



Geometric Shapes / Sizes / Models

LINES • ANGLES • CIRCLES

 LINE	 RAY	 LINE OF SYMMETRY	 PARALLEL LINES
 LINE SEGMENT	 ANGLE / VERTEX	 1° DEGREE	 RIGHT ANGLE
 ACUTE less than 90°	 STRAIGHT 180°	 COMPLEMENTARY add up to 90°	 ARC
 OBTUSE greater than 90°, less than 180°	 COMPLETE 360°	 SUPPLEMENTARY add up to 180°	 CIRCLE
		 SEMICIRCLE	 RADIUS
			 DIAMETER
			 CHORD
			 ELLIPSE

TRIANGLES

 SCALENE TRIANGLE	 RIGHT TRIANGLE
 ISOSCELES TRIANGLE	 EQUILATERAL TRIANGLE
 $\triangle ABC \cong \triangle DEF$	
<p>4 CONGRUENCY CASES</p> <ul style="list-style-type: none"> 1. side, side, side SSS 2. side, angle, side SAS 3. angle, side, angle ASA 4. hypotenuse, side HyS 	
 $\triangle ABC \cong \triangle XYZ$	

POLYGONS

 POLYGON	 QUADRILATERAL
 TRAPEZOID	 PARALLELOGRAM
 RECTANGLE	 RHOMBUS
 SQUARE	 REGULAR PENTAGON
 REGULAR HEXAGON	 REGULAR OCTAGON

3 - D MODELS

 TRIANGULAR PYRAMID	 RECTANGULAR PYRAMID
 TRIANGULAR PRISM	 RECTANGULAR PRISM
 CUBE	 PARALLELEPIPED
 CYLINDER	 CONE
 SPHERE	 ELLIPSOID

Measurements

 Perimeter = $2(l + w)$ Area = lw	 Circumference of a circle = $2\pi r$ Area of a circle = πr^2
 Volume = lwh Surface area = $2(lh + lw + hw)$	 Surface area of sphere = $4\pi r^2$ Volume of a sphere = $\frac{4\pi r^3}{3}$
<p>Area = $\frac{\text{base} \times \text{height}}{2}$</p> $c^2 = a^2 + b^2$ (Pythagorean theorem)	 Surface area of cylinder = $2\pi rh + 2\pi r^2$ Volume of cylinder = $\pi r^2 h$
	 Volume of a cone = $\frac{Bh}{3}$
	 Volume of a pyramid = $\frac{Bh}{3}$ (B = area of base)

Multiplication Chart

	1	2	3	4	5	6	7	8	9	10	11	12
1	1	2	3	4	5	6	7	8	9	10	11	12
2	2	4	6	8	10	12	14	16	18	20	22	24
3	3	6	9	12	15	18	21	24	27	30	33	36
4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
7	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	24	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	108
10	10	20	30	40	50	60	70	80	90	100	110	120
11	11	22	33	44	55	66	77	88	99	110	121	132
12	12	24	36	48	60	72	84	96	108	120	132	144
13	13	26	39	52	65	78	91	104	117	130	143	156
14	14	28	42	56	70	84	98	112	126	140	154	168
15	15	30	45	60	75	90	105	120	135	150	165	180

SMART THINKING

Mathematics



Problem Solving Methods

1 GUESS & CHECK	Make a reasonable guess and check it out; if incorrect, try again.
2 LOOK FOR A PATTERN	The key is to find any differences between given pieces of information.
3 WRITE A NUMBER SENTENCE	Take the written information and write it out in math; ignore irrelevant information.
4 MAKE A DIAGRAM OR MODEL	Drawing a picture or a graph may help solve a problem more easily. You could also make a table to sort information.
5 WORK BACKWARD	Start at the end of a problem and work your way back to the beginning to find the solution.

Think logically... Act it out if you can... Be a smart estimator... Always test your answer.

Order of Operation / Symbols

1 Do operations within parentheses.	()	< Is smaller than
2 Do powers (exponents) and roots.	² √	> Is greater than
3 Do multiplication and division in order from left to right.	x ÷	= Is equal to
4 Do addition and subtraction in order from left to right.	+ -	≈ Approximate
		≤ Is smaller or equal
		≥ Is greater or equal

Fractions, Decimals, Percentages

$\frac{3}{5}$ - numerator	$1 = 1.0 = 100\%$
$\frac{3}{5}$ - denominator	$1/2 = 0.5 = 50\%$
To add or subtract different fractions, first obtain a common denominator:	$1/3 = 0.\bar{3} = 33.\bar{3}\%$
$\frac{1}{3} + \frac{2}{5} = \frac{5}{15} + \frac{6}{15} = \frac{11}{15}$	$1/4 = 0.25 = 25\%$
To multiply :	$1/5 = 0.2 = 20\%$
$\frac{1}{3} \times \frac{2}{5} = \frac{1 \times 2}{3 \times 5} = \frac{2}{15}$	$1/6 = 0.1\bar{6} = 16.\bar{6}\%$
To divide , multiply the first with the reciprocal of the second fraction:	$1/8 = 0.125 = 12.5\%$
$\frac{2}{3} \div \frac{1}{6} = \frac{2}{3} \times \frac{6}{1} = 4$	$1/9 = 0.\bar{1} = 11.\bar{1}\%$
	$1/10 = 0.1 = 10\%$
	$1/12 = 0.08\bar{3} = 8.\bar{3}\%$
	$2/3 = 0.\bar{6} = 66.\bar{6}\%$
	$3/4 = 0.75 = 75\%$

