# 'O' Level Physics Formula Sheet

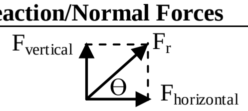
## *Measurements*

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

## *Dynamics*

| | |
|---|---|
| **Newton's First Law**<br>$\sum \vec{F} = 0$ 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**<br>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**<br>$F_{horizontal} = F_r \cos \Theta$<br>$F_{vertical} = F_r \sin \Theta$ |  |

## *Mass, Weight, Density*

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

## *Turning effect of Force*

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

## *Pressure*

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

## *Energy, Work and Power*

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

## *Kinetic Model of Matter*

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

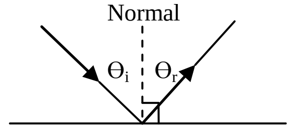
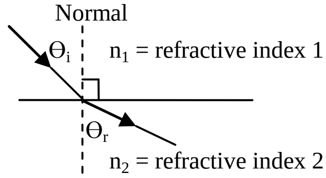
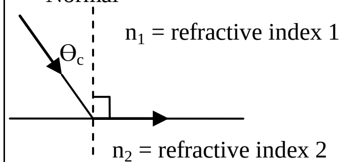
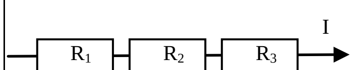
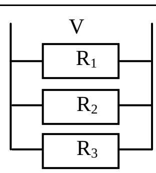
## *Thermal Properties of Matter*

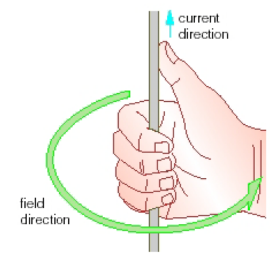
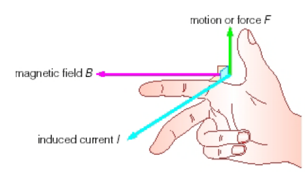
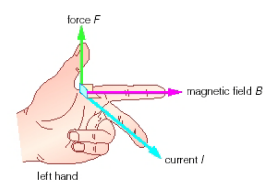
| | |
|---|---|
| **Specific Heat Capacity**<br>**E =** m c ΔT | c = Specific heat capacity (Energy required to raise the temperature of 1kg of the object by 1 °C)<br>m = mass<br>ΔT = change in temperature. |
| **Latent Heat**<br>For melting,<br>**E** = m $L_{fusion}$<br><br>For boiling,<br>**E** = m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

## *General Wave Properties*

| | |
|---|---|
| **Wave Velocity**<br>**v** = f λ | v = velocity of a wave<br>f = frequency<br>λ = wavelength |
| **Wave frequency**<br>$\mathbf{f} = \frac{1}{T}$ | T = Period<br>f = frequency |

# ‘O’ Level Physics Formula Sheet

| *Light* | |
|---|---|
| **Law of Reflection**<br>$\Theta_i = \Theta_r$<br><br>$\Theta_i$ = angle of incidence<br>$\Theta_r$ = angle of reflection |  |
| **Snell’s Law (refraction)**<br><br>$n_1 \text{Sin } \Theta_i = n2 \text{Sin } \Theta_r$<br><br>$\Theta_i$ = angle of incidence<br>$\Theta_r$ = angle of refraction |  |
| **Critical angle**<br><br>$\sin \boldsymbol{\Theta_c} = \frac{n_2}{n_1}$<br><br>(special case of Snell’s law where $\Theta_r$ = 90°) |  |
| **Refractive Index**<br>$\mathbf{n} = \frac{c}{v}$<br><br>(n of air ≈ 1) | c = speed of light in vacuum.<br>v = speed of light in medium<br>Higher reflective index of a medium means light travel slower in the medium |
| **Magnification**<br>$\mathbf{M} = \frac{h_i}{h_o} = \frac{d_i}{d_o}$ | M = magnification<br>h = height<br>d = distance from lens<br>Subscript i = image<br>Subscript o = object |
| ***Current of Electricity*** | |
| **Current**<br>**I** = Q / Δt | Current = rate of flow of charges<br>Q = Charge<br>t=time |
| **Ohm’s Law**<br>**Resistance**<br>**R** = V / I | V = voltage,<br>R = resistance<br>I = current |
| **Resistance of a wire**<br>**R** = ρL/A | ρ = resistivity<br>L = length of wire<br>A = cross sectional area |
| ***D.C. Circuits*** | |
| **Kirchoff’s 1st Law**<br><br>$\sum I_{in} = \sum I_{out}$ | Conservation of charges.<br>$\sum I_{in}$ = Sum of current going into a junction<br>$\sum I_{out}$ = Sum of current going out of a junction |
| **Kirchoff’s 2nd Law**<br><br>$\sum V = \text{E.M.F}$ | ∑V = Sum of potential difference V across all components in a circuit<br>E.M.F = Voltage supplied by the power supply. |
| **Resistance in Series**<br><br>$R_{total} = R_1 + R_2 + R_3$ |  |
| **Resistance in Parallel**<br><br>$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ |  |

| *Practical Electricity* | |
|---|---|
| **Electric Power**<br><br>**P** = VI = $V^2$/R = $I^2$R | P = Power<br>V = voltage<br>R = resistance<br>I = current |
| **Electrical Energy**<br>**E** = Pt = (VI)t | E = energy output<br>P = power<br>t = time<br>V = voltage<br>I = current |
| ***Electromagnetism*** | |
| **Transformer**<br>$\frac{V_p}{V_s} = \frac{N_p}{N_s}$<br>**(ideal transformer)**<br>$V_pI_p = V_sI_s$ | V = voltage<br>N = number of coils<br>I = current<br>Subscript p = primary coil<br>Subscript s = secondary coil |
| **Right hand grip** |  |
| **Fleming’s Right Hand Rule** |  |
| **Fleming’s Left Hand Rule** |  |

MEGA LECTURE

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