‘O’ Level Physics Formula Sheet

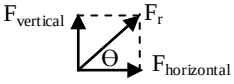
Measurements

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

Kinematics

Average Speed $\mathbf{s} = \Delta d / \Delta t$	Δd = total distance travelled (area under speed-time graph)
	Δx = total displacement
Average Velocity	Δt = total time taken
$\mathbf{v} = \Delta x/\Delta t$	Δ**v** = change in velocity
Acceleration	**Velocity** (slope of displacement-time graph)
$\mathbf{a} = \Delta v/\Delta t$	**Acceleration** (slope of velocity-time graph)
$\mathbf{v} = u + at$	u = initial velocity
$\mathbf{x} = ut + \frac{1}{2}at^2$	v = final velocity
$\mathbf{v}^2 = u^2 + 2ax$	t = time
	a = acceleration
	x = displacement
$\mathbf{v_{free\ fall}} = \sqrt{2gh}$	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 $\mathbf{w} = mg$	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 $\mathbf{P} = \frac{F}{A}$	P = Pressure F = Force over area, A A = Area
Pressure of liquid column $\mathbf{P} = h\rho g$	P = Pressure ρ = density, h = height of liquid column g = gravitational field strength.

Energy, Work and Power

Work Done $\mathbf{W} = Fd$	W = work done F= force d= distance in direction of force
Power $\mathbf{P} = W/t = Fv$	Work done per unit time, t
Kinetic Energy $\mathbf{E_k} = \frac{1}{2}mv^2$	E_k = Kinetic Energy m = mass v = velocity
Gravitational Potential Energy $\mathbf{E_p} = mgh$	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 $PV \propto T$	P = pressure of fixed mass of gas V = volume occupies by fixed mass of gas T = Temperature of gas
$P_1V_1 = P_2V_2$	Subscript 1 = initial state Subscript 2 = final state

Thermal Properties of Matter

Specific Heat Capacity $\mathbf{E} = m\,c\,\Delta T$	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, $\mathbf{E} = m\,L_{fusion}$ For boiling, $\mathbf{E} = m\,L_{vaporization}$	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 $\mathbf{v} = f\lambda$	v = velocity of a wave f = frequency λ = wavelength
Wave frequency $\mathbf{f} = \frac{1}{T}$	T = Period f = frequency

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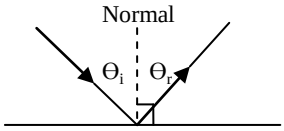
Light

Law of Reflection
$\Theta_i = \Theta_r$

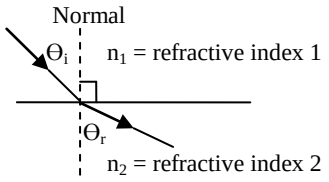
Θ_i = angle of incidence
Θ_r = angle of reflection



Snell’s Law (refraction)

$n_1 \text{Sin}\ \Theta_i = n2\text{Sin}\ \Theta_r$

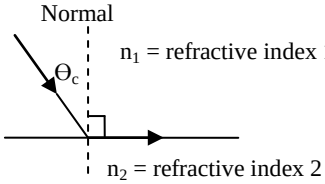
Θ_i = angle of incidence
Θ_r = angle of refraction



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

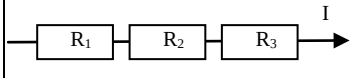
Kirchoff’s 2nd Law

$\sum V = \text{E.M.F}$

$\sum V$ = Sum of potential difference V across all components in a circuit
E.M.F = Voltage supplied by the power supply.

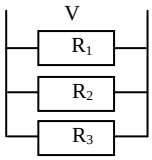
Resistance in Series

$R_{total} = R_1 + R_2 + R_3$



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

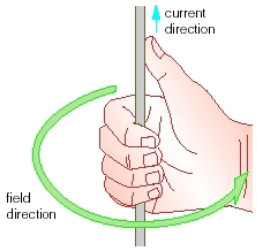
E = energy output
P = power
t = time
V = voltage
I = current

Electromagnetism

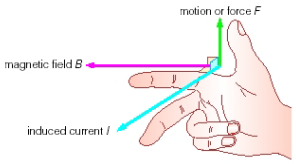
Transformer
$\frac{V_p}{V_s} = \frac{N_p}{N_s}$
(ideal transformer)
$V_pI_p = V_sI_s$

V = voltage
N = number of coils
I = current
Subscript p = primary coil
Subscript s = secondary coil

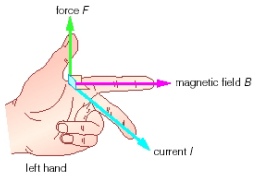
Right hand grip



Fleming’s Right Hand Rule



Fleming’s Left Hand Rule



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1. PHYSICS Ordinary Level (Syllabus 5058)
2. Education Haven (http://matchtutor.com.sg)