Squares and Square Roots

n	n ²	√n	n	n ²	√n	n	n ²	√n
1	1	1	7	49	2.646	15	225	3.873
2	4	1.414	8	64	2.828	20	400	4.472
3	9	1.732	9	81	3	25	625	5
4	16	2	10	100	3.162	100	10,000	10
5	25	2.236	11	121	3.317	1/2	1/4	0.707
6	36	2.449	12	144	3.464	1/4	1/16	1/2

Metric System / Conversions

1,000	100	10	1	.1	.01	.001
kilo	hecto	deca		deci	centi	milli
km	hm	dam	m	dm	cm	mm
kg	hg	dag	g	dg	cg	mg
kl	hl	dal	l	dl	cl	ml

Metric system
 1 m² = 10,000 cm²
 1 hectare (ha) = 10,000 m²
 1 km² = 100 ha
 1 metric ton (t) = 1,000 kg

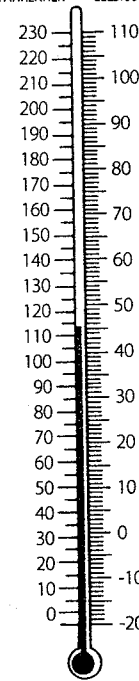
English system

1 foot (ft) = 12 inches (in) 1' = 12"
 1 yard (yd) = 3 feet = 36 inches
 1 mile (mi) = 1,760 yards = 5,280 feet
 1 tablespoon (T) = 3 teaspoons (t)
 1 cup (c) = 16 T = 8 fluid ounces (fl oz)
 1 pint (pt) = 2 c
 1 quart (qt) = 2 pt = 4 c = 32 fl oz
 1 gallon (gal) = 4 qt
 1 ft² = 144 in²
 1 yd² = 9 ft²
 1 acre = 4,840 yd²

LENGTH / AREA		WEIGHT / CAPACITY	
to go from	to multiply by	to go from	to multiply by
cm → in	0.3937	g → oz	0.0353
in → cm	2.54	oz → g	28.35
m → ft	3.2808	kg → lbs	2.2046
ft → m	0.3048	lbs → kg	0.4536
km → mi	0.6214	t → T	1.1023
mi → km	1.609	T → t	0.9072
m ² → ft ²	10.76	ml → fl oz	0.0338
ft ² → m ²	0.0929	fl oz → ml	29.575
km ² → mi ²	0.3861	l → gal	0.2642
mi ² → km ²	2.59	gal → l	3.785

Temperature

FAHRENHEIT CELSIUS



°C → °F:
 n x 1.8; add 32
 °F → °C:
 n - 32; multiply by 0.5555

Common Units used with the International System

UNITS OF MEAS.	ABBREV.	RELATION	UNITS OF MEAS.	ABBREV.	RELATION
meter*	m	length	degree Celsius	°C	temperature
hectare	ha	area	kelvin	K	thermodynamic temp.
tonne	t	mass	pascal	Pa	pressure, stress
kilogram	kg	mass	joule	J	energy, work
nautical mile	M	distance (navigation)	newton	N	force
knot	kn	speed (navigation)	watt	W	power, radiant flux
liter*	L	volume or capacity	ampere	A	electric current
second	s	time	volt	V	electric potential
hertz	Hz	frequency	ohm	Ω	electric resistance
candela	cd	luminous intensity	coulomb	C	electric charge

APPENDIX 7

Table for length conversion

Unit	mm	cm	m	km	in	ft	yd	mi
1 millimeter	1	0.1	0.001	10^{-6}	0.0397	0.00328	0.00109	6.21×10^{-7}
1 centimeter	10	1	0.01	0.0001	0.3937	0.0328	0.0109	6.21×10^{-6}
1 meter	1000	100	1	0.001	39.37	3.281	1.094	6.21×10^{-4}
1 kilometer	10^6	10^5	1000	1	39,370	3281	1093.6	0.621
1 inch	25.4	2.54	0.0254	2.54×10^{-5}	1	0.0833	0.0278	1.58×10^{-5}
1 foot	304.8	30.48	0.3048	3.05×10^{-4}	12	1	0.333	1.89×10^{-4}
1 yard	914.4	91.44	0.9144	9.14×10^{-4}	36	3	1	5.68×10^{-4}
1 mile	1.61×10^6	1.01×10^5	1.61×10^3	1.6093	63,360	5280	1760	1

