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
CIRCLE	ELLIPSE		
OBTUSE greater than 90°, less than 180°	COMPLETE 360°	SUPPLEMENTARY add up to 180°	SEMICIRCLE
RADIUS	DIAMETER	CHORD	

TRIANGLES

SCALENE TRIANGLE	RIGHT TRIANGLE
ISOSCELES TRIANGLE	EQUILATERAL TRIANGLE

$\Delta ABC \cong \Delta DEF$

4 CONGRUENCY CASES

1. side, side, side — SSS
2. side, angle, side — SAS
3. angle, side, angle — ASA
4. hypotenuse, side — HyS

$\Delta ABC \cong \Delta XYZ$

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 = l w

Volume = lwh
Surface area = 2(lh + lw + hw)

Circumference of a circle = $2\pi r$
Area of a circle = πr^2

Surface area of sphere = $4\pi r^2$
Volume of a sphere = $\frac{4\pi r^3}{3}$

Area = $\frac{\text{base x height}}{2}$

$c^2 = a^2 + b^2$ (Pythagorean theorem)

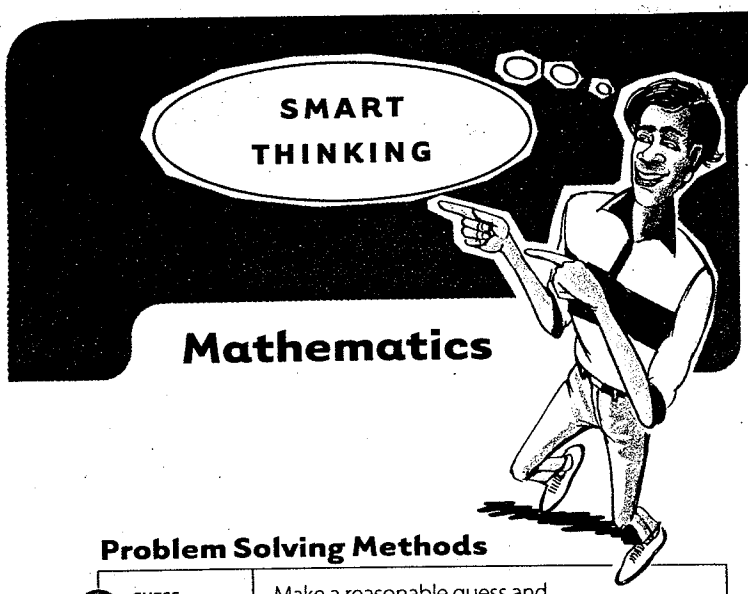
Surface area of cylinder = $2\pi rh + 2\pi r^2$
Volume of cylinder = $\pi r^2 h$

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



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.	$^2\sqrt{\ }$	> 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
5 – denominator

To ***add*** or ***subtract*** different fractions, first obtain a common denominator:

$\frac{1}{3}+\frac{2}{5}=\frac{5}{15}+\frac{6}{15}=\frac{11}{15}$

To ***multiply:***

$\frac{1}{3}\times\frac{2}{5}=\frac{1\times2}{3\times5}=\frac{2}{15}$

To ***divide,*** multiply the first with the reciprocal of the second fraction:

$\frac{2}{3}\div\frac{1}{6}=\frac{2}{3}\times\frac{6}{1}=4$

1	= 1.0	= 100%
1/2	= 0.5	= 50%
1/3	= $0.\overline{3}$	= $33.\overline{3}$%
1/4	= 0.25	= 25%
1/5	= 0.2	= 20%
1/6	= $0.1\overline{6}$	= $16.\overline{6}$%
1/8	= 0.125	= 12.5%
1/9	= $0.\overline{1}$	= $11.\overline{1}$%
1/10	= 0.1	= 10%
1/12	= $0.08\overline{3}$	= $8.\overline{3}$%
2/3	= $0.\overline{6}$	= $66.\overline{6}$%
3/4	= 0.75	= 75%

