

CONVERSION TABLES

METERS	YARDS	INCHES
1.000	1.093	39.37
.914	1.000	36.00

CENTIMETERS	INCHES	FEET
1.00	.394	.0328
2.54	1.000	1/12
30.48	12.000	1.000

KILOMETERS	MILES
1.000	.621
1.609	1.000

GRAMS	OUNCES	POUNDS
1.00	.035	.002
28.35	1.000	1/16
453.59	16.000	1.000
1,000.00	35.274	2.205

KILOGRAMS	OUNCES	POUNDS
1.000	35.274	2.205
.028	1.000	1/16
.454	16.000	1.000

LITERS	PINTS	QUARTS	GAL.
1.000	2.113	1.057	.264
.473	1.000	1/2	1/8
.946	2.000	1.000	1/4
3.785	8.000	4.000	1.000

LENGTH	1 meter (m) = 100 cm = 1,000 mm
	1 millimeter (mm) = .001 m
	1 centimeter (cm) = .01 m
	1 decimeter (dm) = .1 m
	1 decameter (dkm) = 10 m
	1 hectometer (hm) = 100 m
	1 kilometer (km) = 1,000 m

CAPACITY	1 liter (l) = 100 cl = 1,000 ml
	1 milliliter (ml) = .001 l
	1 centiliter (cl) = .01 l
	1 deciliter (dl) = .1 l
	1 decaliter (dcl) = 10 l
	1 hectoliter (hl) = 100 l
	1 kiloliter (kl) = 1,000 l

WEIGHT	1 gram (g) = 100 cg = 1,000 mg
	1 milligram (mg) = .001 g
	1 centigram (cg) = .01 g
	1 decigram (dg) = .1 g
	1 decagram (dkg) = 10 g
	1 hectogram (hg) = 100 g
	1 kilogram (kg) = 1,000 g

Useful Information

MULTIPLICATION TABLE

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

Table of Time Measure

60 seconds	= 1 minute
60 minutes	= 1 hour
24 hours	= 1 day
7 days	= 1 week
30 days	= 1 calendar month
12 months	= 1 year
365 days	= 1 common year
366 days	= 1 leap year
100 years	= 1 century

Table of Dry Measure

2 pints (pt.)	= 1 quart (qt.)
8 quarts	= 1 peck (pk.)
4 pecks	= 1 bushel (bu.)
1 cord	= 128 cu. ft.

Table of Liquid Measure

4 gills (gi.)	= 1 pint (pt.)
2 pints	= 1 quart (qt.)
4 quarts	= 1 gallon (gal.)
3 1/2 gallons	= 1 barrel (bbl.)
2 barrels	= 1 hogshead (hhd.)

Table of Paper Measure

24 sheets	= 1 quire
20 quires	= 1 ream
10 reams	= 1 bale

Table of Linear Measure

12 inches	= 1 foot
3 feet	= 1 yard
16 1/2 feet (5 1/2 yds.)	= 1 rod
660 feet	= 1 furlong
320 rods (5280 ft.)	= 1 mile

Miscellaneous Measures

12 units	= 1 dozen
12 doz.	= 1 gross
12 gr.	= 1 great gross
20 units	= 1 score
1 hand	= 4 inches
1 fathom	= 6 feet
1 knot	= 6086 feet
3 knots	= 1 league
1 bushel potatoes	= 60 lbs.
1 barrel flour	= 196 lbs.
1 cu. ft. of water	= 7.48 liquid gals. and weighs 62.425 lbs.
Diameter of circle x 3.1416 = circumference.	
Diameter of circle squared x .7854 = area.	
Atmospheric pressure is 14.7 lbs. per sq. in. at sea level.	
13 1/2 cu. ft. of air weighs 1 lb.	

Table of Cubic Measure

1728 cubic inches	= 1 cubic foot
27 cubic feet	= 1 cubic yard
128 cubic feet	= 1 cord of wood
24 3/4 cubic feet	= 1 perch of stone
NOTE—A cord of wood is a pile 8 feet long, 4 feet wide and 4 feet high.	
A perch of stone or brick is 16 1/2 feet long, 1 1/2 feet wide, and 1 foot high.	

Table of Avoirdupois Weight

16 drams	= 1 ounce (oz.)
16 ounces	= 1 pound (lb.)
100 pounds	= 1 hundredweight (cwt.)
2000 pounds	= 1 ton (T.)
2240 pounds	= 1 long ton (L. T.)

Table of Troy Weight

24 grains (gr.)	= 1 pennyweight (dwt.)
20 pennyweights	= 1 ounce (oz.)
12 ounces	= 1 pound (lb.)

Table of Circular Measure

60 seconds (")	= 1 minute (')
60 minutes	= 1 degree (°)
360 degrees	= 1 circumference
A degree of the earth's surface on a meridian = 69.16 miles.	

Table of Apothecaries' Weight

20 grains (gr.)	= 1 scruple (℥)
3 scruples	= 1 dram (ʒ)
8 drams	= 1 ounce (℥)
12 ounces	= 1 pound (lb.)

Table of Surface Measure

144 sq. in.	= 1 sq. ft.
9 sq. ft.	= 1 sq. yd.
30 1/4 sq. yds.	= 1 sq. rod
160 sq. rods	= 1 acre
640 acres	= 1 sq. mile
An acre measures 208.71 ft. on each side.	
A section of land is 1 sq. mile.	
A quarter section is 160 acres.	
A township is 36 sq. miles.	

