.50, 14. .00813, 15. 100,000, 16. 307,000, 17. 4,740,
18. 134,000, 19. 86,000,000, 20. 34.0

Work Sheet No. 17

1. 2.204, 2. 2.308, 3. 3.39, 4. 0.755, 5. 0.190, 6. 0.0912, 7. 68.8, 8. 9.55, 9. 22.7,
10. 16.4, 11. .2135, 12. 21.45, 13. .3749, 14. 4.302, 15. .6534, 16. 19.91, 17. 4.44, 18. 3.061,
19. 9.302, 20. 3.516, 21. .6188, 22. 30.64, 23. 17.82, 24. 35.80, 25. 10.005, 26. 45.50,
27. 19.15, 28. 1.443, 29. 4.259, 30. 914. 9, 31. 33.57, 32. 6.261, 33. 9.383, 34. .0991,
35. 9.987, 36. .2045

1. 2.845, 2. 7.789, 3. 3.499, 4. 4.3489, 5. 34.55, 6. 12.34, 7. 3.113, 8. .8534, 9. 37.04,
10. 17.53, 11. 4.262, 12. 8.828, 13. .4985, 14. .5753, 15. 48.97, 16. .9929, 17. 15.56,
18. .8256, 19. 2.51, 20. .469

Work Sheet No. 18

1. 126.3, 2. 7.570, 3. .516, 4. 1.327, 5. 8,290,000, 6. 1,401, 7. 0.00307, 8. 550,500,
9. 12.68, 10. 1.096, 11. 7.27, 12. 10.29, 13. 2.64, 14. 0.661, 15. 108.6, 16. 30.75

Work Sheet No. 19

I. 1.0654, .770, .0008, .407
II. 1.156, 9.786, 110.6, 2. 687, 25.16
III. 13,000, 7,902, 10.697, 16.67
IV. 150.8, .8275, 179.6, .7547
V. 17.14, 13.45, 15.97, 52.96, 2114.3
VI. 6.684, 85.03, 4.149, 25.48

Work Sheet No. 20

I. $\frac{a}{h}$, $\frac{b}{h}$, $\frac{a}{b}$, $\frac{b}{h}$, $\frac{a}{h}$, $\frac{b}{a}$, $\frac{9}{15}$, $\frac{12}{15}$, $\frac{9}{12}$, $\frac{12}{15}$, $\frac{9}{15}$, $\frac{12}{9}$, $\frac{5}{13}$, $\frac{12}{13}$, $\frac{5}{12}$, $\frac{12}{13}$, $\frac{5}{13}$, $\frac{12}{5}$

II. $\frac{10}{14}$, $\frac{10}{14}$, $\frac{10}{10}$, $\frac{10}{14}$, $\frac{10}{14}$, $\frac{10}{10}$, $\frac{31.2}{45.2}$, $\frac{32.7}{45.2}$, $\frac{31.2}{32.7}$, $\frac{32.7}{45.2}$, $\frac{31.2}{45.2}$, $\frac{32.7}{31.2}$, $\frac{1489}{1560}$, $\frac{476}{1560}$, $\frac{1489}{476}$, $\frac{476}{1560}$, $\frac{1489}{1560}$, $\frac{476}{1489}$

Work Sheet No. 21

A. 8°20' B. 1°6' C. 2°10' D. 18°0' E. 41°30' F. 57°0' G. 2°55' H. 1°30' I. 0°56' J. 9°30'

ANSWERS

Work Sheet No. 21 continued

K. 0°43' L. 14°00' M. 6°10' N. 3°12' O. 6°40' P. 26°30' Q. 1°42' R. 72°00' S. 4°50' T. 21°00'
U. 34°30' V. 2°32' W. 47°30' X. 11°20' Y. 68°00'

1. .70711, 2. .50000, 3. .3665, 4. .8111, 5. .7051, 6. .7373, 7. .1965, 8. .1147, 9. .0237,
10. .9799, 11. .1481, 12. .9205, 13. .2644, 14. .6157, 15. .7333, 16. .3104, 17. .4772, 18. .6691,
19. .2079, 20. .0262, 21. .9682, 22. .8572, 23. .3502, 24. .2504, 25. .5925, 26. .4874, 27. .7538,
28. .9397, 29. .1406, 30. .0625