Squares and Square Roots

n	n^2	$\sqrt{n}$
1	1	1
2	4	1.414
3	9	1.732
4	16	2
5	25	2.236
6	36	2.449

n	n^2	$\sqrt{n}$
7	49	2.646
8	64	2.828
9	81	3
10	100	3.162
11	121	3.317
12	144	3.464

n	n^2	$\sqrt{n}$
15	225	3.873
20	400	4.472
25	625	5
100	10,000	10
1/2	1/4	0.707
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

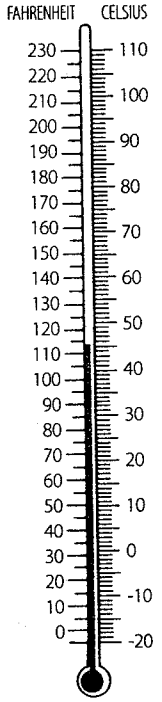
Metric system

1 m^2	= 10,000 cm^2
1 hectare (ha)	= 10,000 m^2
1 km^2	= 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 ft^2	= 144 in^2	
1 yd^2	= 9 ft^2	
1 acre	= 4,840 yd^2	

Temperature



°C → °F: n x 1.8; add 32

°F → °C: n − 32; multiply by 0.5555

LENGTH / AREA

to go from	to	multiply by
cm	→ in	0.3937
in	→ cm	2.54
m	→ ft	3.2808
ft	→ m	0.3048
km	→ mi	0.6214
mi	→ km	1.609
m^2	→ ft^2	10.76
ft^2	→ m^2	0.0929
km^2	→ mi^2	0.3861
mi^2	→ km^2	2.59

WEIGHT / CAPACITY

to go from	to	multiply by
g	→ oz	0.0353
oz	→ g	28.35
kg	→ lbs	2.2046
lbs	→ kg	0.4536
t	→ T	1.1023
T	→ t	0.9072
ml	→ fl oz	0.0338
fl oz	→ ml	29.575
l	→ gal	0.2642
gal	→ l	3.785

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

*Canadian preferred spelling: metre, litre.

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	slug	short ton	metric ton	long ton
ounce	1	6.25×10^{-2}	2.835×10^{-2}	2.891×10^{-3}	1.943×10^{-3}	3.125×10^{-5}	2.835×10^{-5}	2.79×10^{-5}
pound	16	1	0.4536	4.625×10^{-2}	3.108×10^{-2}	5×10^{-4}	4.536×10^{-4}	4.464×10^{-4}
kilogram	35.28	2.205	1	0.102	6.852×10^{-2}	1.102×10^{-3}	0.001	9.842×10^{-4}
metric slug	345.9	21.62	9.807	1	0.6721	92.51	9.807×10^{-3}	9.651×10^{-3}
slug	514.7	32.17	14.59	1.49	1	62.17	1.459×10^{-2}	1.436×10^{-2}
short ton	3.2×10^{4}	2,000	907.2	92.51	62.16	1	0.907	0.8929
metric ton	3.528×10^{4}	2.205	1.000	102	68.52	1.103	1	0.9842
long ton	3.584×10^{4}	2,240	1.016	103.7	69.63	1.12	1.016	1

Force

Unit	Equivalent[1,2]			
	dyne	newton	$pound_{force}$	$kilogram_{force}$
dynes	1	1×10^{-5}	2.248×10^{-6}	1.02×10^{-6}
newtons	1×10^{5}	1	0.2248	0.102
$pound_{force}$	4.448×10^{5}	4.448	1	0.4536
$kilogram_{force}$	9.807×10^{5}	9.807	2.205	1

