Forces | Revision Booklet

Force

What is a force?

- Anything that causes an object to change its velocity

What is the S.I. unit of force?

- Newtons (N)

Forces can ...

- cause an object to stretch
- cause an object to compress
- cause an object to twist
- cause an object to change velocity (speed in a given direction)

Who is Isaac Newton?

- English physicist, mathematician and philosopher
- Studied at Cambridge where he earned a professorship
- Introduced the three laws of motion
- Introduced the idea of gravity

How do we measure a force?

- Newton meter / force meter

How do we calculate force?

- Formula: force (N) = mass (kg) x acceleration (m/s^2)

Force Calculations

Example 1

What force is required to give a car of mass 1000kg and acceleration of 2m/s²?

Solution

Force (N) = mass (kg) x acceleration (m/s²)

Force (N) = 1000kg x 2m/s²

Force (N) = 2000N

Example 2

What is the mass of a bowling ball that has a force of 100N placed on it and is accelerating at 20"m/ s²?

Solution

$$\text{Mass (kg)} = \frac{\text{Force (N)}}{\text{Acceleration (m/s}^2\text{)}}$$

$$\text{Mass (kg)} = \frac{100\text{N}}{20\text{m/s}^2}$$

Mass (kg) = 5kg

Example 3

A force of 100N is placed on a shopping trolley of mass 20kg. What will be the acceleration of the trolley?

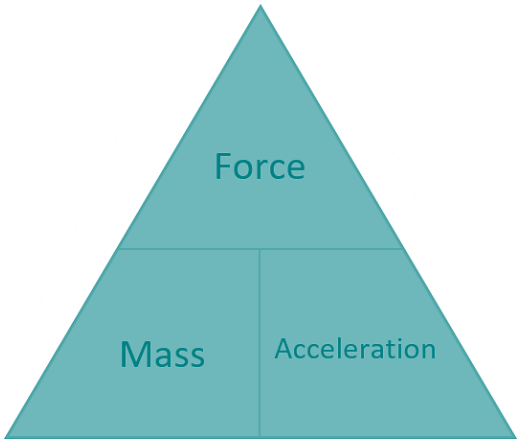
Solution

$$\text{Acceleration (m/s}^2\text{)} = \frac{\text{Force (N)}}{\text{Mass (kg)}}$$

$$\text{Acceleration (m/s}^2\text{)} = \frac{100\text{N}}{20\text{kg}}$$

Acceleration (m/s²) = 5m/s²

Formula



Acceleration

What is acceleration?

- Change in velocity per second

What is the S.I. unit of velocity?

- Per second (m/s^2)

Acceleration vs. Deceleration

- Acceleration is speeding up
- Deceleration is slowing down

Balanced and unbalanced forces

What is a balanced force?

- Causes an object to move at a constant velocity

Examples of balanced forces

- A parked car
- A car driving at constant speed on a road
- A pot of flowers sitting on a table
- Cycling at a constant speed
- Sitting on a chair

What is an unbalanced force?

- Cause an object to change velocity

Examples of unbalanced forces

- A car braking on a road
- A car speeding up on a road
- A pot of flowers falling off a table
- Cycling down a hill and not braking
- A rocket launching

Types of forces

- **Friction**
- **Weight**
- **Air resistance**
  Describes the opposing forces of a moving object as it passes through the air)
- **Buoyancy**
  The upward force exerted by a fluid that opposes the weight of a partially or fully immersed object
- **Magnetic forces**
  Attraction or repulsion that arises between electrically charged particles because of their motion
- **Electric forces**
  Attraction or repulsion that arises between electrically charged particles

An electric force exists between all charged particles, whether or not they're moving. A magnetic force exists between moving charged particles. This means that every charged particle gives off an electric field, whether or not it's moving.

Friction

What is friction?

- A force that opposes motion

What are the advantages of friction?

- Brakes
- Slows down rain and hailstones
- Allows us to move

What are the disadvantages of friction

- It makes things slow down
- Wastes energy
- Causes wear

How can we reduce friction?

- Lubrication
- Ball bearings
- Streamlining

Weight

What is weight?

- A measure of the force of gravity acting on an object

How do we calculate weight?

- Formula: weight (N) = mass (kg) x acceleration of gravity (m/s^2)

What is the S.I. unit of weight?

- Newtons (N)

Weight Calculations

Example 1

Tom's mass is 75kg. How much would he weigh on Earth? The acceleration of gravity on Earth is 9.8m/s².

Solution

Weight (N) = mass (kg) x Mass
= acceleration of gravity (m/s²)

Weight (N) = 75kg x 9.8m/s2

Weight (N) = 735N

Example 2

The acceleration of gravity on Jupiter is 25m/s2. If Louise weighs 1625N on Jupiter, what is Louise's mass?

Solution

$$\text{Mass} = \frac{\text{Weight (N)}}{\text{Acceleration of Gravity (m/s}^2\text{)}}$$

$$\text{Mass} = \frac{1625\text{N}}{25\text{m/s}^2}$$

Mass = 65kg

Example 3

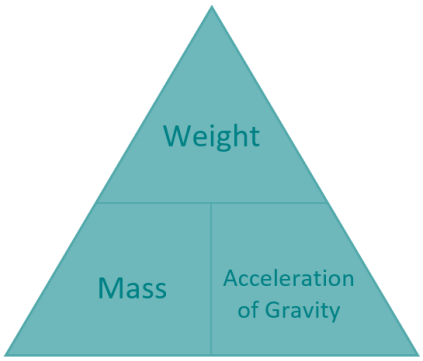
When Neil Armstrong landed on the moon, he had a mass of 74kg and weighed 118.4N. What is the acceleration of gravity on the moon?

Solution

$$\text{Acceleration of Gravity (m/s}^2\text{)} = \frac{\text{Weight (N)}}{\text{Mass (kg)}}$$

$$\text{Acceleration of Gravity (m/s}^2\text{)} = \frac{118.4\text{N}}{74\text{kg}}$$

Acceleration of Gravity (m/s²) = 1.6m/s²



Mass vs. Weight

Mass

- The amount of matter in a substance
- The mass of an object is constant throughout the universe
- The mass of an object can never be zero
- Measured in kilograms (kg)

Weight

- A measure of the force of gravity acting on an object
- The weight of an object is constant throughout the universe
- The weight of an object can be zero if no gravity is present