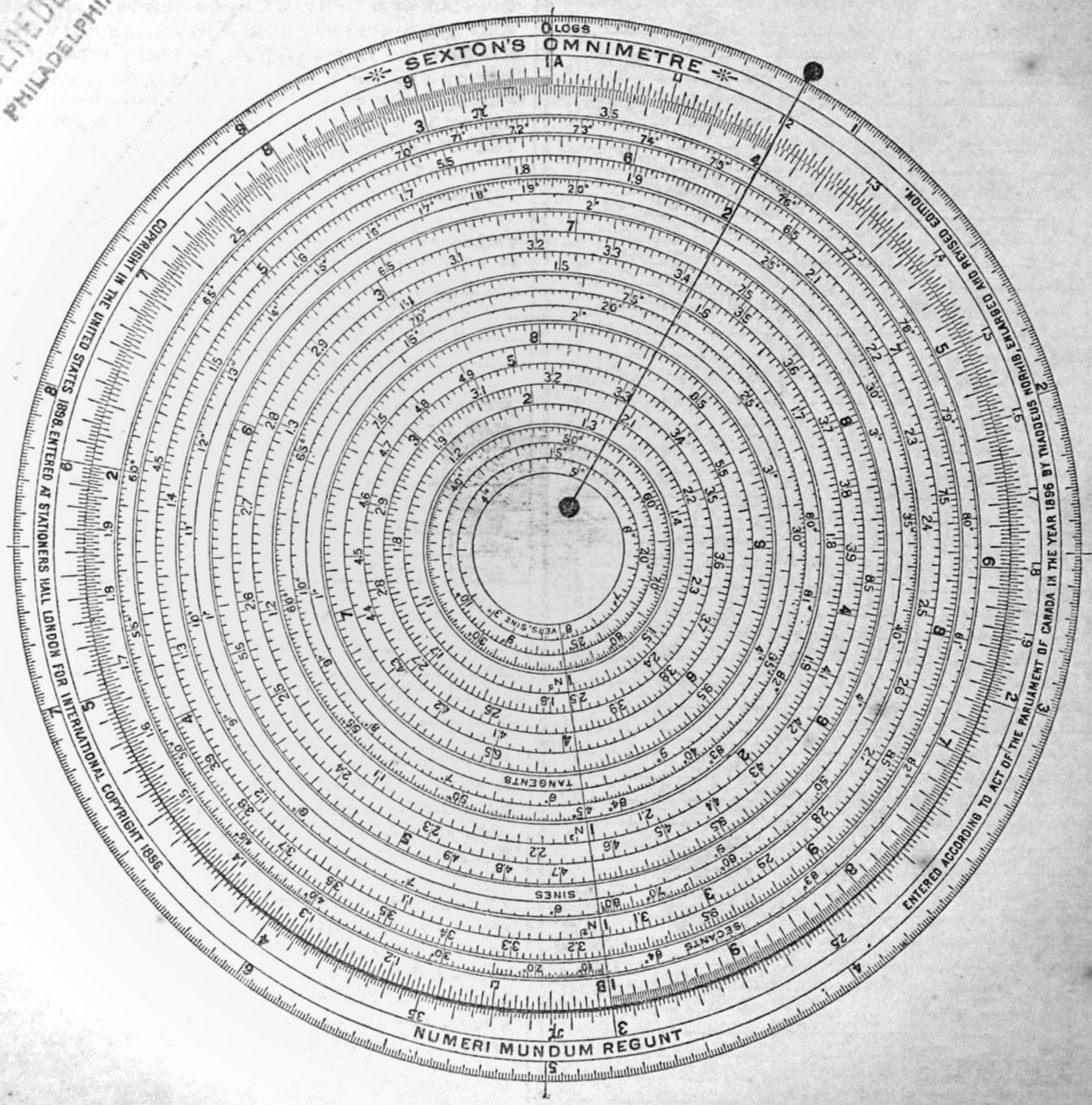
DIRECTIONS FOR USING

SEXTON'S OMNIMETRE

WITH FORMULAE, EXAMPLES AND PROBLEMS.



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LOG. Scale of LOGARITHMS of the Numbers shown on scale "A." This means that for any number shown on scale A we may read the decimal part of its logarithm directly on scale LOG. the same as though we read from a table of logarithms. Example: Log. 1.2=0.0792, Log. 12=1.0792, Log. 120=2.0792, Log. 0.12=$\bar{1}$.0792, Log. 0.012=$\bar{2}$.0792, etc.

A Scale of NUMBERS on Rule or Base. This means that the lines are to be read as though they were figures; for instance, if we call the starting-point 1 the next line to it will be 1.005, and the second line will be 1.010, etc. If we call the starting-point 1000, then the next line to the right will be 1005, and so on, varying by 5 in the fourth place until we get to 2 or 200; then, as the lines get closer, we commence to read by 1 in the third place, or 201, 202, etc., until the lines get so close that it is necessary to vary by 2 in the third place, so that the line next to the starting point on the left-hand side is read 998, or 9.98.

B Scale of NUMBERS on Slide or Movable Disc. As scale A and B are exactly alike, all that has been said about the readings on scale A applies equally well to scale B.

Sec. Scale of SECANTS, to be read on scale B for the angle shown on Sec. This means that for any angle on the scale of Secants, we may read its numerical value on scale B by the aid of the runner. As the secant of any angle is always greater than 1, there is no difficulty in locating the decimal point. Example: The Secant of 75° 32′=4.002

N^2 Scale of SQUARES, to be read on scale B for the number shown on N^2. If the number be on the inner circle its square will have 1, 3, 5, or 7 figures, and if on the outer circle 2, 4, 6, or 8 figures. This means that to find the square of any number, we first look on the N^2 circle and find the number, note the circle it is found on, then bring the runner over it and read the square of it on the B circle under the runner, knowing from the above definition just how many figures it will have. Or if we desire the SQUARE ROOT of any number, we find that number on the B circle, bring the runner over it, then look on the N^2 circle and read its root under the runner, knowing from the above definition exactly which circle to look on and just how many figures there will be in the root. Example: The square of 2=4, the square of 6.325=40, the square of 20=400, the square of 63.25=4000, the square root of 40000=200, and the square root of 400000=632.45.

Sin. Scale of SINES, to be read on scale B for the angle shown on Sin. If the angle be between 0° 35′ and 5° 45′, read 0.01 to 0.10. If between 5° 45′ and 85°, read 0.10 to 1.0. This means that to find the natural sine of any angle, we seek that angle on scale Sin., bring the runner over it, hold the runner in place, look on scale B under the runner and read its numerical value. Example: The sine of 2° 18′=0.0401, the sine of 23° 35′=0.400.