ABBREVIATIONS/SYMBOLS	NAME	SYMBOL	Z	ATOMIC WEIGHT	mp °C (S-sublimate)	bp °C
ASA and SI	Actinium	Ac	89	227.028	1050	3200
alternating current	Aluminum	Al	13	26.9815	660.3	2467
ampere	Americium	Am	95	243	994	2607
ampere-hour	Antimony	Sb	51	121.75	630.7	1750
angstrom	Argon	Ar	18	39.948	-189.2	-185
astronomical unit	Arsenic	As	33	74.9216	S 613	
atmosphere	Astatine	At	85	210	302	337
atomic number	Barium	Ba	56	137.33	725	1640
atomic weight	Berkelium	Bk	97	247		
boiling point	Beryllium	Be	4	9.0122	1278	2970
British thermal unit	Bismuth	Bi	83	208.98	271.3	1560
centimeter	Bohrium	Bh	107	262.12		
calorie	Boron	B	5	10.81	2079	S 2550
candle	Bromine	Br	35	79.904	-7.2	58.78
candlepower	Cadmium	Cd	48	112.41	320.9	765
centigrade degree	Calcium	Ca	20	40.08	839	1484
Curie	Californium	Cf	98	251		
deuterium	Carbon	C	6	12.011	S 3652	
direct current	Cerium	Ce	58	140.12	798	3257
electron volt	Cesium	Cs	55	132.905	28.40	669
electromotive force	Chlorine	Cl	17	35.453	-100.9	-34.6
frequency	Chromium	Cr	24	51.996	1857	2672
fahrenheit degree	Cobalt	Co	27	58.933	1495	2870
foot candle	Copper	Cu	29	63.546	1083	2567
foot-pound	Curium	Cm	96	247	1340	
gram	Dubnium	Db	105	262.61		
heat energy	Dysprosium	Dy	66	162.50	1409	2335
horsepower	Einsteinium	Es	99	254		
hour	Erbium	Er	68	167.26	1522	2510
hundred	Europium	Eu	63	151.96	822	1597
infrared	Fermium	Fm	100	257		
kilometer	Fluorine	F	9	18.998	-219	188
kilowatt	Francium	Fr	87	223	27	677
kilowatt-hour	Gadolinium	Gd	64	157.25	1311	3233
light year	Gallium	Ga	31	69.72	29.78	2403
liter	Germanium	Ge	32	72.59	937.4	2830
lumens	Gold	Au	79	196.96	1064	3080
micron	Hafnium	Hf	72	178.49	2227	4602
mile	Hassium	Hs	108	(265)		
milliliter	Helium	He	2	4.0026	-269	
millimeter	Holmium	Ho	67	164.93	1470	2720
minute	Hydrogen	H	1	1.00794	-259.1	-253
minute(angle)	Indium	In	49	114.82	156.6	2080
parsec	Iodine	I	53	126.905	113.5	184
part per million	Iridium	Ir	77	192.22	2410	4130
radian	Iroa	Fe	26	55.847	1535	2750
revolutions per min	Krypton	Kr	36	83.80	-156	-152
Roentgen	Lanthanum	La	57	138.906	920	3454
second(angle)	Lawrencium	Lr	103	260		
specific gravity	Lead	Pb	82	207.2	327.5	1740
specific heat	Lithium	Li	3	6.941	180.5	1342
thousand	Lutetium	Lu	71	174.96	1656	3315
torque	Magnesium	Mg	12	24.305	648.8	1090
ultraviolet	Manganese	Mn	25	54.938	1244	1962
wavelength	Meltnium	Ml	109	(265)		
year	Mendelevium	Md	101	258		
	Mercury	Hg	80	200.59	-38.8	356.5
	Molybdenum	Mo	42	95.94	2617	4612
	Necodymium	Nd	60	144.24	1010	3127
	Neon	Ne	10	20.179	-248.6	-246
	Neptunium	Np	93	237.048	640	3902
	Nickel	Ni	28	58.69	1453	2732
	Niobium	Nb	41	92.906	2468	4742
	Nitrogen	N	7	14.0067	-209	-195
	Nobelium	No	102	259		
	Osmium	Os	76	190.2	3045	5027
	Oxygen	O	8	15.9994	-218	-183
	Palladium	Pd	46	106.42	1554	3140
	Phosphorus	P	15	30.9738	44.1	280
	Platinum	Pt	78	195.08	1772	3827
	Plutonium	Pu	94	244	641	3232
	Polonium	Po	84	209	254	962
	Potassium	K	19	39.0983	63.25	759
	Praseodymium	Pr	59	140.91	931	3212
	Promethium	Pm	61	145	1080	2460
	Protactinium	Pa	91	231.036	1600	
	Radium	Ra	88	226.025	700	1140
	Radon	Rn	86	222	-71	-61.8
	Rhenium	Re	75	186.207	3180	5627
	Rhodium	Rh	45	102.906	1965	3727
	Rubidium	Rb	37	85.4678	38.8	686
	Ruthenium	Ru	44	101.17	2310	3900
	Rutherfordium	Rf	104	261.11		
	Samarium	Sm	62	150.36	1072	1778
	Scandium	Sc	21	44.9559	1539	2832
	Seaborgium	Sg	106	263.12		
	Selenium	Se	34	78.96	217	684
	Silicon	Si	14	28.0855	1410	2355
	Silver	Ag	47	107.868	961	2212
	Sodium	Na	11	22.9898	97.8	882
	Strontium	Sr	38	87.62	769	1384
	Sulfur	S	16	32.06	112	444
	Tantalum	Ta	73	180.9479	2996	5425
	Technetium	Tc	43	98.90	2172	4877
	Tellurium	Te	52	127.60	449	989
	Terbium	Tb	65	158.925	1360	3041
	Thallium	Tl	81	204.383	303	1457
	Thorium	Th	90	232.038	1750	4790
	Thulium	Tm	69	168.934	1545	1727
	Tin	Sn	50	118.71	231	2270
	Titanium	Ti	22	47.88	1660	3287
	Tungsten	W	74	183.85	3410	5660
	Ununnilium	Uun	110	(269)		
	Unununium	Uuu	111	(272)		
	Ununium	Uub	112	(277)		
	Uranium	U	92	238.029	1132	3818
	Vanadium	V	23	50.9415	1890	3380
	Xenon	Xe	54	131.29	-111.9	-107
	Ytterbium	Yb	70	173.04	824	1193
	Yttrium	Y	39	88.9059	1523	3337
	Zinc	Zn	30	65.39	419	907
	Zirconium	Zr	40	91.224	1852	4377

