# GCE Physics Unit 1.1 Basic Physics

## 6 essential base units:

**Quantities are expressed with a value and a unit. There are 6 base units:**

| Base quantity | Unit |
|---|---|
| **Mass** | kg |
| **Length** | m |
| **Time** | s |
| **Electrical current** | A |
| **Temperature** | K |
| **Amount of a substance** | mol |

Other units, such as Newtons, N, and Joules, J, represent **a combination of these base units**. For example, using the equation for force, $F$=$ma$, you can express Newtons in terms of base units.

$$N = kg\ m\ s^{-2}$$

Another important skill is proving that an equation is **homogeneous**. This means that the units for both sides of the equation are the same.

## Scalar and vector:

Scalar quantities, such as mass, have a magnitude only.

Vector quantities, such as force or acceleration, have a magnitude and direction.

## Density:

Density is a measure of how concentrated the mass in a material is. It can be calculated using this equation;

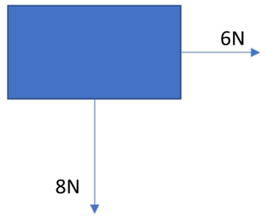
$$\rho = \frac{m}{V}$$

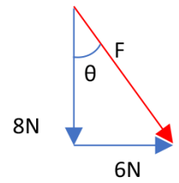
Remember to give your answer in SI units, kg m$^{-3}$. Often information about density is given in g and cm$^3$.

## Adding vectors:

Force is a vector quantity, therefore when more than one force is acting on an object you must consider the direction and magnitude when calculating the resultant force.

When forces are at right angles to each other, you can use Pythagoras' theorem to calculate the magnitude of the resultant force and trigonometry to calculate its direction.




$$F = \sqrt{8^2 + 6^2} = 10N$$

$\theta = tan^{-1}\left(\frac{6}{8}\right)$ = 38.9° from the vertical

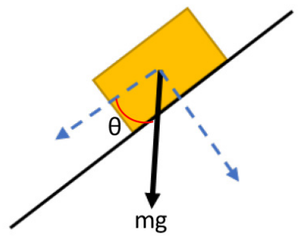
This method works for all vector quantities.

## Resolving vectors:

Often you will need to calculate the force in a certain direction in order to use it in an equation. However, the force will not always be in the direction that you need but at an angle. In this situation you must calculate the **component of the force in the direction** you require.

In this example, the weight of the object, mg, is acting vertically downwards but the acceleration is along the slope. You can use **trigonometry** to calculate this;

$F_{along\ the\ slope} = mg\ cos\ \theta$




## Moment/Torque:

A moment, or torque, is a turning effect of a force about a point. It is calculated using this equation,

$$Moment = F \times d$$

Where $F$ is the force and $d$ is the perpendicular distance to the force. It is expressed in units of N m.

## Principle of moments:

If an object is in equilibrium;

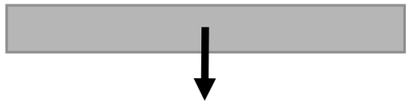
- The **resultant force** on it must be zero.
- The **resultant moment** about any point must be zero. (The clockwise and anticlockwise moments must be equal in magnitude.)

Remember when making calculations with these conditions, you may need to use some trigonometry to calculate **components of the force** or **perpendicular distances** from the pivot.

## Centre of gravity:

When using weight of an object in principle of moment questions, you must consider where the weight is acting. Although gravity acts on the whole object its weight can be considered as acting on one point, the **centre of gravity**.

For example, the C of G for this rod is the mid-point.



$\rho$ = density in kg m$^{-3}$ | m = mass in kg | $V$ = volume in m$^3$ | $F$ = force in Newtons (N) | $d$ = perpendicular distance in m