**MOTION**

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| **QUANTITY / LAW** | **FORMULA / WORDING** | **UNIT** |
| *Velocity (v)* | Displacement / Time | m/s or ms-1 |
| *Speed (s)* | Distance / Time |
| *Acceleration (a) or Deceleration* | Δ Velocity / Δ Time | m/s2 or ms-2 |
| *Gradient/Slope of a Graph* | y2 – y1  x2 – x1 | y-unit  x-unit |
| *Displacement*  *(in v-t graph)* | Calculate area of shape under required portion of given v-t graph. | m |
| *Displacement (if trapezium)* | ½ x (sum of parallel sides of trapezium) x height | m |
| *Newton’s 1st Law (Law of Inertia)* | An object at rest remains at rest, or an object in motion remains in motion in a straight line at constant velocity, unless acted upon by an external force. | |
| *Newton’s 2nd Law* | Force = Mass x Acceleration  (F = ma) | |
| *Newton’s 3rd Law* | For every action force, there is an equal and opposite reaction force. | |
| *Momentum (p)* | Mass x Velocity  (p = m x v) | kg m/s or kg ms-1 |
| *Law of Conservation of Linear Momentum* | For perfectly elastic objects, the total momentum before collision is equal to the total momentum after collision.  (mv)before = (mv)after | |

**ENERGY**

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| **QUANTITY / LAW** | **FORMULA / WORDING** | **UNIT** |
| *Work, or Energy (E)* | Force x Distance | J or Nm |
| *Power (P)* | Energy / Time | W or J/s |
| *Kinetic Energy (KE)* | KE = ½ mv2 | J |
| *Gravitational Potential Energy (GPE)* | Mass x gravitational force x height  ( GPE = mgh ) | J |
| *Law of Conservation of Energy* | Energy can neither be created nor destroyed, but can only be converted into different forms | |
| *Efficiency* | Useful output x 100%  Input | % |
| *Energy Used (in a circuit or heater)* | E = I x V x t or E = P x t | J |

**STATICS**

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| **QUANTITY / LAW** | **FORMULA / WORDING** | **UNIT** |
| *Weight (w)* | Mass x Acceleration due to Gravity (~10 ms-2) (w=mg) | N or  kg ms-2 |
| *Density (*ρ*)* | Mass / Volume  (ρ = m / v ) | kg/m3 or g/cm3 |
| *Relative density* | ρ(substance)/ρ(reference) | No unit. |
| *Archimedes’ Principle* | The volume of fluid displaced by an object is equal to the volume of said object. | |
| *Moment of a force* | Force x (Perpendicular distance from fulcrum) | J or Nm |
| *Principle of Moments* | For a system in equilibrium, the sum of anti-clockwise moments is equal to the sum of clockwise moments.  (F1D1 = F2D2) | |
| *Hooke’s Law* | The extension of a spring is directly proportional to the load attached until it reaches its elasticity limit.  F = kx  (F = Force, k = gradient, x = extension) | |

**PRESSURE**

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| **QUANTITY / LAW** | **FORMULA / WORDING** | **UNIT** |
| *Pressure against a surface (P)* | Force / Surface Area  P = F / A | Pa or N/m2 |
| *Pressure in a fluid (P)* | Density x Depth x Gravitational Force *(*ρ*hg)* | Pa or N/m2 |
| *Pascal’s Law* | The pressure exerted at a given point in an incompressible fluid is distributed equally through all points in the fluid. | |
| *Boyle’s Law* | The volume of a gas is inversely proportional to the pressure, given that temperature is constant.  (P1V1 = P2V2) or PV = k | |
| *Charles’ Law* | The volume of a gas is directly proportional to its temperature, given that pressure is constant.  (V1 / T1 = V2 / T2) or V/T = k | |
| *Pressure Law* | The temperature of a gas is directly proportional to its pressure, given that volume is constant.  (P1 / T1 = P2 / T2) or P/T = k | |
| *Complete Gas Equation* | P1V1 = P2V2  (all three gas laws in one)  T1 T2 | |

