# List of Data, Formulae and Relationships

## *Data*

| | |
|---|---|
| molar gas constant | $R = 8.31$ J mol$^{-1}$ K$^{-1}$ |
| Avogadro constant | $N_A = 6.02 \times 10^{23}$ mol$^{-1}$ |
| acceleration due to gravity | $g = 9.81$ m s$^{-2}$ (close to the Earth) |
| universal gravitational constant | $G = 6.67 \times 10^{-11}$ N m$^2$ kg$^{-2}$ |
| speed of light in vacuum | $c = 3.00 \times 10^8$ m s$^{-1}$ |
| charge of electron | $e = 1.60 \times 10^{-19}$ C |
| electron rest mass | $m_e = 9.11 \times 10^{-31}$ kg |
| permittivity of free space | $\varepsilon_0 = 8.85 \times 10^{-12}$ C$^2$ N$^{-1}$ m$^{-2}$ |
| permeability of free space | $\mu_0 = 4\pi \times 10^{-7}$ H m$^{-1}$ |
| atomic mass unit | $u = 1.661 \times 10^{-27}$ kg      (1 u is equivalent to 931 MeV) |
| astronomical unit | $AU = 1.50 \times 10^{11}$ m |
| light year | $ly = 9.46 \times 10^{15}$ m |
| parsec | $pc = 3.09 \times 10^{16}$ m $= 3.26$ ly $= 206265$ AU |
| Stefan constant | $\sigma = 5.67 \times 10^{-8}$ W m$^{-2}$ K$^{-4}$ |
| Planck constant | $h = 6.63 \times 10^{-34}$ J s |

## *Rectilinear motion*

For uniformly accelerated motion :

$$v = u + at$$
$$s = ut + \frac{1}{2}at^2$$
$$v^2 = u^2 + 2as$$

## *Mathematics*

| | |
|---|---|
| Equation of a straight line | $y = mx + c$ |
| Arc length | $= r\,\theta$ |
| Surface area of cylinder | $= 2\pi rh + 2\pi r^2$ |
| Volume of cylinder | $= \pi r^2 h$ |
| Surface area of sphere | $= 4\pi r^2$ |
| Volume of sphere | $= \frac{4}{3}\pi r^3$ |

For small angles, $\sin\theta \approx \tan\theta \approx \theta$ (in radians)

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## Astronomy and Space Science

$U = -\dfrac{GMm}{r}$      gravitational potential energy

$P = \sigma A T^4$      Stefan's law

$\left|\dfrac{\Delta f}{f_0}\right| \approx \dfrac{v}{c} \approx \left|\dfrac{\Delta\lambda}{\lambda_0}\right|$      Doppler effect

## Energy and Use of Energy

$E = \dfrac{\Phi}{A}$      illuminance

$\dfrac{Q}{t} = \kappa \dfrac{A(T_H - T_C)}{d}$ rate of energy transfer by conduction

$U = \dfrac{\kappa}{d}$      thermal transmittance U-value

$P = \dfrac{1}{2}\rho A v^3$      maximum power by wind turbine

## Atomic World

$\frac{1}{2} m_e v_{max}^2 = hf - \phi$      Einstein's photoelectric equation

$E_n = -\dfrac{1}{n^2}\left\{\dfrac{m_e e^4}{8h^2 \varepsilon_0^2}\right\} = -\dfrac{13.6}{n^2}$ eV

energy level equation for hydrogen atom

$\lambda = \dfrac{h}{p} = \dfrac{h}{mv}$      de Broglie formula

$\theta \approx \dfrac{1.22\lambda}{d}$      Rayleigh criterion (resolving power)

## Medical Physics

$\theta \approx \dfrac{1.22\lambda}{d}$      Rayleigh criterion (resolving power)

$\text{power} = \dfrac{1}{f}$      power of a lens

$L = 10 \log \dfrac{I}{I_0}$      intensity level (dB)

$Z = \rho c$      acoustic impedance

$\alpha = \dfrac{I_r}{I_0} = \dfrac{(Z_2 - Z_1)^2}{(Z_2 + Z_1)^2}$ intensity reflection coefficient

$I = I_0 e^{-\mu x}$      transmitted intensity through a medium

A1. $E = mc\,\Delta T$ — energy transfer during heating and cooling

A2. $E = l\,\Delta m$ — energy transfer during change of state

A3. $pV = nRT$ — equation of state for an ideal gas

A4. $pV = \frac{1}{3}Nm\overline{c^2}$ — kinetic theory equation

A5. $E^K = \frac{3RT}{\;}$ — molecular kinetic energy

B1. $F = m\frac{\Delta v}{\;} = \frac{\Delta p}{\;}$ — force

B2. $\text{moment} = F \times d$ — moment of a force

B3. $E_P = mgh$ — gravitational potential energy

B4. $E_K = \frac{1}{2}mv^2$ — kinetic energy

B5. $P = Fv$ — mechanical power

B6. $\frac{v^2}{r}\;$ — centripetal acceleration

B7. $F = \frac{Gm_1 m_2}{\;}$ — Newton's law of gravitation

C1. $\Delta y = \frac{\lambda D}{\;}$ — fringe width in double-slit interference

C2. $d\sin\theta = n\lambda$ — diffraction grating equation

C3. $\frac{1}{\;} + \frac{1}{\;} = \frac{1}{\;}$ — equation for a single lens

D1. $F = \frac{Q_1 Q_2}{\;}$ — Coulomb's law

D2. $E = \frac{Q}{\;}$ — electric field strength due to a point charge

D3. $E = \frac{V}{\;}$ — electric field between parallel plates (numerically)

D4. $R = \frac{\rho l}{\;}$ — resistance and resistivity

D5. $R = R_1 + R_2$ — resistors in series

D6. $\frac{1}{\;} = \frac{1}{\;} + \frac{1}{\;}$ — resistors in parallel

D7. $P = IV = I^2 R$ — power in a circuit

D8. $F = BQv\sin\theta$ — force on a moving charge in a magnetic field

D9. $F = BIl\sin\theta$ — force on a current-carrying conductor in a magnetic field

D10. $B = \frac{\mu_0 I}{\;}$ — magnetic field due to a long straight wire

D11. $B = \frac{\mu_0 NI}{\;}$ — magnetic field inside a long solenoid

D12. $\varepsilon = N\frac{\Delta\Phi}{\;}$ — induced e.m.f.

D13. $\frac{V_s}{\;} \approx \frac{N_s}{\;}$ — ratio of secondary voltage to primary voltage in a transformer

E1. $N = N_0 e^{-kt}$ — law of radioactive decay

E2. $t = \frac{\ln 2}{\;}$ — half-life and decay constant

E3. $A = kN$ — activity and the number of undecayed nuclei

E4. $\Delta E = \Delta mc^2$ — mass-energy relationship