N^3 Scale of CUBES, to be read on scale B for the number shown on N^3. If the number be on the inner circle its cube will have 1, 4, or 7 figures. If on the second circle, 2, 5, or 8 figures. If on the third circle, 3, 6, or 9 figures. This means that to find the cube of any number, we first look on the N^3 circles and find the number, note the circle it is found on, then bring the runner over it and read the cube of it on the B circle under the runner, knowing from the above definition just how many figures it will have. Or if we desire the CUBE ROOT of any number, we find that number on the B circle, bring the runner over it, then look on the N^3 circle and read its root under the runner, knowing from the above definition exactly which circle to look on and just how many figures there will be in the root. Example: The cube of 1.587=4, the cube of 3.42=40, the cube of 7.368=400, the cube root of 4000=15.874, the cube root of 40000=34.2, the cube root of 400000=73.68.

Tang. Scale of TANGENTS, to be read on scale B for the angle shown on Tang. If the angle be between 0° 35′ and 5° 40′, read 0.01 to 0.10. If between 5° 45′ and 45°, read 0.10 to 1.0. If between 45° and 84° 15′, read 1.0 to 10. This means that to find the numerical value of the tangent of any angle we seek that angle on scale Tang., bring the runner over it, hold the runner in place, then look on scale B, and under the runner read its numerical value, placing the decimal point according to the circle in which the angle is found, as defined above. Example: Tangent 2° 17′=0.04. Tangent 21° 48′=0.40. Tangent 75° 58′=4.00.

N^5 Scale of FIFTH POWERS, to be read on scale B for the number shown on N^5. If the number be on the inner circle its fifth power will have 1, 6, or 11 figures. If on the second circle, 2, 7, or 12 figures. If on the third circle, 3, 8, or 13 figures. If on the fourth circle, 4, 9, or 14 figures. If on the fifth circle, 5, 10, or 15 figures. This means that to find the fifth power of any number, we first look on the N^5 circle and find the number, note the circle it is found on, then bring the runner over it and read its fifth power on the B circle under the runner, knowing from the above definition just how many figures it will have. Or if we desire the FIFTH ROOT of any number, we find that number on the B circle, note how many figures it contains, bring the runner over it, then look on the proper N^5 circle and read its root under the runner, knowing from the above definition exactly which circle to look on and just how many figures there will be in the root. Example: The fifth root of 4=1.3195. The fifth root of 40=2.0913. The fifth root of 400=3.314. The fifth root of 4000=5.253. The fifth root of 40000=8.325. And, finally, the fifth power of 13.195=399988, or practically 400000.

V. S. Scale of VERSED SINES, to be read on scale B for the angle shown on V. S. If the angle be between 2° 35′ and 8° 5′, read 0.001 to 0.010. If between 8° 5′ and 25° 50′, read 0.010 to 0.100. If between 25° 50′ and 90°, read 0.10 to 1.00. This means that to find the numerical value of the versed sine of any angle, find the angle on scale V. S., bring the runner over it, hold the runner in place, then look on scale B, and under the runner read its numerical value, placing the decimal point according to the circle in which the angle is found, as defined above. Example: The versed sine of 5° 8′=0.004. The versed sine of 16° 16′=0.040. The versed sine of 53° 8′=0.400, etc.

The Button or Clamp-screw (the button being used on the No. 1 and No. 2, and the clamp-screw on the No. 3 Omnimetre) is not designed to turn any part of the instrument, but simply to serve as a pivot and to pick it up by. The clamp-screw of the No. 3 is also used to clamp the two discs together when many readings are to be taken from one setting, as in converting cubic feet to gallons, inches to millimetres, etc.

In operating it is advisable to hold the two discs together with the left hand while moving the runner with the right hand, then hold the runner to the lower disc with the thumb and forefinger of the right hand while moving the upper disc with the left hand.

To MULTIPLY: Bring 1 on scale B to the multiplicand on scale A; move the runner to the multiplier on scale B; under the runner on scale A will be found the product.

To DIVIDE: Bring the divisor on scale B to the dividend on scale A; over 1 on scale B will be found the quotient on scale A.

Note: The few words devoted to Multiplication and Division give but a faint idea of the scope of the instrument, as will be seen from the numerous examples which follow, where it is shown that it is as easy to multiply and divide by all the functions contained on the inner circles as by the numbers on the A and B circles.

In the various examples given in the following pages the co-efficients, although taken from recognized authorities, are not intended but for the purpose of showing the method of solution of the formulæ, as most engineers prefer to use their own factors.

The sign "‖" means that while the runner is held to the lower disc, the upper disc is to be moved until the numbers on the B circle coincide with the numbers on the A circle, corresponding numbers together. This operation is required in nearly every case when the answer to a problem is to be read from the inner circles. It is also sometimes convenient to start an example with the two discs brought together, as then all the values are represented on both the A and B circles.

The RUNNER is the movable strip or marker above the two discs. In the No. 1 Omnimetre it has a radial edge, and in the No. 2 and No. 3 it has a fine radial line drawn on it to enable one to read more accurately the values sought under it. By its aid we are enabled to continue an operation indefinitely, and read the values of the several circles with ease.

CARE OF THE INSTRUMENT. In cleaning the No. 1 grade ordinary rubber can be used; but with the eburnated surfaces of No. 2 and No. 3 an occasional rubbing with any soft cloth is all that is required. The clamp-nut of the No. 3 requires but the slightest movement to bind or free the discs; further freedom is injurious to the centers.

The illustration on page 1 is a representation of the No. 3 Omnimetre reduced. The No. 1 and No. 2 differ somewhat in the arrangement of the circles, and do not contain the Fifth Powers.

The two discs in the above-mentioned cut are set in the most trying position to test the accuracy of the instrument, viz.: 1 on B to 3 on A, which is very nearly half way around the circle from the starting point.

It will be observed that the product (of each number on the B circle multiplied by 3) may be read on the A circle opposite that number, and vice versa. The quotient of every number on the A circle, divided by its coincident number on the B circle, may be read on the A circle over 1 on the B circle.

The heavy radial line represents the runner, which is purposely set to illustrate the readings in the foregoing explanations.

~~~ SEXTON'S OMNIMETRE ~~~

4-4-96

EXAMPLES

~~~ MULTIPLICATION ~~~

23 × 75 = 1725

BRING 1 ON B TO 23 ON A, OVER 75 ON B FIND 1725 ON A.

13 × 15 × 17 = 3315

BRING 1 ON B TO 13 ON A, MOVE RUNNER TO 15 ON B, BRING 1 ON B TO RUNNER - OVER 17 ON B FIND 3315 ON A

147.5 × SECANT 41°20' = 196.4

BRING 1 ON B TO 147.5 ON A, OVER 41°20' ON "SEC." FIND 196 ON A

27 × 7.36² = 1462.5

BRING 1 ON B TO 27 ON A, OVER 7.36 ON N² FIND 1462.5 ON A.