APPENDIX 8

Table for area conversion

Unit	cm ²	m ²	km ²	ha	in ²	ft ²	yd ²	mi ²	ac
1 sq. centimeter	1	0.0001	10^{-10}	10^{-8}	0.155	1.08×10^{-3}	1.2×10^{-4}	3.86×10^{-11}	2.47×10^{-8}
1 sq. meter	10^4	1	10^{-6}	10^{-4}	1550	10.76	1.196	3.86×10^{-7}	2.47×10^{-4}
1 sq. kilometer	10^{10}	10^6	1	100	1.55×10^9	1.076×10^7	1.196×10^6	0.3861	247.1
1 hectare	10^8	10^4	0.01	1	1.55×10^7	1.076×10^5	1.196×10^4	3.861×10^{-3}	2.471
1 sq. inch	6.452	6.45×10^{-4}	6.45×10^{10}	6.45×10^{-8}	1	6.94×10^{-3}	7.7×10^{-4}	2.49×10^{-10}	1.574×10^{-7}
1 sq. foot	929	0.0929	9.29×10^{-8}	9.29×10^{-6}	144	1	0.111	3.587×10^{-8}	2.3×10^{-5}
1 sq. yard	8361	0.8361	8.36×10^{-7}	8.36×10^{-5}	1296	9	1	3.23×10^{-7}	2.07×10^{-4}
1 sq. mile	2.59×10^{10}	2.59×10^6	2.59	259	4.01×10^9	2.79×10^7	3.098×10^6	1	640
1 acre	4.04×10^7	4047	4.047×10^{-3}	0.4047	6.27×10^6	43,560	4840	1.562×10^{-3}	1

APPENDIX 9

Table for volume conversion

Unit	mL	liters	m ³	in ³	ft ³	gal	ac-ft	million gal
1 milliliter	1	0.001	10^{-6}	0.06102	3.53×10^{-5}	2.64×10^4	8.1×10^{-10}	2.64×10^{-10}
1 liter	10^3	1	0.001	61.02	0.0353	0.264	8.1×10^{-7}	2.64×10^{-7}
1 cu. meter	10^6	1000	1	61,023	35.31	264.17	8.1×10^{-4}	2.64×10^{-4}
1 cu. inch	16.39	1.64×10^{-2}	1.64×10^{-5}	1	5.79×10^{-4}	4.33×10^{-3}	1.218×10^{-8}	4.329×10^{-9}
1 cu. foot	28,317	28.317	0.02832	1728	1	7.48	2.296×10^{-5}	7.48×10^6
1 U.S. gallon	3785.4	3.785	3.78×10^{-3}	231	0.134	1	3.069×10^{-6}	10^6
1 acre-foot	1.233×10^9	1.233×10^6	1233.5	75.27×10^6	43,560	3.26×10^5	1	0.3260
1 million gallons	3.785×10^9	3.785×10^6	3785	2.31×10^8	1.338×10^5	10^6	3.0684	1

APPENDIX 10

Table for time conversion

Unit	sec	min	hours	days	years
1 second	1	1.67×10^{-2}	2.77×10^{-4}	1.157×10^{-5}	3.17×10^{-8}
1 minute	60	1	1.67×10^{-2}	6.94×10^{-4}	1.90×10^{-6}
1 hour	360	60	1	4.17×10^{-2}	1.14×10^{-4}
1 day	8.64×10^4	1440	24	1	2.74×10^{-3}
1 year	3.15×10^7	5.256×10^5	8760	365	1

Appendix 9.A. Continued
Velocity

Unit	Equivalent ^{1,2}				
	feet per day	kilometers per hour	feet per second	miles per hour	meters per second
feet per day	1	1.27×10^{-5}	1.157×10^{-5}	7.891×10^{-6}	3.528×10^{-6}
kilometers per hour	7.874×10^4	1	0.9113	0.6214	0.2778
feet per second	8.64×10^4	1.097	1	0.6818	0.3048
miles per hour	1.267×10^5	1.609	1.467	1	0.447
meters per second	2.835×10^5	3.6	3.281	2.237	1

Mass

Unit	Equivalent ^{1,2}					
	ounce	pound	kilogram	metric slug	short ton	metric ton
ounce	1	6.25×10^{-2}	2.835×10^{-2}	2.891×10^{-3}	3.125×10^{-3}	2.835×10^{-3}
pound	16	1	0.4536	4.625×10^{-2}	5×10^{-2}	4.536×10^{-2}
kilogram	35.28	2.205	1	0.102	1.102×10^{-3}	0.001
metric slug	345.9	21.62	9.807	1	92.51	9.807×10^{-3}
slug	514.7	32.17	14.59	1.49	62.17	1.459×10^{-2}
short ton	3.2×10^4	2,000	907.2	62.16	1	0.907
metric ton	3.528×10^4	2,205	1,000	68.52	1.103	1
long ton	3.584×10^4	2,240	1,016	69.63	1.12	1.016

