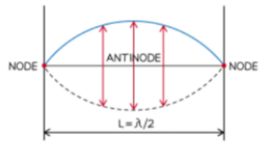
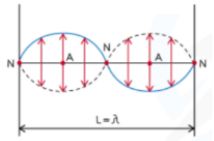
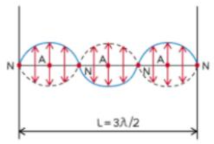
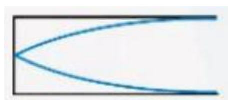
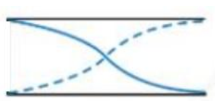
CIE A Level Physics Formula Sheet (2025, 2026 and 2027 Syllabus)

AS Level Physics (9702)

Chapter 1: Physical Quantities and Unit	
Chapter 2: Kinematics	
Average velocity $(\text{ms}^{-1}) = \dfrac{\text{displacement (m)}}{\text{time (s)}}$	$v = \dfrac{x}{t}$
Acceleration $(\text{ms}^{-2}) = \dfrac{\text{final velocity }(\text{ms}^{-1}) - \text{initial velocity}(\text{ms}^{-1})}{\text{time (s)}}$	$a = \dfrac{v-u}{t}$
Equations of motion	$v = u + at$
	$d = ½(v+u)t$
	$d = ut + ½at^2$
	$v^2 = u^2 + 2ad$
Chapter 3: Dynamics	
Force (N) = mass (kg) × acceleration (ms^{-2})	$F = ma$
Force (N) $= \dfrac{\text{change in momentum }(\text{kgms}^{-1})}{\text{time (s)}}$	$F = \dfrac{\Delta p}{t}$
Momentum (kgms^{-1}) = mass (kg) × velocity (ms^{-1})	$p = mv$
Chapter 4 Forces, Density and Pressure	
Moment (Nm) = Force (N) × perpendicular distance from pivot (m)	$M = Fd$
Sum of clockwise moments (Nm) = sum of anticlockwise moments (Nm)	$F_1d_1 = F_2d_2$
Density $(\text{kgm}^{-3}) = \dfrac{\text{mass (kg)}}{\text{volume}^{\ 3}}$	$\rho = \dfrac{m}{V}$
Pressure(Pa) $= \dfrac{\text{Force (N)}}{\text{area }(\text{m}^2)}$	$P = \dfrac{F}{A}$
Fluid Pressure (Pa) = density (kgm^{-3}) × gravitational field strength (ms^{-2} or Nkg^{-1}) × height (m)	$P = \rho gh$
Force (Newtons) = density (kgm^{-3}) × gravitational field strength (ms^{-2} or Nkg^{-1}) × volume (m^3)	$P = \rho gV$
Chapter 5: Work, Energy and Power	
Work (J) = force (N) × distance moved (m)	$W = Fd$
Efficiency (%) $= \dfrac{\text{useful power output (W or J)}}{\text{total power input (W or J)}} \times 100\%$	$\eta = \dfrac{P_{out}}{P_{in}} \times 100\%$
Power (W) $= \dfrac{\text{work (J)}}{\text{time (s)}}$	$P = \dfrac{W}{t}$
Power (W) = Force (N) × velocity (ms^{-1})	$P = Fv$
Gravitational potential energy (J) = mass (kg) × gravitational field strength (ms^{-2} or Nkg^{-1}) × height (m)	$GPE = mgh$
Kinetic Energy (J) = ½ × mass (kg) × velocity² (ms^{-1})	$KE = ½mv^2$
Chapter 6: Deformation of Solids	
Hooke's law: Force (N) = constant (Nm^{-1}) × extension (m)	$F = kx$
Stress (Pa) $= \dfrac{\text{Force (N)}}{\text{area }(\text{m}^2)}$	$\sigma = \dfrac{F}{A}$
Strain $= \dfrac{\text{Change in length (meters)}}{\text{Original length (meters)}}$	$\varepsilon = \dfrac{x}{L}$
Elastic modulus (Pa) $= \dfrac{\text{Stress (Pa)}}{\text{Strain}}$	$E = \dfrac{\sigma}{\varepsilon} = \dfrac{(\frac{F}{A})}{(\frac{x}{L})} = \dfrac{FL}{Ax}$
Elastic potential energy (Joules) = ½ × Force (N) × change in length (x)	$EPE = ½Fx$
Elastic potential energy (Joules) = ½ × spring constant (Nm^{-1}) × change in length $(\text{m})^2$	$EPE = ½kx^2$

Chapter 7: Waves	
$\text{Frequency (Hz)} = \dfrac{1}{\text{Period (s)}}$	$f = \dfrac{1}{T}$
Wave speed (ms^{-1}) = frequency (Hz) × wavelength (m)	$V = f\lambda$
$\text{Intensity (Wm}^{-3}) = \dfrac{\text{Power (W)}}{\text{Area (m}^{-3})}$	$I = \dfrac{P}{A}$