67.5 × 2.375² = 380.7

BRING 1 ON B TO 67.5 ON A, OVER 2.375 ON N² FIND 380.7 ON A

725 × SINE 38°10' = 446

BRING 1 ON B TO 725 ON A, OVER 38°10' ON "SINE" FIND 446 ON A

1425 × SINE 2°15' = 55.95

BRING 1 ON B TO 1425 ON A, OVER 2°15' ON "SINE" FIND 55.95 ON A

7.15 × 9.25³ = 5659

BRING 1 ON B TO 7.15 ON A, OVER 9.25 ON N³ FIND 5659 ON A

0.875 × 23.5³ = 11356

BRING 1 ON B TO .875 ON A, OVER 23.5 ON N³ FIND 11356 ON A

41.2 × 2.065³ = 363.7

BRING 1 ON B TO 41.3 ON A, OVER 2.065 ON N³ FIND 363.7 ON A

23 × TANGENT 82°25' = 172.8

BRING 1 ON B TO 23 ON A, OVER 82°25' ON "TANG." FIND 172.8 ON A

17 × TANGENT 38°40' = 13.6

BRING 1 ON B TO 17 ON A, OVER 38°40' ON "TANG." FIND 13.6 ON A

895 × TANGENT 3°35' = 56.05

BRING 1 ON B TO 895 ON A, OVER 3°35' ON "TANG." FIND 56.05 ON A

0.75 × 6.72⁵ = 10278

BRING 1 ON B TO 0.75 ON A, OVER 6.72 ON N⁵ FIND 10278 ON A

1.15 × 4.24⁵ = 1575.9

BRING 1 ON B TO 1.15 ON A, OVER 4.24 ON N⁵ FIND 1575.9 ON A

0.872 × 2.69⁵ = 122.8

BRING 1 ON B TO 0.872 ON A, OVER 2.69 ON N⁵ FIND 122.8 ON A

2.47 × 1.67⁵ = 32.08

BRING 1 ON B TO 2.47 ON A, OVER 1.67 ON N⁵ FIND 32.08 ON A

3.53 × 1.56⁵ = 32.6

BRING 1 ON B TO 3.53 ON A, OVER 1.56 ON N⁵ FIND 32.6 ON A

345 × VERS. SINE 31°50' = 51.9

BRING 1 ON B TO 345 ON A, OVER 31°50' ON "V.S." FIND 51.9 ON A

672 × VERS. SINE 9°45' = 9.7

BRING 1 ON B TO 672 ON A, OVER 9°45' ON "V.S." FIND 9.7 ON A

1425 × VERS. SINE 7°35' = 12.46

BRING 1 ON B TO 1425 ON A, OVER 7°35' ON "V.S." FIND 12.46 ON A

CIRCUMF. OF CIRCLE 45.2 DIAM. = 142.

BRING 1 ON B TO π ON A, OVER 45.2 ON B FIND 142 ON A

AREA OF CIRCLE 43.6 DIAM. = 1493

BRING 4 ON B TO π ON A, OVER 43.6 ON N² FIND 1493 ON A

VOLUME OF SPHERE 15.25 DIAM. = 1857

BRING 6 ON B TO π ON A, OVER 15.25 ON N³ FIND 1857 ON A

VOLUME OF CONE 11.25 DIA. AT BASE BY 16.25 HIGH = 538.4

BRING 12 ON B TO π ON A, MOVE RUNNER TO 11.25 ON N², BRING 1 ON B TO RUNNER, OVER 16.25 ON B FIND 538.4 ON A

~~ SEXTON'S OMNIMETRE ~~

1.4.96

EXAMPLES

~~ DIVISION ~~

$\frac{765}{225} = 3.4$

BRING 225 ON B TO 765 ON A, OVER 1 ON B FIND 3.4 ON A

$\frac{295 \times 476}{1245} = 131.9$

BRING 1245 ON B TO 345 ON A, OVER 476 ON B FIND 131.9 ON A

$\frac{89 \times 193 \times 715}{378 \times 1895} = 5.587$

BRING 378 ON B TO 29 ON A, MOVE RUNNER TO 193 ON B, BRING 1895 ON B TO RUNNER, OVER 715 ON B FIND 5.587 ON A

$\frac{324}{156.5}$ = SECANT 61°7'

BRING 156.5 ON B TO 324 ON A, MOVE RUNNER TO 1 ON B, ||, UNDER RUNNER FIND 61°7' ON "SEC."

$\frac{7250}{37.3^2} = 5.21$

BRING 37.3 ON N^2 TO 7250 ON A, OVER 1 ON B FIND 5.21 ON A

$\frac{18.75^2}{217} = 1.62$

BRING 217 ON B TO 1 ON A, OVER 18.75 ON N^2 FIND 1.62 ON A

$\frac{352}{580.4}$ = SINE 37°20'

BRING 580.4 ON B TO 352 ON A, MOVE RUNNER TO 1 ON B, ||, UNDER RUNNER FIND 37°20' ON "SIN."

$\frac{137}{1849}$ = SINE 4°15

BRING 1849 ON B TO 137 ON A, MOVE RUNNER TO 1 ON B, ||, UNDER RUNNER FIND 4°15' ON "SIN."

$\frac{7350}{6.26^3} = 29.96$

BRING 6.26 ON N^3 TO 7350 ON A, OVER 1 ON B FIND 29.96 ON A

$\frac{307^3}{169^3} = 5.995$

BRING 169 ON N^3 TO 1 ON A, OVER 307 ON N^3 FIND 5.995 ON A

$\frac{7.25^3}{203} = 1.877$

BRING 203 ON B TO 1 ON A, OVER 7.25 ON N^3 FIND 1.877 ON A

$\frac{615}{\text{TG. } 61°20'} = 336.2$

BRING 61°20' ON "TANG." TO 615 ON A, OVER 1 ON B FIND 336.2 ON A

$\frac{97.5}{135.5}$ = TANGENT 35°44'

BRING 135.5 ON B TO 97.5 ON A, MOVE RUNNER TO 1 ON B, ||, UNDER RUNNER FIND 35°44' ON "TANG."