Developed by
Physics Teacher
Fred Bucheit

EQUATIONS

$v_{av} = d / t$	$\tau = I \times \alpha$	$W = F \times d$	$K.E. = .5m \times v^2$
$v_{av} = (V_i + V_f) / 2$	$F \times t = m \times \Delta v$	$P.E. = m \times g \times h$	$P.E. = m \times g \times h$
$\Delta v = v_f - v_i$	$P = F / A$	$F = (G \times m_1 \times m_2) / d^2$	$F = (G \times m_1 \times m_2) / d^2$
$a = \Delta v / t$	$p = h \times D_w$	$g = G \times M / R^2$	$g = G \times M / R^2$
$F = m \times a$	$F = m \times v^2 / r$	$v = r \times \omega \text{ (rad/s)}$	$v = r \times \omega \text{ (rad/s)}$
$w = m \times g$	$D = m/vol : w/vol$	$a = r \times \alpha \text{ (rad/s}^2\text{)}$	$a = r \times \alpha \text{ (rad/s}^2\text{)}$
$\tau = I \times \alpha$	$p = m \times v$	$E = m \times c^2$	$E = m \times c^2$
$F \times t = m \times \Delta v$	$L = I \times \omega$	$E = h \times f$	$E = h \times f$
$P = F / A$	$W = F \times d$	$f = -k \times x$	$f = -k \times x$
$p = h \times D_w$	$K.E. = .5m \times v^2$	$f = \mu \times n$	$f = \mu \times n$
$F = m \times v^2 / r$	$P.E. = m \times g \times h$	$Q = m \times c \times \Delta T$	$Q = m \times c \times \Delta T$
$D = m/vol : w/vol$	$F = (G \times m_1 \times m_2) / d^2$	$\Delta L = L_0 \times \alpha \times \Delta T$	$\Delta L = L_0 \times \alpha \times \Delta T$
$p = m \times v$	$g = G \times M / R^2$	$P \times V = n \times R \times T$	$P \times V = n \times R \times T$
$L = I \times \omega$	$v = r \times \omega \text{ (rad/s)}$	$n \times \sin \theta = n' \times \sin \theta'$	$n \times \sin \theta = n' \times \sin \theta'$
$W = F \times d$	$a = r \times \alpha \text{ (rad/s}^2\text{)}$	$T = 1 / f$	$T = 1 / f$
$K.E. = .5m \times v^2$	$E = m \times c^2$	$T = 2 \times \pi \times \sqrt{l/g}$	$T = 2 \times \pi \times \sqrt{l/g}$
$P.E. = m \times g \times h$	$E = h \times f$	$T = 2 \times \pi \times \sqrt{m/k}$	$T = 2 \times \pi \times \sqrt{m/k}$
$F = (G \times m_1 \times m_2) / d^2$	$f = -k \times x$	$v = l \times \lambda$	$v = l \times \lambda$
$g = G \times M / R^2$	$f = \mu \times n$	$1/f = 1/o + 1/i$	$1/f = 1/o + 1/i$
$v = r \times \omega \text{ (rad/s)}$	$Q = m \times c \times \Delta T$	$V = E / q$	$V = E / q$
$a = r \times \alpha \text{ (rad/s}^2\text{)}$	$\Delta L = L_0 \times \alpha \times \Delta T$	$V = I \times R$	$V = I \times R$
$E = m \times c^2$	$P \times V = n \times R \times T$	$P = V \times I$	$P = V \times I$
$E = h \times f$	$n \times \sin \theta = n' \times \sin \theta'$	$P = I^2 R$	$P = I^2 R$
$f = -k \times x$	$T = 1 / f$	$F = QvB$	$F = QvB$
$f = \mu \times n$	$T = 2 \times \pi \times \sqrt{l/g}$	$T = T_0 / \sqrt{1 - (v^2/c^2)}$	$T = T_0 / \sqrt{1 - (v^2/c^2)}$
$Q = m \times c \times \Delta T$	$T = 2 \times \pi \times \sqrt{m/k}$	earthquake energy	earthquake energy
$\Delta L = L_0 \times \alpha \times \Delta T$	$v = l \times \lambda$	$E(\text{joule}) = 2.5 \times 10^{4+1.5M}$	$E(\text{joule}) = 2.5 \times 10^{4+1.5M}$
$P \times V = n \times R \times T$	$1/f = 1/o + 1/i$	Kepler's law	Kepler's law
$n \times \sin \theta = n' \times \sin \theta'$	$V = E / q$	$T^2 = (4\pi^2/GM)r^3$	$T^2 = (4\pi^2/GM)r^3$
$T = 1 / f$	$V = I \times R$	$rem = rad \times RBE$	$rem = rad \times RBE$
$T = 2 \times \pi \times \sqrt{l/g}$	$P = V \times I$	$x = (-b \pm \sqrt{b^2 - 4ac}) / 2a$	$x = (-b \pm \sqrt{b^2 - 4ac}) / 2a$
$T = 2 \times \pi \times \sqrt{m/k}$	$P = I^2 R$	$a^2 = b^2 + c^2 - 2b \times c \times \cos(A)$	$a^2 = b^2 + c^2 - 2b \times c \times \cos(A)$
$v = l \times \lambda$	$F = QvB$	$a / \sin A = b / \sin B = c / \sin C$	$a / \sin A = b / \sin B = c / \sin C$
$1/f = 1/o + 1/i$	$T = T_0 / \sqrt{1 - (v^2/c^2)}$	$f = I_o (v \pm V_o) / (v \pm V_o)$	$f = I_o (v \pm V_o) / (v \pm V_o)$
$V = E / q$	earthquake energy	$\sin 2(\theta) = 2 \sin(\theta) \cos(\theta)$	$\sin 2(\theta) = 2 \sin(\theta) \cos(\theta)$
$V = I \times R$	$E(\text{joule}) = 2.5 \times 10^{4+1.5M}$	$v = v_o + at$	$v = v_o + at$
$P = V \times I$	Kepler's law	$\omega = \omega_o + \alpha t$	$\omega = \omega_o + \alpha t$
$P = I^2 R$	$T^2 = (4\pi^2/GM)r^3$	$x = v_o t + \frac{1}{2} at^2$	$x = v_o t + \frac{1}{2} at^2$
$F = QvB$	$rem = rad \times RBE$	$\theta = \omega_o t + \frac{1}{2} \alpha t^2$	$\theta = \omega_o t + \frac{1}{2} \alpha t^2$
$T = T_0 / \sqrt{1 - (v^2/c^2)}$	$x = (-b \pm \sqrt{b^2 - 4ac}) / 2a$	$v^2 = v_o^2 + 2ax$	$v^2 = v_o^2 + 2ax$
earthquake energy	$a^2 = b^2 + c^2 - 2b \times c \times \cos(A)$	$\omega^2 = \omega_o^2 + 2\alpha\theta$	$\omega^2 = \omega_o^2 + 2\alpha\theta$
$E(\text{joule}) = 2.5 \times 10^{4+1.5M}$	$a / \sin A = b / \sin B = c / \sin C$	$x = \frac{1}{2} (v_o + v) t$	$x = \frac{1}{2} (v_o + v) t$
Kepler's law	$f = I_o (v \pm V_o) / (v \pm V_o)$	$\theta = \frac{1}{2} (\omega_o + \omega) t$	$\theta = \frac{1}{2} (\omega_o + \omega) t$
$T^2 = (4\pi^2/GM)r^3$	$\sin 2(\theta) = 2 \sin(\theta) \cos(\theta)$	$x = v t - \frac{1}{2} at^2$	$x = v t - \frac{1}{2} at^2$
$rem = rad \times RBE$	$v = v_o + at$		
$x = (-b \pm \sqrt{b^2 - 4ac}) / 2a$	$\omega = \omega_o + \alpha t$		
$a^2 = b^2 + c^2 - 2b \times c \times \cos(A)$	$x = v_o t + \frac{1}{2} at^2$		
$a / \sin A = b / \sin B = c / \sin C$	$\theta = \omega_o t + \frac{1}{2} \alpha t^2$		
$f = I_o (v \pm V_o) / (v \pm V_o)$	$v^2 = v_o^2 + 2ax$		
$\sin 2(\theta) = 2 \sin(\theta) \cos(\theta)$	$\omega^2 = \omega_o^2 + 2\alpha\theta$		
$v = v_o + at$	$x = \frac{1}{2} (v_o + v) t$		
$\omega = \omega_o + \alpha t$	$\theta = \frac{1}{2} (\omega_o + \omega) t$		
$x = v_o t + \frac{1}{2} at^2$	$x = v t - \frac{1}{2} at^2$		
$\theta = \omega_o t + \frac{1}{2} \alpha t^2$			

ROMAN NUMERALS

I = 1	D = 500
V = 5	M = 1000
X = 10	L = 50
L = 50	C = 100
C = 100	

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DEFINITIONS OF SI BASE UNITS (1984)

Quant.	Symb	SI Unit	Symb	Definition
Length	l	meter	m	distance traveled by light in 1/299792458 s
Mass	m	kilogram	kg	mass of cylinder kept in Sevres France
Time	t	second	s	duration of 9192631770 periods of cesium atom
Current	I	ampere	A	force of 2×10^{-7} N/m of wire kept 1 meter apart
Temp.	T	kelvin	K	1/273.16 of temp. of triple point of water
Lum. Intensity	I _v	candela	cd	lum. intensity of monochro. radiation of (1/683)W/sr
Amt. Subst.	n	mole	mol	amount of substance which has as many entities as atoms in .012 kg of carbon 12

(Derived units below)

Activity	becquerel	Bq	1/s
Absorb. dose	gray	Gy	J/kg
Angular velocity		ω	rad/s
Angular acceleration		α	rad/s ²
Angular momentum		L	
Capacitance	farad	F	C/V
Charge	coulomb	C	As
Conductance	siemens	S	AV
Electric field strength		volt/meter	
Electrical potential difference	volt	V	J/(A x s)
Energy	joule	J	m x kg/s ²
Force	newton	N	m x kg/s ²
Frequency	hertz	Hz	1/s
Inductance	henry	H	V x s/A
Illuminance	lux	lx	cd x sr/m ²
Luminous flux	lumen	lm	cd x sr
Luminance			cd/m ²
Magnetic field strength	tesla	T	Wb/m
Mag. flux	weber	Wb	V s
Moment inertia		I	
Momentum		p	
Moment force		M	
Pressure	pascal	Pa	N/m ²
Plane angle	radian	rad	
Power	watt	W	J/s
Power	pascal	Pa	N/m ²
Power		T	s
Resistance	ohm	Ω	V/A
Solid angle	steradian	sr	

PREFIXES

atto	a	10 ⁻¹⁸
deca	da	10 ¹
hecto	h	10 ²
kilo	k	10 ³
mega	M	10 ⁶
giga	G	10 ⁹
tera	T	10 ¹²
peta	P	10 ¹⁵
exa	E	10 ¹⁸

FUNDAMENTAL PHYSICAL CONSTANTS

Atomic mass unit	u	1.6605655 x 10 ⁻²⁷ kg
mass C ¹² atom/12	N _A	6.022045 x 10 ²³ / mol
Avagadro	k	1.380662 x 10 ⁻²³ J/K
Boltzmann	K	8.98755 x 10 ⁹ Nm ² / C ²
Coulomb force	e	1.6021892 x 10 ⁻¹⁹ C
Elementary charge	m _e	.9109534 x 10 ⁻³⁰ kg
Electron mass	G	6.6720 x 10 ⁻¹¹ Nm ² / kg ²
Gravitation		931.5016 MeV
Mass energy/amu	R	8.31441 J / (mol x K)
Molar gas	m _n	1.6749543 x 10 ⁻²⁷ kg
Neutron mass	h	6.626176 x 10 ⁻³⁴ Js
Planck	m _p	1.6726485 x 10 ⁻²⁷ kg
Proton mass	c	2.99792458 x 10 ⁸ m/s
Speed light	σ	5.67032 x 10 ⁻⁸ W / (m ² K ⁴)
Stefan-Boltzmann	γ	.5772156649
Eulers constant		22.4136 liter
Std volume ideal gas at STP (0°C and 1.0 bar)		1.61803 39887
Golden ratio	e =	2.71828182845904
	π =	3.141592653589793

