

RULES RELATIVE TO THE CIRCLE

TO FIND DIAMETER

- Multiply circumference by 0.3183.
- Or divide circumference by 3.1416.

TO FIND CIRCUMFERENCE

- Multiply diameter by 3.1416.
- Or divide diameter by 0.3183.

TO FIND RADIUS

- Multiply circumference by 0.15915.
- Or divide circumference by 6.28318.

TO FIND SIDE OF AN INSCRIBED SQUARE

- Multiply diameter by 0.7071.
- Or multiply circumference by 0.2251.
- Or divide circumference by 4.4428.

TO FIND SIDE OF AN EQUAL SQUARE

- Multiply diameter by 0.8862.
- Or divide diameter by 1.1284.
- Or multiply circumference by 0.2821.
- Or divide circumference by 3.545.

SQUARE

- A side multiplied by 1.1442 equals diameter of its circumscribing circle.
- A side multiplied by 4.443 equals circumference of its circumscribing circle.
- A side multiplied by 1.128 equals diameter of an equal circle.
- Square inches multiplied by 1.273 equals circle inches of an equal circle.

TO FIND THE AREA OF A CIRCLE

- Multiply circumference by $\frac{1}{4}$ of the diameter.
- Or multiply the square of diameter by 0.7854.
- Or multiply the square of circumference by 0.07958.
- Or multiply the square of $\frac{1}{2}$ diameter by 3.1416.

TO FIND THE SURFACE OF A SPHERE OR GLOBE

- Multiply the diameter by the circumference.
- Or multiply the square of diameter by 3.1416.
- Or multiply four times the square of radius by 3.1416.
- To find cubic inches in a globe multiply cube of diameter by 0.5236.
- Any circle whose diameter is double that of another contains four times the area of the other.

MATERIALS REQUIRED FOR 100 SQUARE FEET OF SURFACE FOR VARYING THICKNESS OF CONCRETE OR MORTAR

- C. Cement in sacks.
- F.A. Fine Aggregate (Sand) in Cu. Ft.
- C.A. Coarse Aggregate (Pebbles or Broken Stone) in Cu. Ft.

UNITS OF VOLUME AND WEIGHT

TROY WEIGHT

24 grains = 1 pennyweights
20 pennyweights = 1 ounce
12 ounces = 1 pound
(used for weighing gold, silver and jewels)

APOTHECARIES' WEIGHT

20 grains = 1 scruple
3 scruples = 1 dram
8 drams = 1 ounce
12 ounces = 1 pound

AVOIRDUPOIS WEIGHT

27-1/3 grains = 1 dram
16 drams = 1 ounce
16 ounces = 1 pound
25 pounds = 1 quarter
4 quarters = 1 hundredweight
2,000 pounds = 1 short ton
2,240 pounds = 1 long ton

DRY MEASURE

2 pints = 1 quart
8 quarts = 1 peck
4 pecks = 1 bushel
36 bushels = 1 chaldron

LIQUID MEASURE

4 gills = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
31-1/2 gallons = 1 barrel
2 barrels = 1 hogshead

TIME MEASURE

60 seconds = 1 minute
60 minutes = 1 hour
28, 29, 30 or 31 days = 1 month
30 days = 1 month (when computing interest)
365 days = 1 year
24 hours = 1 day
7 days = 1 week

CIRCULAR MEASURE

60 seconds = 1 minute
60 minutes = 1 degree
4 quadrants = 12 signs
360 degrees = 1 circle
30 degrees = 1 sign
90 degrees = 1 quadrant

LONG MEASURE

12 inches = 1 foot
3 feet = 1 yard
5-1/2 yards = 1 rod
40 rods = 1 furlong
8 furlongs = 1 statute mile
3 miles = 1 league

CLOTH MEASURE

2-1/4 inches = 1 nail
4 nails = 1 quarter
4 quarters = 1 yard

MARINER'S MEASURE

6 feet = 1 fathom
120 fathoms = 1 cable length
7-1/2 cable lengths = 1 mile
5,280 feet = 1 statute mile
6,085 feet = 1 nautical mile