**THERMODYNAMICS**

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| **QUANTITY / LAW** | **FORMULA / WORDING** | **UNIT** |
| *Specific Heat Capacity (c)* | The amount of heat 1kg of a substance can absorb before its temperature rises by 1K.  (E = mcΔ*Ө*) | J/kg K or  J kg-1 K-1 |
| *Heat Capacity (C)* | Mass x Specific Heat Capacity | J/K |
| *Specific Latent Heat of Fusion (Lf)* | The amount of heat 1kg of a substance can absorb to convert it from a solid to liquid without changing its temperature. (E = mLf) | J/kg  or J kg-1 |
| *Specific Latent Heat of Vapourization (Lv)* | The amount of heat 1kg of a substance can absorb to convert it from a liquid to gas without changing its temperature. (E = mLv) | J/kg  or J kg-1 |
| *Kinetic Theory of Matter* | When heated, the bonds between molecules break, causing the molecules to separate, move faster and also collide against surfaces more often, thus increasing pressure. | |

**WAVES / OPTICS**

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| **QUANTITY / LAW** | **FORMULA / WORDING** | **UNIT** | |
| *Velocity (V)* | Frequency x Wavelength  ( V = f λ ) | m/s or ms-1 | |
| *Frequency (f)* | No. of waves / Time | Hz or s-1 | |
| *Period of a wave (T)* | 1\_\_\_\_  frequency | s | |
| *Two Laws of Reflection* | 1. The incident ray, reflected ray and normal all lie on the same plane.  2. The angle of incidence is equal to the angle of reflection. (Өi = Өr) | | |
| *Two Laws of Refraction* | 1. The incident ray, refracted ray and normal all lie on the same plane.  2. Snell’s Law, which is denoted by:  *n = sin i / sin r* or *n = sin r / sin i* | | |
| *Refractive index (n)(given velocity)* | Velocity through air (c)\_  Velocity through medium (v) | | No unit. |
| *Critical angle* | Өi when angle of refraction = 90o | | |
| *Total internal reflection* | Occurs when the angle of incidence is greater than the critical angle. | | |
| *Magnification* | Size of image / Size of Object | | |

**ELECTRICITY**

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| **QUANTITY / LAW** | **FORMULA / WORDING** | **UNIT** |
| *Voltage (V) a.k.a. p.d* *or e.m.f.* | V = IR | V |
| *Power (P)* | P = VI or P = I2R | W |
| *Energy (E)* | E = IVt or E = P x t | J |
| *Resistance (series) (R)* | RT = R1 + R2 ... | Ω |
| *Resistance (parallel) (R)* | 1 = 1 + 1 …  RT R1 R2 | Ω |
| *Charge (Q)* | Q = I x t | C |
| *Ohm’s Law* | The current in a wire is directly proportional to its p.d. (V = IR) | |
| *Faraday’s Law* | A current in a coil can be induced by moving it through a magnetic field. | |
| *Transformer*  *(turns/coils)* | Np / Ns = Vp / Vs  ...where, N = No. of Turns/Coils | |
| *Transformer*  *(current)* | Vp Ip = Vs Is  …where, p = primary, s = secondary | |

**ATOMIC PHYSICS**

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| --- | --- |
| *Atomic Number* | No. of Protons |
| *Nucleon Number* | No. of Protons + No. of Neutrons |
| *Isotope* | An element with the same atomic no. of another but different mass no. |
| *Half-Life* | The amount of time it takes to half of a substance to radioactively decay. |
| *Energy gained in a nuclear reaction* | ΔE = Δmc2 (Einstein’s formula)  Δm=change in mass, c= speed of light |

**UNIT NOTATIONS**

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| --- | --- |
| **PREFIX** | **NOTATION** |
| Nano (n) | 10-9 |
| Micro (μ) | 10-6 |
| Milli (m) | 10-3 |
| Centi (c) | 10-2 |
| Kilo (k) | 103 |
| Mega (M) | 106 |

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Upper Level Educational Institute