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Constants Astrodynamic Constants

Defining
Primary
Derived

This page contains selected constants commonly used in astrodynamic computations. The term "**constant**" is used loosely. Specifically, some values are derived from other constants and/or results of numerical fits to measured data (e.g. planetary mass ratios). Constants are represented in three groups: "defining", "primary", and "derived". References are listed below.

Defining Constants

Julian day	$d = 86400 \text{ s}$
Julian year	$y = 365.25 \text{ d}$
Julian century	$Cy = 36525 \text{ d}$
speed of light	$c = 299792458 \text{ m/s}$
Gaussian gravitational constant	$k = 0.01720209895 \text{ (AU}^3/\text{d}^2\text{kg)}^{1/2}$

Primary Constants

mean sidereal day	86164.09054 s [23:56:04.09054]
sidereal year (quasar ref. frame)	365.25636 d
light time for 1 AU	$\tau_{AU} = 499.004783806 (\pm 0.00000001) \text{ s}$
gravitational constant	$G = 6.67259 (\pm 0.00030) \times 10^{-11} \text{ kg}^{-1} \text{ m}^3 \text{ s}^{-2}$
general precession in longitude	$5028.83 (\pm 0.04) \text{ arcsec/Cy}$
obliquity of ecliptic (J2000)	$\epsilon = 84381.412 (\pm 0.005) \text{ arcsec}$
obliquity of ecliptic (J2000) [IAU 1976]	84381.448 arcsec
mass ratio: sun/Mercury	$6023600. (\pm 350.)$
mass ratio: sun/Venus	$408523.71 (\pm 0.06)$
mass ratio: sun/(Earth+Moon)	$328900.56 (\pm 0.02)$
mass ratio: sun/(Mars system)	$3098708. (\pm 9.)$
mass ratio: sun/(Jupiter system)	$1047.3486 (\pm 0.0008)$
mass ratio: sun/(Saturn system)	$3497.898 (\pm 0.018)$
mass ratio: sun/(Uranus system)	$22902.98 (\pm 0.03)$
mass ratio: sun/(Neptune system)	$19412.24 (\pm 0.04)$
mass ratio: sun/(Pluto system)	$1.35 (\pm 0.07) \times 10^8$

Derived Constants

astronomical unit distance	$AU = c * \tau_{AU} = 1.49597870691 \times 10^{11} (\pm 3) \text{ m}$
heliocentric gravitational constant	$GM_{sun} = k^2 AU^3 d^{-2} = 1.32712440018 \times 10^{20} (\pm 8 \times 10^9) \text{ m}^3 \text{ s}^{-2}$
mass ratio: Earth / Moon	$81.30059 (\pm 0.00001)$

Notes and References

- Data are from the 1994 IAU file of current best estimates unless otherwise noted.
- Planetary ranging determines the Earth/Moon mass ratio.
- The value for 1 AU is taken from JPL's planetary ephemeris DE-405.