Work Sheet No. 21A

15. 9°55', 3°55', 4°32', 2°52', 1°7',
16. 37°54', 84°12', 87°, 30°, 85°2',
17. .00698, 18. .00436, 19. .00465, 20. .00021, 21. .00180, 22. .00301

Work Sheet No. 22

1. .6249, 2. .2586, 3. .4877, 4. .3346, 5. .9380, 6. .1509, 7. 5715, 8. .0297, 9. .0676,
10. .0758, 11. 1.4460, 12. 2.4960, 13. 1.0446, 14. 3.6059, 15. 9.3831, 16. 22.904, 17. 1.1571,
18. 17.169, 19. 10058, 20. 5.9758,

21. 13°20', 34°20', 5°20', 24°50', 16°20', 5°
22. 53°, 81°40', 68°, 62°50', 87°, 77°40'

1. 4.931, 2. 10.31, 3. .04531, 4. 13.88, 5. 14.722, 7. 262.2, 7. .1946, 8. 118.4, 9. 46.01,
10. 98.06, 11. 17.13, 12. 20.30, 13. 99.84, 14. 1.198, 15. 3,843, 16. 187,400, 17. 159.1,
18. .2414, 19. 575.5, 20. 386.3

Work Sheet No. 23

1. 5.95, 2. 59,528, 3. 57.5, 52.1, 4. 9.5206, 89°20', 5. 15.79, 37°4', 6. 8.334,
7. 58°5', .81403

Work Sheet No. 24

1. Angle B. 51°, b. 4.146, c. 5.328
2. Angle A. 25°22', Angle B. 110°38', b. 11.775
3. No. Solution
4. Angle A. 53°16', Angle B. 42°43', a. 63.91
5. Angle B. 61°, a. .021873, c. .041218
6. Angle A. 89°, c. 26.639, b. 66.388
7. Angle B. 79°, b. 12.676, c. 11.506
8. Angle A. 56°, a. 293.79, b. 345.29

Work Sheet No. 25

1. 10^9, 2. 3^7, 3. 14^{26}, 4. 19^{10}, 5. 2.4^8, 6. 8^9, 7. 1^{39}, 8. 11, 9. $.02^{15}$, 10. 4^{124}, 11. 9^{11},
12. 12^{20}, 13. $.004^{10}$, 14. 1.2^{13}, 15. 9.8^{29}, 16. 209, 17. 124^4, 18. 523, 19. 84^{50}, 20. $1,001^{07}$,
21. 10^{-1}, 22. 10^2, 23. 4^2, 24. 5^3, 25. 8^{13}, 26. 9.5^2, 27. 14.2, 28. 12.7, 29. $.004^8$,
30. 1.02^{15}, 31. 172, 32. 95.04^3, 33. 19^2, 34. 48^8, 35. 11.11^2, 36. 28^9, 37. 84.1^{28}, 38. $.102^3$,
39. $.045033$, 40. 5114

Work Sheet No. 26

a. 2^2, b. 4^2, c. 99, d. 511, e. 10^5, f. 7.2^5, g. $.0046$, h. 12.1^2, i. 4093, j. 5.15^2, k. 1123,
l. 2^{204}, m. 4765, n. 7064^8, o. 715, p. 2353, q. 330, r. 9^{140}, s. 9^2, t. 1.040710

Work Sheet No. 27

1. 4×10^{-6}, 2. 5.14×10^{-3}, 3. 1.23×10^{-1}, 4. 4.56×10^{-2}, 5. 7.8×10^{-5}, 6. 1×10^{-6},
7. 1.775×10^{-1}, 8. 1.861×10^{-2}, 9. 4.14×10^{-4}, 10. 1.12×10^{-6}, 11. 3.2×10^{-1}, 12. 5.09×10^{-5},
13. 4×10^{-5}, 14. 5×10^{-1}, 15. 2.941×10^{-2}, 16. 6.543×10^{-4}, 17. 1.11×10^{-4}, 18. 9.999×10^{-1},
19. 2.6×10^{-2}, 20. 5.2×10^{-3}

