Physical Constants and Conversion Factors

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Physical Constants

c = speed of light = (2.99793 ± 0.00001) x 10^{10} [cm/s] = 186,284 [mi/s]
e = elementary (electron) charge = (1.60207 ± 0.00007) x 10^{-19} [abs coulombs] = (4.80288 ± 0.00021) x 10^{-10} [esu]
r_0 =classical electron radius = e^2 / m_0c^2 = 2.818 x10^{-13} [cm]
e/m = specific elementary charge = (1.75888 ± 0.00005) x10^{11} [abs coulombs/kg]
g = acceleration due to gravity (standard) = 32.174 [ft/s^2] = 980.665 [cm/ s^2] = 386.09 [in/ s^2] = 21.94 [mi/h-s]
N_a = Avogadro's number = (6.02472 ± 0.00036) x 10^{23} [molecules/g-mole] (physical scale) = (6.02308 ± 0.00040) x 10^{23} [molecules/g-mole] (chemical scale)
k = Boltzmann's constant = (1.38042 ± 0.00010) x 10^{-16} [ergs/ ^{0}K]
h = Planck's constant = (6.6262 ± 0.00005) x 10^{-27} [erg.s]
hc = 12.4 [keV.Å]
$h/2\pi = \hbar$ =1.0544 x 10^{-27} [erg.sec] = 0.6582 x 10^{-15} [eV.sec]
σ = Stefan-Boltzmann Law (for blackbody) = (5.6686 ± 0.0005) x 10^{-5} [erg/cm^2 s(^{0}K)^4]
F = Faraday constant = (96.520 ± 3) [abs coulombs/g equivalent]
ε_0 = permittivity of free space = 1/ μ_0c^2 =(8.8542 ± 0.0001) x 10^{-12} [farad/m]
μ_0 = permeability of free space = 12.5664 x 10^{-7} [henry/m]
$\alpha_0 = h^2/4\pi me^2$ = first Bohr's radius = (5.29171 ± 0.00006) x 10^{-9} [cm]
R_0 = gas constant per mole = (8.31662 ± 0.00038) x 10^7 [erg/^{0}K-mole] (physical scale) = (8.20545 ± 0.00037) 10^{-2} [liter atm/^{0}K-mole] (chemical scale)
Fine structure constant = $e^2/\hbar c = 2\pi e^2/hc$ = 1/137

Conversions

1 [barn (b) cross section] = 10^{-24} [cm^2]
1 [Curie (Ci) activity] = 3.7 x 10^{10} [transformations/s] = 3.7 x 10^{10} [Becquerel (Bq)] = 2.22 x 10^{12} [transformations/min] = 3.7 x 10^4 [Rutherford]
1 [Bq] = 1 [transformation/s]
1 [Röntgen of exposure] = ionization by x or gamma rays resulting in 1 esu of charge in 1 cm^3 of air (STP) = 1.61 x 10^{12} [ion pairs/gm of air]
STP = standard temperature and pressure = 0 ^{0}C and 760 [mm Hg]
Rest energy of the electron = 0.51098 [MeV]
Electron mass = m_e =(9.1085 ± 0.0006) x 10^{-28} [g] = 0.51098 [MeV]= 5.48760 x 10^{-4} [amu]
Proton mass = (1.67243 ± 0.00010) x 10^{-24} [g] = 938.232 [MeV] = 1.00727 [amu]
Neutron mass = (1.67474 ± 0.00010) x 10^{-24} [g] = 939.526 [MeV] = 1.00866 [amu]
Alpha particle mass = (6.6442 ± 0.0012) x 10^{-24} [g] = 3727.377 [MeV] = 4.00260 [amu]
Hydrogen atomic mass = (1.67335 ± 0.00010) x 10^{-24} [g] = 938.743 [MeV] = 1.00782 [amu]
1 [amu (Atomic Mass Unit)] = 1.6605 x 10^{-27} [kg] = 1.6605 x 10^{-24} [gm] = 931.48 [MeV]
M = mass of the earth = 5.983 x 10^{24} [kg] = 6.595 x 10^{21} [tons]

G = Newton's gravity constant = (6.670 $\pm$ 0.005) x 10^{-8} [cm^3/ g.s]
1 [kWh] = 4.2 x 10^{-5} g U^{235} fission
= 6.4 x 10^{-6} g T in DT fusion reaction
= Average noon insolation in 1 h on horizontal plane of 1 m^2 area
= 0.74 lb (highest power station efficiency on 12,500 [Btu/lb] coal)
1 eV = 1.61 x 10^{-12} [erg]
π = 3.1415926535
e = 2.7182818284
$\log_e n = \log_e 10 \times \log_{10} n = 2.3026 \log_{10} n$

Time (T)

1 [week] = 7 [days] = 168 [h] = 10,080 [min] = 604,800 [s]
1 [mean solar day] = 1440 [min] = 86,400 [s]
1 [calendar year] = 365 [days] = 8760 [h] = 5.256 x 10^5 [min] = 3.1536 x 10^7 [s]
1 [sidereal year] 3.15576 x 10^7 seconds= 365.256 [days (mean solar)] = 8766.14 [h (mean solar)]