Observed frequency (Hz) $= \dfrac{\text{speed of sound waves (ms}^{-1})}{\text{speed of sound waves (ms}^{-1}) \pm \text{source velocity(ms}^{-1})} \times \text{source frequency (Hz)}$	$f_0 = \dfrac{v}{v \pm v_s} f_s$
Remaining intensity (Wm^{-3}) = Original intensity (Wm^{-3}) × cos² (angle between polarized light and transmission axis)	$I = I_0 \cos^2 \theta$
Chapter 8: Superposition	
Two fixed ends string	
Fundamental  	$\lambda = 2L$ $f = \dfrac{c}{2L}$
Second harmonic  	$\lambda = L$ $f = \dfrac{c}{L}$
Third harmonic  	$\lambda = \dfrac{2L}{3}$ $f = \dfrac{3c}{2L}$
Both ends closed air column	
	$L = \dfrac{n\lambda}{2}$ $f = \dfrac{nv}{2L}$
One end open air column	
	$L = \dfrac{n\lambda}{4}$ $f = \dfrac{nv}{4L}$
Both ends open air column	
	$L = \dfrac{n\lambda}{2}$ $f = \dfrac{nv}{2L}$
$\text{Wavelength (m)} = \dfrac{\text{slit width (m)} \times \text{distance between two successive lines (m)}}{\text{distance to screen (m)}}$	$\lambda = \dfrac{ax}{D}$
$\text{Wavelength (m)} = \dfrac{\text{slit width (m)} \times \sin\text{ (angle of diffraction)}}{\text{nth order of beam}}$	$\lambda = \dfrac{d \sin\theta}{n}$

Chapter 9: Electricity	
Current (A) $= \frac{\text{charge (C)}}{\text{time (s)}}$	$I = \frac{Q}{t}$
Current (A) = Cross-sectional area (m^2) × number of electrons per m^3 (m^{-3}) × drift velocity (ms^{-1}) x electron charge (C)	$I = Anvq$
Voltage (V) $= \frac{\text{energy transferred (J)}}{\text{charge (C)}}$	$V = \frac{W}{Q}$
Energy transferred (J) = power (W) × time (s)	$W = Pt$
Power (W) = current (A) × voltage (V)	$P = IV$
Power (W) = current² (A) × resistance (Ω)	$P = I^2R$
Voltage (V) = current (A) × resistance (Ω)	$V = IR$
Resistance (Ω) $= \frac{\text{resistivity (Ωm)} \times \text{length (m)}}{area(\text{m}^2)}$ Wires have a circular cross section, area = π × radius²	$R = \frac{\rho\, l}{A}$
Chapter 10: DC Circuits	
e.m.f (V) $= \frac{\text{work done by cell (J)}}{\text{charge (C)}}$	$E = \frac{W}{Q}$
e.m.f (V) = potential difference (V) + current (A) × internal resistance (Ω)	$E = V + Ir$
Resistors in series: Total Resistance (Ω) = sum of individual resistors (Ω)	$R_{total} = R_1+R_2+R_3+\ldots R_n$
Resistors in parallel: $\frac{1}{\text{total resistance (Ω)}} = \frac{1}{\text{sum of individual resistors (Ω)}}$	$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots \frac{1}{R_n}$
Output voltage (V) $= \frac{\text{Resistance of resistor attached to voltmeter (Ω)}}{Total\ resistance\ (Ω)}$ × Input voltage (V)	$V_0 = \frac{R_2}{R_1 + R_2}V$
Chapter 11: Particle Physics	
Alpha: ${}^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$	${}^{A}_{Z}X \rightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}He$
Beta: ${}^{234}_{90}Th \rightarrow {}^{234}_{91}Pa + {}^{0}_{-1}e$	${}^{A}_{Z}X \rightarrow {}_{Z+1}^{A}Y + {}^{0}_{-1}e$
Gamma	${}^{A}_{Z}X \rightarrow {}^{A}_{Z}Y + \gamma$

Chapter 12: Motion in a Circle	
Angular displacement (rad) $= \frac{\text{length of arc (m)}}{\text{radius (m)}}$	$\Delta\theta = \frac{\Delta s}{r}$
Angular speed ($rads^{-1}$) = 2 × π × frequency (Hz)	$\omega = 2\pi f$
Tangential velocity (ms^{-1}) = radius (m) × angular speed ($rads^{-1}$)	$V_t = r\omega$
