O Level Physics Formula Sheet

Measurements

Base SI Units Kg, m, s, A, K, mol	Mass SI Unit is Kilogram (kg). Length SI unit is metre (m). Time SI Unit is second (s). Current SI unit is Ampere (A). Temperature SI unit is Kelvin (K). Amount of substance is molar (mol).
Number Prefix n (10^{-9}), μ (10^{-6}), m (10^{-3}), c (10^{-2}), d (10^{-1}), K (10^{3}), M (10^{6})	nano (n), micro (μ), milli (m), centi ©, deci (d), kilo (K), mega (M).

Equations in Motion

Average Speed **s** = Δd / Δt	d=distance, t= time
Average Velocity **v** = Δx/Δt slope of distance-time graph **Acceleration** **A** = Δ**v**/Δt	x = displacement, t= time,
v = u + at **x** = ut + ½ at^2 $\mathbf{v}^2 = u^2 + 2ax$ **v** = $\sqrt{2gh}$	u=initial velocity g =gravitational constant=9.81 m/s^2 h = height

Newton's Laws of Motion

Newton's First Law $\sum \vec{F} = 0$	At equilibrium, the body continues to stay in its state of rest or of uniform speed as long as no net force and no net torque is acting on the body.
Newton's Second Law F= ma	The acceleration of an object is directly proportional to the net force acting on it and inversely proportional to its mass.
Newton's Third Law	For every force object A acts on object B, object B will exert an equal and opposite force on object A.

Forces and Torque

Reaction Forces	Acting in opposite direction. For example, the ground will give a reaction force that is equivalent to the man's weight.
Force Resolution on Inclined Plane $F_{horizontal}$ = F cos Θ $F_{vertical}$ = F sin Θ	Θ is the angle between the horizontal surface and the inclined plane.
Moment of Force m = F d	Moment m is the product of force F and perpendicular distance from the pivot d.
Rotational Balance Anticlockwise Moment = Clockwise Moment	Condition for body in rotational balance

Mass, Weight, Density and Pressure

Weight **w** = mg	Weight w is the product of mass by gravitational field strength
Density $d = \frac{m}{V}$	Density d is given by the ratio of mass m over volume V.
Pressure $P = \frac{F}{A}$	Pressure P is the ratio of force F over area A.
Pressure of liquid column P = ρgh	Pressure h is proportional to density ρ, height of column h and gravitational field strength g.

Work and Energy

Work Done **W** = Fd	F= force, d= distance θ=angle between Force & distance
Power **P**= W/t = Fv	t=time
Kinetic Energy $E_k = \frac{1}{2}mv^2$	M=mass v=velocity
Gravitational Energy E_p = mgh	g = gravity=9.81 m/s h = height
Conservation of Energy $E_1 = E_2$	E_1=Energy Before, E_2=Energy After Energy cannot be created or destroyed, only transformed or converted into other forms. The total energy of a closed system remains the same.

Thermal Energy

Thermal Energy & Specific Heat Capacity **E=** m s ΔT	Energy is required to increase the temperature of matter. m is the mass, s is the specific heat capacity and T is the temperature.
Thermal Energy & Latent Heat For melting, $E = m L_{fusion}$ For boiling, $E = m L_{vaporization}$	Energy is required to matter to change state. L_{fusion} is the latent heat of fusion while $L_{vaporization}$ is the latent heat of vaporization. m is the mass.

Waves

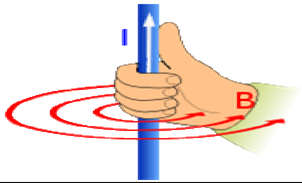
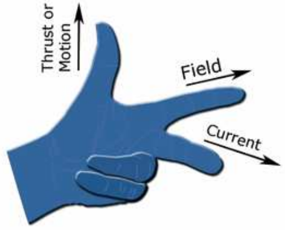
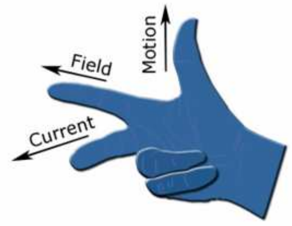
Wave Velocity v = f λ	The velocity of a wave v is the product of its frequency f and wavelength λ.
Period $T = \frac{1}{f}$	Period T is the inverse of frequency f.