Force

Unit	Equivalent ^{1,2}		
	dyne	newton	pound _{force}
dynes	1	1×10^{-5}	2.248×10^{-6}
newtons	1×10^5	1	0.2248
pound _{force}	4.448×10^5	4.448	1
kilogram _{force}	9.807×10^5	9.807	2.205

Density

Unit	Equivalent ^{1,2}			
	pounds per cubic inch	pounds per cubic foot	pounds per gallon	grams per liter
pounds per cubic inch	1	1,728	231	2.768×10^4
pounds per cubic foot	5.787×10^{-4}	1	0.1337	16.02
pounds per gallon	4.33×10^{-3}	7.481	1	119.8
grams per cubic centimeter	3.61×10^{-2}	62.43	8.345	1,000
grams per liter	3.61×10^{-3}	6.24×10^{-2}	8.35×10^{-3}	1

APPENDIX 9.A.
Conversion Tables

Length

Unit	Equivalent ^{1,2}					
	millimeters	inches	feet	meters	kilometers	miles
millimeters	1	3.937×10^{-2}	3.281×10^{-3}	1×10^{-3}	1×10^{-6}	6.214×10^{-7}
inches	25.4	1	8.33×10^{-2}	2.54×10^{-2}	2.54×10^{-5}	1.578×10^{-5}
feet	304.8	12	1	0.3048	3.048×10^{-4}	1.894×10^{-4}
meters	1,000	39.37	3.281	1	1×10^{-3}	6.214×10^{-4}
kilometers	1×10^6	3.937×10^4	3,281	1,000	1	0.6214
miles	1.609×10^6	6.336×10^4	5,280	1,609	1.609	1

Area

Unit	Equivalent ^{1,2}					
	square inches	square feet	square meters	acres	hectares	square miles
square inches	1	6.944×10^{-3}	6.452×10^{-4}	1.994×10^{-8}	6.452×10^{-8}	2.491×10^{-10}
square feet	144	1	9.29×10^{-2}	2.296×10^{-5}	9.29×10^{-9}	3.597×10^{-8}
square meters	1,550	10.76	1	2.471×10^{-4}	1×10^{-4}	3.861×10^{-7}
acres	6.273×10^6	4.356×10^4	4,047	1	0.4047	1.563×10^{-3}
hectares	1.55×10^7	1.076×10^5	1×10^4	2.471	1	3.861×10^{-3}
square kilometers	1.55×10^9	1.076×10^7	1×10^6	247.1	100	0.3861
square miles	4.014×10^9	2.789×10^7	2.59×10^6	640	259	1

Volume

Unit	Equivalent ^{1,2}					
	cubic inches	liters	gallons	cubic feet	cubic yards	acre-ft
cubic inches	1	1.639×10^{-2}	4.379×10^{-3}	5.787×10^{-4}	2.143×10^{-5}	1.379×10^{-8}
liters	61.02	1	0.2642	3.531×10^{-2}	1.308×10^{-3}	8.108×10^{-7}
gallons	231.0	3.785	1	0.1337	4.951×10^{-3}	3.068×10^{-6}
cubic feet	1,728	28.32	7.481	1	3.785×10^{-3}	2.596×10^{-5}
cubic yards	4.666×10^4	764.6	202.0	27	3.704×10^{-2}	2.596×10^{-5}
cubic meters	6.102×10^4	1,000	264.2	35.31	1.308	6.198×10^{-4}
acre-ft	7.527×10^7	1.233×10^6	3.259×10^5	4.356×10^4	1.233	1

Discharge (flow rate, volume/time)

Unit	Equivalent ^{1,2}			
	gallons per minute	liters per second	cubic feet per second	cubic meters per day
gallons per minute	1	6.309×10^{-2}	4.419×10^{-3}	5.45
liters per second	15.85	1	7.005×10^{-2}	86.4
acre-feet per day	226.3	14.28	1	1,234
cubic feet per second	448.8	28.32	1	2,447
cubic meters per day	1.369×10^6	8.64×10^7	6.051×10^6	1

TABLE 4.1 English and SI Units

$1 N = 1 Kg \cdot m / sec^2$

Parameter	English Unit	SI Unit	Conversion Factor	Dimensional Formula
Force	pound (lb)	newton (N)	1 lb = 4.448 N	ML/T^2
Mass	slug	kilogram (kg)	1 slug = 14.594 kg	M
Length	foot (ft)	meter (m)	1 ft = 0.3048 m	L
Time	second (s)	second	1 s = 1 s	T
Density	slug/ft ³	kg/m ³	1 slug/ft ³ = 515.4 kg/m ³	M/L^3
Specific weight	lb/ft ³	N/m ³	1 lb/ft ³ = 157.1 N/m ³	M/L^2T^2
Pressure	lb/ft ²	N/m ²	1 lb/ft ² = 47.88 N/m ²	M/LT^2
Dynamic viscosity	lb-s/ft ²	N-s/m ²	1 lb-s/ft ² = 47.88 N-s/m ²	M/LT
Bulk modulus	lb/ft ²	N/m ²	1 lb/ft ² = 47.88 N/m ²	M/LT^2

