

6 Forces in Equilibrium

6.1 Vectors and Scalars

- A **vector** is any physical quantity that has a direction as well as a magnitude.
 - Displacement, velocity, acceleration, force.
- A **scalar** is any physical quantity that is not directional.
 - Mass, density, volume, energy.

A vector can be **represented as an arrow** - the length of the arrow represents the magnitude of the vector quantity, the direction arrow gives the direction of the vector.

Distance travelled depends on the route, whereas the **direct distance** is always the same.

- **Displacement** is distance in a given direction.
- **Velocity** is speed in a given direction.

Vector Addition

Vectors can be added using a **scale diagram**.

$$OB = OA + AB$$

Vector addition gives the **overall effect** of the vectors. Adding two forces gives the **resultant** of the forces.

- The **resultant** is the combined effect of two forces.

Vectors can also be added using a **calculator**.

In general, if the two perpendicular forces are F_1 and F_2

- The **magnitude** of the resultant $F = \sqrt{F_1^2 + F_2^2}$
- The angle θ between the resultant and F_1 is given by $\tan \theta = F_2/F_1$.

Resolving a Vector into Two Perpendicular Components

Is the process of working out the **components of a vector** in two perpendicular directions given the magnitude and direction of the vector.

A force F can be resolved into two perpendicular components

- $F \cos \theta$ parallel to a line at angle θ to the line of action of the force.
- $F \sin \theta$ perpendicular to the line.