NAME: .....

MEASUREMENTS 1

1. Fig. 1.1 shows a measuring cylinder containing some water.
A student allows 200 drops of water to fall into the water in the measuring cylinder. Fig. 1.2 shows the measuring cylinder after the addition of the drops.

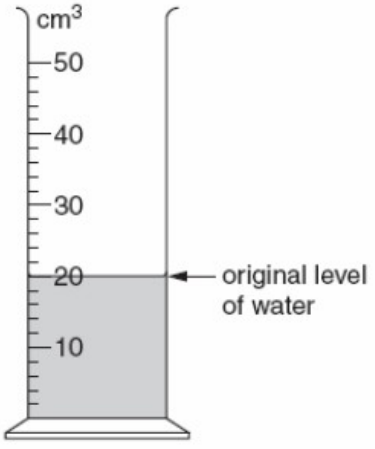


Fig. 1.1

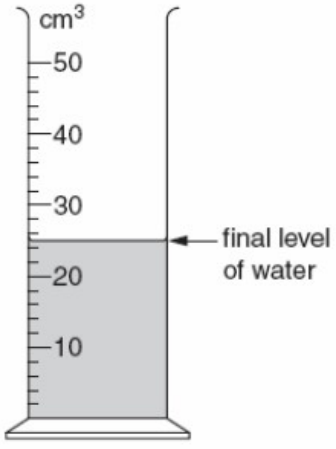


Fig. 1.2

(a) State
(i) the original volume of water in the cylinder,

..... cm^3

(ii) the final volume of water in the cylinder.

..... cm^3
[1]
(b) Calculate the volume of water added.

volume added = ... cm^3 [1]

(c) Calculate the average volume of one of the drops of water.

average volume = ... cm^3 [2]
[Total: 4]

2. Wanyonyi investigated the relationship between mass and weight.
He weighed five different masses using a force meter.

His results are shown in the table.

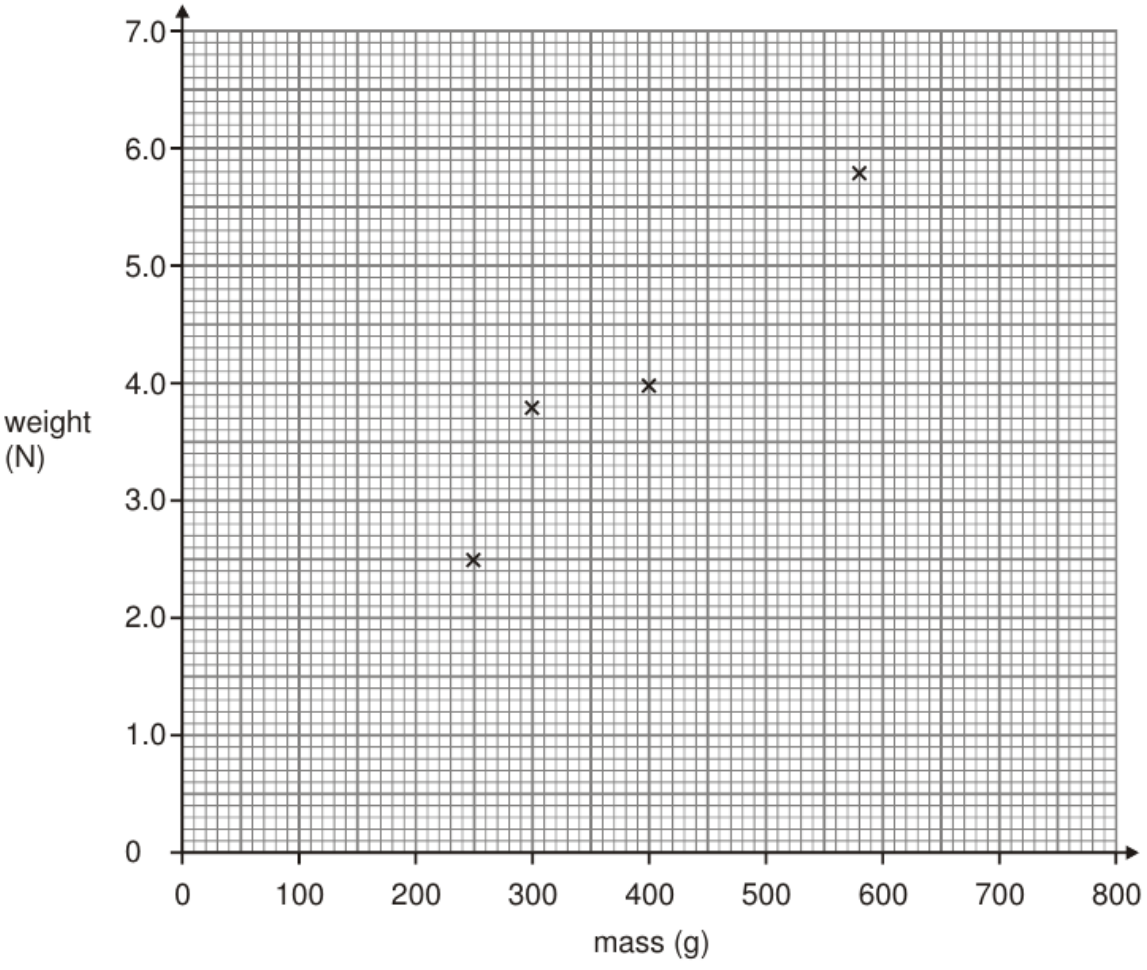
mass (g)	**weight (N)**
150	1.5
250	2.5
300	3.8
400	4.0
580	5.8

(a) He plotted four of his results on a grid as shown below,

(i) Plot the point for the 150 g mass on the graph.

1 mark

(ii) Draw a line of best fit.



1 mark

(b) One of the points Wanyonyi plotted does **not** fit the pattern.

Circle this point on the graph.

1 mark

(c) Use your graph to predict:

(i) the mass of an object weighing 6.5 N;

..... g

1 mark

(ii) the weight of an object of mass 50 g.

..... N

1 mark

(d) Give **one** reason why it is more useful to present the results as a line graph rather than a table.

.....

.....

1 mark

maximum 6 marks

3. You are provided with the following apparatus

- Metre -rule
- Two rectangular wooden blocks

By means of a suitable sketch, explain how you would use the apparatus to determine the diameter of a metal sphere.

[2m]

4. A theatre measures 100 m x 80 m x 25 m. The air inside it has a density of 1.3 kg / m^3 when it is cool.

(a) Calculate the volume of the air in the theatre.

volume of air = ... m^3 [1]

(b) Calculate the mass of the air. State the equation you are using.

mass of air = ... [4]

(c) Some time after the doors are opened, the heating in the theatre is switched on.
State and explain what happens to the mass of the air in the theatre as it warms up.

Statement

.....

.....

Explanation

.....

..... [2]

(d) Suggest why the temperature of the air in the balcony of the theatre (nearer the ceiling) is likely to be greater than that lower down in the theatre.

.....

..... [1]

[Total: 8]

5. An alloy is made by mixing 360 g of copper of density 9 g cm^{-3}, with 80 g of iron of density 8 gcm^{-3}. Find,

(i) The volume of copper

[1m]

(ii) The volume of iron

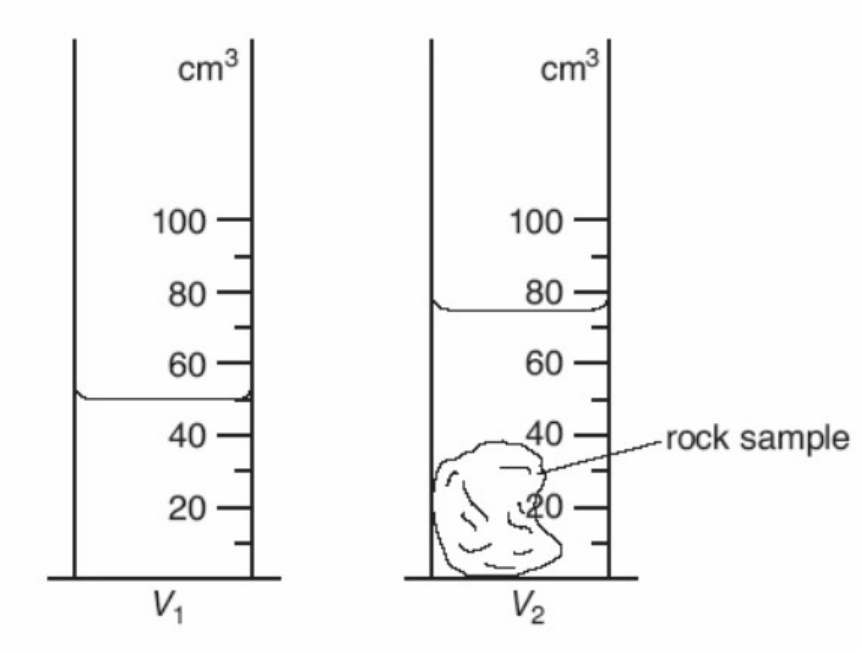
[1m]

(iii) The density of the alloy

[1m]

[Total 3m]

6. (a) A student is investigating the differences in density of small pieces of different rocks. She is using an electronic balance to measure the mass of each sample and using the 'displacement method' to determine the volume of each sample. Fig. 5.1 shows the displacement method.



