IAU (1976) System of Astronomical Constants

Units:

The units meter (m), kilogram (kg), and second (s) are the units of length, mass and time in the International System of Units (SI).

The astronomical unit of time is a time interval of one day (D) of 86400 seconds. An interval of 36525 days is one Julian century.

The astronomical unit of mass is the mass of the Sun (S).

The astronomical unit of length is that length (A) for which the Gaussian gravitational constant (k) takes the value 0·017 202 098 95 when the units of measurement are the astronomical units of length, mass and time. The dimensions of k^2 are those of the constant of gravitation (G), i.e., $L^3M^{-1}T^{-2}$. The term "unit distance" is also used for the length A.

In the preparation of the DE405 ephemeris and the fitting of the ephemeris to all the observational data available, produced small differences in the constants and planetary masses. The modified values of the constants are indicated in brackets following the (1976) System values.

Defining constants:

1.	Gaussian gravitational constant	$k = 0{\cdot}017\ 202\ 098\ 95$
2.	Speed of light	$c = 299\ 792\ 458\ \mathrm{m\,s^{-1}}$

Primary constants:

3.	Light-time for unit distance	$\tau_A = 499{\cdot}004\ 782\ \mathrm{s}$ [499·004 7838 ...]
4.	Equatorial radius for Earth	$a_e = 6378\ 140\ \mathrm{m}$ [6378 137]
5.	Dynamical form-factor for Earth	$J_2 = 0{\cdot}001\ 082\ 63$ [0·001 082 626]
6.	Geocentric gravitational constant	$GE = 3{\cdot}986\ 005 \times 10^{14}\ \mathrm{m^3\,s^{-2}}$ [3·986 004 33 ... × 10^{14}]
7.	Constant of gravitation	$G = 6{\cdot}672 \times 10^{-11}\ \mathrm{m^3\,kg^{-1}\,s^{-2}}$
8.	Ratio of mass of Moon to that of Earth	$\mu = 0{\cdot}012\ 300\ 02$ [0·012 300 038]
9.	General precession in longitude, per Julian century, at standard epoch 2000	$\rho = 5029''{\cdot}0966$
10.	Obliquity of the ecliptic, at standard epoch 2000	$\epsilon = 23^\circ\ 26'\ 21''{\cdot}448$

Derived constants:

11.	Constant of nutation, at standard epoch 2000		$N = 9''{\cdot}2025$
12.	Unit distance	$c\tau_A = A$	$= 1{\cdot}495\ 978\ 70 \times 10^{11}\ \mathrm{m}$ [1·495 978 706 91 × 10^{11}]
13.	Solar parallax	$\arcsin(a_e/A) = \pi_\odot$	$= 8''{\cdot}794\ 148$ [8″·794 144]
14.	Constant of aberration, for standard epoch 2000		$\kappa = 20''{\cdot}49\ 552$
15.	Flattening factor for the Earth		$f = 0{\cdot}003\ 352\ 81 = 1/298{\cdot}257$
16.	Heliocentric gravitational constant	$A^3k^2/D^2 = GS$	$= 1{\cdot}327\ 124\ 38 \times 10^{20}\ \mathrm{m^3\,s^{-2}}$ [1·327 124 40 ... × 10^{20}]
17.	Ratio of mass of Sun to that of the Earth	$(GS)/(GE) = S/E$	$= 332\ 946{\cdot}0$ [332 946·050 895 ...]
18.	Ratio of mass of Sun to that of Earth + Moon	$(S/E)/(1+\mu)$	$= 328\ 900{\cdot}5$ [328 900·561 400]
19.	Mass of the Sun	$(GS)/G = S$	$= 1{\cdot}9891 \times 10^{30}\ \mathrm{kg}$

IAU (1976) System of Astronomical Constants (continued)

20. System of planetary masses

Ratios of mass of Sun to masses of the planets

Mercury	6 023 600		Jupiter	1 047·355	[1 047·3486]
Venus	408 523·5	[408 523·71]	Saturn	3 498·5	[3 497·898]
Earth + Moon	328 900·5	[328 900·561 400]	Uranus	22 869	[22 902·98]
Mars	3 098 710	[3 098 708]	Neptune	19 314	[19 412·24]
			Pluto	3 000 000	[135 200 000]

Other Quantities for Use in the Preparation of Ephemerides

It is recommended that the values given in the following list should normally be used in the preparation of new ephemerides.

21. Masses of minor planets

Minor planet	Mass in solar mass	
(1) Ceres	$5{\cdot}9 \times 10^{-10}$	$[4{\cdot}7 \times 10^{-10}]$
(2) Pallas	$1{\cdot}1 \times 10^{-10}$	$[1{\cdot}0 \times 10^{-10}]$
(4) Vesta	$1{\cdot}2 \times 10^{-10}$	$[1{\cdot}3 \times 10^{-10}]$

22. Masses of satellites

Planet	Satellite	Satellite / Planet
Jupiter	Io	$4{\cdot}70 \times 10^{-5}$
	Europa	$2{\cdot}56 \times 10^{-5}$
	Ganymede	$7{\cdot}84 \times 10^{-5}$
	Callisto	$5{\cdot}6 \times 10^{-5}$
Saturn	Titan	$2{\cdot}41 \times 10^{-4}$
Neptune	Triton	2×10^{-3}

23. Equatorial radii in km

Mercury	2 439	[2 439·76]	Jupiter	71 398	Pluto	2 500
Venus	6 052	[6 052·3]	Saturn	60 000		
Earth	6 378·140	[6 378·137]	Uranus	25 400	Moon	1 738
Mars	3 397·2	[3 397·515]	Neptune	24 300	Sun	696 000

24. Gravity fields of planets

Planet	J_2	J_3	J_4
Earth	+0·001 082 63	$-0{\cdot}254 \times 10^{-5}$	$-0{\cdot}161 \times 10^{-5}$
	[+0·001 082 626]	$[-0{\cdot}2533 \times 10^{-5}]$	$[-0{\cdot}1616 \times 10^{-5}]$
Mars	+0·001 964	$+0{\cdot}36 \times 10^{-4}$	
Jupiter	+0·014 75		$-0{\cdot}58 \times 10^{-3}$
Saturn	+0·016 45		$-0{\cdot}10 \times 10^{-2}$
Uranus	+0·012		
Neptune	+0·004		

(Mars: $C_{22} = -0{\cdot}000\,055$, $S_{22} = +0{\cdot}000\,031$, $S_{31} = +0{\cdot}000\,026$)

25. Gravity field of the Moon

$\gamma = (B - A)/C = 0{\cdot}000\,2278$ $\quad C/MR^2 = 0{\cdot}392$

$\beta = (C - A)/B = 0{\cdot}000\,6313$ $\quad I = 5552''7 = 1^\circ\ 32'\ 32''7$

$C_{20} = -0{\cdot}000\,2027$	$C_{30} = -0{\cdot}000\,006$	$C_{32} = +0{\cdot}000\,0048$
		[+0·000 0049]
$C_{22} = +0{\cdot}000\,0223$	$C_{31} = +0{\cdot}000\,029$	$S_{32} = +0{\cdot}000\,0017$
[+0·000 0225]	[+0·000 0308]	
	$S_{31} = +0{\cdot}000\,004$	$C_{33} = +0{\cdot}000\,0018$
		$S_{33} = -0{\cdot}000\,001$
		[−0·000 0003]