The following list of data, formulae and relationships will be provided in the question papers for candidates’ reference:
List of data, formulae and relationships

**Data**

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

**Rectilinear motion**

For uniformly accelerated motion:

\[
\begin{align*}
v &= u + at \\
\frac{1}{2}v^2 &= u^2 + 2as \\
\end{align*}
\]

**Mathematics**

- Equation of a straight line: \( y = mx + c \)
- Arc length: \( s = r\theta \)
- 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)

**Astronomy and Space Science**

- Gravitational potential energy: \( U = -\frac{GMm}{r} \)
- Stefan’s law: \( P = \sigma AT^4 \)
- Doppler effect: \( \frac{\Delta f}{f_0} \approx \frac{v}{c} \approx \frac{\Delta \lambda}{\lambda_0} \)

**Energy and Use of Energy**

- Illuminance: \( E = \frac{\Phi}{\Delta} \)
- Rate of energy transfer by conduction: \( Q = \kappa \frac{A(T_H - T_C)}{d} \)
- Thermal transmittance U-value: \( U = \frac{\kappa}{d} \)
- Maximum power by wind turbine: \( P = \frac{1}{2} \rho AV^3 \)

**Atomic World**

- Einstein’s photoelectric equation: \( \frac{1}{2} m_e v_{max}^2 = hf - \phi \)
- Energy level equation for hydrogen atom: \( E_n = -\frac{1}{n^2} \left( \frac{m_e q_e^4}{8 \pi \varepsilon_0} \right) = -\frac{13.6}{n^2} \text{ eV} \)
- De Broglie formula: \( \lambda = \frac{h}{p} = \frac{h}{mv} \)
- Rayleigh criterion (resolving power): \( \theta \approx \frac{1.22 \lambda}{d} \)

**Medical Physics**

- Rayleigh criterion (resolving power): \( \theta \approx \frac{1.22 \lambda}{d} \)
- Power of a lens: \( \text{power} = \frac{1}{f} \)
- Intensity level (dB): \( L = 10 \log \frac{I}{I_0} \)
- Acoustic impedance: \( Z = \rho c \)
- Intensity reflection coefficient: \( \alpha = \frac{I_r}{I_0} = \left( \frac{Z_2 - Z_1}{Z_2 + Z_1} \right)^2 \)
- Transmitted intensity through a medium: \( I = I_0 e^{-\mu x} \)
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. \( PV = \frac{1}{3} N \mu c^2 \) kinetic theory equation

A5. \( E_k = \frac{3RT}{2N_A} \) molecular kinetic energy

B1. \( F = m \frac{\Delta v}{\Delta t} = \frac{\Delta p}{\Delta t} \) force

B2. 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. \( a = \frac{v^2}{r} = \omega^2 r \) centripetal acceleration

B7. \( F = \frac{Gm_1m_2}{r^2} \) Newton's law of gravitation

C1. \( \Delta y = \frac{\lambda D}{a} \) fringe separation in double-slit interference

C2. \( d \sin \theta = n \lambda \) diffraction grating equation

C3. \( \frac{1}{u} + \frac{1}{v} = \frac{1}{f} \) equation for a single lens

D1. \( F = \frac{Q_1 Q_2}{4 \pi \varepsilon_0 r^2} \) Coulomb's law

D2. \( E = \frac{Q}{4 \pi \varepsilon_0 r^2} \) electric field strength due to a point charge

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

D4. \( R = \frac{\rho L}{A} \) resistance and resistivity

D5. \( R = R_1 + R_2 \) resistors in series

D6. \( \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} \) resistors in parallel

D7. \( P = IV = I^2 R \) power in a circuit

D8. \( F = BQ v \sin \theta \) force on a moving charge in a magnetic field

D9. \( F = BI \sin \theta \) force on a current-carrying conductor in a magnetic field

D10. \( B = \frac{\mu_0 I}{2 \pi r} \) magnetic field due to a long straight wire

D11. \( B = \frac{\mu_0 NI}{l} \) magnetic field inside a long solenoid

D12. \( \varepsilon = N \frac{\Delta \Phi}{\Delta t} \) induced e.m.f.

D13. \( \frac{V_s}{V_p} \approx \frac{N_s}{N_p} \) ratio of secondary voltage to primary voltage in a transformer

E1. \( N = N_0 e^{-kt} \) law of radioactive decay

E2. \( r_1 = \frac{\ln 2}{k} \) half-life and decay constant

E3. \( A = k N \) activity and the number of undecayed nuclei

E4. \( \Delta E = \Delta mc^2 \) mass-energy relationship