(i) Write down the volume shown in each measuring cylinder.

V1 =.....

V2 =.....

(ii) Calculate the volume V of the rock sample.

V =.....

(iii) Calculate the density of sample A using the equation

$$density = \frac{m}{V}.$$

Where the mass m of the sample of rock is 109 g.

Density =.....

[4]

(b) The table shows the readings that the student obtains for samples of rocks B and C.

Complete the table by;
(i) Inserting the appropriate column headings with units,
(ii) Calculating the densities using the equation

$$density = \frac{m}{V}.$$

sample	*m*/g			*V*/	density/
B	193	84	50	34	
C	130	93	50	43	

[4]

(c) Explain briefly how you would determine the density of sand grains.

.....

..... [1]

[Total: 9m]

7. 1.5 m^3 of water is mixed with 0.50 m^3 of alcohol. The density of water is 1000 kg m^{-3} and the density of alcohol is 800 kg m^{-3}.
What is the density of the mixture with volume 2.0 m^3?

8.

a) You are provided with the following apparatus.

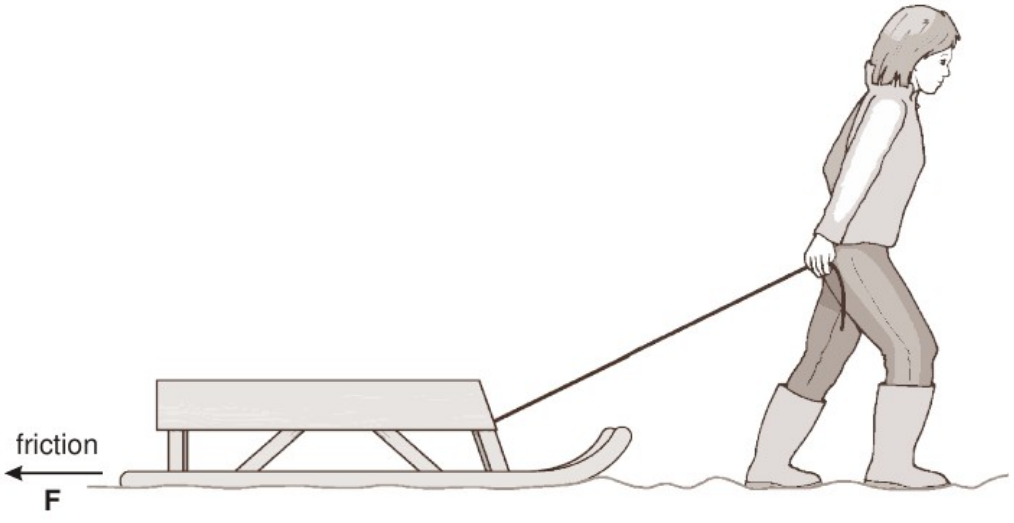
- a spring balance
- a beaker
- cork
- a sinker
- water

Using the above apparatus, describe an experiment to determine the relative density of cork. 5mks

b) A block of metal of volume $80cm^3$ weighs 3.80N in air. Determine it's weight when fully sub merged in a liquid of density $1200kgm^{-3}$

FORCE – QUESTIONS

1. Sally pulls a sledge in the snow.



(a) (i) Draw an arrow on the rope to show the direction of the force of the rope on the sledge.

Label the arrow **R**.

(ii) Draw an arrow on the diagram to show the direction of the force of gravity on the sledge.

Label the arrow **G**.

2 marks

(b) Force **F** is the friction between the sledge and the snow.
Sally then pulled the sledge over a concrete path.

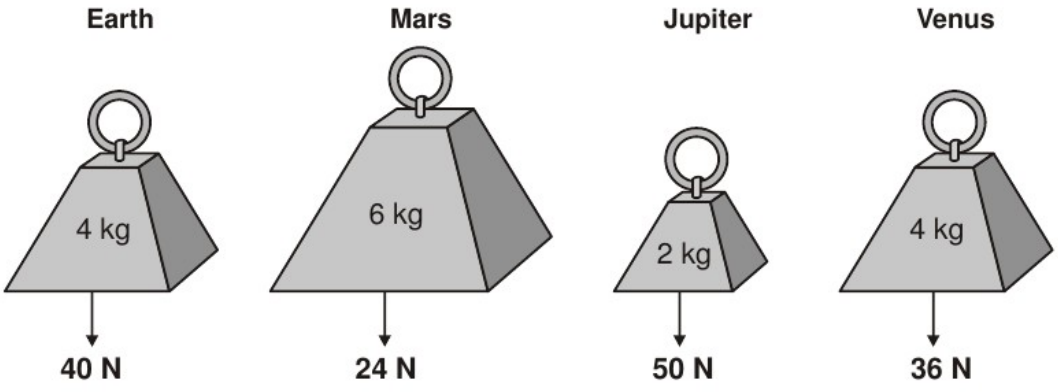
Friction is less on snow than on concrete.
Give the reason for this.

.....

1 mark

maximum 3 marks

2. The drawings show the mass and weight of four objects on different planets.



(a) On which of the four planets is the object with the largest mass?

.....

1 mark

(b) How can you tell, from the drawings, that gravity is greater on Earth than on Venus?

.....

.....

1 mark

(c) Gravity is less on the Moon than on the Earth.

Complete the sentences below to compare the weight and mass of an astronaut on the Moon and on the Earth.

The **weight** of an astronaut on the Moon is ..... the **weight** of an astronaut on the Earth.

1 mark

The **mass** of an astronaut on the Moon is ..... the **mass** of the astronaut on the Earth.

1 mark

(d) The table below gives information about five planets.

planet	distance from the Sun (million km)	time for planet to orbit the Sun (Earth-years)
Venus	110	0.6
Earth	150	1.0
Mars	230	
Jupiter	780	12.0
Saturn	1400	30.0

(i) Look at the information in the table.

How does the time for a planet to orbit the Sun change with its distance from the Sun?

.....

.....

1 mark

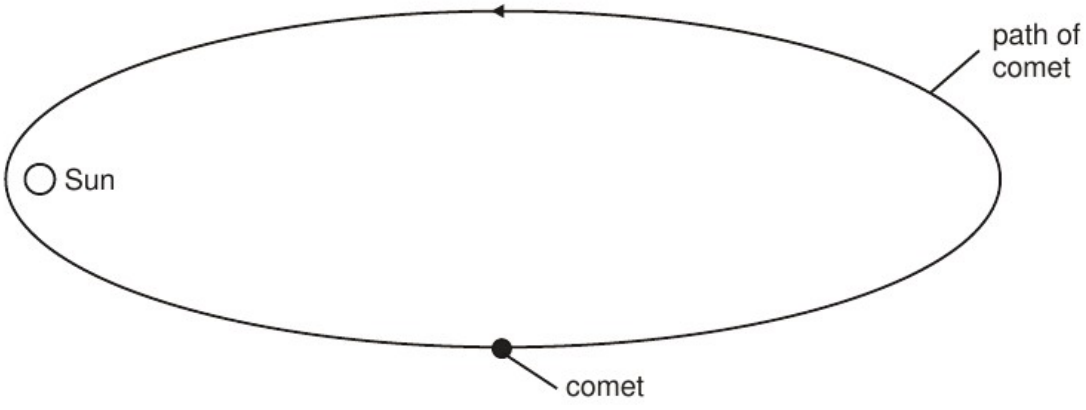
(ii) Use information in the table to estimate the time for Mars to orbit the Sun.