SPEED

1 km/hr =	.9113 ft/s
=	.27777 m/s
=	.6213 mph
1 mph =	1.4666 ft/s
=	.8689 knot
=	.4470 m/s
1 rad/s =	9.549 rpm

LENGTH

1 mil =	.001 inch
1 in =	2.54 cm
1 mile =	5280 ft
1 naut mile =	6076 ft
1 fermi =	10 ⁻¹⁵ meter
1 micron =	1 x 10 ⁻⁶ meter
1 ly =	9.4605 x 10 ¹² km
1 km =	.62137 mile
1 AU =	1.495 x 10 ⁸ km
1 m =	1 x 10 ¹⁰ A
1 pc =	3.086 x 10 ¹³ km
1 m =	3.28 ft
1 pc =	3.26 ly

AREA

Circle =	$\pi \times r^2$
Triangle =	.5 x b x h
Sphere =	$4 \times \pi \times r^2$
Cone =	$\pi \times r \times (l+r)$
Ellipse =	.7854 x d x D
Sector =	.5 x l x r
Doughnut =	9.8696 x d x D
VOLUME	
sphere =	$4/3 \times \pi \times r^3$
cylinder =	$\pi \times r^2 \times h$
cone =	$\pi \times d^2 \times h/12$
pyramid =	area base x h/3
Doughnut =	2.4674 x D x d ²

PRESSURE

1 Pa =	N/m ²
1 bar =	.9869 atm
=	1 x 10 ⁶ dyne/cm ²
=	33.45 ft H ₂ O
=	29.53 in Hg
=	1 x 10 ⁵ pascal
=	750.062 torr
1 psi =	6895 N/m ²
1 atm =	101,325 Pa
1 in. Hg =	.4921 psi
1 d/cm =	.1 N/m

WEIGHT/FORCE

1 lb(avdp) =	1.215 lb(troy)
1 short ton =	2000 lb
1 lb =	4.448 N
1 N =	1 x 10 ⁵ dyne
1 long ton =	2240 lb
1 metric ton =	1000 kg

VOLUME

1 cc =	1 ml
1 ft ³ =	7.480 gal
1 in ³ =	16.387064 cc def
1 teaspoon =	4.93 ml
1 tablespoon =	14.79 ml
1 cc =	20 drops
1 m ³ =	35.31467 ft ³
1 l =	1.0566 qt (US liq)
1 Brit. gal =	1.201 gal

POWER

1 hp =	746 watts
1 hp =	550 ft/s
1 watt =	1 J/s
1 watt =	680 lm
1 cp =	12.56 lm

ERROR IN COMPUTATION

The error in a sum or difference is the sum of the absolute errors.

The error in the product or quotient is the sum of the percentage errors.

The error of x to the n th power is n times the percentage error of x.

MUNICIPAL WASTE

	% by weight		% by weight
Cardboard	18.94	Tissue paper	1.80
Yard waste	11.85	Wood	1.54
Newspaper	6.50	Plastic, rubber	1.36
Ferrous	5.85	Aluminum	1.00
Magazines	5.15	Textile	.77
Wrap paper	3.99	Wax carton	.70
Food waste	3.80	Other metals	.30
Mail	2.49	Copper brass	.20
Food carton	1.86		

Americans generate 160 million pounds of solid waste each year. That amounts to 3.5 pounds per person. Each person in the U.S. uses the energy equivalent of 80 pounds of coal every day. Energy saved from recycling one aluminum can will keep a TV running for three hours. Americans use 65 billion aluminum soda cans every year and 2.5 million plastic bottles every hour.

Material	Density (kg/m ³)	Young's Mod. (10 ⁹ N/m ²)	Ultimate Str. (10 ⁴ N/m ²)
Steel	7860	200	400
Aluminum	2710	70	110
Glass	2190	65	50
Concrete	2320	30	40
Wood	525	13	50
Bone	1900	9	170
Polystyrene	1050	3	48

CHRONOLOGY

3500 BC	writing
3000 BC	Bronze age
2700 BC	pyramid
1800 BC	alphabet
1700 BC	Hammurabi
1200 BC	iron used
600 BC	Buddha
551 BC	Confucius
460 BC	Democritus
470 BC	Socrates
427 BC	Plato
384 BC	Aristotle
300 BC	Euclid
220 BC	Aristarchus
287 BC	Archimedes
4 BC	Christ
570 AD	Muhammad
2nd cent	Ptolemy
1400 AD	Gutenberg
1452	Leonardo
1475	Michelangelo
1473	Copernicus
1571	Kepler
1564	Galileo
1596	Descartes
1642	Newton
1707	Euler
1745	Volta
1789	Faraday
1859	Darwin
1858	Maxwell
1879	Planck
1885	Einstein
1901	Bohr
	Heisenberg

SYSTEM

LENGTH

MASS

TIME

SPEED

ACC

FORCE/

WORK/

WEIGHT

ENERGY

SYSTEM	LENGTH	MASS	TIME	SPEED	ACC	FORCE/	WORK/
						WEIGHT	ENERGY
MKS	meter	kilogram	sec	m/s	m/s ²	newton	joule
cgs	centimeter	gram	sec	cm/s	cm/s ²	dyne	erg
English	foot	slug	sec	ft/s	ft/s ²	pound	ft-lb
MATERIAL	SYMBOL/	M.P.	B.P.	Fusion	Vapor	Sp.Ht	Density
	FORMULA	C°	C°	cal/g	cal/g	Cal/gC°	g/cc
AIR	----	----	----	----	----	.24	.00129
ALUMINUM	Al	660	2460	94.5	2520	.21	2.7
ALCOHOL(ETH)	C ₂ H ₅ OH	-116	78.3	24.9	204	.54	.789
ALCOHOL(METH)	CH ₃ OH	-97.8	64.7	23.7	263	.57	.796
AMMONIA	NH ₃	-75	-33	108	327	.52	.00077
CARBON	C	3550	4827	2090	6490	.17	2.267
CARBON DIOX.	CO ₂	(sub -78.5)	----	7.5	.198	----	.00197
DIAMOND	C	3500	4200	----	----	.104	3.15
FREON 12	CCl ₂ F ₂	-158	-29.8	----	39.4	.145	.00633
GLASS WINDOW	----	1100	----	----	----	.2	2.6
GLUCOSE	C ₆ H ₁₂ O ₆	146	d	----	----	----	1.56
HELIUM	He	----	-269	----	4.9	1.24	.00018
HYDROGEN	H ₂	-259	-253	27.7	108	3.4	.00009
ICE	H ₂ O	0	----	80	----	.49	.917
IRON	Fe	1535	2750	63.7	1514	.11	7.86
LEAD	Pb	327	1740	5.47	205	.03	.11
MERCURY	Hg	-39	357	2.8	70	.033	13.6
NITROGEN	N ₂	-210	-196	6.09	47.6	.244	.00125
OXYGEN	O ₂	-218	-183	3.3	50.9	.217	.0014
PROPANE	C ₃ H ₈	-190	-42	19.1	98	.576	.002
METHANE	CH ₄	-184	-159	14.5	138	----	.0007
SALT	NaCl	800	1413	124	----	.204	2.165
SUCROSE	C ₁₂ H ₂₂ O ₁₁	185	d	----	----	.299	1.58
TIN	Sn	232	2270	13.8	463	.054	7.1
TUNGSTEN	W	3410	5660	45.7	1150	.034	18.6
WATER	H ₂ O	0	100	80	540	1.00	1 at 4C