MISCELLANEOUS

3 inches = 1 palm
4 inches = 1 hand
6 inches = 1 span
18 inches = 1 cubit
21.8 inches = 1 Biblical cubit
2-1/2 feet = 1 military step

SQUARE MEASURE

144 sq. inches = 1 sq. foot
9 sq. feet = 1 sq. yard
30-1/4 sq. yards = 1 sq. rod
40 sq. rods = 1 rood
4 roods = 1 acre
640 acres = 1 sq. mile

SURVEYOR'S MEASURE

7.92 inches = 1 link
10 sq. chains, or 160 sq. rods = 1 acre
640 acres = 1 sq. mile
36 sq. miles (6 miles sq.) = 1 township
25 links = 1 rod
4 rods = 1 chain

CUBIC MEASURE

1,728 cu. inches = 1 cu. foot
27 cu. feet = 1 cu. yard
2,150.42 cu. inches = 1 standard bushel
268.8 cu. inches = 1 standard gallon
1 cu. foot = about 4/5 of a bushel
128 cu. feet = 1 cord (wood)
40 cu. feet = 1 ton (shipping)

METRIC EQUIVALENT LINEAR MEASURE

1 centimeter = 0.3937 inch
1 decimeter = 3.937 inches = 0.328 foot
1 meter = 39.37 inches = 1.0936 yards
1 dekameter = 1.9884 rods
1 kilometer = 0.62137 mile
1 inch = 2.54 centimeters
1 foot = 3.048 decimeters
1 yard = 0.9144 meter
1 rod = 0.5029 dekameter
1 mile = 1.6093 kilometers

SQUARE MEASURE

1 sq. centimeter = 9.1550 sq. inches
1 sq. inch = 6.452 sq. centimeters
1 sq. decimeter = 0.1076 sq. foot
1 sq. foot = 9.2903 sq. decimeters
1 sq. meter = 1.96 sq. yards
1 sq. yard = 0.8361 sq. mile
1 arc = 3.954 sq. rod
1 sq. rod = 0.2529 arc
1 hektar = 2.47 acres
1 acre = 0.4047 hektar
1 sq. kilometer = 0.386 sq. mile
1 sq. mile = 2.59 sq. kilometers

MEASURE OF VOLUME

1 cu. centimeter = 0.061 cu. inch
1 cu. inch = 16.39 cu. centimeters
1 cu. decimeter = 0.0353 cu. foot
1 cu. foot = 28.317 cu. decimeters
1 dekaliter = 2.6417 gallons
1 gallon = 0.3785 dekaliter
1 pk. = 0.881 dekaliter
1 hektoliter = 2.8375 bu.
1 bu. = 0.3524 hektoliter

WEIGHTS

1 gram = 0.3527 ounce
1 ounce = 28.35 grams
1 kilogram = 2.2046 pounds
1 pound = 0.4536 kilograms
1 metric ton = 2,200 pounds or 1.1023 English tons
1 English ton = 0.9072 metric ton

APPROXIMATE METRIC EQUIVALENTS

1 decimeter = 4 inches
1 meter = 1.1 yards
1 liter = 1.06 qt. (liquid) or 0.9 qt. (dry)
1 kilometer = 5/8 mile
1 mile = 1.61 kilometers
1 hektoliter = 2-5/8 bushels
1 kilogram = 2-1/5 pounds
1 hektar = 2-1/2 acres

UNITS OF VOLUME AND WEIGHT (cont.)

- Area of a rectangle = length x breadth
- Area of a triangle = base x 1/2 perpendicular height
- Diameter of a circle = radius x 2
- Circumference of a circle = diameter x 3.1416
- Area of a circle = square of diameter x .7854
- Area of a sector of a circle = (area of circle x number of degrees in arc)/360
- Area of surface of a cylinder = circumference x length area of two ends
- Diameter of a circle having a given area: Divide the area by .7854 and extract the square root
- Volume of a cylinder: Multiply the area of the section in square inches by the length in inches = the volume in cubic feet
- Surface of a sphere = square of diameter x 3.1416
- Solidity of a sphere = cube of diameter x .5236
- Side of an inscribed cube = radius of a sphere x 1.1547
- Area of the base of a pyramid or cone, whether round, square or triangular multiplied by one-third of its height = the solidity
- Diameter x .8862 = side of an equal square
- Diameter x .7071 = side of an inscribed square
- Radius x 6.2832 = circumference
- Circumference = 3.5446 x area of circle
- Diameter = 1.1283 x area of circle
- Length of an arc = number of degrees x .017453 radius
- Degree in arc whose length equals radius = 57° 29'58"
- Length of an arc of 1° = radius x .017543
- Length of an arc of 1 min. = radius x .0002909
- Length of an arc of 1 sec. = radius x .0000048
- $n = \text{proportion of circumference to diameter} = 3.1415926$
- $n^2 = 9.8696044$
- $n = 1.7724538$
- $\text{Log } n = 0.49715$
- $1/n = .31831$
- $1/360 = .002778$
- $360/n = 114.59$