$\frac{\text{TANG. } 5°25'}{0.875} = 0.1084$

BRING 0.875 ON B TO 1 ON A, OVER 5°25' ON "TANG." FIND 0.1084 ON A

$\frac{2.5 \times 3.75^5}{44.2} = 41.94$

BRING 44.2 ON B TO 2.5 ON A, OVER 3.75 ON N^5 FIND 41.94 ON A

$\frac{1430}{2.96^5} = 6.293$

BRING 2.96 ON N^5 TO 1430 ON A, OVER 1 ON B FIND 6.293 ON A

$\frac{245^2}{3.15^5} = 193.54$

BRING 3.15 ON N^5 TO 1 ON A, OVER 245 ON N^2 FIND 193.5 ON A

$\frac{34.4}{236}$ = VERS. SINE 31°20'

BRING 236 ON B TO 34.4 ON A, MOVE RUNNER TO 1 ON B, ||, UNDER RUNNER FIND 31°20' ON "VS."

$\frac{21}{\text{VERS. SINE } 7°25'} = 2510$

BRING 7°25' ON "VS" TO 21 ON A, OVER 1 ON B FIND 2510 ON A

$\sqrt{\frac{8450}{23.5^3}} = 0.8069$

BRING 23.5 ON N^3 TO 8450 ON A, MOVE RUNNER TO 1 ON B, ||, UNDER RUNNER FIND 0.8069 ON N^2

$\sqrt[5]{\frac{47.5^2 \times 313^3}{19.55}} = 81.24$

BRING 19.55 ON B TO 1 ON A, MOVE RUNNER TO 47.5 ON N^2, BRING 1 ON B TO RUNNER, MOVE RUNNER TO 313 ON N^3, ||, UNDER RUNNER FIND 81.24 ON N^5

~~ SEXTONS OMNIMETRE ~~

4-15-96

PRACTICE

NEAREST ANSWER IN 64THS TO 0.735	47/64
COST OF 13 YDS, IF 16¾ YDS. COST $3.37	2.615
" " 18 " " " " " " "	3.62
" " 10 " " " " " " "	2.01

$\sqrt{237} = 15.39$, $\sqrt{23.7} = 4.87$, $\sqrt{2.37} = 1.539$, $\sqrt{.237} = .487$

$\sqrt[3]{975} = 9.916$, $\sqrt[3]{97.5} = 4.603$, $\sqrt[3]{9.75} = 2.136$, $\sqrt[3]{.975} = .9916$

$\frac{\pi}{6} \times 0.26 \times 8.25^3 = 76.44$ = WT. IN LBS OF 8¼" CAST IRON BALL

" " $6.5^3 = 37.39$ = " " " " " 6½" " " "

" " $4^3 = 8.71$ = " " " " " 4" " " "

$\frac{\pi}{4} \times 0.28 \times 1.375^2 \times 12 = 4.95$ = WT. IN LBS. PER FT. OF 1⅜" ROUND IRON

$\frac{\pi}{4} \times \frac{11.5^2 \times 65 \times 300 \times 2 \times 20}{33000 \times 12} = 204.6$ = { HP OF 11½ X 20 ENG. AT 300 REV'S WITH 65 LBS MEAN PRESSURE

$\sqrt[3]{\frac{60 \times 231 \times 6}{\pi}} = 29.8$" = DIAM. OF GLOBE TO HOLD 60 GALLONS.

$\sqrt[3]{\frac{2500 \times 6}{\pi}} = 16.84$ = " " " " " 2500 CUB. FT.

$\sqrt[3]{\frac{6}{\pi} \times \frac{28}{0.26}} = 5.9$" = DIAM. OF 28 LB BALL.

$\frac{1 \times 10700000 \times 0.375^4}{8 \times 12 \times 2.875^3} = 92.75$ = { LOAD IN LBS TO COMPRESS SPRING OF ⅜" ROUND WIRE, MEAN DIAM. 2⅞", 12 COILS, DEFLECTION 1"

$\frac{4}{\pi} \times \frac{92.75}{4.5^2} = 5.83$ = { LBS. PER SQ. IN. TO OPEN A 4½" RELIEF VALVE HELD DOWN BY THE FOREGOING SPRING.

$\sqrt[4]{\frac{\pi \times 8 \times 12 \times 2.875^3 \times 4.5^2 \times 9}{4 \times 1 \times 10700000}} = 0.418$" = { DIA. OF WIRE FOR 9 LBS PER SQ. IN. ON ABOVE RELIEF VALVE

$\frac{32 \times 2400 \times 16}{\pi \times 4^3} = 6112$ = { TORSIONAL STRAIN IN LBS. PER SQ. IN ON 4" STEEL SHAFT 52" LONG, LEVER 32", LOAD 2400 LBS.

$\frac{180}{\pi} \times \frac{2400 \times 32 \times 52 \times 32}{\pi \times 4^4 \times 12000000} = 0.7587$ = { ANGLE OF TORSION IN THE ABOVE SHAFT.

~~ CONVENIENT SETTINGS ~~

SETTING		
π	A	CIRCUMFERENCES OF CIRCLES
1	B	DIAMETERS " "
π	A	AREAS " "
2	N^2	DIAMETERS " "
π	A	VOLUME OF SPHERES
6	B	
	N^3	DIAM. OF SPHERES
0.1361	A	WT. IN LBS OF CAST IRON BALLS
1	N^3	DIAM. OF BALL IN INCHES.
2.62	A	WT. IN LBS PER FT. OF ROUND BAR IRON
1	N^2	DIAM. IN INCHES
2.67	A	WT. IN LBS PER FT. OF ROUND BAR STEEL
1	N^2	DIAM. IN INCHES.
3.33	A	WT. IN LBS PER FT. OF SQUARE BAR IRON
1	N^2	THICKNESS IN INCHES
3.40	A	WT. IN LBS PER FT. OF SQUARE BAR STEEL
1	N^2	THICKNESS IN INCHES.
15	A	INCHES OF MERCURY
17	B	FEET HEAD OF WATER

~~ Sexton's Omnimetre ~~

4.15.96

Examples in Trigonometry.

