Forces

Vectors and Scalar Quantities

A **vector quantity** has a magnitude and direction, eg. a force, velocity, momentum.

A **scalar quantity** only has a magnitude and no direction, eg. speed, distance, time.

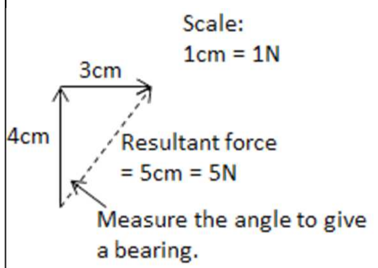
Forces

A **contact force** involves two objects that have to touch for the force to act.
eg. friction, air resistance

A **non-contact force** involves objects that do not need to be touching for the force to act.
eg. gravitational, electrostatic, magnetic

Calculating Forces

A scooter is pushed with 4N north and is blown 3N east by the wind. Find the magnitude and direction of the resultant force.



1. Draw a scale diagram.
2. Join the ends of the two forces (dotted arrow)
3. Measure the length of this line and use the scale to work out the size of the force.
4. Measure the bearing (angle) with a protractor.

Mass, Weight & Gravity

Gravity is a force that acts on a mass. It pulls objects towards the ground, giving them a weight. The gravitational field strength on earth is 9.8N/kg.

Mass is the amount of matter (stuff) in an object. This stays the same anywhere in the universe.

Weight is the force on an object due to gravity. The weight of an object depends on the strength of the gravitational field. So on Earth a 1kg mass weighs 9.8N (1 x 9.8).

$$W = mg$$

Weight (N), Mass (kg), Gravitational field strength (N/kg)

W ∝ m This means that weight is directly proportional to mass – double the mass, the weight doubles.

Elasticity

To stretch, compress or bend an object more than one force must act on it.
Extension is directly proportional to force:

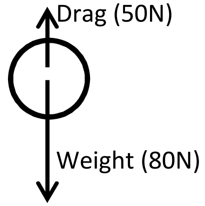
$$F = ke$$

Force (N), Spring constant (N/m), Extension (m)

Stiffer spring = larger number

Resultant Forces

Found by adding together any forces acting along the same line (direction) and subtracting any that act in the opposite direction:



There is a downward resultant force on this object.

The resultant force is 30N (80-50) downwards.

When a **force** moves an object through a **distance**, **energy is transferred** and **work is done**.

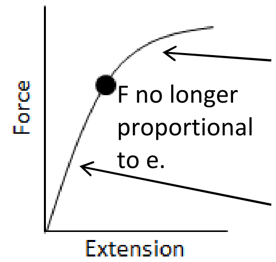
To make something move a force must be applied, which requires energy. The force does work to move the object and energy is transferred between stores. Work done can be calculated:

$$W = Fs$$

Work done (J), Force (N), Distance (m)

REQUIRED PRACTICAL
SEE PRACTICAL SHEET FOR DETAIL

Masses can be hung from a spring (or other elastic object) and a graph like this can be produced.



Object cannot return to its original shape – inelastically deformed.

Object can return to its original shape – elastically deformed.
Extension ∝ force.