..... Earth-years

1 mark

(e) The diagram below shows the path of a comet around the Sun.

On the path of the comet below, place a letter X to show the position where the comet is travelling the fastest.

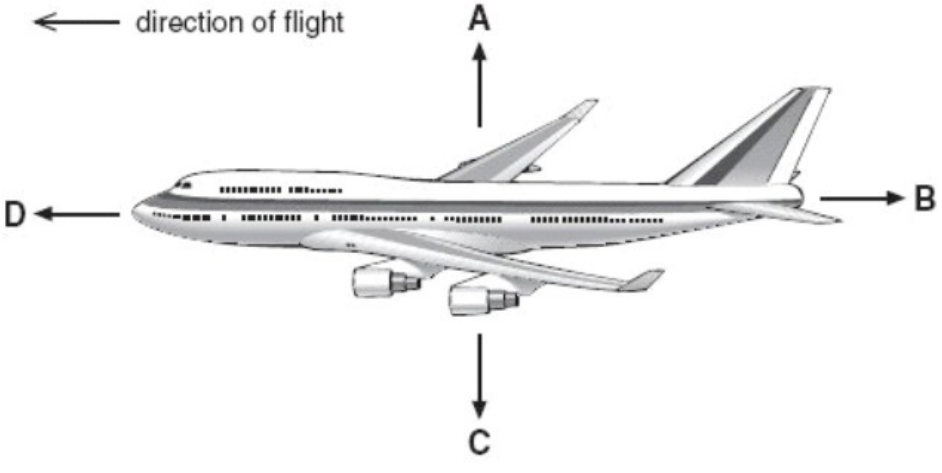


not to scale

1 mark

maximum 7 marks

3. The diagram shows four forces acting on a plane in flight.



(a) Which arrow represents air resistance?
Give the letter.

.....

1 mark

(b) (i) When the plane is flying at a constant height, which **two** forces must be balanced?
Give the letters.

..... and .....

1 mark

(ii) When the plane is flying at a constant speed in the direction shown, which **two** forces must be balanced?
Give the letters.

..... and .....

1 mark

(c) (i) Just before take-off, the plane is speeding up along the ground.

Which statement is true?
Tick the correct box.

Force B is zero.	☐
Force B is greater than force D.	☐
Force D is equal to force B.	☐
Force D is greater than force B.	☐

1 mark

(ii) Which statement is true about the plane just as it leaves the ground?
Tick the correct box.

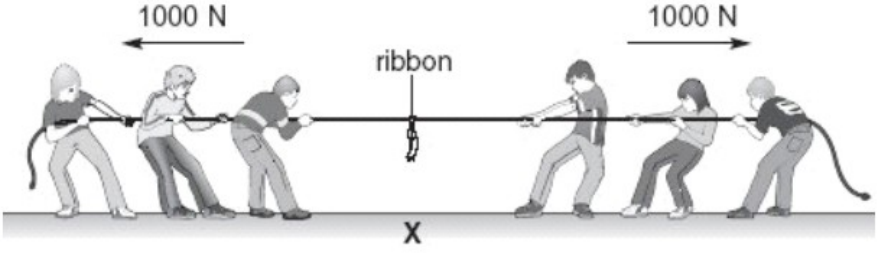
Force C is zero.	☐
Force C is greater than force A.	☐
Force A is equal to force C.	☐
Force A is greater than force C.	☐

1 mark

maximum 5 marks

4. The drawings in parts (a), (b) and (c) show two teams of pupils in a tug-of-war.
There is a ribbon tied to the middle of the rope.

(a) The sizes and directions of the forces of each team are shown.



team A **team B**

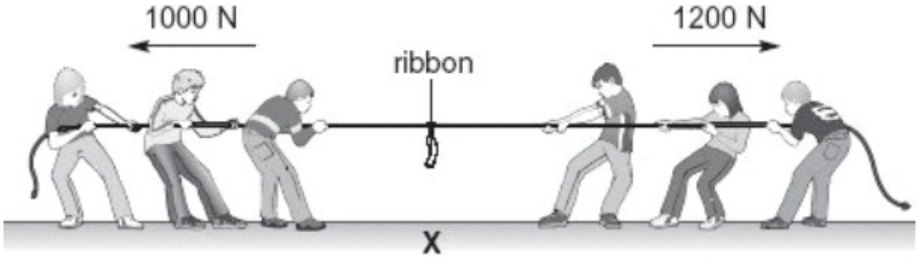
The ribbon stays above point X on the ground.
Give the reason for this.

.....

.....

1 mark

(b) The teams then pull with the forces shown below.

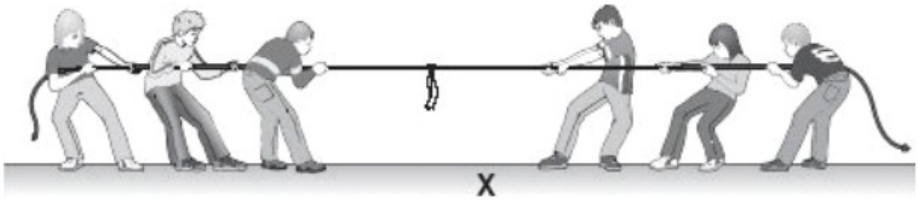


team A **team B**

Draw an arrow on the rope to show the direction in which the ribbon will move.

1 mark

(c) Later, the ribbon was to the left of point X as shown below.



team A **team B**

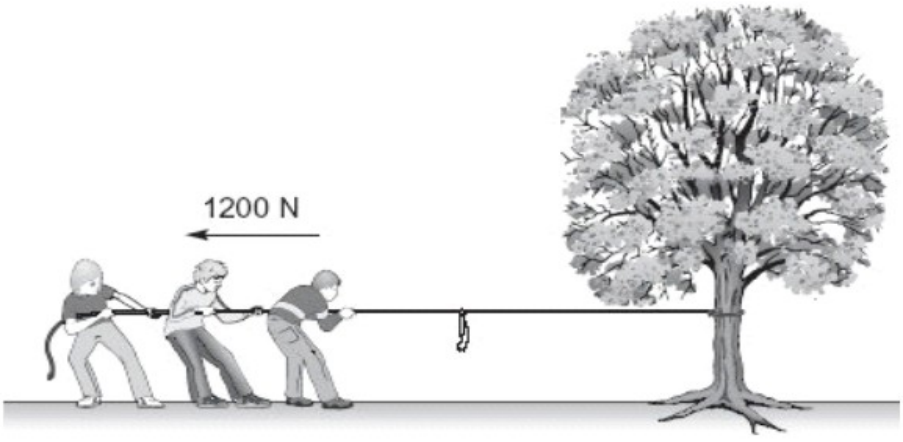
Why did the ribbon move towards the left?

.....

.....

1 mark

(d) Team A practises by pulling a rope tied to a tree.



The team pulls with a force of 1200 N but the tree does **not** move.

What is the force of the tree on the rope?
Tick the correct box.

zero	☐	less than 1200 N	☐	1200 N	☐	more than 1200 N	☐

1 mark

(e) The pupils do **not** slip because there is a force between their shoes and the ground. What is the name of this force?

.....

1 mark

5. Russell investigated the relationship between mass and weight.
He weighed five different masses using a force meter.

His results are shown in the table.

