

AS Level Physics Formula Sheet

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1 Kinematics

1.1 Speed, Velocity and Acceleration

$$s = \frac{\Delta d}{\Delta t}$$

$$\vec{v} = \frac{\Delta \vec{s}}{\Delta t}$$

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$$

$$\vec{a}_{avg} = \frac{\text{total displacement}}{\text{total time taken}}$$

1.2 Equations of Motion (SUVAT)

$$\vec{v} = \vec{u} + \vec{a}t$$

$$\vec{s} = \vec{u}t + \frac{1}{2}\vec{a}t^2$$

$$\vec{s} = \vec{v}t - \frac{1}{2}\vec{a}t^2$$

$$\vec{v}^2 = \vec{u}^2 + 2\vec{a}\vec{s}$$

$$\vec{s} = \left(\frac{\vec{u} + \vec{v}}{2}\right)t$$

2 Projectile Motion

2.1 Maximum Height

$$H_{max} = \frac{\vec{u}^2 \sin^2 \theta}{2g}$$

2.2 Time of Flight

$$T = \frac{2\vec{u} \sin \theta}{g}$$

2.3 Horizontal Range

$$R = \frac{2\vec{u}^2 \sin \theta \cos \theta}{g}$$

$$R = \frac{\vec{u}^2 \sin(2\theta)}{g}$$

3 Dynamics

3.1 Newton's Laws

$$\vec{p} = m\vec{v}$$

$$\vec{F} = \frac{\Delta\vec{p}}{t}$$

$$\vec{F} = \frac{m(\vec{v} - \vec{u})}{t}$$

$$\vec{F} = m\vec{a}$$

3.2 Equilibrium

$$\Sigma\vec{F} = 0$$

$$\Sigma\tau = 0$$

3.3 Moments

$$\tau = \vec{F} \cdot d$$

$$\Sigma M_{cw} = \Sigma M_{acw}$$

3.4 Principle of Conservation of Momentum

$$\vec{p}_f = \vec{p}_i$$

3.5 Elastic Collision

$$m_1\vec{u}_1 + m_2\vec{u}_2 = m_1\vec{v}_1 + m_2\vec{v}_2$$

$$\frac{1}{2}m_1\vec{u}_1^2 + \frac{1}{2}m_2\vec{u}_2^2 = \frac{1}{2}m_1\vec{v}_1^2 + \frac{1}{2}m_2\vec{v}_2^2$$

3.6 Kinetic Energy and Momentum

$$E_k = \frac{\vec{p}}{2m}$$
$$\frac{1}{2}m\vec{v}^2 = \frac{\vec{p}}{2m}$$

4 Work, Power, Energy

4.1 Gravitational Potential Energy

$$E = mgh$$
$$\Delta E = mg\Delta h$$

4.2 Kinetic Energy

$$E = \frac{1}{2}m\vec{v}^2$$

4.3 Work

Note: if the object is not moving at an angle, $\theta = 0$ and $\cos\theta = 1$

$$W = \vec{F} \cdot \vec{s} \cos\theta$$

4.4 Power

$$P = \frac{W}{t} = \frac{E}{t}$$
$$P = \vec{F} \cdot \vec{v}$$

4.5 Efficiency

$$\eta = \frac{E_o}{E_i}$$
$$\eta = \frac{W_o}{W_i}$$
$$\eta = \frac{P_o}{P_i}$$

5 Fluid Dynamics

5.1 Density

$$\rho = \frac{m}{V}$$

5.2 Pressure

$$P = \frac{F}{A}$$

5.3 Hydrostatic Pressure

$$P = \rho gh$$
$$\Delta P = \rho g \Delta h$$

5.4 (*) Stoke's Law

Note: This is an extension of the CAIE 9702 Physics syllabus, we will only be using this equation to derive a relation.

$$\vec{F}_v = 6\pi a\eta\vec{v}$$

We can see that the force experienced due to the viscosity \vec{F}_v , of the liquid is directly proportional to the speed \vec{v} .

6 Deformation of Solids

6.1 Hooke's Law

$$\vec{F} = kx$$

6.2 Combination of Springs (Series)

$$\Sigma x = x_1 + x_2 + \dots + x_n$$

$$x_n = \frac{\vec{F}}{k_n}$$

$$x_1 + x_2 + \dots + x_n = \frac{\vec{F}}{k_1} + \frac{\vec{F}}{k_2} + \dots + \frac{F}{k_n}$$

$$\vec{F} = \left(\frac{1}{\Sigma K} \right) = \vec{F} \left(\frac{1}{k_1} + \frac{1}{k_2} + \dots + \frac{1}{k_n} \right)$$

$$\vec{F} \left(\frac{1}{\Sigma K} \right) = \vec{F} \left(\frac{1}{k_1} + \frac{1}{k_2} + \dots + \frac{1}{k_n} \right)$$

$$\frac{1}{\Sigma K} = \frac{1}{k_1} + \frac{1}{k_2} + \dots + \frac{1}{k_n}$$

6.3 Combination of Springs (Parallel)

$$\vec{F} = kx$$

$$\Sigma \vec{F} = \vec{F}_1 + \vec{F}_2 + \dots + \vec{F}_n$$

$$\Sigma \vec{F} = k_1x + k_2x + \dots + k_nx$$

$$\Sigma \vec{F} = (k_1 + k_2 + \dots + k_n)x$$

$$\Sigma k = k_1 + k_2 + \dots + k_n$$

6.4 Elastic Potential Energy

$$E_p = \frac{1}{2} \vec{F}x$$

$$E_p = \frac{1}{2} kx^2$$

6.5 Stress

Stress is essentially another word for pressure, however pressure is used when talking about fluids, and stress when talking about solids.