Compliments of

Science Kit & Boreal Laboratories

Tonawanda, NY/San Luis Obispo, CA
St. Catharines, Ontario, Canada1-800-828-7777 (phone)/1-800-828-3299 (FAX)
1-800-387-9393 (phone)/1-800-668-9106 (FAX)

SPECIFIC HEAT CAPACITY	THERMAL CONDUCT.	THERMODYNAMIC EFFICIENCY %	TEMPERATURE	ENERGY	ENERGY IN FUELS
$kJ/kg \times ^\circ C$	$W/m \times ^\circ C$				
Silver .234	CO ₂ .0145	Liquid fuel rocket 48	Trip point H ₂ O 273.16 K	1 Btu = 251.996 cal	Alcohol 79,434 BTU/gal
Aluminum .900	Air .0237	Steam turbine 46	H ₂ O boil 373 K	= 1055.056 J	Animal fat 17,115 BTU/lb
Gold .130	Oxygen .0246	Diesel engine 37	Candle 1700 K	= 778.169 ft-lb	Butter 16,575 BTU/lb
Bismuth .123	Down .025	Gas engine 25	Methane 2300 K	1 kW h = 3412.14 BTU	Coal 10,000-14,000 BTU/lb
Copper .385	Methane .0305	Steam engine 08	Bulb Filament 2800 K	1 amu = 931.169 MeV	Corn oil 16,000 BTU/l
Iron .448	Styrofoam .040	Thermocouple 07	Acetylene 3588 K	1 J = 1×10^7 erg	Crude oil 14,593 BTU/gal
Ice 2.10	Cork .042		Carbon arc 4000 K	1 eV = 1.60219×10^{-12} erg	Fuel oil 146,390 BTU/gal
Brick .837	Fiberglass .045		Molecules break 4300 K	1 langley = 1 cal/cm ²	Gasoline 127,654 BTU/gal
Concrete .879	Cardboard .064		Surface of Sun 6000 K	1 quad = 1×10^{15} BTU	Liq. pet gas 95,500 BTU/gal
Brass .385	Rubber .12	SURFACE TENSION N/m	Center of Sun 2×10^7 K	solar constant = 1340 W/m ²	Nat. gas 1050 BTU/ft ³
Magnesium 1.04	Helium .142	Hg .44	Hydrogen bomb 1×10^8 K	3×10^{10} fissions/s = 1 W	Oak 7188 BTU/lb
Sodium 1.23	Hydrogen .167	ethyl alcohol .023			Pine 7963 BTU/lb
Nickel .431	Wood .19	water 0 °C .076	TEMP CONVERSION / ABS ZERO	ENERGY	Peanuts 10,161 BTU/lb
Lead .130	Water .569	20 °C .072	C = (F - 32) x 5/9 0 K	$\times 10^{-4}$ km/Joule	Propane 92,000 BTU/gal
Zinc .352	Concrete 1.0	100 °C .059	F = (C x 9/5) + 32 -273.15 C	Bicycle 13.2	Propane 21,700 BTU/lb
Wood 2.81	Glass .75 -1.2		K = C + 273.15 -459.67 F	Subway 4.5	9 food calories in 1 g fat
---LIQUIDS---	Gold 318	DEVICE WATTS		Walk 3.3	1 ton TNT = 4.2×10^{18} erg
Benzene 1.62	Ice 2.21	Digital Watch 1.2×10^{-5}	DEVICE WATTS	Bus 2.5	U ²³⁵ fission = 8.2×10^{13} J/kg
Bromine .448	Steel 15-50	Small desk radio 5	2 door refrigerator 780	Car, small 1.2	1 g D fused = 3.02×10^9 BTU
Ethyl alc 2.43	Iron 73	Human heart 8	Steam iron 840	Car, medium .8	
Methyl alc 2.52	Brass 120	PC (no hard drive) 37	2 slot toaster 840	Jet .8	
Water 4.19	Aluminum 228	13 inch color TV 48	Dishwasher 1032	Horse .6	
---GASES---	Copper 386	20 inch color TV 84	Microwave oven 1200	Taxi .1	
Steam 2.05	Silver 420	Electric typewriter 108	Clothes washer 1200		
Argon .523	Diamond 1360	PC with hard drive 168	Clothes dryer 6480	U.S. ENERGY USE	
CO ₂ .95		Drip coffee maker 420	Home water heater 4500	QUAD/YR	
Chlorine .481		Garage door opener 540	Electric furnace 20,000	Coal 19.4	
Helium 5.24		Vacuum cleaner 648	Locomotive 1,800,000	Oil 18.9	
Hydrogen 14.2		Sandwich maker 780	747 engines 210,000,000	Nat gas 18.9	
Nitrogen 1.04			Saturn 5 Rocket 1.2×10^{11}	Nuclear 4.1	
Neon 1.03			Lightning 3.7×10^{12}	Hydro 3.0	
Oxygen .917				Wood 2.6	
				Other .2	
MASS VARIOUS	SOUND LEVEL dB	MUSIC NOTE	R VALUE	DENSITY g/cc	SPARK GAP
huttle 79,000 kg	Threshold of hearing 0	A 440 std.	Ice .069	Ash .752	kilo 25 cm
ailroad car 32,000 kg	Rustle leaves 10	C 261.63	Glass(w) .14	Balsa .12	volt sphere needle
ar 1500 kg	Whisper 1 meter 20	D 293.66	Red brick .23	Bone 1.8	5 16 cm .42 cm
aseball 140 g	Office 50	E 329.63	Sand .37	Brick 2.00	10 .32 cm .85 cm
ennis ball 58 g	Conversation 1 m 60	F 349.23	Cement .485	Cedar .53	20 .64 cm 1.75cm
olf ball 46 g	Jackhammer 1 m 90	G 392.00	Snow(comp).67	Chaik 2.50	40 1.32cm 3.81cm
owling ball 7.3 kg	Rock group 110	A 440.00	Maple .9	Charcoal .24-48	80 2.74cm 11.1cm
ickel 5 g	Threshold pain 120	B 493.88	Oak .98	Clay 1.90	160 5.95cm 28.1cm
ullet 4.5 g	Jet engine 50 m 130	C 523.25	Dry soil 1.04	Coal soft 1.50	300 13.3cm 54.7cm
ing pong ball 2 g	Saturn rocket 50 m 200		Firebrick 1.2	Concrete 2.25	AVERAGE SIZE in μm
asketball .598 kg	0 dB = 1×10^{-12} W/m ²	COEFFICIENT OF EXPANSION $\times 10^{-6}/^\circ C$ linear	Pine 1.28	Cork .24	H2 .00025
ool ball .2 kg	SPEED SOUND m/s	Al 24	Sawdust 2.4	Earth dry 1.36	Virus .01
raight pin .095 g	CO ₂ 0°C 258	Cu 17	Charcoal 2.7	Ebony 1.22	Tobacco Smoke .1
ostage stamp .0616 g	Air 0°C 331	Ag 18.9	Celotex 2.94	Gasoline .68	Sea Salt .2
	Air 20°C 343	Au 14.2	Balsa 3.0	Gold 19.3	Dried Milk 1
	He 0°C 965	Fe 11.7	Cork 3.22	Granite 2.7	Bacteria 3
ydrogen maser clock	Ethanol 20°C 1156	Steel 11.5	Glasswool 3.45	Hemlock .400	Red Blood Cells 7