Lineal Feet	x .00019	= Miles
Lineal Yards	x .0005	= Miles
Square Inches	x .007	= Square Feet
Square Feet	x .111	= Square Yards
Square Yards	x .002067	= Acres
Acres	x 4840	= Square Yards
Cubic Inches	x .00058	= Cubic Feet
Cubic Feet	x .03704	= Cubic Yards
Circular Inches	x .00546	= Square Feet
Cylinder Inches	x .0004546	= Cubic Feet
Cylinder Feet	x .02909	= Cubic Yards
Links	x .22	= Yards
Links	x .66	= Feet
Feet	x 1.5	= Links
Width in Chains	x 8	= Acres per Mile
183346 Circ. In.		= 1 Square Foot
2200 Cylindrical In.		= 1 Cubic Foot
Cubic Feet	x 7.48	= U.S. Gallons
Cubic Inches	x .004329	= U.S. Gallons
U.S. Gallons	x .13367	= Cubic Feet
U.S. Gallons	x 231	= Cubic Inches
Cubic Feet	x .8036	= U.S. Bushel
Cubic Inches	x .000466	= U.S. Bushel
Cylind. Ft. of Water	x 6	= U.S. Gallons
Pounds Avoirdupois	x .009	= Hundredweights (112)
Pounds Avoirdupois	x .00045	= Tons (2240)
Cubic Ft. of Water	x 62.5	= Pounds Avoirdupois
Cubic In. of Water	x .03617	= Pounds Avoirdupois
Cylind. Ft. of Water	x 49.1	= Pounds Avoirdupois
Cylind. In. of Water	x .02842	= Pounds Avoirdupois

13.44 U.S. Gallons of Water = 1 Hundredweight

268.8 U.S. Gallons of Water = 1 Ton

1.8 Cubic Feet of Water = 1 Hundredweight

35.88 Cubic Feet of Water = 1 Ton

Column of Water, 12 inches high and 1 inch in diameter
= .341 lbs.

U.S. Bushel	x .0495	= Cubic Yards
U.S. Bushel	x 1.2446	= Cubic Feet
U.S. Bushel	x 2150.42	= Inches