$$\sigma = \frac{F}{A}$$

6.6 Tensile Strain

Tensile Strain is the only type of strain in syllabus.

$$\text{strain} = \frac{\Delta l}{l}$$

6.7 Young's Modulus

$$E = \frac{\vec{F}L}{Ax}$$

7 Electricity

7.1 Electric Current

$$I = \frac{Q}{t}$$

$$I = \frac{ne}{t}$$

7.2 Drift Velocity

$$I = nA\bar{v}_d e$$
$$\bar{v}_d = \frac{1}{nAe}$$

7.3 Potential Difference

$$V = \frac{E}{Q}$$
$$V = \frac{W}{Q}$$

7.4 Electrical Resistance

$$R = \frac{V}{I}$$

7.5 Electric Power

$$P = VI$$
$$P = I^2 R$$
$$P = \frac{V^2}{R}$$

7.6 Electric Energy

$$E = I^2 R t$$
$$E = \frac{V^2 t}{R}$$

7.7 Resistivity

$$\rho = \frac{RA}{L}$$

7.8 Internal Resistance

$$E = IR + Ir$$
$$E = I(R + r)$$

7.9 Kirchhoff's Current Law (KCL)

$$\Sigma I = 0$$
$$I_{in} = I_{out}$$

7.10 Kirchhoff's Voltage Law (KVL)

$$\Sigma E = \Sigma V$$

$$\Sigma E = \Sigma(IR)$$

7.11 Combined Resistance (Series)

$$\Sigma R = R_1 + R_2 + \dots + R_n$$

7.12 Combined Resistance (Parallel)

$$\frac{1}{\Sigma R} = \frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_n}$$

7.13 Potential Dividers

Note: Here V_1 is the voltage of the top resistor, and V_2 is the voltage of the bottom resistor.

$$V_1 = \left(\frac{V}{R_1 + R_2} \right) \cdot R_1$$

$$V_2 = \left(\frac{V}{R_1 + R_2} \right) \cdot R_2$$

8 Waves

8.1 Wave Equation

$$\vec{v} = f\lambda$$

8.2 Doppler Effect of Sound Waves

$$f = f_o \left(\frac{v}{v \pm v_s} \right)$$

8.3 Malu's Law

$$I = I_o \cos^2 \theta$$

8.4 (*) Intensity of a Wave

This is not a required formula to know, only the relation we can derive from it.

$$I = 2\pi^2 f^2 A^2 \rho \vec{v}$$

We can see that intensity is directly proportional to amplitude squared (A^2) as well as a few other relations.

8.5 Relation of Phase and Path Difference

Here Δx is the path difference

$$\phi = \frac{2\pi}{\lambda} \cdot \Delta x$$

8.6 Constructive Interference

$$\phi = 2n\pi$$

8.7 Destructive Interference

$$\phi = (2n + 1)\pi$$

8.8 Young's Double-Slit Experiment

$$\lambda = \frac{ax}{D}$$

8.9 Diffraction at an angle

$$\lambda = \frac{d \sin \theta}{n}$$

$$d = \frac{1}{c}$$

8.10 Stationary Waves: Closed Pipe

For $n = 0, 1, 2, 3, \dots$

$$L = \frac{(2n + 1)\lambda}{4}$$

8.11 Stationary Waves: Open Pipe

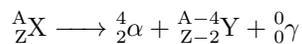
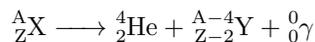
For $n = 1, 2, 3, \dots$

$$L = \frac{n\lambda}{2}$$

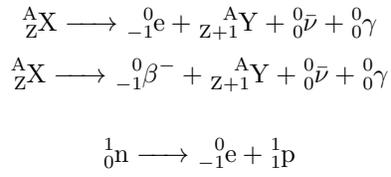
9 Particle Physics

9.1 α Decay

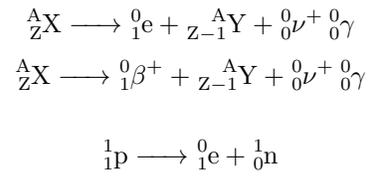
Note: Here ${}^0_0\gamma$ is the energy released, you will learn about this in A2.



9.2 β^- Decay



9.3 β^+ Decay



9.4 γ Decay

