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Last-modified: $Date: 93/04/01 14:39:04 $

This list was originally compiled by Dale Greer. Additions would be appreciated.

Numbers in parentheses are approximations that will serve for most blue-skying purposes.

Unix systems provide the 'units' program, useful in converting between different systems (metric/English, etc.)

7726 m/s (8000) -- Earth orbital velocity at 300 km altitude

3075 m/s (3000) -- Earth orbital velocity at 35786 km (geosync)

6371 km (6400) -- Mean radius of Earth

6378 km (6400) -- Equatorial radius of Earth

1738 km (1700) -- Mean radius of Moon

5.974e24 kg (6e24) -- Mass of Earth

7.348e22 kg (7e22) -- Mass of Moon

1.989e30 kg (2e30) -- Mass of Sun

3.986e14 m^3/s^2 (4e14) -- Gravitational constant times mass of Earth

4.903e12 m^3/s^2 (5e12) -- Gravitational constant times mass of Moon

1.327e20 m^3/s^2 (13e19) -- Gravitational constant times mass of Sun

384401 km (4e5) -- Mean Earth-Moon distance

1.496e11 m (15e10) -- Mean Earth-Sun distance (Astronomical Unit)

1 megaton (MT) TNT = about 4.2e15 J or the energy equivalent of about .05 kg (50 gm) of matter. Ref: J.R Williams, "The Energy Level of Things", Air Force Special Weapons Center (ARDC), Kirtland Air Force Base, New Mexico, 1963. Also see "The Effects of Nuclear Weapons", compiled by S. Glasstone and P.J. Dolan, published by the

US Department of Defense (obtain from the GPO).

Where d is distance, v is velocity, a is acceleration, t is time.

Additional more specialized equations are available from:

ames.arc.nasa.gov:pub/SPACE/FAQ/MoreEquations

For constant acceleration

$$d = d_0 + vt + .5at^2$$

$$v = v_0 + at$$

$$v^2 = 2ad$$

Acceleration on a cylinder (space colony, etc.) of radius r and

rotation period t:

$$a = 4 \pi^2 r / t^2$$

For circular Keplerian orbits where:

V_c = velocity of a circular orbit

V_{esc} = escape velocity

M = Total mass of orbiting and orbited bodies

G = Gravitational constant (defined below)

$u = G * M$ (can be measured much more accurately than G or M)

$K = -G * M / 2 / a$

r = radius of orbit (measured from center of mass of system)

V = orbital velocity

P = orbital period

a = semimajor axis of orbit

$$V_{esc} = \sqrt{2 * M * G / r} = \sqrt{2} * V_c$$

$$V^2 = u/a$$

$$P = 2 \pi / (\sqrt{u/a^3})$$

$K = 1/2 V^2 - G * M / r$ (conservation of energy)

The period of an eccentric orbit is the same as the period

of a circular orbit with the same semi-major axis.

Change in velocity required for a plane change of angle phi in a

circular orbit:

delta V = 2 sqrt(GM/r) sin (phi/2)

Energy to put mass m into a circular orbit (ignores rotational

velocity, which reduces the energy a bit).

GMm (1/Re - 1/2Rcirc)

Re = radius of the earth

Rcirc = radius of the circular orbit.

Classical rocket equation, where

dv= change in velocity

Isp = specific impulse of engine

Ve= exhaust velocity

x= reaction mass

m1= rocket mass excluding reaction mass

Ve= Isp * g

dv= Ve * ln((m1 + x) / m1)

= Ve * ln((final mass) / (initial mass))

Relativistic rocket equation (constant acceleration)

t (unaccelerated) = c/a * sinh(a*t/c)

d = c**2/a * (cosh(a*t/c) - 1)

v = c * tanh(a*t/c)

Relativistic rocket with exhaust velocity Ve and mass ratio MR:

at/c = Ve/c * ln(MR), or

t (unaccelerated) = c/a * sinh(Ve/c * ln(MR)) d = c**2/a * (cosh(Ve/C * ln(MR)) - 1)

v = c * tanh(Ve/C * ln(MR))

Converting from parallax to distance:

d (in parsecs) = 1 / p (in arc seconds)

d (in astronomical units) = 206265 / p

Miscellaneous

f=ma -- Force is mass times acceleration

w=fd -- Work (energy) is force times distance

Atmospheric density varies as exp(-mgz/kT) where z is altitude, m is

molecular weight in kg of air, g is local acceleration of gravity, T

is temperature, k is Bolztmann's constant. On Earth up to 100 km,

d = d0*exp(-z*1.42e-4)

where d is density, d0 is density at 0km, is approximately true, so

Atmospheric scale heightDry lapse rate

(in km at emission level) (K/km)

Earth	7.5	9.8
Mars	11	4.4
Venus	4.9	10.5
Titan	18	1.3
Jupiter	19	2.0
Saturn	37	0.7
Uranus	24	0.7
Neptune	21	0.8
Triton	8	1

Titius-Bode Law for approximating planetary distances:

R(n) = 0.4 + 0.3 * 2^N Astronomical Units (N = -infinity for

Mercury, 0 for Venus, 1 for Earth, etc.)

This fits fairly well except for Neptune.

6.62618e-34 J-s (7e-34) -- Planck's Constant "h"

1.054589e-34 J-s (1e-34) -- Planck's Constant / (2 * PI), "h bar"

1.3807e-23 J/K(1.4e-23) - Boltzmann's Constant "k"

5.6697e-8 W/m^2/K (6e-8) -- Stephan-Boltzmann Constant "sigma"

6.673e-11 N m^2/kg^2 (7e-11) -- Newton's Gravitational Constant "G"

0.0029 m K (3e-3) -- Wien's Constant "sigma(W)"

3.827e26 W (4e26) -- Luminosity of Sun

1370 W / m^2 (1400) -- Solar Constant (intensity at 1 AU)

6.96e8 m (7e8) -- radius of Sun

1738 km (2e3) -- radius of Moon

299792458 m/s (3e8) -- speed of light in vacuum "c"

9.46053e15 m (1e16) -- light year

206264.806 AU (2e5) -- \

3.2616 light years (3) -- --> parsec

3.0856e16 m (3e16) -- /

Black Hole radius (also called Schwarzschild Radius):

2GM/c^2, where G is Newton's Grav Constant, M is mass of BH,

c is speed of light

Things to add (somebody look them up!)

Basic rocketry numbers & equations

Aerodynamical stuff

Energy to put a pound into orbit or accelerate to interstellar

velocities.

Non-circular cases?

NEXT: FAQ #7/15 - Astronomical Mnemonics