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PLANET	MASS Kg	RADIUS Km	SP.GR. g	SIDEREAL PERIOD m/s/s	EQUATOR TO ORBIT	DIST TO SUN KM	ORBITAL PERIOD	ESCAPE VEL km/s	INCL TO ECLIPTIC	MAX APP MAGNIT.	# of MOONS	ATMOSPHERE
MERCURY	3.3 x 10 ²²	2439	5.44	3.7 59d	<28deg	57.9 x 10 ⁶	87.96d	4.2	7 DEG	-1.9	0	Temp 8 miles -67 F
VENUS	4.87 x 10 ²⁴	6052	5.24	8.7 244.3d	177deg	108.2 x 10 ⁶	224.68d	10.3	3.38 DEG	-4.4	0	Temp 30 miles 28 F
EARTH	5.98 x 10 ²⁴	6378	5.49	9.8 23h 56m 4.1s	23deg 27m	149.6 x 10 ⁶	365.26d	11.2	0 DEG	---	1	Temp 50 miles -135 F
MARS	6.4 x 10 ²³	3398	3.9	3.7 24h 37m 23s	23deg 59m	227.9 x 10 ⁶	686.95d	5.0	1.85 DEG	-2.8	2	
JUPITER	1.90 x 10 ²⁷	71900	1.34	24.9 9h 50m 30s	3deg 5m	778.3 x 10 ⁶	4334.3d	61	1.3 DEG	-2.5	16	ABSORPTION
SATURN	5.69 x 10 ²⁶	60330	.7	10.5 10h 14m	26deg 44m	1427 x 10 ⁶	10760d	37	2.5 DEG	-4	19	SOLAR %
URANUS	8.69 x 10 ²⁵	26145	1.19	9 23h 50m?	97deg 55m	2871 x 10 ⁶	30685d	22	.77 DEG	5.7	15	Ag polished .07
NEPTUNE	1.03 x 10 ²⁶	24750	1.66	11.7 18h 26m?	28deg 48m	4497 x 10 ⁶	60189d	25	1.77 DEG	7.6	2	Pt polished .15
PLUTO	1.2 x 10 ²²	1550	.87	.57 6d 9h 21m	54deg?	5900 x 10 ⁶	90465d	1.2?	17.15 DEG	15	1	Ni polished .15

EARTH
 Mass 5.98 x 10²⁴ kg
 Radius(equat) 6378.5 km
 Radius(polar) 6357 km
 Sidereal day 8.6164 x 10⁴ s
 Solar day 8.6400 x 10⁴ s
 Sidereal year 3.1558150 x 10⁷ s
 Tropical year 3.1556926 x 10⁷ s
 Core temp 5000 K
 Crust thick 8km-70 km
 Mean density crust 2.67 g/cc
 Mean depth ocean 3.8 km
 Age 4.5-5 billion years
 Temp surface average 20°C
 10/4/1582 -> 10/15/1582
 Reflectivity 48%
 Mass Atmosphere 5.1 x 10¹⁸ kg
 Mass Ocean 1.4 x 10²¹ kg
 Mean height land 623 m
 Area land 1.49 x 10¹⁴ m²
 Area oceans 3.61 x 10¹⁴ m²
 Precession axis 25,800 yr
 Penhelion 146,960,000 km Jan 2
 Aphelion 151,959,000 km July 4
 Equat. rotat. velocity 465 m/s
 Orbital speed 29.8 km/s
 Thermal grad. 30 C/km
 Highest pt. Everest 8840 m
 Deep ocean Mariana 10,530 m
 Highest temp 136 F Libya
 Lowest temp -125 F Antarctica
 Mag Field .5 Gauss

SUN
 Mass 1.991 x 10³⁰ g
 Radius 6.960 x 10⁵ km
 Mean density 1.410 g/cc
 Energy output 3.86 x 10³³ erg/s
 Surface gravity 274.4 m/s²
 Rotates 27 days
 Center temp 1.5 x 10⁷ K
 Surface temp 5780 K
 Apparent mag -26.7
 Abs mag +4.84
 Sunspot cycle 22 yr
 Mass loss 6 x 10⁸ tons/s
 95% energy 2900-25000 Å
 75% hydrogen
 23% helium
 Angular diameter 32'
 4 H 4.03130 u
 1 He 4.00268 u
 mass loss .02862 u
 Speed in Galaxy 220 km/s

WEIGHT ON EARTH
 on earth 1kg weighs 9.8N
 on earth 1kg weighs 2.2lb
 1 gram = 5 carat(metric)
 = .5644 dram
 = 15.43 grain
 = .7716 scruple
 1 lb = .45359237 kg def.

LIGHT
 1 lux = 1 lumen/m²
 1 phot = 10000 lux
 1 lumen = cd x sr
 1 nit = 1 candela/m²
 1 lm/cm² = 1 Lambert
 1 lm/ft² = 1 ft x c
 1 ft x c = 10.76 lux

H₂O IN SATURATED AIR
 4.8 g/m³ @ 0°C
 17.1 g/m³ @ 20°C
 30 g/m³ @ 30°C

HALF LIVES
 C¹⁴ 5730 yr
 Co⁶⁰ 5.3 yr
 Sr⁹⁰ 27.7 yr
 U²³⁸ 4.5 x 10⁹ yr
 K⁴⁰ 1.3 x 10⁹ yr
 I¹³¹ 8.04 d
 30 yr
 2.4 x 10⁴ yr
 H³ 12.26 yr
 Rn²²² 3.82 d
 Ra²²⁶ 1600 yr

RADIATION
 A rad of radiation = absorption of 100 ergs/g of material.
 A rem = rad x QF(quality factor)
 QF of X-rays, gamma, beta = 1
 QF of neutrons = 2 to 10
 QF of alpha = 10 to 20
 1 Curie = decay of 37 billion atoms/s.
 Our body contains K-40, C-14, Tritium.
 10,000 mrem: negligible effects
 (1 dose)
 100,000 mrem: no overt effects
 (1 dose)
 1 million mrem: immediate nausea;
 death 2 weeks.
 8,000 decays/s in our body is normal.
 C¹⁴ -> N¹⁴ + beta

MOON
 Mass 7.35 x 10²² kg
 Radius 1.74 x 10⁶ m
 Sidereal period 27.32 d
 Synodic period 29.53 d
 Max umbra on Earth 168 mi.
 Dist from earth increase 3 cm/yr
 Angular diameter 32'
 Gravity .17 of earth
 Escape speed 2.4 km/s
 Reflectivity 12%
 Orbit 5° from ecliptic
 Rise 50 minutes later/day
 Surface temp noon 373 K
 Surface temp midnight 100 K
 Apogee 406,700 km
 Perigee 356,400 km
 Albedo 7%
 Saros cycle 18 yr 11 d

PRESSURE ALTITUDE bp C
 760 mm 0 ft 100
 702 mm 2000 ft 97.8
 656 mm 4000 ft 96.0
 610 mm 6000 ft 94.0
 568 mm 8000 ft 92.1
 522 mm 10000 ft 89.8
 424 mm 15000 ft 84.4
 350 mm 20000 ft 79.6
 225 mm 30000 ft 69.2
 87.5mm 50000 ft 48.9
 8.2 mm 10 x 10⁵ ft 9.8

HUMAN EXPOSURE TO RADIATION; MILLIREM
 Cosmic rays 44/yr
 Food/H₂O/air 35/yr
 Chest x-ray 30/yr
 Earth/house 30/yr
 Bomb test 4/yr
 Nuc plant 2/yr
 Television .5/yr

DRY AIR
 78% N₂
 21% O₂
 .93% Ar
 .03% CO₂

DECAY SERIES

Alpha-A
 Beta-B
 Gamma-G
 U238 4.5 x 10⁹ yr A
 Th234 24 d B,G
 Pa234 6.6 h B,G
 U234 2.5 x 10⁵ yr A
 Th230 7.6 x 10⁴ yr A,G
 Ra226 1620 yr A,G
 Rn222 3.8 d A
 Po218 3 min A
 Pb214 26.8 min B,G
 Bi214 19.7 min A,B,G
 Po214 1.6 x 10⁻⁴ s A
 Pb210 22 yr B,G
 Bi210 5.1 d B
 Po210 138 d A,G
 Pb206 stable

POPULATION

5000BC 80M
 4000BC 100M
 3000BC 125M
 2000BC 150M
 1000BC 175M
 1 AD 200M
 1000AD 350M
 1650AD 500M
 1850AD 1B
 1945AD 2.3B
 1980AD 4.4B
 1990AD 5B
EARTH CRUST %
 46.4 O₂ 2.33 Mg
 28.2 Si 2.09 K
 8.32 Al .57 Ti
 5.63 Fe .14 H
 4.15 Ca .02 C
 2.36 Na