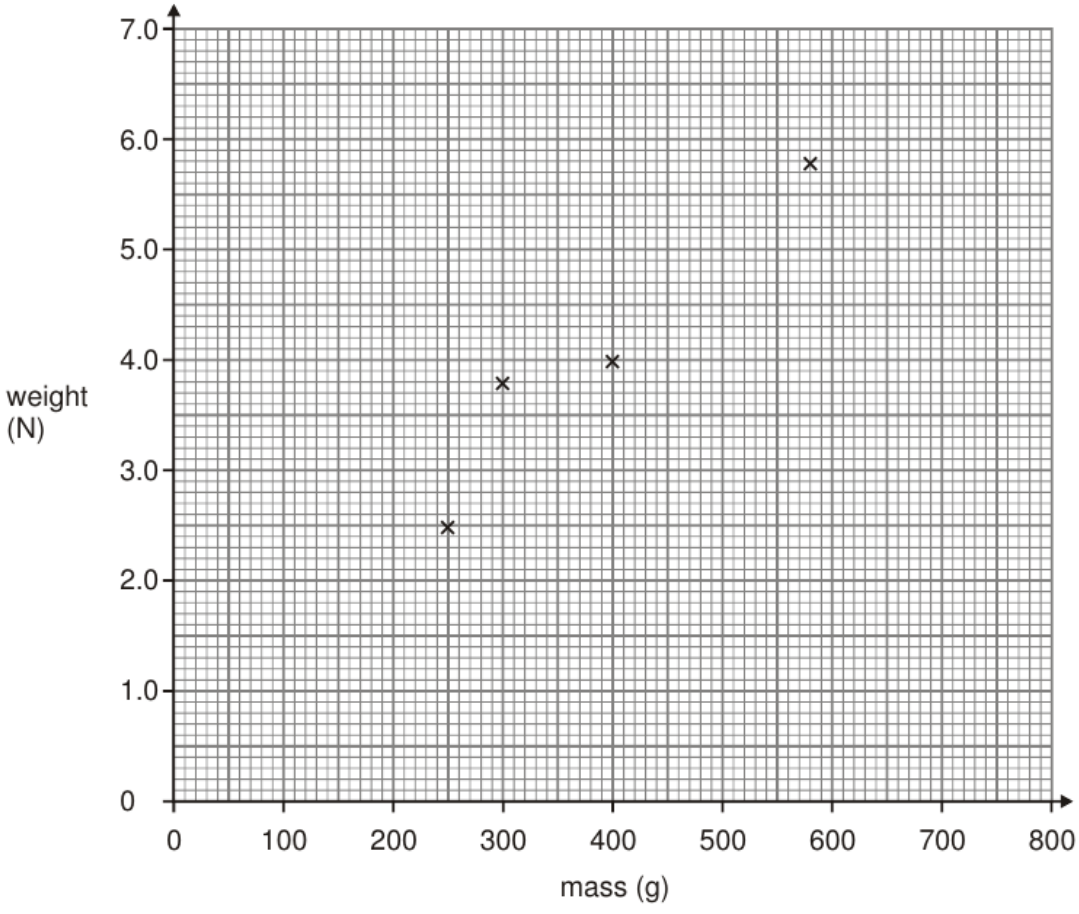
mass (g)	weight (N)
150	1.5
250	2.5
300	3.8
400	4.0
580	5.8

(a) He plotted four of his results on a grid as shown below,

(i) Plot the point for the 150 g mass on the graph.

1 mark

(ii) Draw a line of best fit.



1 mark

(b) One of the points Russell plotted does **not** fit the pattern.

Circle this point on the graph.

1 mark

(c) Use your graph to predict:

(i) the mass of an object weighing 6.5 N;

..... g

1 mark

(ii) the weight of an object of mass 50 g.

..... N

1 mark

(d) Give **one** reason why it is more useful to present the results as a line graph rather than a table.

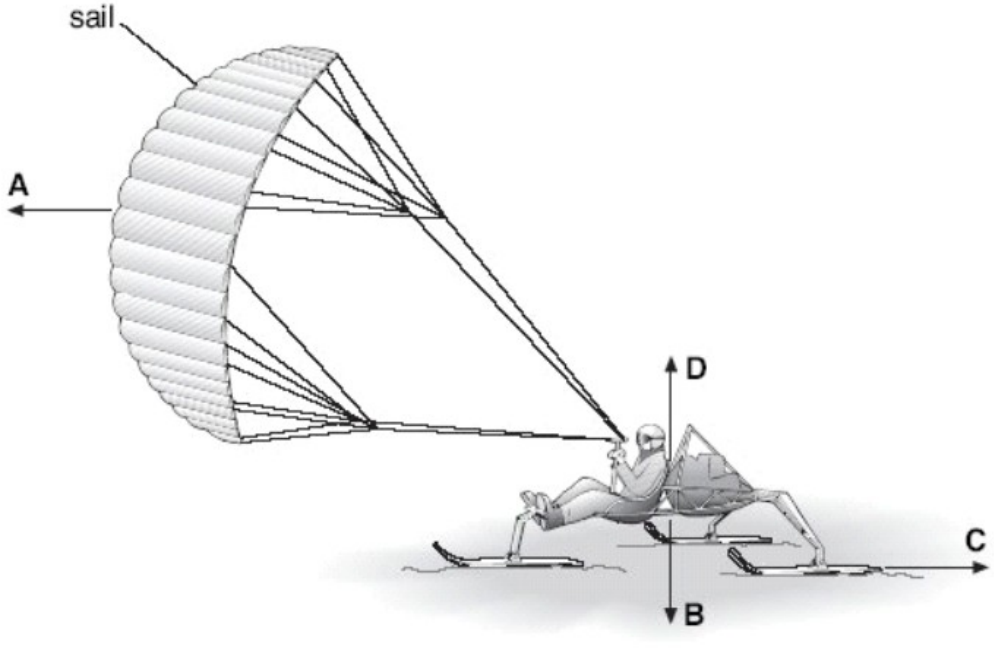
.....

.....

1 mark

maximum 6 marks

6. The drawing shows a snow-buggy being pulled by a sail.
The buggy rests on three skis on the snow.



(a) The drawing shows four forces that act when the snow-buggy is moving.

Draw a line from each force in the list below to the correct letter from the diagram.
Draw only **three** lines.

force	letter
the weight of the buggy	A
the force pulling the buggy along	B
the friction between the skis and the snow	C
	D

3 marks

(b) A scientist travelled 80 kilometres (km) each day in the buggy.

How many kilometres did he travel in 10 days?

..... km

1 mark

(c) The buggy carried the scientist, food and equipment for the journey.
The table shows how the total mass changed.

	total mass at start of journey (kg)	total mass at end of journey (kg)
mass of buggy, scientist, food and equipment	295	130

The buggy sank deeper into the snow at the start of the journey than at the end.

Why did it sink deeper at the start? Use the table to help you.

.....

.....

1 mark

(d) The buggy rests on three skis instead of three wheels.

Why are skis better than wheels for travelling on snow?

.....

.....

1 mark

(e) When a bigger sail is used, the buggy goes faster.

How does a bigger sail help the buggy to go faster?

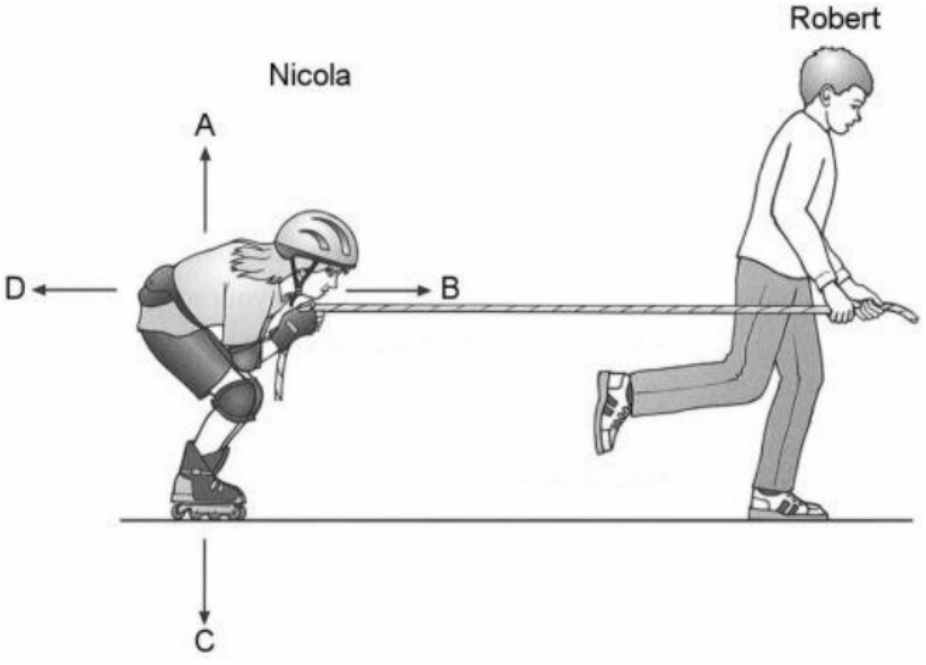
.....

.....

1 mark

maximum 7 marks

7. (a) Nicola is trying out her new roller blades. Robert is pulling her along with a rope. Arrows A, B, C and D show the directions of four forces acting on Nicola.



(i) Which arrow shows the direction of the force of **gravity** on Nicola?
Give the letter.

.....