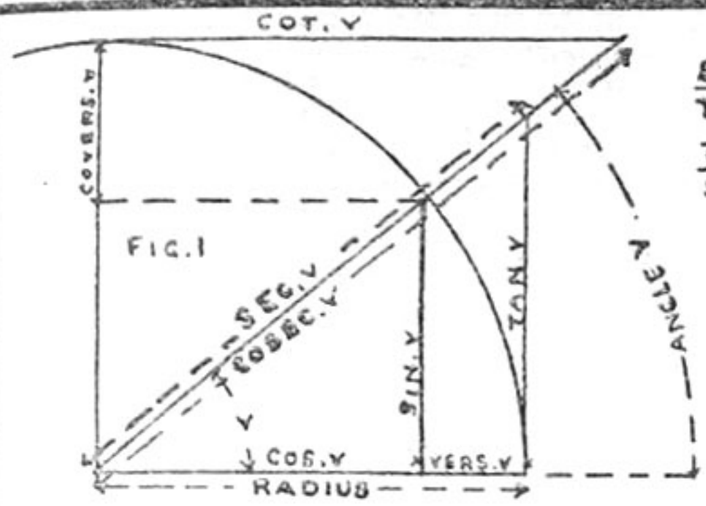


FIG. 1

— EQUIVALENTS —

$\frac{SIN.V}{TAN.V} = COS.V$

$\frac{TAN.V}{SIN.V} = SEC.V$

$\frac{1}{SIN.V} = COSEC.V$

$\frac{1}{TAN.V} = COT.V$

$1 - COS.V = VERS.V$

$1 - SIN.V = COVERS.V$

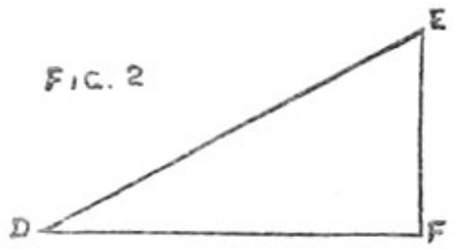


FIG. 2

$SIN.D = \frac{EF}{DE}$ $\quad COS.D = \frac{DF}{DE}$

$TAN.D = \frac{EF}{DF}$ $\quad COT.D = \frac{DF}{EF}$

$SEC.D = \frac{DE}{DF}$ $\quad COSEC.D = \frac{DE}{EF}$

$VERS.D = \frac{DE - DF}{DE}$ $\quad COVERS.D = \frac{DE - EF}{DE}$

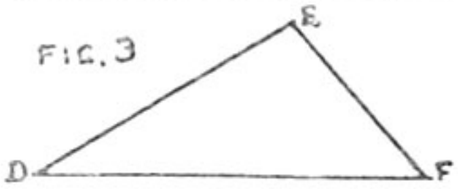


FIG. 3

$\overline{DE} = \frac{\overline{EF} \, SIN.F}{SIN.D} = \frac{\overline{DF} \, SIN.F}{SIN.E}$

$SIN.D = \frac{\overline{EF} \, SIN.F}{DE} = \frac{\overline{EF} \, SIN.E}{DF} = SIN.(E+F)$

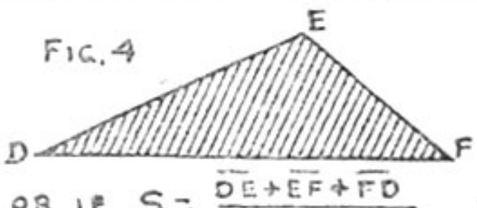


FIG. 4

$AREA = \frac{\overline{DF} \times \overline{DE} \times SIN.D}{2} = \frac{\overline{EF} \times \overline{DF} \times SIN.F}{2}$

$= \frac{\overline{DF} \times \overline{EF} \times SIN.E}{2}$

OR IF $S = \frac{\overline{DE} + \overline{EF} + \overline{FD}}{2}$ THEN AREA $= \sqrt{S(S-\overline{DE})(S-\overline{EF})(S-\overline{FD})}$

EXAMPLES

IN FIG. 2 FIND ANGLE "D" IF $\overline{DE} = 87$ AND $\overline{EF} = 23$

BRING 87 ON B UNDER 23 ON A, MOVE RUNNER TO 1 ON B, II, UNDER RUNNER FIND 15°20' ON "SIN." = ANGLE D.

IF $\overline{DE} = 255$ AND $\overline{EF} = 17$, D WILL BE 3°49' BY THE SAME METHOD

IN FIG. 2 FIND ANGLE D" IF $\overline{EF} = 555$ AND $\overline{DF} = 375$.

BRING 375 ON B TO 555 ON A, MOVE RUNNER TO 1 ON B, II, UNDER RUNNER FIND 55°57' ON "TAN," = ANGLE D.

IF $\overline{EF} = 17$ & $\overline{DF} = 23$ "D" WILL BE 36°32' BY THE SAME METHOD

" " = 32 " " = 475 " " " 3°51' " " " "

IN FIG. 3 FIND "$\overline{DE}$" IF $\overline{EF} = 34$, F = 53°30', D = 29°10'

BRING 29°10' ON "SIN" TO 34 ON A, OVER 53°30' ON "SIN."

FIND 56.08 ON A, = $\overline{DE}$

IN FIG. 3 FIND ANGLE "D" IF $\overline{EF} = 41$, F = 39°20', $\overline{DE} = 77$.

BRING 77 ON B TO 41 ON A, MOVE RUNNER TO 39°20' ON "SIN", II, UNDER RUNNER FIND 19°43' ON "SIN" = ANGLE "D"

IN FIG. 4 FIND AREA IF $\overline{DF} = 72.5$, $\overline{DE} = 53.8$ AND D = 14°35'

BRING 2 ON B TO 72.5 ON A, MOVE RUNNER TO 53.8 ON B, BRING 1 ON B TO RUNNER, MOVE RUNNER TO 14°35' ON "SIN." UNDER RUNNER FIND 491 ON A = AREA.

~~ Sexton's Omnimetre ~~

4.12.96

Equivalents for Scales A & B

~~ LENGTH ~~

198	Inches	=	1	Rod = 25 Links
72	"	=	1	Fathom
10	"	=	254	Millimeters = 25.4 c/m
4	"	=	1	Hand
7	"	=	4	Russian Verschoks
66	Feet	=	4	Rods = 1 Chain = 100 Links
660	"	=	1	Furlong
5280	"	=	1	Statute Mile
6	"	=	1	Fathom
328	"	=	100	Metres
3280	"	=	1	Kilometre
7	"	=	1	Russian Sazhine
82	Yards	=	75	Metres
7	"	=	9	Russian Arschines
43	Chains	=	865	Metres
115	Statute Miles	=	100	Nautical Miles
87	" "	=	140	Kilometres
350	" "	=	528	Russian Versts
13	Nautical Miles	=	24	Kilometres
1	Russian Verst	=	500	Russian Sazhines
9	" Yerschoks	=	400	Millimetres
16	" "	=	1	Russian Arschine

~~ SURFACE ~~

144	Sq. Inches	=	1	Sq. Ft.
31	" "	=	200	Sq. Centimetres
9	Sq. Feet	=	1	Sq Yard
140	" "	=	13	Sq. Metres
121	Sq. Yards	=	4	Sq. Rods
61	" "	=	51	Sq. Metres
4840	" "	=	1	Acre
160	Sq. Rods	=	1	"
640	Acres	=	1	Sq. Mile
42	"	=	17	Hectares
1	"	=	10	Sq. Chains
540	"	=	200	Russian Dessiatinas
22	Sq. Miles	=	57	Sq. Kilometres