MILKY WAY
 Diameter 10 x 10⁵ ly
 Thick 700 ly
 Sun to center 2.77 x 10⁴ ly
 Mass 2 x 10⁴³ grams
 Age 1 x 10¹⁰ yr
 Period rotation 2 x 10⁸ yr
 Stars 1 x 10¹¹
 To LMC 1.6 x 10⁵ ly
 To SMC 1.8 x 10⁵ ly
 To Andromeda 2.2 x 10⁶ ly
 1 x 10¹¹ galaxies in universe

COEFFICIENT OF FRICTION

	μ_s	μ_k
Tire slide on macadam	.6	.2
Wood slide on wood	.25-.50	.15
Steel on steel	.75	.56
Rubber on concrete	1.0	.8
Glass on glass	.94	.4
Waxed ski on snow	.15	.04
Metal/metal lubed	.15	.06
Ice on ice at 0°	.1	.02
Teflon/teflon	.04	.04
Human joints	.01	.003
Tire rolling on road		.04
Steel roll on steel		.003

GRAVITATIONAL ACCELERATION

Alaska 9.8223495 m/s²
 Columbia 9.7739015 m/s²
 NIST 9.80102394 m/s²
 2 sec pendulum .993577 m

MOMENT INERTIA

Hoop(normal axis) $I = m \times r^2$
 Hoop(diameter) $I = .5m \times r^2$
 Cylinder(normal axis) $I = .5m \times r^2$
 Rod(middle) $I = (1/12)m \times L^2$
 Rod(end) $I = (1/3)m \times L^2$
 Solid sphere $I = (2/5)m \times r^2$
 Hollow sphere $I = (2/3)m \times r^2$

TO HORIZON HEIGHT DIST.

5 ft 2.5mi
 10ft 3.6mi
 20ft 5.1mi
 40ft 7.2mi
 100ft 11.5mi
 500ft 25.6mi
 900ft 34.4mi

Temperature outer space 2.7 K
 Halley comet has 76 yr period, 12 km diameter, return 2062 diameter
 Tunguska explosion- 10 megaton, 30 June 1908
 Neutral H 21 cm wavelength
 Meteor showers -> Leonid Nov 16, Perseid Aug 11,
 Lyrid April 21

One ton air conditioning = 12,000 Btu/hr
 Year gets 1 msec longer after 100 yr
 Earth loses 2 x 10²⁰ cal/yr from interior
 Human heart uses 8 watts
 Hurricane Allen unleashed energy of 400 twenty megaton bombs
 A large coal fired utility burns 24,000 tons of coal a day
 CO₂ level in air has gone from 315 ppm in 1958 to 350 ppm in 1990
 A pulsar has mass of sun with a diameter of about 10 miles. It spins at 2000 rev/s.
 Hubble const.=17km/s per MLY
 The period of a close satellite is about 90 min.
 Radius of orbit geosynchronous satellite is 4 x 10⁷ m
 Niagara falls -> 7 x 10⁷ gal/min.

RISK OF DEATH

Auto 1 in 4K	Plane 1 in 100K
Falls 1 in 10K	Electrocute 1 in 160K
Fires 1 in 25K	Bathtub 1 in 650K
Drown 1 in 30K	Lightning 1 in 1200K
Guns 1 in 100K	Tornado 1 in 2500K

Compliments of

Science Kit & Boreal Laboratories

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 St. Catharines, Ontario, Canada 1-800-387-9393 (phone)/1-800-668-9106 (FAX)

PERIODIC TABLE OF THE ELEMENTS

According to the Commission on Atomic Weights and Isotopic Abundances, International Union of Pure and Applied Chemistry (IUPAC) and the latest information, Atomic weights are relative to 1/12 the weight of the Carbon 12 atom.

1 Hydrogen H 1.00794	2 Helium He 4.00260																			18 Neon Ne 20.179																
3 Lithium Li 6.941	4 Beryllium Be 9.01218	5 Boron B 10.811	6 Carbon C 12.011	7 Nitrogen N 14.0067	8 Oxygen O 15.9994	9 Fluorine F 18.998403	10 Neon Ne 20.179													18 Argon Ar 39.948																
11 Sodium Na 22.98977	12 Magnesium Mg 24.305	13 Aluminum Al 26.98154	14 Silicon Si 28.0855	15 Phosphorus P 30.97376	16 Sulfur S 32.066	17 Chlorine Cl 35.453	18 Argon Ar 39.948	19 Potassium K 39.0983	20 Calcium Ca 40.078	21 Scandium Sc 44.9559	22 Titanium Ti 47.88	23 Vanadium V 50.9415	24 Chromium Cr 51.996	25 Manganese Mn 54.9380	26 Iron Fe 55.847	27 Cobalt Co 58.9332	28 Nickel Ni 58.69	29 Copper Cu 63.546	30 Zinc Zn 65.38	31 Gallium Ga 69.72	32 Germanium Ge 72.59	33 Arsenic As 74.9216	34 Selenium Se 78.96	35 Bromine Br 79.904	36 Krypton Kr 83.80											
37 Rubidium Rb 85.4678	38 Strontium Sr 87.62	39 Yttrium Y 88.9059	40 Zirconium Zr 91.22	41 Niobium Nb 92.9064	42 Molybdenum Mo 95.94	43 Technetium Tc (98)	44 Ruthenium Ru 101.07	45 Rhodium Rh 102.9055	46 Palladium Pd 106.42	47 Silver Ag 107.8682	48 Cadmium Cd 112.41	49 Indium In 114.82	50 Tin Sn 118.69	51 Antimony Sb 121.75	52 Tellurium Te 127.60	53 Iodine I 126.9045	54 Xenon Xe 131.29	55 Cesium Cs 132.9054	56 Barium Ba 137.33	57 Francium Fr (223)	58 Radium Ra 226.0254	59 Actinium Ac 227.0278	60 Thorium Th 232.0381	61 Protactinium Pa 231.0369	62 Uranium U 238.0289	63 Neptunium Np 237.0482	64 Plutonium Pu 244	65 Americium Am 243	66 Curium Cm 247	67 Berkelium Bk 247	68 Californium Cf 251	69 Einsteinium Es 252	70 Fermium Fm 257	71 Mendelevium Md 258	72 Nobelium No 259	73 Lawrencium Lr 260
The subgroup designations 1 through 18 are those adopted in August 1984 by the Commission on Nomenclature of Inorganic Chemistry of IUPAC, and since accepted by the American Chemical Society (ACS) for use in its publications. They replace the A & B designations that were applied inconsistently in North America and Europe.																																				
The Council of the International Union of Pure and Applied Chemistry (IUPAC) approved final recommendations for names of elements 101-109. By a vote of 64 to 5 (with 12 abstentions) delegates from IUPAC's 40 member countries accepted the report of its Committee on Nomenclature of Inorganic Chemistry (CNIC), thus ending a three-year controversy over the names of the short-lived, artificially produced elements.																																				
Elements 104-112																																				
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TABLE 1-2: SI UNIT PREFIXES

Multiplication Factor	Prefix	Symbol	Pronunciation	Term
$1\,000\,000\,000\,000\,000\,000 = 10^{18}$	exa	E	EHKS uh	one quintillion
$1\,000\,000\,000\,000\,000 = 10^{15}$	peta	P	PEHT uh	one quadrillion
$1\,000\,000\,000\,000 = 10^{12}$	tera	T	TEHR uh	one trillion
$1\,000\,000\,000 = 10^9$	giga	G	JHG uh	one billion
$1\,000\,000 = 10^6$	mega	M	MEHG uh	one million
$1\,000 = 10^3$	kilo	k	KIHL uh	one thousand
$100 = 10^2$	hecto	h	HEHK toh	one hundred
$10 = 10^1$	deka	da	DEHK uh	ten
$0.1 = 10^{-1}$	deci	d	DEHS uh	one tenth
$0.01 = 10^{-2}$	centi	c	SEHN tuh	one hundredth
$0.001 = 10^{-3}$	milli	m	MIHL uh	one thousandth
$0.000\,001 = 10^{-6}$	micro	μ	MY kroh	one millionth
$0.000\,000\,001 = 10^{-9}$	nano	n	NAN oh	one billionth
$0.000\,000\,000\,001 = 10^{-12}$	pico	p	PEEK oh	one trillionth
$0.000\,000\,000\,000\,001 = 10^{-15}$	femto	f	FEHM toh	one quadrillionth
$0.000\,000\,000\,000\,000\,001 = 10^{-18}$	atto	a	AT oh	one quintillionth