Light and Optics	
Law of Reflection $\theta_1 = \theta_2$	The angle of incident Θ_1 is equal to the angle of reflection Θ_2. Both are with respect to the perpendicular normal of the surface of the mirror.
Snell's Law (refraction) $n_1 \sin\theta_1 = n_2 \sin\theta_2$	The angle of incident Θ_1 and angle of refraction Θ_2 is with respect to the perpendicular normal of the surface between the two medium.
Critical Angle $\sin\theta_c = \frac{n_2}{n_1}$	The critical angle θc is the angle of incidence beyond which total internal reflection occurs. The index of refraction for the medium in which the incident ray is traveling is n_1, the index of refraction for the second medium which the refracted ray is traveling is n_2.
Index of Refraction $n = \frac{c}{v}$	The higher the index of refraction is for a medium, the slower is the speed of light v in the medium. c is the speed of light in vacuum.
The Lens Equation $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$	The focal length of the lens f is: • Positive for a converging lens • Negative for a divergent lens The object distance d_o is: • Positive if it is on the side of the lens from which the light is coming • Negative if on the opposite side The image distance d_i is: • Positive if it is on the opposite side of the lens from which the light is coming • Negative if on the same side
Magnification $m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$	For an upright image, the magnification m is positive and for an inverted image m is negative.

Focal Length of a mirror $f = \frac{1}{2}r$	For a spherical mirror, the focal length is half of the radius of curvature.

Electronic Circuits	
Current **I** = ΔC / Δt	C=Charge t=time
Ohm's Law Resistance R = V / I	V=voltage, R= resistance, I = current
Resistance of a wire **R** = ρL/A	ρ = resistivity L = length of wire A = cross sectional area
Electric Power **P** = VI $= V^2/R$ $= I^2R$	Combining ohm's law the power P can be calculated using any combination of these three equation variations.
Electrical Energy **E** = Pt = VIt	Electrical energy can be calculated by the product of power and time.
Root Mean Square Voltage & Current & Power $V_{rms} = \frac{V_o}{\sqrt{2}}, I_{rms} = \frac{I_o}{\sqrt{2}}$ $P_{rms} = I_{rms}^2 R = \frac{I_0^2 R}{2} = \frac{1}{2}P$	For an AC circuit, the root-mean-square (rms) values can be calculated from the peak values. $P_{rms} = 0.5\ P_{max}$
Resistance in Series $R_{total} = R_1 + R_2 + R_3$	Resistance in series adds up. Having more obstacles along the path for current means more resistance.
Resistance in Parallel $\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$	Resistance in parallel takes the reciprocal. Parallel path for current to go through means lesser resistance.
Kirchhoff's First Law $\sum^{incoming} I = \sum^{outgoing} I$	Sum of all incoming currents at a junction is the same as sum of all the outgoing current at a junction.
Kirchoff's Second Law	Sum of all potential difference V in components of a circuit is equal to the electromotive force EMF

$\sum V = EMF$	supplied by the power supply.

Electromagnetism	
Transformer $\frac{V_p}{Vs} = \frac{n_p}{n_s}$	The ratio of the voltage V_p and V_s in a transformer is proportional to the ratio of the number of coils n_p and n_s.
Right Hand Grip Rule I is the current. B is the magnetic field.	
Fleming's Left Hand Rule (Motor Rule) Thumb is for the motion. Index finger is for the magnetic field. Second finger is for the current.	
Fleming's Right Hand Rule (Generator) Thumb is for the motion. Index finger is for the magnetic field. Second finger is for the current.	

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