Centripetal acceleration (ms^{-2}) $= \frac{\text{tangential velocity } (ms^{-1})^2}{\text{radius (m)}}$	$a_c = \frac{v_t^2}{r}$
Centripetal acceleration (ms^{-2}) = radius (m) × angular speed ($rads^{-1}$)^2	$a_c = r\omega^2$
Centripetal force (N) $= \frac{\text{mass (kg)} \times \text{tangential velocity } (ms^{-1})^2}{\text{radius (m)}}$	$F_c = \frac{mv_t^2}{r}$
Centripetal force (N) = mass (kg) × radius (m) × angular speed ($rads^{-1}$)^2	$F_c = mr\omega^2$
Chapter 13: Gravitational Field	
Gravitational field strength (ms^{-2}) $= \frac{\text{Weight (N)}}{mass\ (kg)}$	$g = \frac{F}{m}$
Gravitational force (N) $= \frac{\text{Gravitational constant } (Nm^2kg^{-2}) \times \text{mass of object one (kg)} \times \text{mass of object two (kg)}}{\text{separation}^2 (m^2)}$	$F_G = \frac{Gm_1m_2}{r^2}$
Gravitational field strength (ms^{-2}) $= \frac{\text{Gravitational constant } (Nm^2kg^{-2}) \times \text{mass of object (kg)}}{\text{separation}^2 (m^2)}$	$g = \frac{Gm_1}{r^2}$
Gravitational potential (Jkg^{-1}) $= \frac{-\text{Gravitational constant } (Nm^2kg^{-2}) \times \text{mass of object (kg)}}{\text{separation (m)}}$	$\phi = \frac{-Gm_1}{r}$
Gravitational potential energy (J) $= \frac{\text{Gravitational constant } (Nm^2kg^{-2}) \times \text{mass of object one (kg)} \times \text{mass of object two (kg)}}{\text{separation (m)}}$	$GPE = \frac{Gm_1m_2}{r}$
Chapter 14: Temperature	
Celsius to Kelvin: Temperature in Celsius (°C) = Temperature in Kelvin (K) - 273.15	$T = \theta + 273.15$
Energy (J) = mass (kg) × specific heat capacity ($Jkg^{-1}°C^{-1}$) × temperature change (°C)	$Q = mc\theta$
Energy (J) = mass (kg) × specific latent capacity (Jkg^{-1})	$Q = mL$
Chapter 15: Ideal Gases	
Pressure (Pa) × Volume (m^3) = number of moles × molar gas constant ($m^2\ kg\ s^{-2}\ K^{-1}\ mol^{-1}$) × Temperature (K)	$pV = nRT$
Pressure (Pa) × Volume (m^3) = Number of molecules × Boltzman constant ($J\ K^{-1}$) × Temperature (K)	$pV = NkT$
Mean square speed (ms^{-1})	$\sqrt{\langle c^2 \rangle} = c_{rms}$
Pressure (Pa) × Volume (m^3) = 1/3 × Number of molecules × mass of one molecule of gas (kg) × mean square speed of the molecules (ms^{-1})	$pV = \frac{1}{3} Nm\langle c^2 \rangle$
Kinetic energy (J) = 3/2 × Boltzman constant ($J\ K^{-1}$) × Temperature (K)	$E_K = 3/2\ kT$

Chapter 16: Thermodynamics	
Work (J) = Pressure (Pa) × Change in volume (m^3)	$W = p\Delta V$
Change in internal energy (J) = Energy supplied by heating (J) + Work done on system (J)	$\Delta U = q + W$
Chapter 17: Oscillations	
Angular frequency ($rads^{-1}$) = 2 × π × frequency (Hz)	$\omega = 2\pi f$
Acceleration of an object oscillating in SHM (ms^{-2}) = - angular frequency^2 ($rads^{-1}$)^2 × displacement (m)	$a = -\omega^2 x$
Position (m) = maximum displacement (m) × sin (angular frequency ($rads^{-1}$) × time (s))	$x = x_0 \sin(\omega t)$
Position (m) = maximum displacement (m) × cos (angular frequency ($rads^{-1}$) × time (s))	$x = x_0 \cos(\omega t)$
Speed (ms^{-1}) = maximum speed (ms^{-1}) × cos (angular frequency ($rads^{-1}$) × time (s))	$v = v_0 \cos(\omega t)$
