

## Fundamental constants

|                                  |               |   |                                                        |
|----------------------------------|---------------|---|--------------------------------------------------------|
| Speed of light in vacuum         | $c$           | = | $2.998 \times 10^8 \text{ m s}^{-1}$                   |
| Planck constant                  | $h$           | = | $6.626 \times 10^{-34} \text{ J s}$                    |
| Boltzmann constant               | $k_B$         | = | $1.381 \times 10^{-23} \text{ J K}^{-1}$               |
| Stefan-Boltzmann constant        | $\sigma$      | = | $5.670 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$ |
| Elementary charge                | $e$           | = | $1.602 \times 10^{-19} \text{ C}$                      |
| Universal gravitational constant | $G$           | = | $6.674 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$  |
| Universal gas constant           | $R$           | = | $8.315 \text{ J mol}^{-1} \text{ K}^{-1}$              |
| Avogadro constant                | $N_A$         | = | $6.022 \times 10^{23} \text{ mol}^{-1}$                |
| Wien's displacement law          | $\lambda_m T$ | = | $2.898 \times 10^{-3} \text{ m K}$                     |
| Mass of electron                 | $m_e$         | = | $9.109 \times 10^{-31} \text{ kg}$                     |
| Mass of proton                   | $m_p$         | = | $1.673 \times 10^{-27} \text{ kg}$                     |
| Mass of neutron                  | $m_n$         | = | $1.675 \times 10^{-27} \text{ kg}$                     |
| Atomic mass unit (a.m.u.)        |               | = | $1.661 \times 10^{-27} \text{ kg}$                     |

## Astronomical data

|                                                |                         |   |                                                                 |
|------------------------------------------------|-------------------------|---|-----------------------------------------------------------------|
| 1 parsec                                       | 1 pc                    | = | $3.086 \times 10^{16} \text{ m}$                                |
|                                                |                         | = | 206 265 au                                                      |
|                                                |                         | = | 3.262 ly                                                        |
| 1 astronomical unit (au)                       | 1 au                    | = | $1.496 \times 10^{11} \text{ m}$                                |
| 1 jansky                                       | 1 Jy                    | = | $10^{-26} \text{ W m}^{-2} \text{ Hz}^{-4}$                     |
| Hubble constant                                | $H_0$                   | = | $70 \text{ km s}^{-1} \text{ Mpc}^{-1}$                         |
| Solar luminosity                               | $L_\odot$               | = | $3.826 \times 10^{26} \text{ W}$                                |
| Apparent angular diameter of Sun               | $\theta_\odot$          | = | 32'                                                             |
| Effective temperature of Sun                   | $T_{\text{eff}, \odot}$ | = | 5778 K                                                          |
| Obliquity of the ecliptic (Earth)              | $\varepsilon$           | = | 23.5°                                                           |
| Inclination of the lunar orbit w.r.t. ecliptic |                         | = | 05°08'43''                                                      |
| Apparent visual magnitude of full moon         |                         | = | -12.74                                                          |
| North Ecliptic Pole (J2000.0)                  | $(\alpha_E, \delta_E)$  |   | (18 <sup>h</sup> 00 <sup>m</sup> 00 <sup>s</sup> , +66°33'39'') |
| North Galactic Pole (J2000.0)                  | $(\alpha_G, \delta_G)$  |   | (12 <sup>h</sup> 51 <sup>m</sup> 26 <sup>s</sup> , +27°07'42'') |
| 1 sidereal day                                 |                         | = | 23 <sup>d</sup> 56 <sup>m</sup> 04 <sup>s</sup>                 |
| 1 tropical year                                |                         | = | 365.2422 solar days                                             |
| 1 sidereal year                                |                         | = | 365.2564 solar days                                             |

## Solar magnitudes

|                     |   |        |
|---------------------|---|--------|
| Apparent visual     | = | −26.75 |
| Absolute visual     | = | +4.82  |
| Apparent bolometric | = | −26.83 |
| Absolute bolometric | = | +4.74  |

## Solar system

| Object  | Mean radius (km) | Mass (kg)              | Semi-major axis (au) | Eccentricity |
|---------|------------------|------------------------|----------------------|--------------|
| Sun     | 695 500          | $1.988 \times 10^{30}$ | ---                  | ---          |
| Mercury | 2 440            | $3.301 \times 10^{23}$ | 0.387                | 0.206        |
| Venus   | 6 052            | $4.867 \times 10^{24}$ | 0.723                | 0.007        |
| Earth   | 6 378            | $5.972 \times 10^{24}$ | 1.000 000            | 0.016 710    |
| Moon    | 1 737            | $7.346 \times 10^{22}$ | 0.002 572            | 0.054 900    |
| Mars    | 3 390            | $6.417 \times 10^{23}$ | 1.524                | 0.093        |
| Jupiter | 69 911           | $1.898 \times 10^{27}$ | 5.203                | 0.048        |
| Saturn  | 58 232           | $5.683 \times 10^{26}$ | 9.537                | 0.054        |
| Uranus  | 25 362           | $8.681 \times 10^{25}$ | 19.189               | 0.047        |
| Neptune | 24 622           | $1.024 \times 10^{26}$ | 30.070               | 0.009        |

## Gauss's formulae

Cosine theorem :  $\cos a \cos b = \cos c \cos A + \sin c \sin A \cos B$

Sine theorem :  $\frac{\sin a}{\sin A} = \frac{\sin b}{\sin B} = \frac{\sin c}{\sin C}$