1 mark

(ii) Which arrow shows the direction of the force of the **rope** on Nicola?
Give the letter.

.....

1 mark

(b) Robert pulls Nicola at a steady speed of 2 metres per second. How far will Nicola travel in 10 seconds?

..... metres

1 mark

(c) Nicola lets go of the rope and she slows down. Gravity still acts on Nicola.

Give the name of **one** other force still acting on Nicola after she lets go of the rope.

.....

1 mark

maximum 4 marks

8. (a) Megan was doing time-trials on her bike around a 400 metre horizontal track.

(i) She took 32 seconds to travel 400 m.
What was her average speed? Give the unit.

.....

.....

1 mark

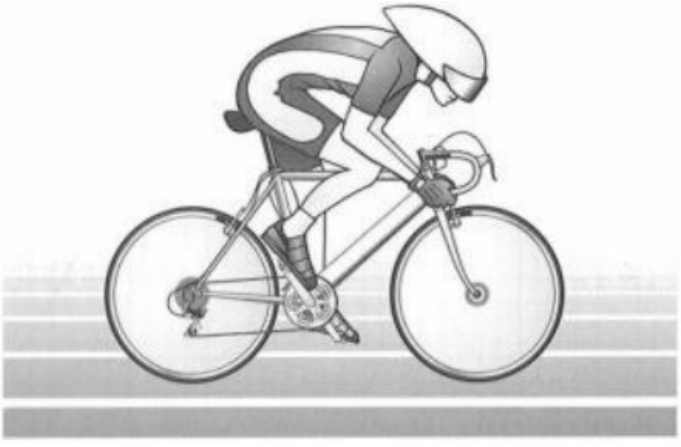
(ii) Compare the forward force on the bike with the backward force on the bike when Megan was travelling at a constant speed.

.....

.....

1 mark

(b) Megan then crouched down over the handlebars to make herself more streamlined, as shown below.
She continued to pedal with the same force as before.



Compare the forward and backward forces on Megan and her bike now.

.....

.....

1 mark

Explain your answer.

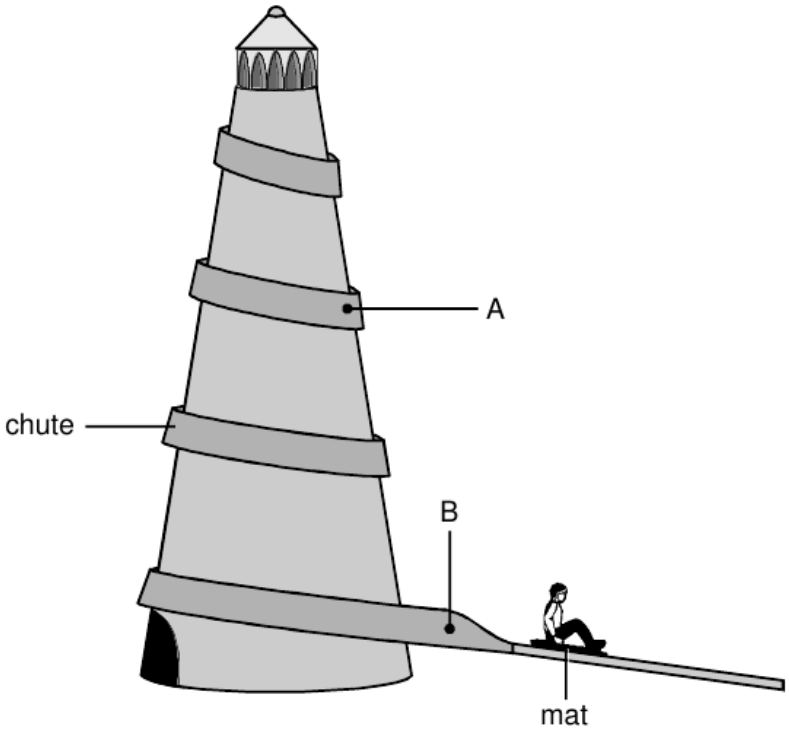
.....

.....

1 mark

maximum 4 marks

9. Anil sits on a mat at the top of a helter-skelter and then slides down a chute around the outside.



(a) (i) Name **two** of the forces acting on Anil as he slides from point A to point B.

1. .....

2. .....

2 marks

(ii) As Anil slides from point A to point B, the forces acting on him are balanced.

Describe Anil's speed when the forces acting on him are balanced.

.....

1 mark

(b) Anil goes back for a second go. This time he sits on a smooth cushion instead of a mat.

He goes much faster on the cushion. Give the reason for this.

.....

1 mark

(c) On his third go Anil lies back on the cushion with his arms by his side.

What happens to his speed? Give the reason for your answer.

.....

.....

.....

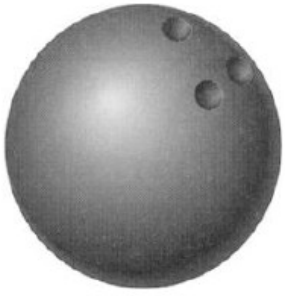
2 marks

Maximum 6 marks

10. The picture shows a man called Aristotle. He lived in Greece over 2000 years ago.

Aristotle said that the heavier an object is, the faster it will fall to the ground.

(a) The drawings below show a bowling ball, a cricket ball and a ping-pong ball. Lila dropped them all at the same time from the same height.



bowling ball
mass=5 000 g

cricket ball
mass=160 g

ping-pong
mass=2.5 g

If Aristotle was correct, which of the three balls would you expect to reach the ground first?
Give the reason for your answer.

.....

.....

1 mark

(b) Joe said that it would be a fairer test if Lila had only used a cricket ball and a hollow plastic ball as shown below.

cricket ball
mass = 160 g

hollow plastic ball
mass=56 g

Why was Joe correct?

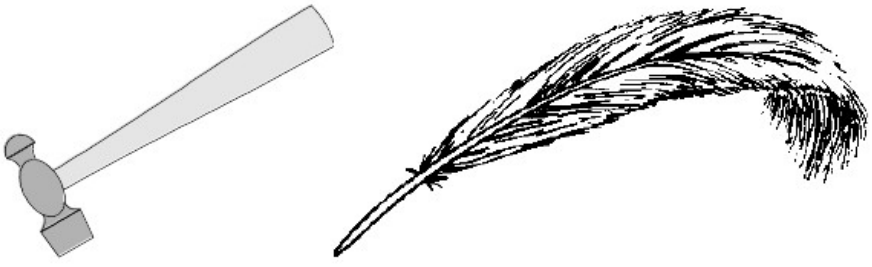
.....

.....

1 mark

(c) About 400 years ago in Italy, a man called Galileo had a different idea. He said that all objects dropped from the same height would reach the ground at the same time.

(i) Lila dropped a hammer and a feather at the same time from the same height.



If Galileo was correct, which, if either, would reach the ground first?

.....

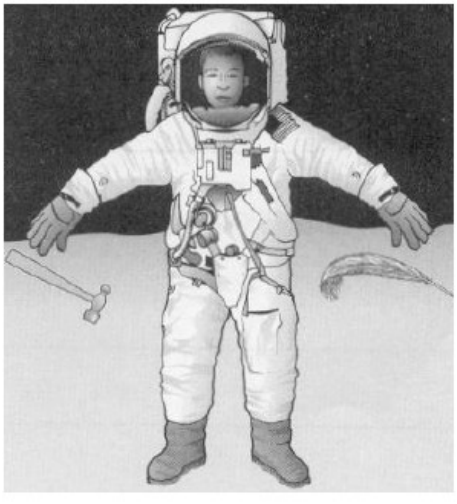
1 mark

(ii) Gravity acts on both the hammer and the feather as they fall. Give the name of **one** other force which acts on them as they fall.

.....

1 mark

(iii) An astronaut on the moon dropped a hammer and a feather at the same time from the same height.



How would the results of the astronaut's experiment on the Moon be different from Lila's experiment on the Earth?

.....

Explain your answer.

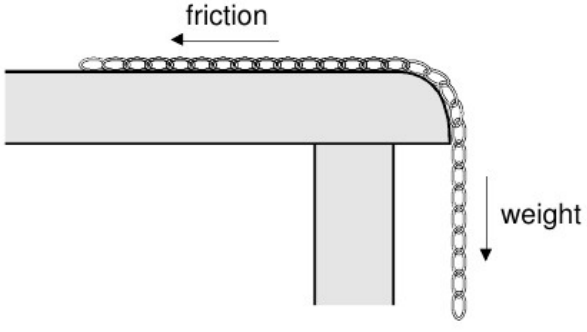
.....