$\text{speed } (\text{ms}^{-1}) = \pm\text{angular frequency } (\text{rads}^{-1}) \times \sqrt{\text{maximum displacement (m)}^2 - \text{position (m)}^2}$	$v = \pm\omega\sqrt{x_0^2 - x^2}$
Total energy of a system (J) = $\frac{1}{2}$ × mass (kg) × angular frequency ($rads^{-1}$)^2 × maximum displacement (m)^2	$E = \frac{1}{2} m \omega^2 x_0^2$
Chapter 18: Electric Fields	
$\text{Electric field strength } (\text{NC}^{-1}) = \frac{\text{Force (N)}}{\text{Charge (C)}}$	$E = \frac{F}{q}$
$\text{Electric field strength } (\text{Vm}^{-1}) = \frac{\text{Potential difference (V)}}{\text{Separation between the plates (m)}}$	$E = \frac{\Delta V}{\Delta d}$
$\text{Electrostatic force (N)} = \frac{\text{point charge one } (C) \times \text{point charge two (C)}}{4 \times \pi \times \text{permittivity of free space } (\text{Fm}^{-1}) \times \text{separation}^2 (\text{m}^2)}$	$F = \frac{Q_1 Q_2}{4\pi\varepsilon_0 r^2}$
$\text{Electric field strength } (\text{Vm}^{-1}) = \frac{\text{point charge } (C)}{4 \times \pi \times \text{permittivity of free space } (\text{Fm}^{-1}) \times \text{separation}^2 (\text{m}^2)}$	$E = \frac{Q}{4\pi\varepsilon_0 r^2}$
$\text{Electric potential (V)} = \frac{\text{point charge (C)}}{4 \times \pi \times \text{permittivity of free space } (\text{Fm}^{-1}) \times \text{separation } (m)}$	$V = \frac{Q}{4\pi\varepsilon_0 r}$
$\text{Electric potential energy (J)} = \frac{\text{point charge one } (C) \times \text{point charge two (C)}}{4 \times \pi \times \text{permittivity of free space } (\text{Fm}^{-1}) \times \text{separation (m)}}$	$EPE = \frac{Q_1 Q_2}{4\pi\varepsilon_0 r}$

Chapter 19: Capacitance	
Capacitance (Farad) $= \frac{\text{Charge (C)}}{\text{Potential difference (V)}}$	$C = \frac{Q}{V}$
Capacitance (Farad) $=$ $4 \times \pi \times$ permittivity of free space $(\mathrm{Fm}^{-1}) \times$ separation (m)	$C = 4\pi\varepsilon_0 r$
Capacitor in parallel: Total capacitance (F) = sum of individual capacitance (F)	$C_{total} = C_1 + C_2 + C_3 + \ldots C_n$
Capacitor in series: $\frac{1}{\text{total capacitance (F)}} = \frac{1}{\text{sum of individual capacitance (C)}}$	$\frac{1}{C_{total}} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots \frac{1}{C_n}$
Elastic stored (Joules) = ½ × Capacitance (F) × Potential difference $(V)^2$	$W = ½ CV^2$
Time constant (s) = resistance (Ω) × capacitance (F)	$\tau = RC$
Equations to determine current, potential difference, and charge left after a certain amount of time	$I = I_0 e^{-\frac{t}{RC}}$ $V = V_0 e^{-\frac{t}{RC}}$ $Q = Q_0 e^{-\frac{t}{RC}}$
Chapter 20: Magnetic Fields	
Force (N) = Magnetic field flux density (Tesla) × Current (A) × Length (m) × sin (angle between conductor and magnetic field)	$F = BIL \sin \theta$
Force (N) = Magnetic field flux density (Tesla) × Charge (C) × speed of charge (ms^{-1}) × sin (angle between charge trajectory and magnetic field)	$F = BQv \sin \theta$
Hall voltage (V) $= \frac{\text{Magnetic field flux density (T)} \times \text{Currrent (A)}}{\text{number density of electrions } (\mathrm{m}^{-3}) \times \text{thickness (m)} \times \text{charge (C)}}$	$v_H = B \frac{I}{ntq}$
Magnetic flux (Webers) = magnetic flux density (T) × area (m^2) × cos (degrees)	$\Phi = BA \cos \theta$