~~ WEIGHT ~~

7000	Grains	=	1	lb Avoirdupois
5760	"	=	1	" Troy
108	"	=	7	Grammes
108	"	=	1,641	Russian Zolotniks
6	Ounces Avoir	=	170	Grammes
16	" "	=	1	lb. Avoir
12	" Troy	=	1	" Troy
112	Pounds Avoir.	=	1	Cwt.
2240	" "	=	1	Ton
75	" "	=	34	Kilog's
36	" "	=	1	Russian Pood
268	" Troy	=	100	Kilog's
1	" "	=	240	Dwt.
63	Cwt.	=	3200	Kilog's
63	Tons - English	=	64	Tonnes - French

~~ Sextons Omnimetre ~~

4-12-96 Equivalents for Scales A & B

~~ VOLUME ~~

1728	Cub. Inches	=	1	Cub Ft.
231	" "	=	1	U.S. Gallon
6100	" "	=	22	Imp. Gallons
5	" "	=	82	Cub. Centim's
27	Cub. Ft.	=	1	" Yard
107	" "	=	800	U.S. Gallons
69	" "	=	430	Imp. "
600	" "	=	17	Cub. Metres
6	" "	=	170	Litres
10	" "	=	8	Bushels
1	" "	=	50	Lbs Coal
35.9	" "	=	2240	Lbs. Water
128	" "	=	1	Cord of Wood
343	" "	=	1	Russian Sazhine
85	Cub. Yards	=	65	Cub. Metres
10	" "	=	217	Bushels
6	U.S. Gal's	=	5	Imp. Gal's
14	" "	=	53	Litres
325	" "	=	100	Russian Vedro
32	" "	=	1	Barrel
46	Imp. "	=	209	Litres
4	Pecks	=	1	Bushel
100	"	=	881	Litres
1	Bushel of Coal	=	63	Pounds

~~ PRESSURES ~~

1	Lbs. per Sq Inch	=	144	Lbs. per Sq. Ft.
640	" " " "	=	45	Kilog's per Sq. Centim.
28	" " " "	=	57	In's. of Mercury
26	" " " "	=	720	" " Water
26	" " " "	=	60	Ft. of Water
500	" " " "	=	34	Atmospheres
1	" " " "	=	15	In's. of Sulph. Acid
51	" " " Foot	=	249	Kilog's per Sq. Metre
5800	" " " "	=	82	In's. of Mercury
385	" " " "	=	74	" " Water
312	" " " "	=	5	Ft. of Water
7200	" " " "	=	3.4	Atmospheres
59	" " " Yard	=	32	Kilog's per Sq. Metre
99	Atmospheres	=	2960	In's of Mercury
30	"	=	31	Kilog's per Sq. Centim.
23	"	=	780	Ft. of Water
9	"	=	31	Metres of Water
10	Metres of Water	=	1	Kilog. per Sq. Centim.

~~ POWER ~~

1	Horse Power	=	33000	Ft. lbs per Minute
1	" "	=	550	" " " Second
1	" "	=	746	Watts or Volt Amperes
1	" "	=	2750	Candle Power
289	" "	=	293	Horse Power (French)

~~ Sexton's Omnimetre ~~

4-8-96 -Examples-

If it takes 13.5 yds. of cloth 27" wide to make a dress, How many yds of cloth 31" wide will be required?

Scale A	27	11.76	Answer
" B	31	13.5	

If the 27" cloth cost $1.25 per yd, what must the 31" cloth be sold at to be equivalent in price?

Scale A	31	1.43½	Ans.
" B	27	1.25	

If 73 men can do a job in 135 days, How long will it take 91 men to do the same job?

Scale A	73	108.3	Ans.
" B	91	135	

If 16 men can dig a ditch 15' wide, 7' deep, 37' long in 29 days of 11 hrs. each, How long will it take 27 men to dig a ditch 13' wide, 11' deep, 47' long, working 9 hours per day?

Scale A	16										36.34	Ans.
" B	27	R13	15R	R11	7R	R47	37R	R11	9R	29		

If 2 men can dig a well 3.25' diam, 27' deep in 7 days, How long will it take 5 men to dig a well 7.25' diam, 37' deep?

Scale A	2					19.095	Ans.
" B	5			R37	27R	7	
" N^2		R7.25	3.25R				

What pressure in lbs per Sq. In. is equivalent to a head of 34' of water?

Scale A	26	14.75	Ans.
" B	60	34	

What head of water in Ft. is equivalent to 18 lbs per Sq. In.?

Scale A	60	41.5	Ans.
" B	26	18	

What Horse Power will 50 cubic feet of water per minute give under a head of 400 Ft?

Scale A	7			37.8	Ans.
" B	3700	R400	1R	50	

What head in Ft. is required to produce a flow of 3.066 cubic ft. per sec. through a 6" pipe 20' long!

Scale A	47			10.12	Ans.
" N^2			1R	3.066	
" N^5	95	R3235			

What frictional head in Ft. must be provided for in order to discharge 2150 U.S. Gal's of water per minute through an 8" pipe 580 Ft. long.

Scale A	.000591			48.35	Ans
" B		R580	1R		
" N^2				R2150	
" N^5	8				

What diam. must we make a ball of cast iron to weigh 129.5 lbs.

Scale A	6						
" B	51	R129.5	0.26R	R1	11	R	
" N^3						9.935	Ans.

~~ SEXTON'S OMNIMETRE ~~

PROBLEMS EASILY SOLVED BY ITS AID

WHAT DIAM. IN FT IS REQUIRED IN A PIPE 2640 FT. LONG TO DISCHARGE 1.782 CUB. FT. OF WATER PER SEC. UNDER A HEAD OF 6 FT. ?

SCALE	A	2640						
"	B	6				11	R	
"	N^2		R 1.782	1R				
"	N^5				R 0.295		1	ANS.

WHAT DIAM. IN IN'S IS REQUIRED IN A PIPE 988 YDS, LONG TO GIVE A FLOW OF 35000 CUB. FT OF GAS PER HOUR UNDER A HEAD OF 0.625 OF WATER PRESSURE. SPEC. GRAV. OF GAS BEING 0.4 ?

SCALE	A	988						
"	B	0.625	R 0.4			11	R	
"	N^2			1200R	R 35000			
"	N^5						14"	ANS.

WHAT DIAM. IN IN'S. IS REQUIRED IN A PIPE 1425 YDS LONG TO DISCH. ARGE 22100 CUB. FT. OF GAS PER HOUR UNDER A HEAD OF 0.875 OF WATER, SPEC. GRAV. OF GAS BEING 0.45 ?

SCALE	A	1425						
"	B	0.875	R 0.45			11	R	
"	N^2			1200R	R 22100			
"	N^5						12"	ANS.