CONVERSION TABLE

MILLIMETERS AND FRACTIONS OF MILLIMETERS TO INCHES IN DECIMALS

1/100B = 0.0003937 inches

mm	inches	mm	inches	mm	inches	mm	inches	mm	inches
1/50 =	.00079	31/50 =	.02441	11 =	.43307	41 =	1.61417	71 =	2.79527
2/50 =	.00157	32/50 =	.02520	12 =	.47244	42 =	1.65354	72 =	2.83464
3/50 =	.00236	33/50 =	.02598	13 =	.51181	43 =	1.69291	73 =	2.87401
4/50 =	.00315	34/50 =	.02677	14 =	.55118	44 =	1.73228	74 =	2.91338
5/50 =	.00394	35/50 =	.02756	15 =	.59055	45 =	1.77165	75 =	2.95275
6/50 =	.00472	36/50 =	.02835	16 =	.62992	46 =	1.81102	76 =	2.99212
7/50 =	.00551	37/50 =	.02913	17 =	.66929	47 =	1.85039	77 =	3.03149
8/50 =	.00630	38/50 =	.02992	18 =	.70866	48 =	1.88976	78 =	3.07986
9/50 =	.00709	39/50 =	.03071	19 =	.74803	49 =	1.92913	79 =	3.11023
10/50 =	.00787	40/50 =	.03150	20 =	.78740	50 =	1.96850	80 =	3.14960
11/50 =	.00866	41/50 =	.03228	21 =	.82677	51 =	2.00787	81 =	3.18897
12/50 =	.00945	42/50 =	.03307	22 =	.86614	52 =	2.04724	82 =	3.22834
13/50 =	.01024	43/50 =	.03386	23 =	.90551	53 =	2.08661	83 =	3.26771
14/50 =	.01102	44/50 =	.03465	24 =	.94488	54 =	2.12598	84 =	3.30708
15/50 =	.01181	45/50 =	.03543	25 =	.98425	55 =	2.16536	85 =	3.34645
16/50 =	.01260	46/50 =	.03622	26 =	1.02362	56 =	2.20472	86 =	3.38582
17/50 =	.01339	47/50 =	.03701	27 =	1.06299	57 =	2.24409	87 =	3.42519
18/50 =	.01417	48/50 =	.03780	28 =	1.10236	58 =	2.28346	88 =	3.46456
19/50 =	.01496	49/50 =	.03858	29 =	1.14173	59 =	2.32283	89 =	3.50393
20/50 =	.01575	1 =	.03937	30 =	1.18110	60 =	2.36220	90 =	3.54330
21/50 =	.01654	2 =	.07874	31 =	1.22047	61 =	2.40157	91 =	3.58267
22/50 =	.01732	3 =	.11811	32 =	1.25984	62 =	2.44094	92 =	3.62204
23/50 =	.01811	4 =	.15748	33 =	1.29921	63 =	2.48031	93 =	3.66141
24/50 =	.01890	5 =	.19685	34 =	1.33858	64 =	2.51968	94 =	3.70078
25/50 =	.01969	6 =	.23622	35 =	1.37795	65 =	2.55905	95 =	3.74015
26/50 =	.02047	7 =	.27559	36 =	1.41732	66 =	2.59842	96 =	3.77952
27/50 =	.02126	8 =	.31496	37 =	1.45669	67 =	2.63779	97 =	3.81889
28/50 =	.02205	9 =	.35433	38 =	1.49606	68 =	2.67716	98 =	3.85826
29/50 =	.02283	10 =	.39370	39 =	1.53543	69 =	2.71653	99 =	3.89763
30/50 =	.02362			40 =	1.57480	70 =	2.75590	100 =	3.93700

10 millimeters = 1 centimeter = 0.3937 inch

10 centimeters = 1 decimeter = 3.937 inches

10 decimeters = 1 meter = 39.37 inches

25.4 millimeters = 1 inch

DECIMAL CONVERSION TABLE – EIGHTHS, SIXTEENTHS, THIRTY-SECONDS AND SIXTY-FOURTHS

Eighths	9/16 = .5625	17/32 = .53125	9/64 = .140625	37/64 = .578125
1/8 = .125	11/16 = .6875	19/32 = .59375	11/64 = .171875	39/64 = .609375
1/4 = .250	13/16 = .8125	21/32 = .65625	13/64 = .203125	41/64 = .640625
3/8 = .375	15/16 = .9375	23/32 = .71815	15/64 = .234375	43/64 = .671875
1/2 = .500		25/32 = .78125	17/64 = .265625	45/64 = .703125
5/8 = .625	Thirty-Seconds	27/32 = .84375	19/64 = .296875	47/64 = .734375
3/4 = .750	1/32 = .03125	29/32 = .90625	21/64 = .328125	49/64 = .765625
7/8 = .875	3/32 = .09375	31/32 = .96875	23/64 = .359375	51/64 = .796875
	5/32 = .15625		25/64 = .390625	53/64 = .828125
Sixteenths	7/32 = .21875	Sixty-Fourths	27/64 = .421875	55/64 = .859375
1/16 = .0625	9/32 = .28125	1/64 = .015625	29/64 = .453125	57/64 = .890625
3/16 = .1875	11/32 = .34375	3/64 = .046875	31/64 = .484375	59/64 = .921875
5/16 = .3125	13/32 = .40625	5/64 = .078125	33/64 = .515625	61/64 = .953125
7/16 = .4375	15/32 = .46875	7/64 = .109375	35/64 = .546875	63/64 = .985375

