‘O’ Level Physics Formula Sheet

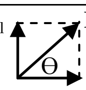
Measurements

Base SI Units Kg m s A K mol	 SI Unit for mass: Kilogram SI Unit for length: metre SI Unit for time: second SI Unit for current: Ampere SI Unit for Temperature: Kelvin SI Unit for Amount of substance: molar
Number Prefix n (10^{-9}) μ (10^{-6}) m (10^{-3}) c (10^{-2}) d (10^{-1}) K (10^{3}) M (10^{6})	 nano micro milli centi deci Kilo Mega

Kinematics

Average Speed **s** = Δd / Δt **Average Velocity** **v** = Δx/Δt **Acceleration** **a** = Δ**v**/Δt	Δd = total distance travelled (area under speed-time graph) Δx = total displacement Δt = total time taken Δ**v** = change in velocity **Velocity** (slope of displacement-time graph) **Acceleration** (slope of velocity-time graph)
$v = u + at$ $x = ut + ½ at^2$ $v^2 = u^2 + 2ax$ $v_{free\ fall} = \sqrt{2gh}$	u = initial velocity v = final velocity t = time a = acceleration x = displacement h = height g = gravitational constant = 9.81 m/s^2

Dynamics

Newton’s First Law $\sum \vec{F} = 0$ at equilibrium	A body continues to stay in its state of rest or uniform motion in a straight line as long as there is no net force/moment 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 giving rise to **Reaction/Normal Forces**
Resolving forces $F_{horizontal} = F_r \cos \Theta$ $F_{vertical} = F_r \sin \Theta$	

Mass, Weight, Density

Weight **w** = mg	w = Weight m = mass g = gravitational field strength
Density $\rho = \frac{m}{V}$	ρ = density m = mass V = volume

Turning effect of Force

Moment of Force M = F d	M = Moment F = force d = ⊥ distance from force to pivot
Principle of Moment Σ Anticlockwise Moment = Σ Clockwise Moment	For a body in rotational equilibrium, Sum of ACW Moment = sum of CW Moment

Pressure

Pressure $P = \frac{F}{A}$	P = Pressure F = Force over area, A A = Area
Pressure of liquid column **P** = hρg	P = Pressure ρ = density, h = height of liquid column g = gravitational field strength.

Energy, Work and Power

Work Done **W** = Fd	W = work done F= force d= distance in direction of force
Power **P** = W/t = Fv	Work done per unit time, t
Kinetic Energy $E_k = \frac{1}{2}mv^2$	E_k = Kinetic Energy m = mass v = velocity
Gravitational Potential Energy $E_p = mgh$	g = gravity =9.81 m/s h = height m = mass
Conservation of Energy $E_1 = E_2$	E_1 = Total Energy Before E_2 = Total Energy After Energy cannot be created or destroyed. It can only be transformed or converted into other forms.

Kinetic Model of Matter

Ideal Gas Law PV ∞ T $P_1V_1 = P_2V_2$	P = pressure of fixed mass of gas V = volume occupies by fixed mass of gas T = Temperature of gas Subscript 1 = initial state Subscript 2 = final state

Thermal Properties of Matter

Specific Heat Capacity **E** = m c ΔT	c = Specific heat capacity (Energy required to raise the temperature of 1kg of the object by 1 °C) m = mass ΔT = change in temperature.
Latent Heat For melting, $E = m L_{fusion}$ For boiling, $E = m L_{vaporization}$	L_{fusion} = latent heat of fusion (Energy required to change 1kg of solid to liquid at the constant temp) $L_{vaporization}$ = latent heat of vaporization (Energy required to change 1kg of liquid to gas at the constant temp) m = mass

General Wave Properties

Wave Velocity **v** = f λ	v = velocity of a wave f = frequency λ = wavelength
Wave frequency $f = \frac{1}{T}$	T = Period f = frequency

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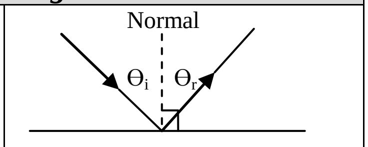
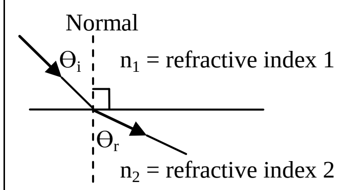
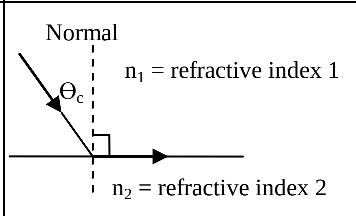
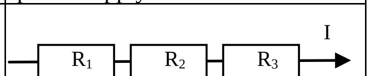
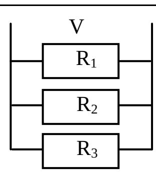
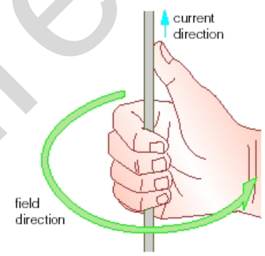
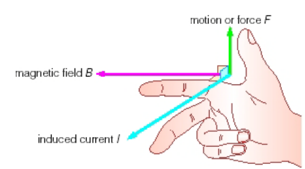
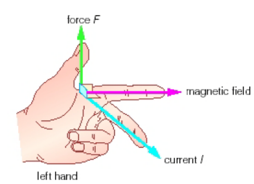
Light	
Law of Reflection $\Theta_i = \Theta_r$ Θ_i = angle of incidence Θ_r = angle of reflection	
Snell’s Law (refraction) $n_1 \text{Sin } \Theta_i = n2\text{Sin } \Theta_r$ Θ_i = angle of incidence Θ_r = angle of refraction	
Critical angle $\sin \boldsymbol{\Theta_c} = \frac{n_2}{n_1}$ (special case of Snell’s law where $\Theta_r = 90°$)	
Refractive Index $\mathbf{n} = \frac{c}{v}$ (n of air ≈ 1)	c = speed of light in vacuum. v = speed of light in medium Higher reflective index of a medium means light travel slower in the medium
Magnification $\mathbf{M} = \frac{h_i}{h_o} = \frac{d_i}{d_o}$	M = magnification h = height d = distance from lens Subscript i = image Subscript o = object

Current of Electricity	
Current **I** = Q / Δt	Current = rate of flow of charges Q = 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

D.C. Circuits	
Kirchoff’s 1st Law $\sum I_{in} = \sum I_{out}$	Conservation of charges. $\sum I_{in}$ = Sum of current going into a junction $\sum I_{out}$ = Sum of current going out of a junction
Kirchoff’s 2nd Law $\sum V = \text{E.M.F}$	∑V = Sum of potential difference V across all components in a circuit E.M.F = Voltage supplied by the power supply.
Resistance in Series $R_{total} = R_1 + R_2 + R_3$	
Resistance in Parallel $\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$	

Practical Electricity	
Electric Power **P** = VI = V^2/R = I^2R	P = Power V = voltage R = resistance I = current
Electrical Energy **E** = Pt = (VI)t	E = energy output P = power t = time V = voltage I = current

Electromagnetism	
Transformer $\frac{V_p}{V_s} = \frac{N_p}{N_s}$ **(ideal transformer)** $V_pI_p = V_sI_s$	V = voltage N = number of coils I = current Subscript p = primary coil Subscript s = secondary coil
Right hand grip	
Fleming’s Right Hand Rule	
Fleming’s Left Hand Rule	

GCE Compilation