



Section A

- Which of these is the equation for calculating speed from distance and time?
 - ☐ A: speed = time $\times$ distance
 - ☐ B: speed = distance $\times$ time
 - ☐ C: speed = time $\div$ distance
 - ☐ D: speed = distance $\div$ time
- A typical speed for a car in a built-up area is
 - ☐ A: 1.4 m/s
 - ☐ B: 6 m/s
 - ☐ C: 10.5 m/s
 - ☐ D: 31 m/s
- The speed of sound in air is typically
 - ☐ A: 340 000 000 m/s
 - ☐ B: 340 m/s
 - ☐ C: 3.4 m/s
 - ☐ D: 0.34 m/s
- What is the correct unit for weight?
 - ☐ A: g
 - ☐ B: kg
 - ☐ C: J
 - ☐ D: N
- What is the correct value and unit for gravitational field strength?
 - ☐ A: 10 N/kg
 - ☐ B: 10 g
 - ☐ C: 10 m/s
 - ☐ D: 10 N
- Which of Newton's laws of motion states 'for every action there is an equal and opposite reaction'?
 - ☐ A: Newton's 1st Law
 - ☐ B: Newton's 2nd Law
 - ☐ C: Newton's 3rd Law

Sort the quantities from the box into the correct column of the table

Scalar	Vector

mass distance acceleration
speed velocity energy time
power force displacement

Key Word: **scalar**
a quantity with magnitude only

Key Word: **vector**
a quantity with magnitude AND direction

Use the information in the diagram to help fill the gaps in the text underneath.

The diagram shows the forces acting on a car which is travelling along a flat straight road.

Resultant force
A single force that is the result of two or more forces acting on an object. Calculated by taking away forces that are opposite from each other and adding together any forces that act in the same direction.

There is a resultant force of N acting on the car. This means that the car's motion can be described as in the direction of the resultant force. If the magnitude of the weight is 19000 N then the reaction force must be N

Section B

A submarine is travelling at a constant depth in the sea. It starts to move forwards. Draw a free-body force diagram for all the forces acting on the submarine. Label these forces. (2 marks)

Newton's 1st Law
A resultant force larger than zero causes acceleration in the direction of the resultant force

The lengths of the arrows on a free-body force diagram should be proportional to the sizes of the forces.

A speed skater is standing on the ice waiting for the start of a race.

Newton's 3rd Law
If one object pushes another (an action force), the second object pushes back just as hard in the opposite direction (a reaction force)

(a) Describe the action and reaction forces acting between the skater and the ground.

The action is theand the reaction is (2 marks)

All object on earth experience a force called weight. Weight and mass are *not the same thing* but they are closely related to each other. Weight is a force. Mass is a measure of how much matter (stuff) something is made of.

(i) State the equation that links weight and mass.

(ii) What unit does mass have to be measured in to let us use this equation?

(iii) What unit does weight have to be in to use this equation.

(iv) What is the magnitude of the gravitation field strength experience by objects on Earth.

Match the methods of travelling to the speeds most typical for them.

walking	55 m/s
driving through a town	1.4 m/s
high-speed train	6 m/s
cycling	10.5 m/s
driving on a motorway	250 m/s
flying	31 m/s

Section C

distance travelled = average speed × time

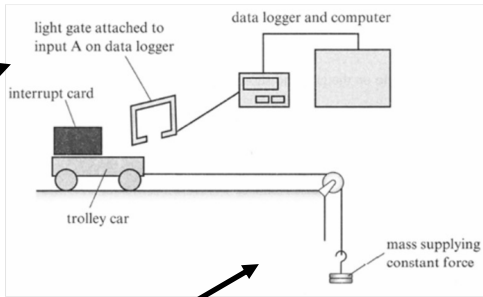
weight = mass × gravitational field strength

$W = m \times g$

Light gates are used to record how long it takes for the interrupt card to pass through.
Light gate reading 200 ms. Interrupt card length 10 cm.
What was the speed of the trolley through the light gate?
(hint: convert the values to standard units first)

..... m/s

Why is a light gate used rather than a stopwatch?



The force pulling on the trolley is equal to the weight hanging from the string.
What was the force is a total mass of 300 g was hanging from the string?

..... N

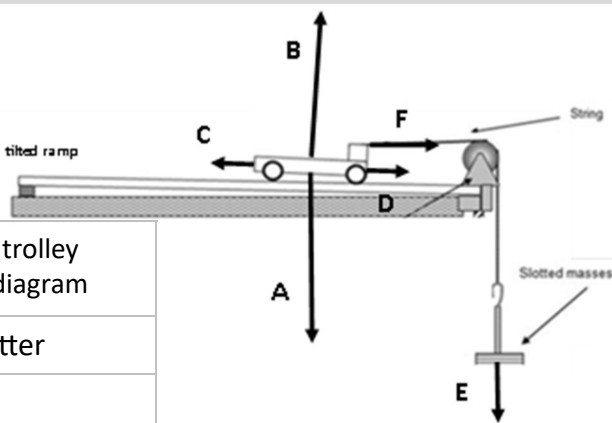
acceleration = change in velocity ÷ time taken

$a = \frac{(v - u)}{t}$

In experiments where a force is being applied to accelerate a trolley the ramp is tilted a small amount. Why?

Light gates can be used to record the speed at two places on the ramp. If the time taken for the trolley to move between the light gates is also recorded then the acceleration can be calculated.
Speed at top of ramp = 0.4 m/s. Speed at bottom of ramp = 1.2 m/s
Time from top to bottom = 1.25 s. What was the acceleration of the trolley?

..... m/s²



Match the forces involved in the trolley experiment to the letters in the diagram

Force	Letter
Weight of trolley	
Weight of masses	
Normal reaction force	
Friction	
Tension of string	
Horizontal component of weight of trolley	

How would the results of the experiment differ if the ramp was covered in cooking oil?

To use the equipment to investigate the effect of force on acceleration masses must be moved from between the hook and the trolley rather than simply adding or removing them from the hook.

Why?

Section D

force = mass × acceleration

$F = m \times a$

Newton's 2nd Law
The **acceleration** of an object depends on the **force** acting on the object and the **mass** of the object.

A girl takes 20 s to walk between two lamp posts that are 30 m apart. What was the girl's average speed?

What is the average acceleration of a book that undergoes a change of velocity of 5 m/s during a 0.5 s fall?

A trolley has a mass of 2 kg and accelerates at 2.5 m/s² when a force is applied to it. How big is the force?

An astronaut on the moon experiences a gravitational field strength of 1.6 N/kg. If they have a mass of 80 kg what is their weight?

A car is travelling at 10 m/s when it starts to overtake a lorry. 2 seconds later it is travelling at 16 m/s. Calculate the acceleration of the car.

How long would it take someone to walk 5 km if they were travelling at 1.4 m/s?

A 1025 kg robot on Mars experiences a weight of 3790 N. What is the gravitational field strength at the surface of Mars?

Calculate the initial velocity of a skydiver if they accelerate at an average rate of 8 m/s² for 5 seconds to reach a speed of 50 m/s.

A cargo ship is travelling at a speed of 8 m/s when the captain switches the engines to reverse. If this causes an acceleration of −0.05 m/s² then what will the speed of the ship be two and a half minutes later?

Answers	0.5	5	3	1.5
3.7	10	10	3571	128