WHAT DIAM. IN IN'S IS REQUIRED IN A PIPE 63300 FT. LONG TO DISCHARGE 278 CUB. FT. OF AIR PER MIN. ALLOWING A FRICTIONAL HEAD OF 63 Lbs PER Sq. IN. ?

SCALE	A	63300				
"	B	63		11	R	
"	N^2		R 278			
"	N^5				6"	ANS

WHAT FRICTIONAL HEAD IN Lbs PER Sq. IN. IS REQUIRED IN AN 8" PIPE 63400 FT LONG TO GIVE A FLOW OF 463 CUB. FT. OF AIR PER MIN. ?

SCALE	A	63400			36.9	ANS.
"	B	1.125			10000	
"	N^2		R 463			
"	N^5			8R		

WHAT QUANTITY IN CUB. FT PER SEC WILL FLOW OVER A WEIR 200 FT. LONG UNDER A HEAD OF 1.5 FT. ?

SCALE	A	333				1224	ANS.
"	B	1		R 1.837	1R	200	
"	N^2		1.837				
"	N^3		1.5				

WHAT SPEED IN KNOTS PER HOUR WILL A STEAMSHIP MAKE UNDER 2900 INDICATED HORSE POWER HAVING A SKIN RESISTANCE OF 16200 Sq. FT.

SCALE	A	2900						
"	B	16200	R 1	.000053R	R 1	11	R	
"	N^3						15	ANS

WHAT IHP IS REQUIRED TO PROPEL A VESSEL OF 8500 TONS DISPLACEMENT AT 17 KNOTS PER HOUR ?

SCALE	A	.0034				6957	ANS
"	B	1		R 416.5	1R		
"	N^2		8500				
"	N^3		416.5			17	

NOTE: 416.5 IS THE CUBE ROOT OF 8500^2

SEXTON'S OMNIMETRE

3.7.97 PROBLEMS WITH SOLUTIONS.

$(0.76)^{-\frac{0.41}{1.41}} = 1.083$

L		0.119.			.0346	
A	1		0.119	.0346	1.083	ANS.
B	0.76	1	1.41	0.41		

$(0.76)^{0.41} = 0.894$

L		0.119			.0488			
A	1		0.119	.0488	1.119	1	.0894	ANS.
B	0.76	1	1	0.41		1.119	1	

A STONE DROPPED DOWN A WELL IS HEARD TO STRIKE THE WATER IN JUST 3 SECONDS, HOW DEEP IS THE WELL ? ASSUMING THE ACCELERATION OF GRAVITY (g) = 32.16 AND THE VELOCITY OF SOUND = 1140 FT. PER SECOND.

A	32.16	0.117	0.117	133.5	ANS. IN FT.
B	2280		1	1140	
N^2		2.883			

NOTE: t = TIME IN SEC'S FOR BODY TO FALL; t' = " " " " SOUND TO RETURN; S = SPACE FALLEN THROUGH IN FT.
$S = \frac{gt^2}{2} = 1140\,t'$ OR $\frac{32.16}{2280} = \frac{t'}{t^2}$

AND AS $t + t' = 3$, IT IS EASY TO FIND TWO NUMBERS (ONE IN N^2 AND ONE IN "A") WHOSE SUM SHALL EQUAL 3.

WHAT FIBRE STRAIN IN Lbs. PER Sq. IN. WILL BE PRODUCED IN A FLAT STEEL SPRING $\frac{3}{32}" \times \frac{7}{8}" \times 5\frac{1}{2}"$ UNDER A CENTER LOAD OF 32 Lbs. ?

A	32							34328	ANS.
B	4	R 5.5	7R	R 6		R 8	1R		
N^2					3R			32	

HOW MUCH WILL THE ABOVE SPRING DEFLECT UNDER THE LOAD OF 32 Lbs., ASSUMING THE MODULUS OF ELASTICITY = 28500000 Lbs. ?

A	32							.0648
B	48	R 12	7R	R 8	28500000R			
N^3						R 5.5	3R	32

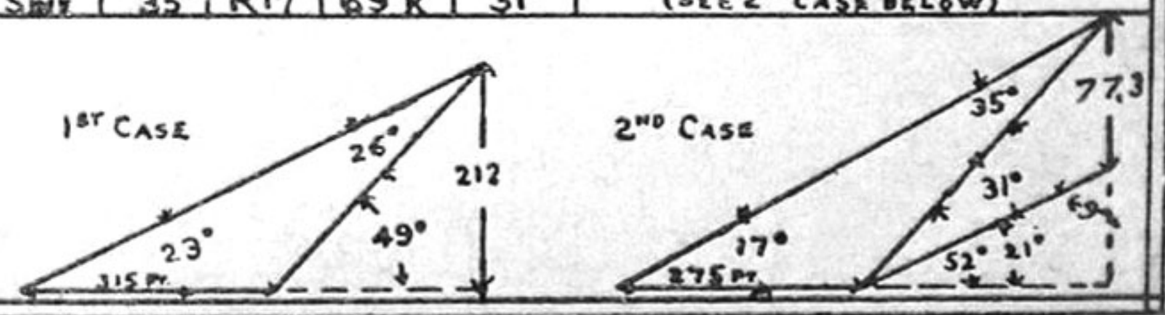
ANS. IN IN'S

A PERSON OBSERVES THE ELEVATION OF A CHIMNEY TO BE 23°; HE THEN WALKS 315 FEET DIRECTLY TOWARDS THE CHIMNEY AND OBSERVES THE ELEVATION TO BE 49°. FIND HEIGHT OF CHIMNEY ?

A	315			212	ANS. IN FT.
B			1R		
SINE	26°	R 23°		49°	(SEE 1ST CASE BELOW)

A PERSON OBSERVES THE ELEVATION OF A TOWER ON A HILL TO BE 17°; HE THEN WALKS 275 FT. DIRECTLY TOWARDS IT AND FINDS THE ANGLE OF ELEVATION TO THE TOP TO BE 52°, AND TO THE BASE 21°. FIND HEIGHT OF TOWER IN FT. ?

A	275			77.3	ANS.
SINE	35°	R 17°	69°R	31°	(SEE 2ND CASE BELOW)



~~ SEXTON'S OMNIMETRE ~~

5.8.96. FORMULAE

IN THE FOLLOWING TABLES, THE EXPRESSIONS "aR", Rb, ETC, MEAN THAT "a" (ON THE SCALE INDICATED IN THE NARROW COLUMN) IS TO BE MOVED TO THE RUNNER, THEN THE RUNNER TO "b" ETC. THE RUNNER IS THE MOVABLE STRIP OR MARKER ABOVE THE TWO DISCS.