.....

2 marks

Maximum 6 marks

11. The diagram shows a chain hanging down over the edge of a table.



Two of the forces on the chain are:

- the weight of the part of the chain which is hanging over the edge;
- friction between the chain and the table.

(a) The chain is **not** moving. What does this tell you about these two forces acting on the chain?

1 mark

(b) The chain is moved slightly to the right. It begins to slide off the table.

(i) What does this tell you about these two forces now?

……

1 mark

(ii) Describe how the size of each force changes as the chain slides off the table.

- weight of the part of the chain hanging over the edge ……

……

- friction between the chain and the table ……

……

2 marks

(iii) How does the speed of the chain change as it slides off the table?

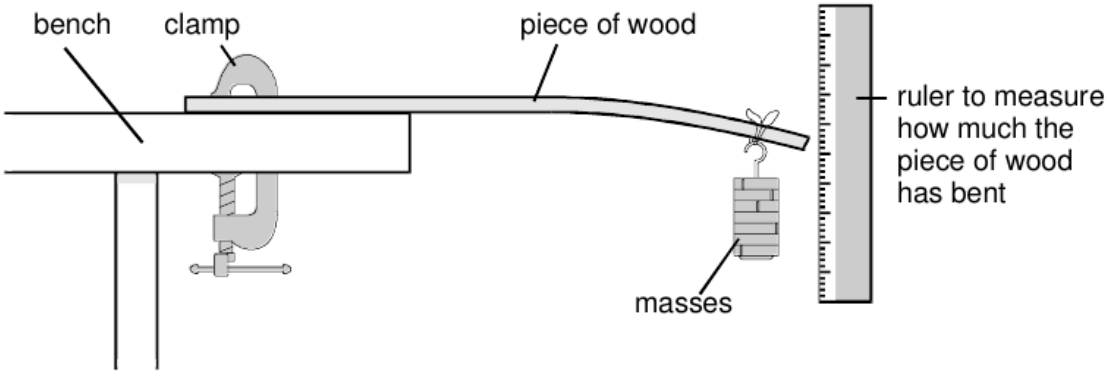
……

……

1 mark

Maximum 5 marks

12. Ruth is investigating how much a piece of wood can bend. She hangs some masses on the end of the piece of wood and measures how far the wood has bent.

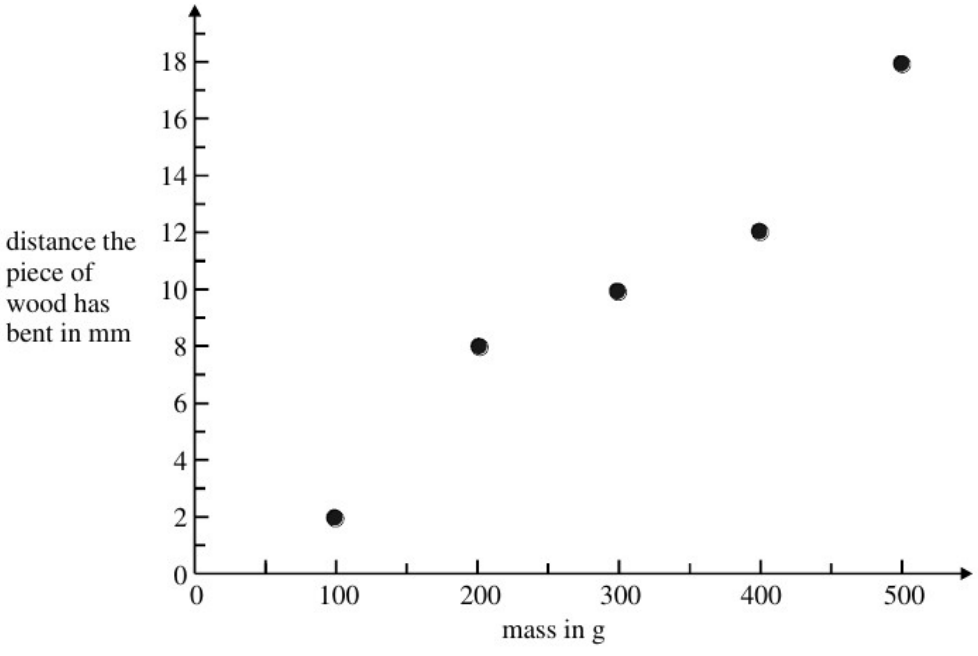


(a) Give the name of the force which pulls the masses downwards.

.....

1 mark

(b) The graph below shows Ruth's results.



(i) Complete the graph by drawing a straight line of best fit.

1 mark

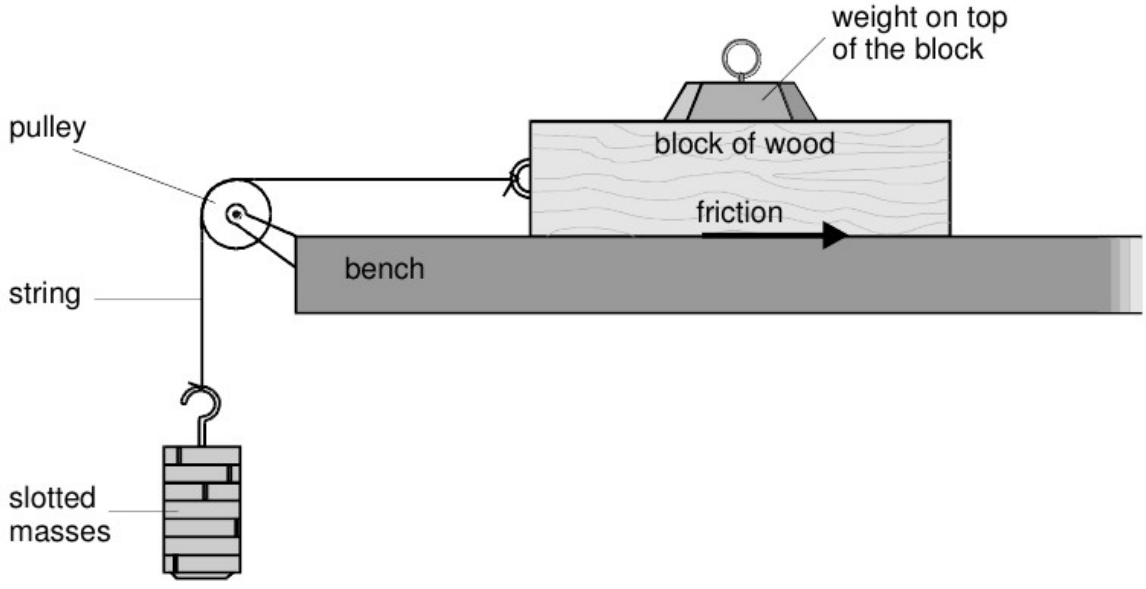
(ii) A mass of 350 g is hung on the piece of wood. How much does the wood bend?

..... mm

1 mark

Maximum 3 marks

13. Nazia is investigating how easily a block of wood slides along a wooden bench. The diagram shows her experiment.



(a) Nazia does the experiment with different weights on top of the block. She counts how many slotted masses she needs to hang from the string to make the block of wood slide. Her results are shown in the table.

weight on top of the block in N	number of slotted masses needed
0	5
1	7
2	9
3	1
4	13

(i) Describe how the number of slotted masses needed to move the block varies with the weight on top of the block.

.....

.....

1 mark

(ii) Nazia does the experiment with a weight of 3.5 N on top of the block of wood.

How many slotted masses would she need to make the block slide?

.....

1 mark

(b) Nazia does her experiment again. This time she slides the block of wood over a sheet of glass instead of the bench top.

(i) Suggest how her results would be different this time.

.....

.....

1 mark

(ii) Using the same sheet of glass and block of wood, and keeping the same weight on top, suggest **one** way Nazia could reduce the force of friction.

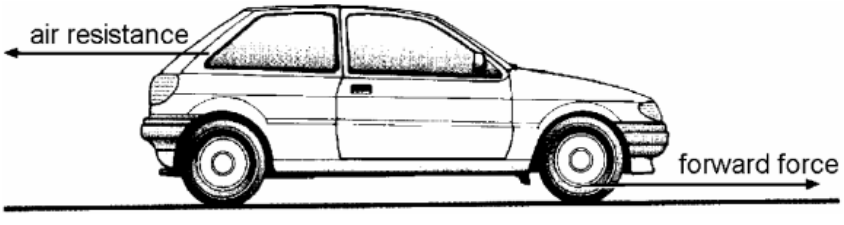
.....