METRIC AND ENGLISH OR U.S. EQUIVALENT MEASURES

MEASURES OF LENGTH

1 meter	= 39.3 inches 3.28083 feet 1.0936 yards
1 centimeter	= .3937 inch
1 millimeter	= .03937 inch, or ca. 1/25 inch
1 kilometer	= 0.62137 mile
1 foot	= .3048 meter
1 inch	= 2.54 centimeters 25.4 millimeters

MEASURES OF VOLUME AND CAPACITY

1 cubic meter	= 35.314 cubic feet 264.2 U.S. gallons (231 cu. in.) 1.308 cubic yards
1 cubic decimeter	= 61.023 cubic inches .0353 cubic feet
1 cubic centimeter	= .061 cubic inch
1 liter	= 1 cubic decimeter 61.023 cubic inches .0353 cubic foot 1.0567 quarts (U.S.) .2642 gallon (U.S.) 2.202 lbs. of water at 62° F.
1 cubic yard	= .7645 cubic meter
1 cubic foot	= .02832 cubic meter 28.317 cubic decimeters 28.317 liters
1 cubic inch	= 16.383 cubic centimeters
1 gallon (British)	= 4.543 liters
1 gallon (U.S.)	= 3.785 liters

MEASURES OF WEIGHT

1 gram	= 15.432 grains
1 kilogram	= 2.2046 pounds
1 metric ton	= .9842 ton of 2,240 pounds 19.68 hundredweights 2,204.6 pounds
1 grain	= 0.648 gram
1 ounce avoirdupois	= 28.35 grams
1 pound	= .4536 kilogram
1 ton of 2,240 pounds	= 1.016 metric tons 1016 kilograms

MEASURES OF SURFACE

1 square meter	= 10.764 square feet 1.196 square yards
1 square centimeter	= .155 square inch
1 square millimeter	= .00155 square inch
1 square yard	= .836 square meter
1 square foot	= .0929 square meter
1 square inch	= 6.452 square centimeters 645.2 square millimeters

MISCELLANEOUS

1 kilogram per meter	= .6720 pounds per foot
1 gram per square millimeter	= 1.422 pounds per square inch
1 kilogram per square meter	= .20482 per square foot
1 kilogram per cubic meter	= .06243 per cubic foot
1 degree centigrade	= 1.8 degrees fahrenheit
1 pound per foot	= 1.4882 kilograms per meter

GEOMETRIC FORMULAE

- Area of a square = length x breadth or height
- Area of a rectangle = length x breadth or height
- Area of a triangle = base x 1/2 altitude
- Area of a parallelogram = base x altitude
- Area of a trapezoid = altitude x 1/2 the sum of parallel sides
- Area of a trapezium = divide into two triangles, total their areas
- Circumference of a circle = diameter x 3.1416
- Circumference of a circle = radius x 6.283185
- Diameter of a circle = circumference x .3183
- Diameter of a circle = square root of area x 1.12838
- Radius of a circle = circumference x .0159155
- Area of a circle = half diameter x half circumference
- Area of a circle = square of diameter x .7854
- Area of a circle = square of circumference x .07958
- Area of a sector of a circle = length of arc x 1/2 radius
- Area of a segment of a circle = area of sector of equal radius-area of triangle, when the segment is less, and plus area of triangle when segment is greater than the semi-circle
- Area of circular ring = sum of the diameter of the two circles x difference of the diameter of the two circles and that product x .7854
- Side of a square that shall equal area of a circle = diameter x .8862
- Side of a square that shall equal area of a circle = circumference x .2821
- Diameter of a circle that shall contain area of a given square = side of square x 1.1284
- Side of an inscribed equilateral triangle = diameter x .86
- Side of an inscribed square = diameter x .7071
- Side of an inscribed square = circumference x .225
- Area of an ellipse = product of the two diameters x .7854
- Area of a parabola = base x 2/3 of altitude
- Area of a regular polygon = sum of its sides x perpendicular from its center to one of its sides divided by 2
- Surface of a sphere = diameter x circumference
- Solidity of a sphere = surface x 1/6 diameter
- Solidity of a sphere = cube of diameter x .5236
- Solidity of a sphere = cube of radius x 4.1888
- Solidity of a sphere = cube of circumference x .016887
- Diameter of a sphere = cube root of solidity x 1.2407
- Diameter of a sphere = square root of surface x .56419
- Circumference of a sphere = square root of surface x 1.772454
- Circumference of a sphere = cube root of solidity x 3.8978
- Contents of a segment of a sphere = (height squared plus three times the square of radius of base) x (height x .5236)
- Contents of a sphere = diameter x .5236
- Side of an inscribed cube of a sphere = radius x 1.1547
- Side of an inscribed cube of a sphere = square root of diameter
- Surface of a pyramid or cone = circumference of base x 1/2 of the slant height plus area of base
- Contents of a pyramid or cone = area of base x 1/3 altitude
- Contents of frustrum of a pyramid or cone = sum of circumference at both ends x 1/2 slant height plus area of both ends
- Contents of frustrum of a pyramid or cone = multiply areas of two ends together and extract square root. Add to this root the two areas and x 1/3 altitude
- Contents of a wedge = area of base x 1/2 altitude