$g = \text{ACCELERATION DUE TO GRAVITY} = 9.8 \text{ m/sec}^2$

Equations for areas and volumes

- Circumference of circle = $3.1416 \times \text{dia} = 6.2832 \times \text{radius}$
- Area of circle = $0.7854 \times (\text{dia})^2 = 3.1416 \times (\text{radius})^2$
- Area of sphere = $3.1416 \times (\text{dia})^2$
- Volume of sphere = $0.5236 \times (\text{dia})^3$
- Area of triangle = $0.5 \times \text{base} \times \text{height}$
- Area of trapezoid = $0.5 \times \text{sum of the two parallel sides} \times \text{height}$
- Area of square, rectangle, or parallelogram = $\text{base} \times \text{height}$
- Volume of pyramid = $\text{area of base} \times 1/3 \text{ height}$
- Volume of cone = $0.2618 \times (\text{dia of base})^2 \times \text{height}$
- Volume of cylinder = $0.7854 \times \text{height} \times (\text{dia})^2$

Pressure

Unit	Equivalent ^{1,2}										
	pounds per square inch	pounds per square foot	atmospheres	kilograms per square centimeter	kilograms per square meter	inches of water (68°F)	feet of water (68°F)	inches of mercury (32°F)	millimeters of mercury (32°F)	bars	kilo Pascals
pounds per square inch	1	144	6.805×10^{-2}	7.031×10^{-3}	703.1	27.73	2.311	2.036	51.72	6.895×10^{-2}	6.895
pounds per square foot	6.945×10^{-3}	1	4.73×10^{-4}	4.88×10^{-4}	4.882	0.1926	1.605×10^{-2}	1.414×10^{-2}	0.3591	4.79×10^{-4}	4.79×10^{-2}
atmospheres	14.7	2,116	1	1.033	1.033×10^4	407.5	33.96	29.92	760	1.013	101.3
kilograms per square centimeter	14.22	2,048	0.9678	1	1×10^4	394.4	32.87	28.96	735.6	0.9807	98.07
kilograms per square meter	1.422×10^{-3}	0.2048	9.678×10^{-5}	0.001	1	3.944×10^{-2}	3.287×10^{-3}	2.896×10^{-3}	7.356×10^{-2}	9.807×10^{-5}	9.807×10^{-3}
inches of water (68°F)	3.609×10^{-2}	5.197	2.454×10^{-3}	2.53×10^{-3}	25.38	1	8.333×10^{-2}	7.343×10^{-2}	1.865	2.49×10^{-3}	0.249
feet of water (68°F)	0.4328	62.32	2.945×10^{-3}	3.043×10^{-3}	304.3	12	1	0.8812	22.38	2.984×10^{-2}	2.984
inches of mercury (32°F)	0.4912	70.73	3.342×10^{-3}	3.453×10^{-3}	345.3	13.62	1.135	1	25.4	3.386×10^{-2}	3.386
millimeters of mercury (32°F)	1.934×10^{-2}	2.785	1.316×10^{-3}	1.36×10^{-3}	13.6	0.5362	4.468×10^{-2}	3.937×10^{-2}	1	1.333×10^{-3}	0.1333
bars	14.5	2,089	0.9869	1.02	1.02×10^4	402.2	33.51	29.53	750.1	1	100
kilo Pascals	0.145	20.89	9.869×10^{-3}	1.02×10^{-2}	102	4.022	0.3351	0.2953	7.501	0.01	1

APPENDIX 14
Absolute density and absolute viscosity of water

Temperature (°C)	Density (kg/m ³)	Density (g/cm ³)	Viscosity (g/s-cm)
0	999.841	0.999841	0.017921
1	999.900	0.999900	0.017313
2	999.941	0.999941	0.016728
3	999.965	0.999965	0.016191
4	999.973	0.999973	0.015674
5	999.965	0.999965	0.015188
6	999.941	0.999941	0.014728
7	999.902	0.999902	0.014284
8	999.849	0.999849	0.013860
9	999.781	0.999781	0.013462
10	999.700	0.999700	0.013077
11	999.605	0.999605	0.012713
12	999.498	0.999498	0.012363
13	999.377	0.999377	0.012028
14	999.244	0.999244	0.011709
15	999.099	0.999099	0.011404
16	998.943	0.998943	0.011111
17	998.774	0.998774	0.010828
18	998.595	0.998595	0.010559
19	998.405	0.998405	0.010299
20	998.203	0.998203	0.010050
21	997.992	0.997992	0.009810
22	997.770	0.997770	0.009579
23	997.538	0.997538	0.009358
24	997.296	0.997296	0.009142
25	997.044	0.997044	0.008937
26	996.783	0.996783	0.008737
27	996.512	0.996512	0.008545
28	996.232	0.996232	0.008360
29	995.944	0.995944	0.008180
30	995.646	0.995646	0.008007
35	994.029	0.994029	0.007225
40	992.214	0.992214	0.006560
45	990.212	0.990212	0.005988
50	988.047	0.988047	0.005494