FORMULA		SOLUTION
$ab=x$	A	a, x
	B	1, b
$abc=x$	A	a x
	B	1, Rb, 1R, c
$abcd=x$	A	a x
	B	1, Rb, 1R, Rc, 1R, d
$\frac{a}{b}=x$	A	a, x
	B	b, 1
$\frac{ab}{c}=x$	A	a, x
	B	c, b
$\frac{abc}{de}=x$	A	a x
	B	d, Rb, eR, c
$\frac{abcd}{efg}=x$	A	a x
	B	e, Rb, fR, Rc, gR, d
$a^2=x$	B	x
	N^2	a
$a^3=x$	B	x
	N^3	a
$a^5=x$	B	x
	N^5	a
$\sqrt{a}=x$	B	a
	N^2	x
$\sqrt[3]{a}=x$	B	a
	N^3	x
$\sqrt[5]{a}=x$	B	a
	N^5	x
$\frac{a^2}{b}=x$	A	1, x
	B	b,
	N^2	a
$\frac{a^2b}{c}=x$	A	b, x
	B	c,
	N^2	a
$\frac{a^3}{b}=x$	A	1, x
	B	b,
	N^3	a
$\frac{a^3b}{c}=x$	A	b, x
	B	c,
	N^3	a
$\frac{b}{a^5}=x$	A	b, x
	B	1
	N^5	a,
$\frac{ab^2c^3}{de^5}$	A	a, x
	B	d,
	N^2	Rb,
	N^3	c
	N^5	eR,

FORMULA		SOLUTION
$\frac{\sqrt{ab}}{c}=x$	A	a,
	B	Rb, II, R
	N^2	c, x
$\frac{a\sqrt{b}}{c}=x$	A	b
	B	II, R
	N^2	c, Ra, x c
$c\sqrt{\frac{ab}{d}}=x$	A	a,
	B	d, Rb, 1R, II, R
	N^2	Rc, x
$\sqrt{\frac{a}{bc}}=x$	A	a,
	B	b, R1, cR, R1, II, R
	N^2	x
$c\sqrt{b^3}=x$	B	II II, R
	N^2	Rc, 1R, x
	N^3	Rb,
$\frac{\sqrt{a^3}}{c}=x$	A	1
	B	II, R
	N^2	c, x
	N^3	Ra,
$\sqrt[3]{\frac{ab}{c}}=x$	A	a
	B	c, Rb, II, R
	N^3	x
$\left(\frac{b\sqrt{a}}{c}\right)^2=x$	A	a, x
	N^2	c, b
$\frac{ab}{\sqrt{c}}=x$	B	II cR, II, R
	N^2	Ra, Rb, x
$H^{\frac{2}{3}}=x$	N^2	H
	N^3	x
$H^{\frac{3}{2}}=x$	N^2	x
	N^3	H
$\sqrt[5]{a^2}=x$	N^2	a
	N^5	x
$\sqrt[5]{a^3}=x$	N^3	a
	N^5	x
$\sqrt{a^5}=x$	N^2	x
	N^5	a
$\sqrt[3]{a^5}=x$	N^3	x
	N^5	a
$\sqrt[5]{\frac{a^2b^2}{c^3}}=x$	B	II
	N^2	Ra, Rb, II, R
	N^3	cR,
	N^5	x
$D=\sqrt[5]{\frac{V^2GL}{C^2H}}$	A	L,
	B	H, RG, II, R
	N^2	CR, RV,
	N^5	D

~~ SEXTON'S OMNIMETRE ~~

3.28.97. PROBLEMS.

IT IS OFTEN CONVENIENT TO TRANSFORM AN EQUATION TO SIMPLIFY ITS SOLUTION ON THE OMNIMETRE; THUS: WHAT DIAM. (D) OF PULLEY IS REQUIRED ON THE COUNTER SPINDLE OF A PORTER GOVERNOR TO MAKE THE ENGINE RUN 112.5 REV'S PER MIN. KNOWING THAT WHEN THE GOV. RISES TO ITS MID-POSITION, THE WEIGHT ACTING AT THE CENTER OF THE BALL IN BALL ARM IS 8.93 lbs. THE HEIGHT FROM PLANE OF REVOLUTION TO POINT OF SUSPENSION OF BALLS IS 12".6. THE LOAD LIFTED BY ARMS IS 450 lbs. THE RATIO OF GEARS BETWEEN THE SPINDLE AND COUNTER-SPINDLE IS $\frac{2}{5}$. THE DIAM. OF ENGINE SHAFT PULLEY DRIVING GOV. IS 22".5. $D=\frac{112.5\times22.5\times5}{187.6\times2}\sqrt{\frac{12.6\times8.93}{450}}$

TRANSFORMED IT BECOMES } $D=\sqrt{\frac{112.5^2\times22.5^2\times5^2\times12.6\times8.93}{187.6^2\times2^2\times450}}=16".87$

~~ SOLUTION ~~

A	8.93										
B	4.50	R12.6							II	R	
N^2			2R	R5	187.6R	R22.5	1R	R112.5		16.87	Ans

EQUATIONS OF THE FORM $x=\sqrt{a^2+b^2}$ AND $x=\sqrt{a^2-b^2}$ MAY BE SOLVED BY THE AID OF THE ANGULAR FUNCTIONS. THUS: $\sqrt{142.5^2+62.5^2}=155.6$

— SOLUTION —

A	62.5			142.5	1556	ANS.
B	142.5	R1	II	1		
SEC.					R23°43'	
TANG.			23°43'			

$\sqrt{142.5^2-62.5^2}=128.$

— SOLUTION —

A	142.5			62.5	128	ANS.
B	62.5	R1	II	1		
SEC.			64°			
TANG.					R64°	

NOTE: AS THE FOREGOING METHOD OF EXPRESSING THE SOLUTIONS OF PROBLEMS MAY NOT BE QUITE CLEAR TO EVERY ONE I WILL EXPLAIN THE PRECEDING PROBLEM SOLUTION THUS:

BRING 62.5 ON THE B CIRCLE UNDER 142.5 ON THE A CIRCLE. MOVE RUNNER TO 1 ON THE B CIRCLE, HOLD THE RUNNER FAST TO THE LOWER DISC, THEN MOVE THE UPPER DISC UNTIL IT COINCIDES WITH THE LOWER ONE (ALL FIGURES ALIKE ON BOTH) WHEN ON THE CIRCLE OF SECANTS UNDER THE RUNNER WILL BE FOUND THE ANGLE 64°. NOW (REMEMBERING THE ANGLE FOUND) START AGAIN AND BRING 1 ON THE B CIRCLE UNDER 62.5 ON THE A CIRCLE, NOW BY MOVING THE RUNNER TO 64° IN THE CIRCLE OF TANGENTS WE MAY READ THE ANSWER 128 ON THE A CIRCLE UNDER THE RUNNER.