Density

Unit	Equivalent[1,2]				
	pounds per cubic inch	pounds per cubic feet	pounds per gallon	grams per cubic centimeter	grams per liter
pounds per cubic inch	1	1,728	231	27.68	2.768×10^{4}
pounds per cubic feet	5.787×10^{-4}	1	0.1337	1.6×10^{-2}	16.02
pounds per gallon	4.33×10^{-3}	7.481	1	0.1198	119.8
grams per cubic centimeter	3.61×10^{-2}	62.43	8.345	1	1,000
grams per liter	3.61×10^{-5}	6.24×10^{-2}	8.35×10^{-3}	0.001	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 kilometers	square miles
square inches	1	6.944×10^{-3}	6.452×10^{-4}	1.594×10^{-8}	6.452×10^{-8}	6.452×10^{-10}	2.491×10^{-10}
square feet	144	1	9.29×10^{-2}	2.296×10^{-5}	9.29×10^{-9}	9.29×10^{-8}	3.587×10^{-8}
square meters	1,550	10.76	1	2.471×10^{-4}	1×10^{-4}	1×10^{-6}	3.861×10^{-7}
acres	6.273×10^{6}	4.356×10^{4}	4,047	1	0.4047	4.047×10^{-3}	1.563×10^{-3}
hectares	1.55×10^{7}	1.076×10^{5}	1×10^{4}	2.471	1	0.01	3.861×10^{-3}
square kilometers	1.55×10^{9}	1.076×10^{7}	1×10^{6}	247.1	100	1	0.3861
square miles	4.014×10^{9}	2.788×10^{7}	2.59×10^{6}	640	259	2.59	1

Volume

Unit	Equivalent[1,2]						
	cubic inches	liters	gallons	cubic feet	cubic yards	cubic meters	acre-ft
cubic inches	1	1.639×10^{-2}	4.329×10^{-3}	5.787×10^{-4}	2.143×10^{-5}	1.639×10^{-5}	1.329×10^{-8}
liters	61.02	1	0.2642	3.531×10^{-2}	1.308×10^{-3}	0.001	8.106×10^{-7}
gallons	231.0	3.785	1	0.1337	4.951×10^{-3}	3.785×10^{-3}	3.068×10^{-6}
cubic feet	1,728	28.32	7.481	1	3.704×10^{-2}	2.832×10^{-3}	2.296×10^{-5}
cubic yards	4.666×10^{4}	764.6	202.0	27	1	0.7646	6.198×10^{-4}
cubic meters	6.102×10^{4}	1,000	264.2	35.31	1.308	1	8.106×10^{-4}
acre-ft	7.527×10^{7}	1.233×10^{6}	3.259×10^{5}	4.356×10^{4}	1,613	1,233	1

Discharge (flow rate, volume/time)

Unit	Equivalent[1,2]				
	gallons per minute	liters per second	acre-feet per day	cubic feet per second	cubic meters per day
gallons per minute	1	6.309×10^{-2}	4.419×10^{-3}	2.228×10^{-3}	5.45
liters per second	15.85	1	7.005×10^{-2}	3.531×10^{-2}	86.4
acre-feet per day	226.3	14.28	1	0.5042	1,234
cubic feet per second	448.8	28.32	1.983	1	2,447
cubic meters per day	1.369×10^{9}	8.64×10^{7}	6.051×10^{6}	3.051×10^{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 = Acceleration Due To Gravity = 9.8 m/sec^2

Equations for areas and volumes

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

Pressure

Unit	Equivalent[1,2]										
	pounds per square inch	pounds per square feet	atmospheres	kilograms per square centimeter	kilograms per square meter	inches of water (68°F)[3]	feet of water (68°F)[3]	inches of mercury (32°F)[4]	millimeters of mercury (32°F)[4]	bars	kilo Pascals
pounds per square inch	1	144	6.805×10^{-2}	7.031×10^{-2}	703.1	27.73	2.311	2.036	51.72	6.895×10^{-2}	6.895
pounds per square feet	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]	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)[3]	0.4328	62.32	2.945×10^{-2}	3.043×10^{-2}	304.3	12	1	0.8812	22.38	2.984×10^{-2}	2.984
inches of mercury (32°F)[4]	0.4912	70.73	3.342×10^{-2}	3.453×10^{-2}	345.3	13.62	1.135	1	25.4	3.386×10^{-2}	3.386
millimeters of mercury (32°)[4]	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 9.A. Continued

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

Source: *Handbook of Chemistry and Physics* (Cleveland, Ohio: CRC Publishing Company, 1986).