NOTATION

- | | |
|---|---|
| a Acceleration | P Pressure |
| A Area | q Flux |
| A_f Cross-sectional area of a falling-head tube | Q Discharge (rate) |
| A_c Cross-sectional area of a permeameter sample chamber | S Storativity |
| b Aquifer thickness | S_s Specific storage |
| c Shape factor | S_r Specific retention |
| c_u Uniformity coefficient | S_y Specific yield |
| d Grain size | T Transmissivity |
| D Distance | w Weight |
| d_i Inside diameter of falling-head tube | V Volume |
| d_c Inside diameter of a permeameter sample chamber | V_v Volume of voids |
| F Force | V_w Volume of water |
| g Gravitational constant | W Work |
| h Head | α Compressibility of aquifer skeleton |
| j An exponent | β Compressibility of water |
| K Hydraulic conductivity | γ Specific weight |
| K_h Horizontal hydraulic conductivity | Δh Decline in head |
| K_i Intrinsic permeability | ρ Density |
| K_v Vertical hydraulic conductivity | ρ_b Bulk density |
| L Length | ρ_d Mineral particle density |
| m Mass | ρ_w Density of water |
| n Porosity | |

/	4.4°		4.4°		4.4°		4.4°		/
	Tang	Cotang	Tang	Cotang	Tang	Cotang	Tang	Cotang	
0	.96569	1.03555	60	.97189	1.02892	49	.97189	1.03555	20
1	.96625	1.03495	59	.97246	1.02832	48	.97246	1.03495	19
2	.96681	1.03435	58	.97302	1.02772	47	.97302	1.03435	18
3	.96738	1.03372	57	.97359	1.02713	46	.97359	1.03372	17
4	.96794	1.03312	56	.97416	1.02653	45	.97416	1.03312	16
5	.96850	1.03252	55	.97472	1.02593	44	.97472	1.03252	15
6	.96907	1.03192	54	.97529	1.02533	43	.97529	1.03192	14
7	.96963	1.03132	53	.97586	1.02474	42	.97586	1.03132	13
8	.97020	1.03072	52	.97643	1.02414	41	.97643	1.03072	12
9	.97076	1.03012	51	.97700	1.02355	40	.97700	1.03012	11
10	.97133	1.02952	50						10
11	.97189	1.02892	49						9
12	.97246	1.02832	48						8
13	.97302	1.02772	47						7
14	.97359	1.02713	46						6
15	.97416	1.02653	45						5
16	.97472	1.02593	44						4
17	.97529	1.02533	43						3
18	.97586	1.02474	42						2
19	.97643	1.02414	41						1
20	.97700	1.02355	40						0

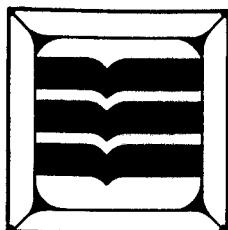
APPENDIX 8. EQUIVALENCE OF SOME UNITS OF WEIGHT AND MEASURE

Underlined figures are exact; others are rounded off. Condensed from Letter Circular 1035 (Jan., 1960) of the U.S. Department of Commerce, National Bureau of Standards, Washington 25, D.C.

- 1 in. = 0.08333 ft; 0.02778 yd; 2.54 cm.
- 1 ft = 12 in.; 0.6061 rods; 0.3048 m; 0.0001894 mi
- 1 yd = 3 ft; 0.9144 m; 0.1818 rods; 0.0005682 mi
- 1 m = 1000 mm; 100 cm; 10 decimeters 0.1 dekameters; 0.01 hectometers; 0.001 km
- 1 m = 39.37 in.; 3.2808 ft; 1.0936 yd; 0.0006214 mi
- 1 fathom = 6 ft; 1.8288 m
- 1 rod = 198 in.; 16.5 ft; 5.5 yd
- 1 chain = 100 links; 66 ft; 0.0125 mi; 20.117 m;
- 1 mi = 5280 ft; 1760 yd; 320 rods; 1609.344 m;
- 1 nautical mi = 6076.1 ft; 1852 m
- 1 sq in. = 6.4516 sq cm; 0.00684 sq ft
- 1 sq ft = 144 sq in.; 0.1111 sq yd; 0.0929 sq m
- 1 sq yd = 1296 sq in.; 9 sq ft; 0.8361 sq m
- 1 sq m = 1551 sq in.; 10.76 sq ft; 1.196 sq yd
- 1 acre = 43560 sq ft; 4840 sq yd; 0.405 hectares; 0.00156 sq mi
- 1 sq mi = 640 acres; 259 hectares
- 1 cu cm = 0.0610 cu in.; 0.000001 cu m
- 1 cu in. = 0.0005787 cu ft; 16.387 cu cm
- 1 cu ft = 1728 cu in.; 0.03704 cu yd; 0.0283 cu m; 7.480 gal (U.S.)
- 1 cu yd = 46656 cu in.; 27 cu ft; 0.7645 cu m
- 1 cu m = 35.315 cu ft; 1.3079 cu yd
- 1 gal (U.S.) = 231 cu in; 128 fl oz; 0.1337 cu ft; 3.785 liters
- 1 liter = 61.025 cu in.; 0.2642 gal (U.S.); 0.0353 cu ft
- 1 acre ft = 43560 cu ft; 325851 gal (U.S.); 1233.5 cu m
- 1 oz (avoir.) = 437.5 grains; 28.350 grams; 0.0625 lbs (avoir.)
- 1 gram = 15.432 grains; 0.03527 oz (avoir.); 0.002205 lbs (avoir.)
- 1 short (net) ton = 2000 lbs; 0.9072 metric ton; 0.8929 long (gross) ton