.....

1 mark

Maximum 4 marks

14. When a car is being driven along, two horizontal forces affect its motion. One is air resistance and the other is the forward force.



(a) (i) Explain how molecules in the air cause air resistance.

.....

.....

1 mark

(ii) Explain why air resistance is larger when the car is travelling faster.

.....

.....

1 mark

(b) (i) Compare the sizes of the forward force and the air resistance when the car is speeding up.

The forward force is .....

.....

1 mark

(ii) Compare the sizes of the two forces while the car is moving at a steady 30 miles per hour.

The forward force is .....

.....

1 mark

(c) The forward force has to be larger when the car is travelling at a steady 60 mph than when it is travelling at a steady 30 mph. Why is this?

.....

.....

1 mark

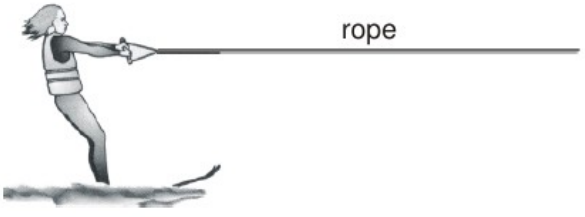
(d) The forward force is the result of the tyres **not** being able to spin on the road surface.
What is the name of the force that stops the tyres spinning?

.....

1 mark

Maximum 6 marks

15. The drawing shows Amy water-skiing.



(a) (i) The rope is pulling Amy. Draw an arrow on the rope to show the direction of this force.
Label the arrow A.

1 mark

(ii) Draw an arrow to show the direction of Amy's weight.
Label the arrow B.

1 mark

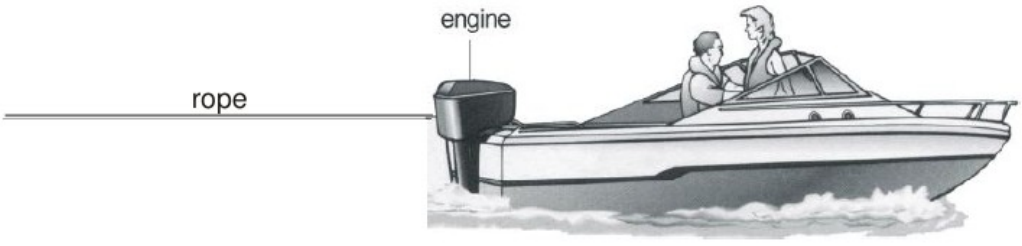
(b) Give the names of **two** other forces which act on Amy or on her skis.

1. .....

2. .....

2 marks

The drawing below shows the speed boat which is pulling Amy along.



(c) The rope which pulls Amy also exerts a force on the boat.
Draw an arrow on the rope to show the direction of this force.
Label the arrow C.

1 mark

(d) The force of the engine on the boat is increased.
What effect will this have on the speed of the boat?

……..……..

1 mark

Maximum 6 marks

16. The drawing shows a man moving a wheelbarrow full of bricks.

(a) Tick the boxes by **two** forces on the wheelbarrow.

the weight of the bricks	☐
the speed of the wheelbarrow	☐
the size of the wheel	☐
the energy of the wheelbarrow	☐
the push of the man's hands on the handles	☐
the weight of the man	☐

2 marks

(b) The man lets go of the handles and the wheelbarrow hits the ground while it is still moving. The wheelbarrow soon stops moving forward.

Give the name of the force which makes the wheelbarrow stop moving forward.

.....

1 mark

(c) One brick drops off the wheelbarrow.

What effect does the force of gravity have on the speed of the brick as it falls?

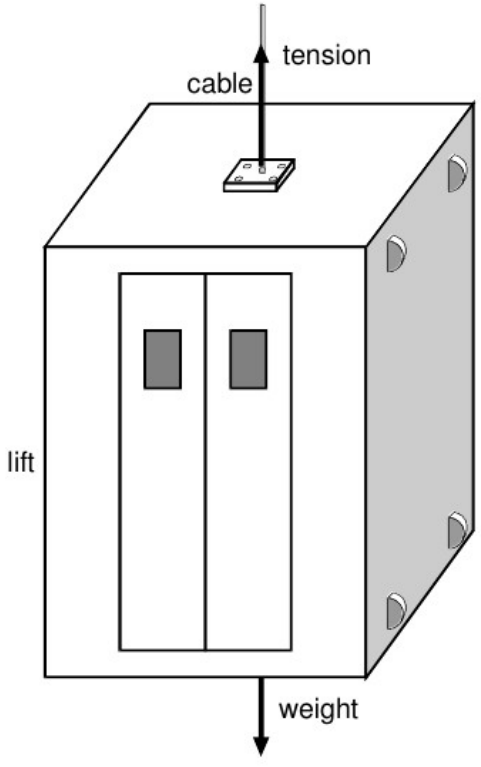
.....

.....

1 mark

Maximum 4 marks

17. The lift in a tall building hangs from a strong cable. The movement of the lift is affected by only two forces.
These forces are the **tension** in the cable and the **weight** of the lift.



(a) The lift is **not** moving. How do the sizes of the two forces compare?
Tick the correct box.

The tension is greater than the weight.	☐
The tension equals the weight.	☐
The tension is less than the weight.	☐
It is impossible to know which is greater.	☐

1 mark

(b) When the lift is moving upwards and its speed is increasing, how do the sizes of the two forces compare?

.....

1 mark

(c) When the lift is moving upwards at a constant speed, how do the sizes of the two forces compare?

.....

1 mark

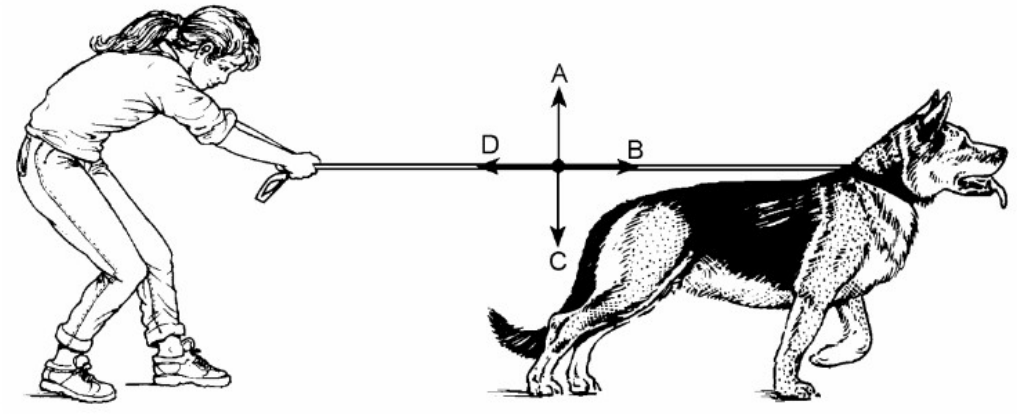
(d) Near the top of the building the lift is moving upwards, but slowing down. How do the sizes of the two forces now compare?

.....

1 mark

Maximum 4 marks

18.



(a) Megan's dog is pulling on his lead.
Which arrow, A, B, C or D, shows the direction of this force?
Give the letter.

.....

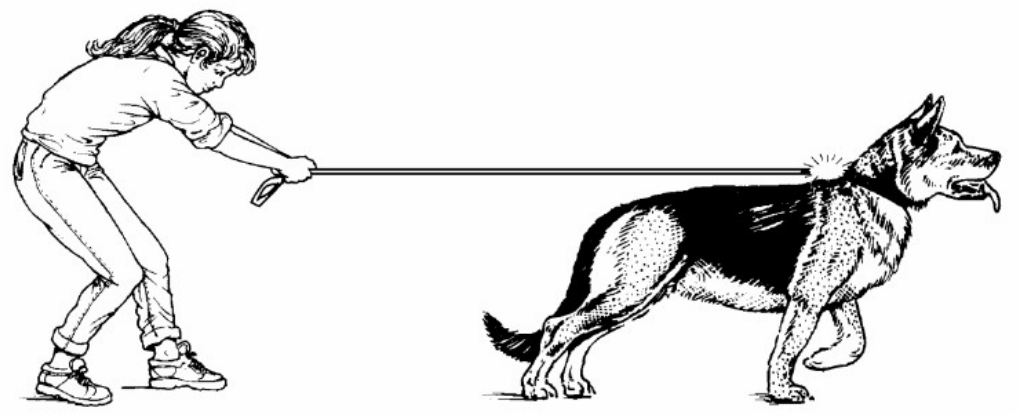
1 mark

(b) Megan has to pull to keep the dog still.
Which arrow shows the direction of this force? Give the letter.