NOTATION

a Acceleration
A Area
$\mathbf{A_t}$ Cross-sectional area of a falling-head tube
$\mathbf{A_c}$ Cross-sectional area of a permeameter sample chamber
b Aquifer thickness
c Shape factor
$\mathbf{c_u}$ Uniformity coefficient
d Grain size
D Distance
$\mathbf{d_t}$ Inside diameter of falling-head tube
$\mathbf{d_c}$ Inside diameter of a permeameter sample chamber
F Force
g Gravitational constant
h Head
j An exponent
K Hydraulic conductivity
$\mathbf{K_h}$ Horizontal hydraulic conductivity
$\mathbf{K_i}$ Intrinsic permeability
$\mathbf{K_v}$ Vertical hydraulic conductivity
L Length
m Mass
n Porosity
P Pressure
q Flux
Q Discharge (rate)
S Storativity
$\mathbf{S_s}$ Specific storage
$\mathbf{S_r}$ Specific retention
$\mathbf{S_y}$ Specific yield
T Transmissivity
w Weight
V Volume
$\mathbf{V_v}$ Volume of voids
$\mathbf{V_w}$ Volume of water
W Work
$\boldsymbol{\alpha}$ Compressibility of aquifer skeleton
$\boldsymbol{\beta}$ Compressibility of water
$\boldsymbol{\gamma}$ Specific weight
$\boldsymbol{\Delta h}$ Decline in head
$\boldsymbol{\rho}$ Density
$\boldsymbol{\rho_b}$ Bulk density
$\boldsymbol{\rho_d}$ Mineral particle density
$\boldsymbol{\rho_w}$ Density of water

′	44° Tang	44° Cotang	′	′	44° Tang	44° Cotang	′	′	44° Tang	44° Cotang	′
0	.96569	1.03553	60	20	.97700	1.02355	40	40	.98843	1.01170	20
1	.96625	1.03493	59	21	.97756	1.02295	39	41	.98901	1.01112	19
2	.96681	1.03433	58	22	.97813	1.02236	38	42	.98958	1.01053	18
3	.96738	1.03372	57	23	.97870	1.02176	37	43	.99016	1.00994	17
4	.96794	1.03312	56	24	.97927	1.02117	36	44	.99073	1.00935	16
5	.96850	1.03252	55	25	.97984	1.02057	35	45	.99131	1.00876	15
6	.96907	1.03192	54	26	.98041	1.01998	34	46	.99189	1.00818	14
7	.96963	1.03132	53	27	.98098	1.01939	33	47	.99247	1.00759	13
8	.97020	1.03072	52	28	.98155	1.01879	32	48	.99304	1.00701	12
9	.97076	1.03012	51	29	.98213	1.01820	31	49	.99362	1.00642	11
10	.97133	1.02952	50	30	.98270	1.01761	30	50	.99420	1.00583	10
11	.97189	1.02892	49	31	.98327	1.01702	29	51	.99478	1.00525	9
12	.97246	1.02832	48	32	.98384	1.01642	28	52	.99536	1.00467	8
13	.97302	1.02772	47	33	.98441	1.01583	27	53	.99594	1.00408	7
14	.97359	1.02713	46	34	.98499	1.01524	26	54	.99652	1.00350	6
15	.97416	1.02653	45	35	.98556	1.01465	25	55	.99710	1.00291	5
16	.97472	1.02593	44	36	.98613	1.01406	24	56	.99768	1.00233	4
17	.97529	1.02533	43	37	.98671	1.01347	23	57	.99826	1.00175	3
18	.97586	1.02474	42	38	.98728	1.01288	22	58	.99884	1.00116	2
19	.97643	1.02414	41	39	.98786	1.01229	21	59	.99942	1.00058	1
20	.97700	1.02355	40	40	.98843	1.01170	20	60	1.00000	1.00000	0
′	45° Cotang	45° Tang	′	′	45° Cotang	45° Tang	′	′	45° Cotang	45° Tang	′

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; 0.00694 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