TABLE 1-1: SI UNITS AND SYMBOLS

Length		Acceleration	
kilometer	km	meter per second squared	m/s ²
meter	m	Frequency	
centimeter	cm	megahertz	MHz
millimeter	mm	kilohertz	kHz
micrometer	μm	hertz	Hz
Area		Density	
square kilometer	km ²	kilogram per cubic meter	kg/m ³
hectare	ha	gram per liter	g/L
square meter	m ²	gram per cubic centimeter	g/cm ³
square centimeter	cm ²	Force	
Mass		kilonewton	kN
megagram	Mg	newton	N
kilogram	kg	Energy or Work	
gram	g	joule	J
milligram	mg	kilowatt hour	kWh
microgram	μg	Power	
Volume of Solids		kilowatt	kW
cubic meter	m ³	watt	W
cubic centimeter	cm ³	Temperature	
Volume of Liquids and Gases		kelvin	K
kiloliter	kL	degrees Celsius	°C
liter	L		
milliliter	mL		
Speed or Velocity			
meter per second	m/s		
kilometer per hour	km/h		



Formulas

Average Speed: $v = \frac{\Delta x}{\Delta t}$

Average Acceleration: $a = \frac{\Delta v}{\Delta t}$

Uniformly Accelerated Motion: $v = v_o + at$

Accelerated Motion: $x = x_o + v_o t + \frac{1}{2} at^2$

Newton's Second Law: $F = ma$

Centripetal Force: $F = \frac{mv^2}{r}$

Law of Universal Gravitation: $F = \frac{Gm_1m_2}{r^2}$

Force Due to Gravity: $F = w = mg$

Work: $W = Fd$

Kinetic Energy: $E = \frac{1}{2} mv^2$

Gravitational Potential Energy: $E = mgh$

Momentum: $p = mv$

Collision in One Dimension: $[m_1v_1 + m_2v_2]_{\text{initial}} = [m_1v_1 + m_2v_2]_{\text{final}}$

Heat Energy: $Q = mc\Delta T$

First Law of Thermodynamics: $\Delta U = Q - W_{(\text{by the system})}$

Work by a Heat Engine: $W = Q_H - Q_L$

Change in Entropy: $\Delta S = \frac{Q}{T}$

Wave Speed: $v = f\lambda$

Current: $I = \frac{q}{t}$

Ohm's Law: $V = IR$

Power Dissipated in a DC Circuit: $P = IV$

Power Dissipated through a Resistor: $P = I^2R$

Units

Force: $1 \text{ N} = 1 \frac{\text{kg m}}{\text{s}^2}$

Energy: $1 \text{ J} = 1 \text{ N m}$

Power: $1 \text{ W} = 1 \frac{\text{J}}{\text{s}}$

Constants

Gravitational Constant: $G = 6.67 \times 10^{-11} \frac{\text{N m}^2}{\text{kg}^2}$

Acceleration Due to Gravity: $g = 9.8 \frac{\text{m}}{\text{s}^2}$

Speed of Light in a Vacuum: $c = 3.00 \times 10^8 \frac{\text{m}}{\text{s}}$

ADVANCED PLACEMENT PHYSICS C EQUATIONS FOR 2000

MECHANICS

$$v = v_0 + at$$

$$x = x_0 + v_0 t + \frac{1}{2} at^2$$

$$v^2 = v_0^2 + 2a(x - x_0)$$

$$\sum \mathbf{F} = \mathbf{F}_{net} = m\mathbf{a}$$

$$\mathbf{F} = \frac{d\mathbf{p}}{dt}$$

$$\mathbf{J} = \int \mathbf{F} dt = \Delta \mathbf{p}$$

$$\mathbf{p} = m\mathbf{v}$$

$$F_{fric} \leq \mu N$$

$$W = \int \mathbf{F} \cdot d\mathbf{s}$$

$$K = \frac{1}{2} mv^2$$

$$P = \frac{dW}{dt}$$

$$\Delta U_g = mgh$$

$$a_c = \frac{v^2}{r} = \omega^2 r$$

$$\boldsymbol{\tau} = \mathbf{r} \times \mathbf{F}$$

$$\sum \boldsymbol{\tau} = \boldsymbol{\tau}_{net} = I\boldsymbol{\alpha}$$

$$I = \int r^2 dm = \sum mr^2$$

$$r_{cm} = \sum m\mathbf{r} / \sum m$$

$$v = r\omega$$

$$\mathbf{L} = \mathbf{r} \times \mathbf{p} = I\boldsymbol{\omega}$$

$$K = \frac{1}{2} I\omega^2$$

$$\omega = \omega_0 + \alpha t$$

$$\theta = \theta_0 + \omega_0 t + \frac{1}{2} \alpha t^2$$

$$F_s = -kx$$

$$U_s = \frac{1}{2} kx^2$$

$$T = \frac{2\pi}{\omega} = \frac{1}{f}$$

$$T_s = 2\pi \sqrt{\frac{m}{k}}$$

$$T_p = 2\pi \sqrt{\frac{\ell}{g}}$$

$$\mathbf{F}_G = -\frac{Gm_1 m_2}{r^2} \hat{\mathbf{r}}$$

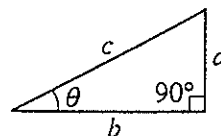
$$U_G = -\frac{Gm_1 m_2}{r}$$

a = acceleration
 F = force
 f = frequency
 h = height
 I = rotational inertia
 J = impulse
 K = kinetic energy
 k = spring constant
 ℓ = length
 L = angular momentum
 m = mass
 N = normal force
 P = power
 p = momentum
 r = radius or distance
 s = displacement
 T = period
 t = time
 U = potential energy
 v = velocity or speed
 W = work
 x = position
 μ = coefficient of friction
 θ = angle
 τ = torque
 ω = angular speed
 α = angular acceleration

GEOMETRY AND TRIGONOMETRY

Rectangle
 $A = bh$
 Triangle
 $A = \frac{1}{2} bh$
 Circle
 $A = \pi r^2$
 $C = 2\pi r$
 Parallelepiped
 $V = \ell wh$
 Cylinder
 $V = \pi r^2 \ell$
 $S = 2\pi r \ell + 2\pi r^2$
 Sphere
 $V = \frac{4}{3} \pi r^3$
 $S = 4\pi r^2$
 Right Triangle
 $a^2 + b^2 = c^2$
 $\sin \theta = \frac{a}{c}$
 $\cos \theta = \frac{b}{c}$
 $\tan \theta = \frac{a}{b}$

A = area
 C = circumference
 V = volume
 S = surface area
 b = base
 h = height
 ℓ = length
 w = width
 r = radius



CALCULUS

$$\frac{df}{dx} = \frac{df}{du} \cdot \frac{du}{dx}$$

$$\frac{d}{dx}(x^n) = nx^{n-1}$$

$$\frac{d}{dx}(e^x) = e^x$$

$$\frac{d}{dx}(\ln x) = \frac{1}{x}$$

$$\frac{d}{dx}(\sin x) = \cos x$$

$$\frac{d}{dx}(\cos x) = -\sin x$$

$$\int x^n dx = \frac{1}{n+1} x^{n+1}, n \neq -1$$

$$\int e^x dx = e^x$$

$$\int \frac{dx}{x} = \ln|x|$$

$$\int \cos x dx = \sin x$$

$$\int \sin x dx = -\cos x$$