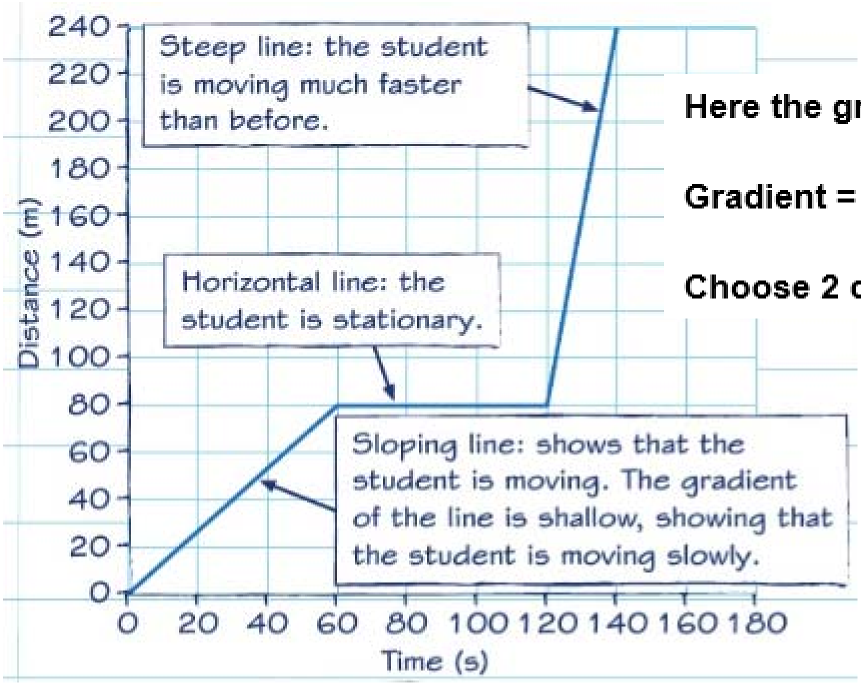
Scalar quantity: has magnitude(size) only. Examples: mass, speed, distance, energy and temperature.

Vector quantity: has magnitude and direction. Examples: force, weight, velocity, displacement, acceleration and momentum.

Velocity is speed in a given direction. Unit: m/s or ms^{-1}

$$Speed = \frac{distance}{time} \qquad Velocity = \frac{displacement}{time}$$

Speed Time Graphs



Here the gradient is the speed

Gradient = $\frac{Y_2 - Y_1}{X_2 - X_1}$

Choose 2 coordinates on the line (X_1, Y_1) **and** (X_2, Y_2)

Acceleration = $\frac{change\ in\ velocity}{time}$

A cat changes its speed from 2.5 m/s to 10.0 m/s over a period of 3.0 s. Calculate the cat's acceleration.

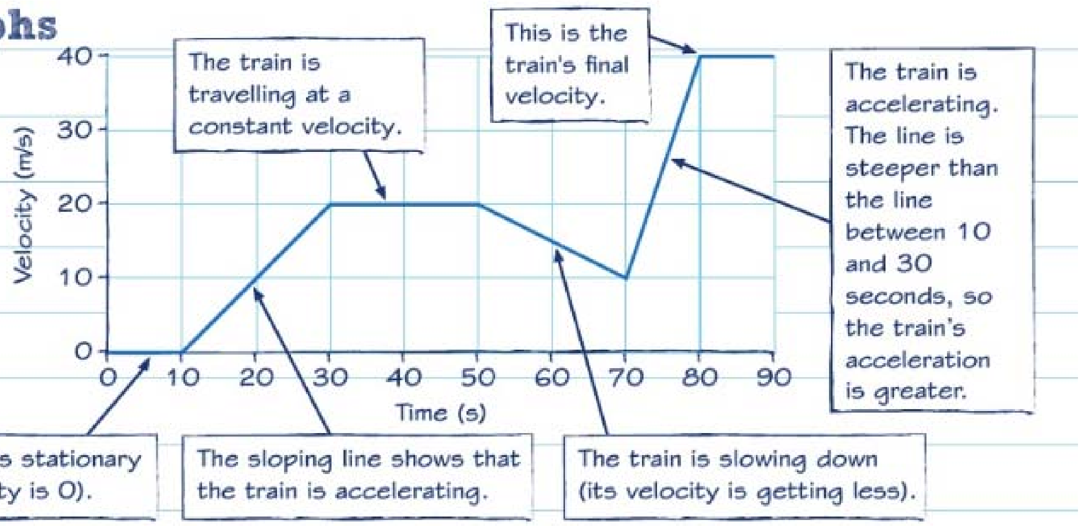
$v^2 - u^2 = 2\ x\ a\ x$ x , where v = new velocity in m/s, u = old velocity in m/s ,
a = acceleration in ms^{-2}, x = distance in m

A motorcyclist passes through green traffic lights with an initial velocity of 4 m/s and then accelerates at a rate of 2.4 m/s², covering a total distance of 200 m. Calculate the final velocity of the motorcycle. **(4 marks)**

Velocity Time Graphs

Velocity/time graphs

This velocity/time graph shows how the velocity of a train along a straight track changes with time.