Conversions of Hydraulic Conductivity, Intrinsic Permeability and Transmissivity

A. Hydraulic Conductivity, K [L/T], and Intrinsic Permeability, k [L^2]

	K								*k*		
	cm/s	*m/s*	*m/day*	*ft/s*	*ft/day*	*ft/yr*	*USgpd/ft²*	*UKgpd/ft²*	*darcy*	*cm²*	*ft²*
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/ft²	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/ft²	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
cm²	8.70E4	8.70E2	7.51E7	2.85E3	2.47E8	9.00E10	1.84E9	1.54E9	1.01E8	1	1.08E-3
ft²	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 [L^2/T]

	m²/s	*m²/min*	*m²/day*	*ft²/s*	*ft²/day*	*USgpd/ft*	*UKgpd/ft*
m²/s	1	6.00E1	8.64E4	1.08E1	9.30E5	6.96E6	5.79E6
m²/min	1.67E-2	1	1.44E3	1.79E-1	1.55E4	1.16E5	9.65E4
m²/day	1.16E-5	6.94E-4	1	1.25E-4	1.08E1	8.05E1	6.70E1
ft²/s	9.29E-2	5.57	8.03E3	1	8.64E4	6.46E5	5.38E5
ft²/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
Length –		
inch	meter	2.540E−2
feet	meter	.3048
yard	meter	.9144
mile	kilometer	1.609
inch	centimeter	2.540
Area –		
sq inch	sq centimeter	6.452
sq feet	sq meter	9.290E−2
sq yard	sq meter	.8361
sq mile	sq kilometer	2.590
acre	sq kilometer	4.047E−3
acre	hectare	.4047
Volume –		
cu feet	cu meter	2.832E−2
cu yard	cu meter	.7646
cu inch	cu centimeter	1.639E1
quart	liter	.9464
gallon	liter	3.785
gallon (UK)	liter	4.546
barrel (petr.)	liter	1.590E2
acre-feet	cu meter	1.234E3
million gal	cu meter	3.785E3
gallon (UK)	gallon (US)	1.200
Mass –		
pound (lb)	kilogram	.4536
ounce	gram	2.835E1
ton, short	tonne (metric)	.9072
ton, long	tonne	1.016
Velocity and gradient –		
feet/sec	meter/sec	.3048
mile/hour	meter/sec	.4470
feet/mile	meter/km	.1894
Flow rate –		
gal/min	liter/sec	6.309E−2
gal/min	cu meter/day	5.300
gal (UK)/min	liter/sec	7.577E−2
10^6 gal/day	liter/sec	4.381E1
10^6 gal/day	cu meter/day	3.785E−3
cu ft/sec (cfs)	liter/sec	2.832E1
acre-feet/day	liter/sec	1.458E−1
gal/day	acre-feet/yr	1.120E−3

A	B	C
Hydraulic conductivity –		
gal/day/ft^2	cm/sec	4.716E−5
gal/day/ft^2	ft/day	.1337
gal/day/ft^2	meter/day	4.075E−2
gal (UK)/day/ft^2	meter/day	4.893E−2
ft/yr	cm/sec	9.665E−7
ft/yr	meter/day	8.351E−4
darcy (atm/cm)	cm/sec	8.584E−4
darcy	ft/day	2.433
darcy	meter/day	.7416
Transmissivity –		
gal/day/ft	sq meter/day	1.242E−2
gal (UK)/day/ft	sq meter/day	1.492E−2
sq ft/sec	sq meter/day	8.027E3
sq ft/day	sq meter/day	9.290E−2
Force and pressure –		
pound (f)	newton	4.448
poundal	newton	.1383
pounds/sq in.	pascal	6.895E3
lb/sq ft	pascal	4.788E1
poundal/sq ft	pascal	1.488
atmosphere	pascal	1.013E5
inches of Hg	pascal	3.386E3
millibar	pascal	1.000E2
psi	kg/cm^2	7.031E−2
ft of H_2O (4°C)	psi	.4335
Work, energy and heat –		
horsepower (US)	horsepower (CV)	1.014
horsepower (US)	kW-hr	.7457
ft-lb/sec	kW	1.356E−3
BTU	kW-hr	2.930E−4
gpm/100′ lift	kW	1.884E−2
ft-lb	joule	1.356
ft-poundal	joule	4.214E−2
BTU	joule	1.055E−3
calorie	joule	4.187
Temperature –		
Fahrenheit	Celsius	5(F−32)/9
Celsius	Fahrenheit	1.8(C)+32
Kelvin	Celsius	K−273.2