UNITS OF MEASUREMENT

UNITS OF VOLUME AND WEIGHT

Water in small tanks, cisterns and sumps is usually measured in gallons.

Water in large tanks and small reservoirs is usually measured in cubic feet or gallons

Water in large reservoirs is most commonly measured in acre-feet.

Units	U.S. Gallons	Imperial Gallons	Cubic Inches	Cubic Feet	Acre-Feet	Pounds*	Cubic Meters	Liters
1 U.S. Gallon =	1	.833	231	.1337	.00000307	8.35	.003785	3.785
1 Imperial Gallon =	1.201	1	277.4	.1605	.00000369	10.02	.004546	4.546
1 Cubic Inch =	.00433	.00360	1	.000579		.0361		.0164
1 Cubic Foot =	7.48	6.23	1728	1	.0000230	62.4	.02832	28.32
1 Acre Foot =	325,850	271,335		43,560	1		1233.5	
1 Pound =	120	.0998	27.7	.0160		1		.454
1 Cubic Meter =	264.18	220	61,023	35.314	.000811	2204	1	1000
1 Liter =	.2642	.220	61.023	.0353		2.2046		1

*Weights shown are based on maximum density of fresh water at 39° F.

UNITS OF FLOW

Cubic foot per second, also written second-foot, is the unit of flow in the English system used to express rate of flow in large pumps, ditches and canals. Flow in pipe lines, from pumps and wells is commonly measured in gallons per minute.

Rates of water consumption and measurement of municipal water supply are ordinarily made in million gallons per day. The Miner's Inch is still used in some localities for irrigation and hydraulic mining, but not suitable for general use.

Units	U.S. Gallons/Minute	Million U.S. Gallons/Day	Cubic Feet/Second	Cubic Meters/Hour	Liter/Second	Miner's Inch As Set By State Laws		
						I	II	III
1 U.S. Gallon/Minute (U.S. G.P.M.) =	1	.001440	.00223	.2270	.0631	.0891	.1114	.0856
1 Million U.S. Gallons/Day (M.GD) =	694.5	1	1.547	157.73	43.8	61.9	77.4	59.4
1 Cubic Foot/Second =	448.8	.646	1	101.9	28.32	40	50	38.4
1 Cubic Meter/Hour =	4.403	.00634	.00981	1	.2778	Ariz.	Idaho	Colo.
1 Liter/Second =	15.85	.0228	.0353	3.60	1	Calif.	Neb.	
1 Miner's Inch (M.I.)	I	11.22	.01618	.0250		Mont.	Nev.	
	II	8.98	.01294	.0200		Oreg.	N. Mex.	
	III	11.69	.01682	.0260		*	Utah	
	IV	12.58	.01811	.0280			Kans.	
							N. Dak.	
							S. Dak.	

IV. A Miner's Inch legally set by British Columbia, 35.7 M.I. = 1 Second-Foot

*Usual practice in Southern California, 50 M.I. = 1 Second-Foot = 448.8 G.P.M.