For all the answers . . .

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National Ground Water Information Center

6375 Riverside Dr. ■ Dublin, OH 43017
(614) 761-3222 ■ FAX (614) 761-3446

Conversions of Hydraulic Conductivity, Intrinsic Permeability and Transmissivity

A. Hydraulic Conductivity, K [L/T], and Intrinsic Permeability, k [L²]

	K								k		
	cm/s	m/s	m/day	ft/s	ft/day	ft/yr	USgpd/ft ²	UKgpd/ft ²	darcy	cm ²	ft ²
cm/s	1	1.00E-2	8.64E2	3.28E-2	2.83E3	1.03E6	2.12E4	1.77E4	1.16E3	1.15E-5	1.24E-8
m/s	1.00E2	1	8.64E4	3.28	2.83E5	1.03E8	2.12E6	1.77E6	1.16E5	1.15E-3	1.24E-6
m/day	1.16E-3	1.16E-5	1	3.80E-5	3.28	1.20E3	2.45E1	2.04E1	1.35	1.33E-8	1.43E-11
ft/s	3.05E1	.305	2.63E4	1	8.64E4	3.15E7	6.46E5	5.38E5	3.55E4	3.50E-4	3.77E-7
ft/day	3.53E-4	3.53E-6	.305	1.16E-5	1	3.65E2	7.48	6.23	.411	4.06E-9	4.36E-12
ft/yr	9.66E-7	9.66E-9	8.35E-4	3.17E-8	2.74E-3	1	2.05E-2	1.71E-2	1.13E-3	1.11E-11	1.20E-14
USgpd/ft ²	4.72E-5	4.72E-7	4.07E-2	1.55E-6	.134	4.88E1	1	.833	5.49E-2	5.42E-10	5.83E-13
UKgpd/ft ²	5.66E-5	5.66E-7	4.89E-2	1.86E-6	.161	5.86E1	1.20	1	6.60E-2	6.51E-10	7.01E-13
darcy	8.58E-4	8.58E-6	7.42E-1	2.82E-5	2.43	8.88E2	1.82E1	1.52E1	1	9.87E-9	1.06E-11
cm ²	8.70E4	8.70E2	7.51E7	2.85E3	2.47E8	9.00E10	1.84E9	1.54E9	1.01E8	1	1.08E-3
ft ²	8.08E7	8.08E5	6.98E10	2.65E6	2.29E11	8.36E13	1.71E12	1.43E12	9.41E10	9.29E2	1

The relation between units of K and k is temperature dependent: these factors are for 60° F.

B. Transmissivity [L²/T]

	m ² /s	m ² /min	m ² /day	ft ² /s	ft ² /day	USgpd/ft	UKgpd/ft
m ² /s	1	6.00E1	8.64E4	1.08E1	9.30E5	6.96E6	5.79E6
m ² /min	1.67E-2	1	1.44E3	1.79E-1	1.55E4	1.16E5	9.65E4
m ² /day	1.16E-5	6.94E-4	1	1.25E-4	1.08E1	8.05E1	6.70E1
ft ² /s	9.29E-2	5.57	8.03E3	1	8.64E4	6.46E5	5.38E5
ft ² /day	1.08E-6	6.45E-5	9.29E-2	1.16E-5	1	7.48	6.23
USgpd/ft	1.44E-7	8.62E-6	1.24E-2	1.55E-6	1.34E-1	1	.833
UKgpd/ft	1.73E-7	1.04E-5	1.49E-2	1.86E-6	1.61E-1	1.20	1

Enter either table at the left with the given unit: move right to the column of the unit to be derived; read the conversion factor as a multiplier.
Example: to convert 2.1 ft/day (hydraulic conductivity) to cm/s: 2.1 ft/day × 3.53E-4 = 7.4E-4 cm/s.
Conversion factors are given in FORTRAN/BASIC notation; thus 3.53E-4 = 3.53 × 10⁻⁴.