1. 1.49×10^5, 2. 1.827×10^3, 3. 1.111×10^3, 4. 2.905×10^3, 5. 4×10^1, 6. 2.6543×10^4,
7. 2.905×10^2, 8. 4.09154×10^5, 9. 2.7×10^7, 10. 3.46027×10^2, 11. 5.1403×10^4, 12. 9×10^0,
13. 2.6414×10^2, 14. 6.15824×10^3, 15. 5.1112×10^4, 16. 5.0496×10^0, 17. 2×10^2, 18. 7×10^8,
19. $9,000000001 \times 10^3$, 20. 1.111111×10^3

Work Sheet No. 28

1. 1,080, 2. 126, 3. 10,600,000, 4. 5,000, 5. .00000000604, 6. 1.28232, 7. 60,200,000,000,
8. 4,096

1. 200, 2. 30, 3. .000000007, 4. .0003, 5. 3, 6. 8400, 7. 86,000,000, 8. 53,000

ANSWERS

Work Sheet No. 29

1. 1.7215, 2. 0.5460, 3. 2.0220, 4. 2.4082, 5. 1.5130, 6. .9872, 7. 3.0235, 8. $\bar{1}$.16732, 9. $\bar{1}$.7499, 10. 2.98945, 11. $\bar{2}$.80550, 12. $\bar{3}$.91540, 13. $\bar{1}$.98900, 14. $\bar{3}$.62221, 15. $\bar{1}$.63043, 16. $\bar{4}$.63448, 17. 1.21748, 18. 4.86864, 19. $\bar{1}$.24055, 20. .28847, 21. .07990, 22. 5.16435, 23. 4.83251, 24. .50664

1. 3.882, 2. 13.21, 3. 2049, 4. 388,000, 5. 222.4, 6. 74.65, 7. 2.6365, 8. 9.3972, 9. .0 12. 30.06

Work Sheet No. 30

1. 2.321, 2. 4,108,000, 3. 89.63, 4. 65.72, 5. 1,204, 6. 10,770,000,000,000, 7. .00000003315, 8. 571,700,000,000,000, 9. 8.822, 10. 1.035, 11. 3.039, 12. 3.696, 13. 5.859, 14. 1.881, 15. 11.51, 16. 1,796,760, 17. .10049, 18. 48,632.1, 19. .1325

Work Sheet No. 31

1. 222.88, 2. 4.66, 3. 26,314.02, 4. 463.43, 5. 55,537.3, 6. .0690, 7. 122,001.2, 8. 9.317, 9. 16,042.63, 10. 59.49, 11. .0741, 12. 484.2, 13. 1.75, 14. .532, 15. 9.208, 16. 25,954.13, 17. 19.223, 18. 20.81, 19. 73.73, 20. 17.95, 21. 2.2,

21. 2.2, 1.77, 1.26, 51.2, 8.73, 7.91

Work Sheet No. 32

1. .431, 2. 10.75, 3. .00876, 4. 9.732, 5. 18.379, 6. 5.9587, 7. 24.086, 8. 101.59, 9. 7.79, 10. 2.39,

11. 4.53, 8.81, 11.61, 199.51, 75.28
12. 4.029, .853, 1.202, 2.572, 3.132
13. 422, 14. 20,099.2, 15. 3.063, 16. .06283

Work Sheet No. 33

1. 1,893.6, 2. 78.76, 3. 73.44, 4. 151,44, 5. 1.0445, 6. 40.96, 7. .5976, 8. .98703, 9. .94656, 10. .80058, 11. 2.1028, 12. 1317.6, 13. 2,481,700, 14. 2.2636, 15. 6182.6, 16. 3.051, 17. 46.913, 18. 1.5452, 19. 117.44, 20. 1.5434,

21. 2.79116, 5.53733, 9.86418-10, .04879, 8.17471, 4.46935
22. 118,910,000, 23. 424,900,000,000, 24. .00000020147, 25. .00000014338