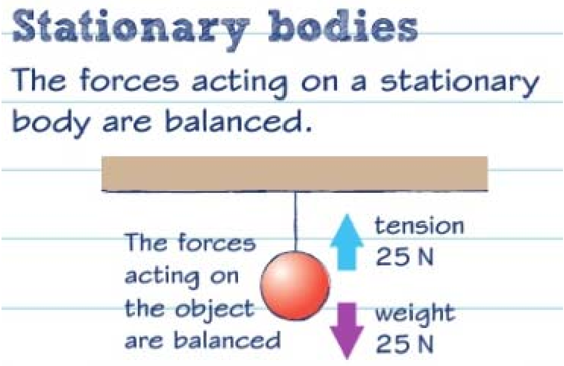
Here the gradient is the acceleration

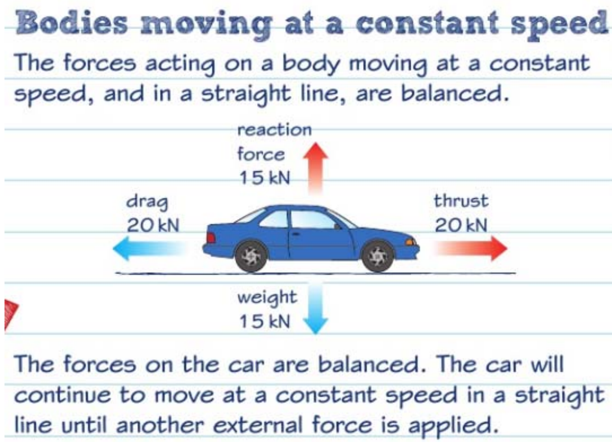
Typical Speeds

Activity	Typical Speed
Walking	1.5 m/s
Running	3.0 m/s
Cycling	6.0 m/s
Driving	12 m/s
Gale force wind	15 m/s
Train	55m/s
Airliner	250 m/s
Speed of sound in air	330 m/s

Acceleration due to gravity, **g**, in free fall is 10 m/s^2

Newton's First Law: A body will remain at rest or continue in a straight line at a constant speed as long as the forces acting on it are balanced.





Unbalanced Forces:

Examples:

Explain the effect that each of these forces will have on a car.

(a) 300 N forward force from the engine, 200 N drag. (3

(b) 200 N forward force from the engine, 400 N friction from brakes.

(c) 300 N forward force, 300 N drag.

Newtons's Second Law: Force = Mass x Acceleration

Example:

A resultant force of 6 N acts on a toy car, giving it an acceleration of 2 m/s^2. Calculate the mass of the toy car. **(3 marks)**

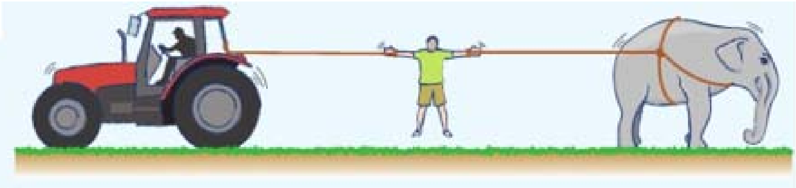
The diagram shows the horizontal forces acting on a boat. The boat has a mass of 400 kg.

Calculate the acceleration of the boat at the instant shown in the diagram. **(3 marks)**

Newton's Third Law: states that for every action there is an opposite and equal reaction.

Example:

Identify five action–reaction pairs that are present in the diagram. **(5 marks)**



1.
2.
3.
4.
5.

Weight: is the force that a body experiences due to its mass and the size of the gravitational field that it is in.
Formula: Weight = mass x acceleration due to gravity
Unit: Newtons (N)
How to measure weight: Newtonmeter

Human Reaction Time: is the time between a stimulus occurring and a response.
Typical reaction time is between 0.20s and 0.25s
Measuring the human reaction time by using the ruler drop test. Steps:
Formula:

The reaction time is determined from the equation:

$$\text{reaction time} = \sqrt{\frac{2 \times \text{distance ruler falls}}{\text{gravitational field strength}}}$$

Repeats can be used to get a mean value for the reaction time.

Stopping distance is the total distance over which a vehicle comes to rest.
Stopping distance = thinking distance + braking distance

Factors that can affect the thinking distance

- Driver being too tired
- Driver being distracted
- Driver having taken alcohol or drugs

Factors that can affect the braking distance

- The amount of friction between the tyres and the road (icy or wet conditions)
- The brakes are worn
- The tyres are worn
- The mass of the car
- Cars speed

Large decelerations release high amount of heat energy, which can cause the brakes to snap and a driver to lose control of their vehicle.