

List of Physics Equations

Suitable for Year 7 to Year 9 IGCSE Science students. SI basic or SI-derived units are bolded.

1. MECHANICS

Speed

Speed is a measure of how fast an object moves. The unit of speed is **meters per second (m/s)**.

$$\text{Instantaneous speed} = \frac{\text{distance}}{\text{short time interval}} \quad (1)$$

$$\text{Average speed} = \frac{\text{total distance}}{\text{long time interval}} \quad (2)$$

Volume

Volume of regular solids

The unit of solid volume is **cubic meter (m³)**.

$$\text{Volume} = \text{length} \times \text{width} \times \text{height} \quad (3)$$

Volume of liquid

Measure the volume using a measuring cylinder. Units of liquid volume can be *cm³* or *ml*.

Volume of irregular solids

Submerge an irregular solid object into a measuring cylinder with water. The increase in water volume is the volume of the object. Units of volume can be *cm³* or *ml*.

$$\text{Volume} = \text{volume}(\text{final}) - \text{volume}(\text{initial}) \quad (4)$$

Density

The unit of density is **kilograms per cubic meter (kg/m³)**.

$$\text{Density} = \frac{\text{mass}}{\text{volume}} \quad (5)$$

Force

Force, F is a push or pull. Force can be measured using a Newtonmeter, forcemeter or weighing balance. The unit of force is **Newton (N)**.

Weight

Weight, W is the force of gravity on an object. Weight can be measured with a spring balance. The unit of weight is **Newton (N)**.

Mass

Mass, m is the amount of matter in an object. Mass can be measured with a mass balance. The unit of mass is **kilogram (kg)**.

Gravitational Constant

Everything on the surface of Earth experiences a constant pull of gravity. The gravitational constant, g on the Earth is **10N/kg**.

$$g = 10N/kg$$

$$Weight = mass \times gravitational\ constant \quad (6)$$

Pressure

Pressure of gas can be measured using a barometer. Pressure of liquid can be measured using a liquid manometer (U-shaped glass tube). The unit of pressure is **pascal (Pa)**.

$$1Pa = 1N/m^2$$

$$Pressure = \frac{force}{area} \quad (7)$$

Moments

Moment of a force

Moment measures the turning effect of a force around a pivot. The unit of moment is **Nm**.

$$Moment = force \times perpendicular\ distance\ from\ pivot \quad (8)$$

Principle of moments

A balanced beam in equilibrium will have equal amounts of clockwise and anticlockwise moments.

$$clockwise\ moment = anticlockwise\ moment \quad (9)$$

$$force_1 \times distance_1 = force_2 \times distance_2 \quad (10)$$

2. ENERGY

The unit of energy is **joule (J)**.

Heat Energy

Heat energy is the energy spreading out from a hot object to the surroundings.

Thermal Energy

Thermal energy is the heat energy stored in a hot object where molecules are constantly moving. The faster the molecules move, the higher the temperature.

Temperature

Temperature is a degree of hotness. Temperature can be measured using a thermometer. The unit of temperature is degree Celsius ($^{\circ}\text{C}$) or **Kelvin (K)**.

$$\text{Temperature}(K) = \text{Temperature}(^{\circ}\text{C}) + 273.15 \quad (11)$$

Kinetic Energy

Kinetic energy, E_k is the energy of a moving object.

Gravitational Potential Energy

Gravitational potential energy, E_p is the energy stored by an object lifted to a height.

Elastic Potential Energy

Elastic potential energy, E_p is the energy stored in an object that is stretched, squashed or deformed.

Principle of Conservation of Energy

Energy cannot be created nor destroyed in an isolated system. The sum of kinetic energy, E_k and potential energy, E_p in the system must be constant.

$$E_k + E_p = \text{constant} \quad (12)$$

$$E_k(\text{initial}) + E_p(\text{initial}) = E_k(\text{final}) + E_p(\text{final}) \quad (13)$$

3. LIGHT

Law of Reflection

Law of reflection states that the angle of incidence, θ_i equals the angle of reflection, θ_r . Angles are measured in **degrees** ($^{\circ}$).

$$\begin{aligned} \text{Angle of incidence} &= \text{Angle of reflection} \\ \theta_i &= \theta_r \end{aligned} \tag{14}$$

Law of Refraction

Refraction is the bending of a light ray as it travels across mediums of different densities.

Light moves along the normal

If light travels into a another medium along the normal, it does not bend.

Light moves towards a denser medium

If light travels into a denser medium, it will bend towards the normal. The angle of incidence will be bigger than the angle of refracted ray:

$$\begin{aligned} \text{Angle of incidence} &> \text{Angle of refraction} \\ \theta_i &> \theta_r \end{aligned} \tag{15}$$

Light moves towards a less dense medium

If light travels into a less dense medium, it will bend away from the normal. The angle of incidence will be smaller than the angle of refracted ray:

$$\begin{aligned} \text{Angle of incidence} &< \text{Angle of refraction} \\ \theta_i &< \theta_r \end{aligned} \tag{16}$$

Frequency

Frequency is the number of vibrations per second. The unit of frequency is **Hertz (Hz)**.

1Hz = 1 vibration per second (s^{-1}).

$$\text{Frequency} = \frac{\text{number of vibrations}}{\text{time}} \tag{17}$$

4. ELECTRICITY

At this level, you need not use these equations for calculations of electric current, voltage, resistance. However, understanding their definitions and Ohm's Law will be greatly beneficial to building your fundamentals.

Current

Current can be measured using an ammeter. The unit of current is **ampere (A)**. The unit of charge is Coulomb (C).

1 ampere = 1 Coulomb of charge per second.

$$1A = 1C/s$$

$$Current = \frac{charge\ flow}{time} \quad (18)$$

Voltage

Voltage can be measured using a voltmeter. The unit of voltage is **volt (V)**. The unit of energy is joules (J). The unit of charge is Coulomb (C).

1 volt = 1 joule of energy per Coulomb of charge.

$$1V = 1J/C$$

$$Voltage = \frac{energy}{charge} \quad (19)$$

Resistance

Resistance can be measured using an ohmmeter. The unit of resistance is **ohm (Ω)**. The unit of potential difference is volt (V). The unit of current is ampere (A).

1 ohm = 1 volt of potential difference per ampere of current.

$$1\Omega = 1V/A$$

$$Resistance = \frac{potential\ difference}{current} \quad (20)$$

Ohm's Law

Ohm's Law states that the current, I passing through a conductor is directly proportional to the voltage, V and inversely proportional to the resistance, R.

$$Voltage = current \times resistance \quad (21)$$
$$V = I \cdot R$$