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

Handy Scientific Data

PHYSICS

FORMULAS

• Composition of Forces

The resultant of two forces acting at an angle upon a given point is equal to the diagonal of a parallelogram of which the two force vectors are sides. The equilibrant equals the magnitude of the resultant, but acts in the opposite direction.

• Accelerated Motion

$$v = at, \text{ or } v = gt$$

v is final velocity; a is acceleration, or g is acceleration due to gravity; t is time

• Accelerated Motion

$$s = \tfrac{1}{2}at^2 \text{ or } s = \tfrac{1}{2}gt^2$$

s is total distance; a is acceleration, or g is acceleration due to gravity; t is time

• Accelerated Motion

$$v = \sqrt{2as}, \text{ or } v = \sqrt{2gs}$$

v is final velocity; a is acceleration, or g is acceleration due to gravity; s is total distance

• Newton's Second Law of Motion

$$F = ma$$

F is force; m is mass; a is acceleration

• Impulse and Momentum

$$Ft = mv$$

F is force; t is time; the product Ft is impulse; m is mass; v is velocity; the product mv is momentum

• Centrifugal Force

$$\text{Centrifugal Force} = \frac{mv^2}{r}$$

m is mass; v is velocity; r is radius of path

• Work

$$W = Fs$$

W is work; F is force; s is distance

• Potential Energy

$$P.E. = mgh$$

P.E. is potential energy; m is mass; g is acceleration due to gravity; h is vertical distance

• Kinetic Energy

$$K.E. = \tfrac{1}{2}mv^2$$

K.E. is kinetic energy; m is mass; v is velocity

PHYSICAL CONSTANTS

$C = 2.9979 \times 10^8$ m/s
$G = 6.6720 \times 10^{-11}$ m³ • s⁻² • kg⁻¹
$e = 1.6022 \times 10^{-19}$ C
$e/m_e = 1.7588 \times 10^{11}$ C • kg⁻¹
$F = 9.6485 \times 10^4$ C • mol⁻¹
$V_m = 22.4138 \times 10^{-3}$ m³ • mol⁻¹
$h = 6.6262 \times 10^{-34}$ J • s
$R = 8.3144$ J • mol⁻¹ • k⁻¹
$N_A = 6.0220 \times 10^{23}$ mol⁻¹
Atomic Mass Unit $\mu = 1.6606 \times 10^{-27}$ kg
$M_e = 9.1094 \times 10^{-31}$ kg
1 Kilogram Calorie (Nutrition Calorie) = 4.1868 Kilojoules
1 BTU = 1.0551kJ

RELATIONS BETWEEN COMMON UNITS

LENGTH
1 in = 2.540 cm
1 ft = 30.48 cm
1 micron (μ) = 0.000001 m = 0.001 mm = 10^{-4} cm
1 millionth micron ($\mu\mu$) = 10^{-10}
1 Angstrom Unit = 10^{-8} cm

VOLUME
1 Liter = 1000 cm³ = 61.024 in³ = 1.05671 qt.

