

## 8 Newton's Laws of Motion

### 8.1 Force and Acceleration

An **air track** allows motion to be observed in the absence of friction.

- The **glider** on the air track floats on a **cushion of air**.
- Provided the track is level, the glider **moves at constant velocity** along the track because friction is absent.

**Newton's first law of motion:** Objects either stay at rest or moves with constant velocity unless acted on by a force.

An object moving at constant velocity is either

- Acted on by no forces, or
- The forces acting on it are **balanced**.

The inverse is true: when an object is acted on by a resultant force, the result is to change the objects velocity.

**Newton's second law of motion:**  $F$  is proportional to  $ma$ .

By defining the **newton** as the amount of force that will give an object of mass 1kg an acceleration of  $1\text{ms}^{-2}$ , the proportional statement can be written as

$$F = ma$$

### Weight

The force of gravity on an object is its **weight**.

The acceleration of a falling object acted on by gravity only is  $g$ . Because the force of is the only force acting on it, its weight can be given by

$$W = mg$$

- When an object is in **equilibrium**, the **support force** on it is equal and opposite to its weight.
- An object placed on a **weighting balance** exerts a force on the balance equal to the weight of the object. Thus the balance measures the weight of the object.

The mass of an object is a measure of its **inertia** - its resistance to change of motion.

- More force is needed to give an object a certain acceleration than to give an object with less mass the same acceleration.

### 8.2 Using $F = ma$

When an object is acted on by two unequal forces acting in **opposite direction**, the object accelerates in the direction of the larger force.

If  $F_1 > F_2$

resultant force  $F_1 - F_2 = ma$