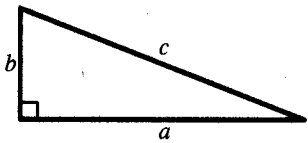
ENGLISH-METRIC UNIT CONVERSION TABLE

To convert A to B, multiply A by C; To convert B to A, divide B by C

A	B	C	A	B	C
Length —			Hydraulic conductivity —		
inch	meter	2.540E-2	gal/day/ft ²	cm/sec	4.716E-5
foot	meter	.3048	gal/day/ft ²	ft/day	.1337
yard	meter	.9144	gal/day/ft ²	meter/day	4.075E-2
mile	kilometer	1.609	gal (UK)/day/ft ²	meter/day	4.893E-2
inch	centimeter	2.540	ft/yr	cm/sec	9.665E-7
Area —			ft/yr	meter/day	8.351E-4
sq inch	sq centimeter	6.452	darcy (atm/cm)	cm/sec	8.584E-4
sq feet	sq meter	9.290E-2	darcy	ft/day	2.433
sq yard	sq meter	.8361	darcy	meter/day	.7416
sq mile	sq kilometer	2.590	Transmissivity —		
acre	sq kilometer	4.047E-3	gal/day/ft	sq meter/day	1.242E-2
acre	hectare	.4047	gal (UK)/day/ft	sq meter/day	1.492E-2
Volume —			sq ft/sec	sq meter/day	8.027E3
cu feet	cu meter	2.832E-2	sq ft/day	sq meter/day	9.290E-2
cu yard	cu meter	.7646	Force and pressure —		
cu inch	cu centimeter	1.639E1	pound (f)	newton	4.448
quart	liter	.9464	poundal	newton	.1383
gallon	liter	3.785	pounds/sq in.	pascal	6.895E3
gallon (UK)	liter	4.546	lb/sq ft	pascal	4.788E1
barrel (petr.)	liter	1.590E2	poundal/sq ft	pascal	1.488
acre-feet	cu meter	1.234E3	atmosphere	pascal	1.013E5
million gal	cu meter	3.785E3	inches of Hg	pascal	3.386E3
gallon (UK)	gallon (US)	1.200	millibar	pascal	1.000E2
Mass —			psi	kg/cm ²	7.031E-2
pound (lb)	kilogram	.4536	ft of H ₂ O (4°C)	psi	.4335
ounce	gram	2.835E1	Work, energy and heat —		
ton, short	tonne (metric)	.9072	horsepower (US)	horsepower (CV)	1.014
ton, long	tonne	1.016	horsepower (US)	kW-hr	.7457
Velocity and gradient —			ft-lb/sec	kW	1.356E-3
feet/sec	meter/sec	.3048	BTU	kW-hr	2.930E-4
mile/hour	meter/sec	.4470	gpm/100' lift	kW	1.884E-2
feet/mile	meter/km	.1894	ft-lb	joule	1.356
Flow rate —			ft-poundal	joule	4.214E-2
gal/min	liter/sec	6.309E-2	BTU	joule	1.055E-3
gal/min	cu meter/day	5.300	calorie	joule	4.187
gal (UK)/min	liter/sec	7.577E-2	Temperature —		
10 ⁶ gal/day	liter/sec	4.381E1	Fahrenheit	Celsius	5(F-32)/9
10 ⁶ gal/day	cu meter/day	3.785E-3	Celsius	Fahrenheit	1.8(C)+32
cu ft/sec (cfs)	liter/sec	2.832E1	Kelvin	Celsius	K-273.2
acre-feet/day	liter/sec	1.458E-1			
gal/day	acre-feet/yr	1.120E-3			

Notes: (1) The "E" notation indicates exponentiation: 2.540E-2 = 2.540 · 10⁻². (2) Unless otherwise noted, all gallons are U.S. gallons. (3) The darcy is a unit of permeability (L²), not of hydraulic conductivity (L/T). (4) A Newton (force) = kg · m/s²; A Pascal (pressure) = kg / m · s²; Joule (energy) = kg · m²/s²; each is a unit in SI. (5) Under "Temperature," entries are formulae, not multipliers.

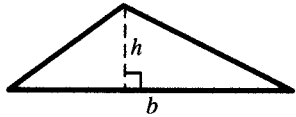
GEOMETRIC FORMULAS



Right Triangle

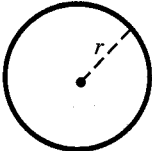
● Triangles

Pythagorean Theorem $a^2 + b^2 = c^2$



Any Triangle

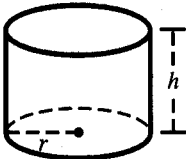
Area $A = \frac{1}{2}bh$



● Circles

Area $A = \pi r^2$

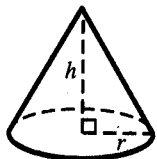
Circumference $C = 2\pi r$



● Cylinders

Surface Area $S = 2\pi r^2 + 2\pi rh$

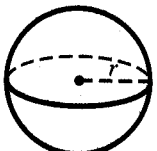
Volume $V = \pi r^2 h$



● Cones

Surface Area $S = \pi r^2 + \pi r\sqrt{r^2 + h^2}$

Volume $V = \frac{1}{3}\pi r^2 h$



● Spheres

Surface Area $S = 4\pi r^2$

Volume $V = \frac{4}{3}\pi r^3$