MASS
1 lb = 453.59 g.
1 kg = 2.2046 lb

ANGLES
1 circumference = 360° = 2π radians
1 radian = 57.2958°

DENSITY
1 gr / cm³ = 62.4 lb / ft³

WORK OR ENERGY
1 ft-lb = 1.356×10^7 ergs
1 joule = 10^7 ergs
1 gr cal = 4.186×10^7 ergs
1 B.T.U. = 777.8 ft-lb = 252.2 g cal

POWER
1 H.P. = 33,000 ft lb / min
= 550 ft lb / sec = 746 watts
1 watt = 1 joule/second

ELECTRICAL UNITS
1 ampere = 10^{-1} ab amps = 3×10^9 ESU
1 volt = 10^8 EMU = $\frac{1}{3} \times 10^{-2}$ ESU
1 coulomb = 10^{-1} EMU = 3×10^9 ESU
1 ohm = 10^9 EMU = $\frac{1}{9} \times 10^{-11}$ ESU
1 farad = 10^{-9} EMU = 9×10^{11} ESU
1 henry = 10^9 EMU = $\frac{1}{9} \times 10^{11}$ ESU

CHEMISTRY

SYMBOLS OF SOME PARTICLES

electron	$_{-1}e^0$	deuteron	$_1H^2$
neutron	$_0n^1$	triton	$_1H^3$
proton	$_1H^1$	alpha particle	$_2He^4$

OXIDATION STATE OF SOME RADICALS

CH_3COO^-	ClO_4^-	$H_2PO_4^-$	NO_3^-
CO_3^{--}	$Cr_2O_7^{--}$	H_3O^+	OH^-
$C_2O_4^{--}$	HCO_3^-	Hg_2^{++}	PO_3^-
ClO^-	HPO_4^{--}	MnO_4^-	PO_4^{---}
ClO_2^-	HSO_3^-	NH_4^+	SO_3^{--}
ClO_3^-	HSO_4^-	NO_2^-	SO_4^{--}

PERIODIC TABLE OF THE ELEMENTS

Atomic weights conform to the 1961 values of the Commission on Atomic Weights.

KEY
Atomic Mass (Weight) — 12.01115
Symbol — C
Atomic Number — 6

Period	IA	IIA	Transition Elements									IIIA	IVA	VA	VIA	VIIA	0
			GROUPS					VIII									
			IIIB	IVB	VB	VIB	VIIB			IB	IIB						
1	1.00797 H 1															1.00797 H 1	4.0026 He 2
2	6.939 Li 3	9.0122 Be 4										10.811 B 5	12.01115 C 6	14.0067 N 7	15.9994 O 8	18.9984 F 9	20.183 Ne 10
3	22.9898 Na 11	24.312 Mg 12										26.9815 Al 13	28.086 Si 14	30.9738 P 15	32.064 S 16	35.453 Cl 17	39.948 Ar 18
4	39.102 K 19	40.08 Ca 20	44.956 Sc 21	47.90 Ti 22	50.942 V 23	51.996 Cr 24	54.9380 Mn 25	55.847 Fe 26	58.9332 Co 27	58.71 Ni 28	63.54 Cu 29	65.37 Zn 30	69.72 Ga 31	72.59 Ge 32	74.9216 As 33	78.96 Se 34	79.909 Br 35	83.80 Kr 36
5	85.47 Rb 37	87.62 Sr 38	88.905 Y 39	91.22 Zr 40	92.906 Nb 41	95.94 Mo 42	(99) Tc 43	101.07 Ru 44	102.905 Rh 45	106.4 Pd 46	107.870 Ag 47	112.40 Cd 48	114.82 In 49	118.69 Sn 50	121.75 Sb 51	127.60 Te 52	126.9044 I 53	131.30 Xe 54
6	132.905 Cs 55	137.34 Ba 56	138.91 La 57	178.49 Hf 72	180.948 Ta 73	183.85 W 74	186.2 Re 75	190.2 Os 76	192.2 Ir 77	195.09 Pt 78	196.967 Au 79	200.59 Hg 80	204.37 Tl 81	207.19 Pb 82	208.980 Bi 83	(210) Po 84	(210) At 85	(222) Rn 86
7	(223) Fr 87	(226) Ra 88	(227) Ac 89															

Lanthanide Series

140.12 Ce 58	140.907 Pr 59	144.24 Nd 60	(147) Pm 61	150.35 Sm 62	151.96 Eu 63	157.25 Gd 64	158.924 Tb 65	162.50 Dy 66	164.930 Ho 67	167.26 Er 68	168.934 Tm 69	173.04 Yb 70	174.97 Lu 71