Mass (M)

1 [gram (g)] = 2.20462 x 10^{-3} [lb (av)] = 0.03527 [oz (av)] = 15.4324 [grains]
1 [pound (lb) avoirdupois (av)] = 16 [oz (av)] = 7,000 [grains] =256 [drams (av)] =453.5924 [g]
1 [ounce (oz) (av)] =16 [drams (av)] = 437.5 [grains] = 28.34953 [g]
1 [short ton] = 2,000 [lb (av)] = 907.185 [kg] = 20 [hundredweight (long)]
1 [long ton] = 2,240 [lb (av)] = 1,016.0470 [kg] =20 [hundredweight (long)]
1 [metric tonne] = 1,000 [kgs]
1 [kg] = 1,000 [gms]

Density (ML^{-3})

1 [lb/ft^3] = 5.787 x 10^{-4} [lb/in^3] = 16.018 [kg/m^3] = 1.6018 x 10^2 [g/cm^3]
1 [g/cm^3] = 0.03613 [lb/in^3] = 64.23 [lb/ft^3]

Pressure ($ML^{-1}T^{-2}$)

1 [atmosphere (atm)] = 1.0133 [bar] = 14.696 [lb/in^2] = 1.013246 x 10^6 [dyn/cm^2] =760 [Torr] = 1033.2 [g/cm^2 (0 ^{0}C)] = 760 [mm Hg (0 ^{0}C)] = 29.921 [in Hg (0 ^{0}C)] = 33.903 [ft water (0 ^{0}C)]
1 [dyn/cm^2] = 1.01971 x 10^{-3} [g/cm^2] = 1.4504 x 10^{-5} [lb/in^2]
1 [bar] = 1.0 x 10^6 [dyn/cm^2] = 0.98692 [atm]
1 [lb wt/ in^2] = 70.307 [g/cm^2] = 68.947 [dyn/cm^2]

Speed (LT^{-1})

1 m/s = 3.6 km/h = 2.237 mph = 1.944 knots
1 knot = 1 nautical mile per hour = 0.5144 m/s = 1.852 km/h = 1.125 mph

Acceleration (LT^{-2})

1 [ft/s^2] = 30.4801 [cm/s^2] = 0.6818 [mi/h-s]

Energy and Work (MLT^{-2})

1 atomic mass unit [amu] = 931.494 [MeV] = 1.66054 x 10^{-24} [gm]
1 electron volt [eV] = 1.60207 x 10^{-19} [J (abs)]
1 [Joule (International)] = 1.000165 [Joule (abs)]
1 [absolute (abs) Joule (J)] = 1 [N meter (N.m)] = 1 x 10^7 [ergs] = 1 x 10^7 [dyn.cm] = 1 [W.s] = 1 [V.coulomb] = 0.73756 [ft.lb] = 2.3889 x 10^4 [kg.calorie (mean)] = 9,4805 x 10^4 [Btu (mean)] = 23.730 [ft.poundal] = 2.778 x 10^{-7} [kWh] =3.725 x 10^{-7} [hp.h]
1 [g calorie] = 4.186 [J (abs)]
1 [g calorie (15 ^oC)] = 4.1855 [J (abs)] = 0.003968 [Btu]
1 [kWh] = 3413.0 [Btu (mean)] = 2.6552 x 10^6 [ft.lb] = 1.3410 [hp.h]
1 [liter atm (normal)] = 3.7745 x 10^{-5} [hp.h] = 24.206 [g cal (mean)] = 101.328 [J (abs)] 1 J (Joule) = 1 W.sec = 0.2388 cal
1J = 10^7 ergs
1 GJ (Gigajoule) = 10^9 J
1 TJ (Terajoule) = 10^{12} J
1 PJ (Petajoule) = 10^{15} J
1 kWhr (kilo Watt hour) = 3,600,000 Joules
1 toe (tonne oil equivalent)
= 7.4 barrels of crude oil, primary energy
= 7.8 barrels, total final consumption
= 1270 m^3 of natural gas (methane)
= 2.3 metric tonnes of coal
1 Mtoe (Million metric tonnes oil equivalent) = 41.868 PJ
1 cal = 4.12 J
1 kilocalorie (1 Cal, the unit used in nutrition = 1 kcal) = 1,000 calories
1 BTU = 1055 J
1 barrel of oil (42 gal) = 6.12 X 10^9 J = 1.7 X 10^3 kWh
1 ton of coal = 2.5 X 10^7 BTU = 2.2 X 10^{10} J
1 cubic foot of natural gas = 1,000 BTU
1 therm = 10^5 BTU = 100 cu ft of natural gas
1 quad = 10^{15} BTU
1 kWh = 3.6 X 10^6 J = 3.4 x 10^3 BTU

Power

1 horsepower = 0.75 kW
1 W (Watt) = 1 J/sec
1 kW = 1.359 HP