Magnetic flux linkage (Wb turns) = magnetic flux density (T) × area (m^2) × turns of wire × cos (degrees)	$\Phi N = BAN \cos \theta$
Chapter 21: Alternating Current	
Current (A) = Peak current (A) × sin (angular frequency (rads^{-1}) × time (s))	$I = I_0 \sin (\omega t)$
Voltage (V) = Peak voltage (V) × sin (angular frequency (rads^{-1}) × time (s))	$V = V_o \cos (\omega t)$
RMS Current (A) $= \frac{\text{Peak current (A)}}{\sqrt{2}}$	$I_{rms} = \frac{I_0}{\sqrt{2}}$
RMS Voltage (V) $= \frac{\text{Peak voltage (V)}}{\sqrt{2}}$	$V_{rms} = \frac{V_0}{\sqrt{2}}$
Mean power (W) $= \frac{\text{Power (W)}}{2}$	$P_{mean} = \frac{P}{2}$

Chapter 22: Quantum Physics	
Photon energy (J) = Planck's constant (Js) × frequency (Hz)	E = hf
$\text{Momentum (Ns)} = \frac{\text{Energy (J)}}{\text{speed of light (ms}^{-1})}$	$p = \frac{E}{c}$
Photon energy (J) = threshold energy (J) + $\frac{1}{2}$ × mass (kg) × velocity (ms^{-1})^2	$hf = \Phi + 1/2mv^2$
$\text{wavelength (m)} = \frac{\text{Planck's constant (Js)}}{\text{Momentum (Ns)}}$	$\lambda = \frac{h}{p}$
Photon energy (J) = Difference between two energy levels (J)	$hf = E_1 - E_2$
Chapter 23: Nuclear Physics	
Energy (J) = mass defect (kg) × speed of light (ms^{-1})^2	$E = mc^2$
Average decay rate (s) = decay constant (s^{-1}) × number of remaining nuclei	$A = \frac{\Delta N}{\Delta t} = -\lambda N$
$\text{Half life (s)} = \frac{0.693}{\text{decay constant } (s^{-1})}$	$t_{0.5} = \frac{0 \cdot 693}{\lambda}$
Number of remaining nuclei = Original number of nuclei × $e^{-\text{decay constant }(s^{-1})\text{time(s)}}$	$N = N_0 e^{-\lambda t}$
Chapter 24: Medical Physics	
Acoustic impedance (kg m^{-2} s^{-1}) = density (kgm^{-3}) × speed of sound in material (ms^{-1})	Z = ρc
$\frac{\text{Intensity of reflected wave (Wm}^{-2})}{\text{Intensity of incident wave (Wm}^{-2})} = \frac{(\text{impendance of material two (kgm}^{-2}\text{s}^{-1}) - \text{impendanceof material one(kgm}^{-2}\text{s}^{-1}))^2}{(\text{impendance of material two (kgm}^{-2}\text{s}^{-1}) + \text{impendanceof material one(kgm}^{-2}\text{s}^{-1}))^2}$	$\frac{I_r}{I_0} = \frac{(z_2 - z_1)^2}{(z_2 + z_1)^2}$
Intensity (Wm^{-2}) = Intensity of incident beam (Wm^{-2}) × $e^{-\text{absoprtion coefficient }(m^{-1})\text{distance(m)}}$ (for ultrasound and x-ray)	$I = I_0 e^{-\mu x}$
Chapter 25: Astronomy and Cosmology	
$\text{Radiant flux intensity (Wm}^{-2}) = \frac{\text{Luminosity (W)}}{4 \times \pi \times \text{distance}^2(\text{m}^2)}$	$F = \frac{L}{4\pi d^2}$
Wavelength (m) × temperature (K) = $2 \cdot 9 \times 10^{-3}$	$\lambda_{nax}T = 2 \cdot 9 \times 10^{-3}$
Luminosity (W) = 4 × π × radius^2 (m^2) × Stefan-Boltzmann constant ($Wm^{-2}K^{-4}$) × temperature^4 (K)^4	$L = 4\Pi r^2 \sigma T^4$
$\frac{\text{shift in wavelength (m)}}{\text{source wavelength (m)}} = \frac{\text{shift in frequency (Hz)}}{\text{source frequency (Hz)}} = \frac{\text{speed of recession (ms}^{-1})}{\text{speed of light (ms}^{-1})}$	$\frac{\Delta\lambda}{\lambda} = \frac{\Delta f}{f} = \frac{v}{C}$
Velocity (ms^{-1}) = Hubble's constant (s^{-1}) × distance (m)	$v = H_0 d$