Actinide Series

232.038 Th 90	(231) Pa 91	238.03 U 92	(237) Np 93	(242) Pu 94	(243) Am 95	(247) Cm 96	(247) Bk 97	(249) Cf 98	(254) Es 99	(253) Fm 100	(256) Md 101	(254) No 102	(257) Lw 103

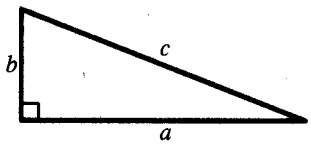
Numbers in parentheses are mass numbers of most tables or most common isotope

STANDARD OXIDATION POTENTIALS

Ionic Concentrations 1 molal in water at 25°C

Half cell Reaction	E° (volts)
$Li = Li^+ + e$	3.05
$Rb = Rb^+ + e^-$	2.93
$K = K^+ + e^-$	2.93
$Cs = Cs^+ + e^-$	2.92
$Ba = Ba^{++} + 2e^-$	2.90
$Sr = Sr^{++} + 2e^-$	2.89
$Ca = Ca^{++} + 2e^-$	2.87
$Na = Na^+ + e^-$	2.71
$Mg = Mg^{++} + 2e^-$	2.37
$Be = Be^{++} + 2e^-$	1.85
$Al = Al^{+++} + 3e^-$	1.66
$Mn = Mn^{++} + 2e^-$	1.18
$Zn = Zn^{++} + 2e^-$	0.76
$Cr = Cr^{+++} + 3e^-$	0.74
$Fe = Fe^{++} + 2e^-$	0.44
$Cd = Cd^{++} + 2e^-$	0.40
$Co = Co^{++} + 2e^-$	0.28
$Ni = Ni^{++} + 2e^-$	0.25
$Sn = Sn^{++} + 2e^-$	0.14
$Pb = Pb^{++} + 2e^-$	0.13
$H_2 = 2H^+ + 2e^-$	0.00
$Sn^{++} = Sn^{++++} + 2e^-$	−0.15
$Cu^+ = Cu^{++} + e^-$	−0.15
$Cu = Cu^{++} + 2e^-$	−0.34
$2I^- = I_2 + 2e^-$	−0.53
$Fe^{++} = Fe^{+++} + e^-$	−0.77
$2Hg = Hg_2^{++} + 2e^-$	−0.79
$Ag = Ag^+ + e^-$	−0.80
$Hg_2^{++} = 2Hg^{++} + 2e^-$	−0.92
$2Br^- = Br_2(l) + 2e^-$	−1.07
$NO + 2H_2O =$ $NO_3^- + 4H^+ + 4e^-$	−0.96
$2H_2O = O_2 + 4H^+ + 4e^-$	−1.23
$2Cr^{+++} + 7H_2O =$ $Cr_2O_7^{--} + 14H^+ + 6e^-$	−1.33
$2Cl^- = Cl_2 + 2e^-$	−1.36
$Au = Au^{+++} + 3e^-$	−1.50
$Mn^{++} + 4H_2O =$ $MnO_4^- + 8H^+ + 5e$	−1.51
$2F^- = F_2 + 2e^-$	−2.87

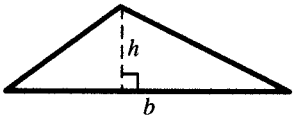
GEOMETRIC FORMULAS



Right Triangle

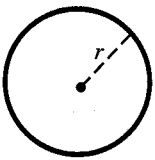
Triangles

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



Any Triangle

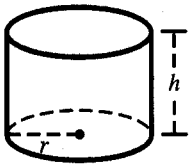
Area $A = \frac{1}{2}bh$



Circles

Area $A = \pi r^2$

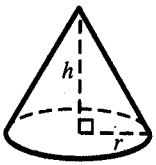
Circumference $C = 2\pi r$



Cylinders

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

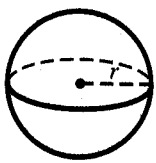
Volume $V = \pi r^2 h$



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