.....

1 mark

(c) Suddenly the dog's collar breaks.



(i) When the collar breaks, the lead moves.
Draw an arrow on the diagram to show which way the lead starts to move.

1 mark

(ii) Why does the lead move when the collar breaks?

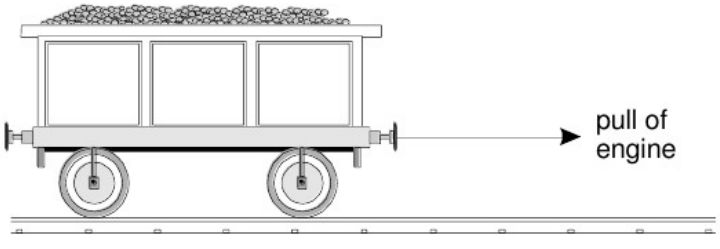
.....

.....

1 mark

Maximum 4 marks

19.



(a) A railway engine is being used to try to pull a wagon along a level track. The wagon's brakes are on, and the wagon does not move.

(i) Draw **one** arrow on the diagram to show the direction of the force which prevents the wagon from moving.

1 mark

(ii) Is the force which prevents the wagon from moving **greater than**, **equal to** or **less than** the pull of the engine?

.....

1 mark

(b) (i) When the wagon's brakes are off, the engine pulls the wagon forwards. A frictional force also acts on the wagon. In what direction does the frictional force act?

1 mark

(ii) The pull of the engine is 5000 N. When the wagon's speed is increasing, how large is the frictional force?
Tick the correct box.

zero	☐
between 0 and 5000 N	☐
5000 N	☐
more than 5000 N	☐

1 mark

(c) After a while, the wagon travels at a steady speed. The engine is still pulling with a force of 5000 N.

How large is the frictional force now?
Tick the correct box.

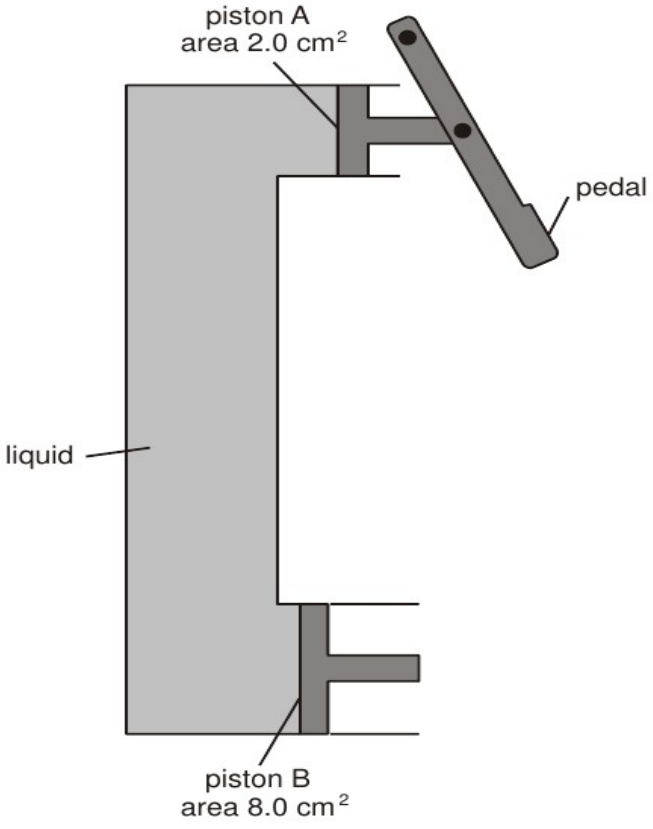
zero	☐
between 0 and 5000 N	☐
5000 N	☐
more than 5000 N	☐

1 mark

Maximum 5 marks

PRESSURE

1. The diagram below shows a container filled with a liquid.



At each end of the container there is a piston.
Piston A has a smaller area than piston B.

(a) (i) Rebekah pushes on the pedal. This produces a force of 200 N on piston A.

Calculate the pressure that piston A exerts on the liquid.
Give the unit.

.....

.....

2 marks

(ii) The liquid in the container exerts the same pressure on piston B.

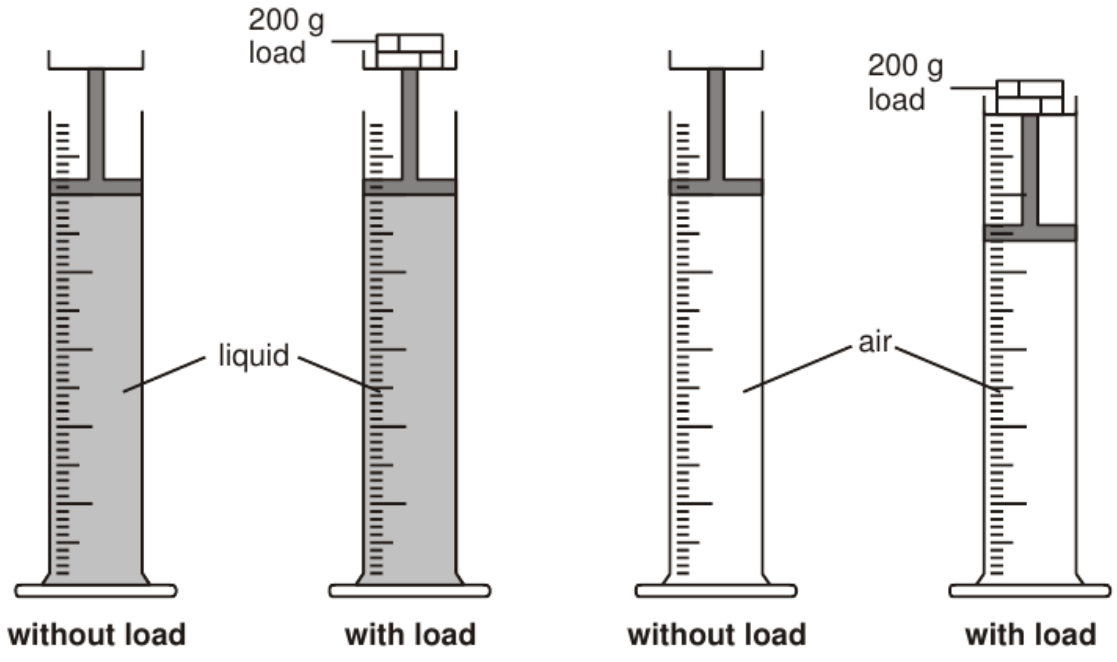
Use this pressure to calculate the force on piston B.

.....

..... N

1 mark

(b) Rebekah set up a different experiment as shown below.
She measured the volume of the liquid and the air in the cylinders before and after a 200 g load was added to the piston.



(i) When the loads were added to the pistons, the volume of the liquid did **not** change but the volume of the air decreased.

Explain why this happened.

.....

.....

1 mark

(ii) The diagram on the opposite page represents the way the brake system of a car works.
The brake pedal pushes piston A.
Piston B pushes the brakes on.

If air bubbles get into the liquid, the brakes do **not** work properly.
Explain why.
Use the diagrams above to help you.

.....

.....

1 mark

maximum 5 marks

2. Tom tries on four types of footwear in a sports shop.

ski boot

trainer

ice skate

walking boot

(a) (i) When Tom tries on the footwear, which one sinks into the carpet the most?

.....

1 mark

(ii) When Tom tries on the footwear, what is the same for each type of footwear? Tick the correct box.

the area of the footwear	☐
Tom's weight on the footwear	☐
the material of the footwear	☐
the weight of the footwear	☐

1 mark

(b) The drawing below shows a snowshoe.

How do snowshoes help people to walk in deep snow?

.....

.....

1 mark

(c) Choose the correct word from the list to complete the sentence below.

air resistance **friction** **gravity** **magnetism**

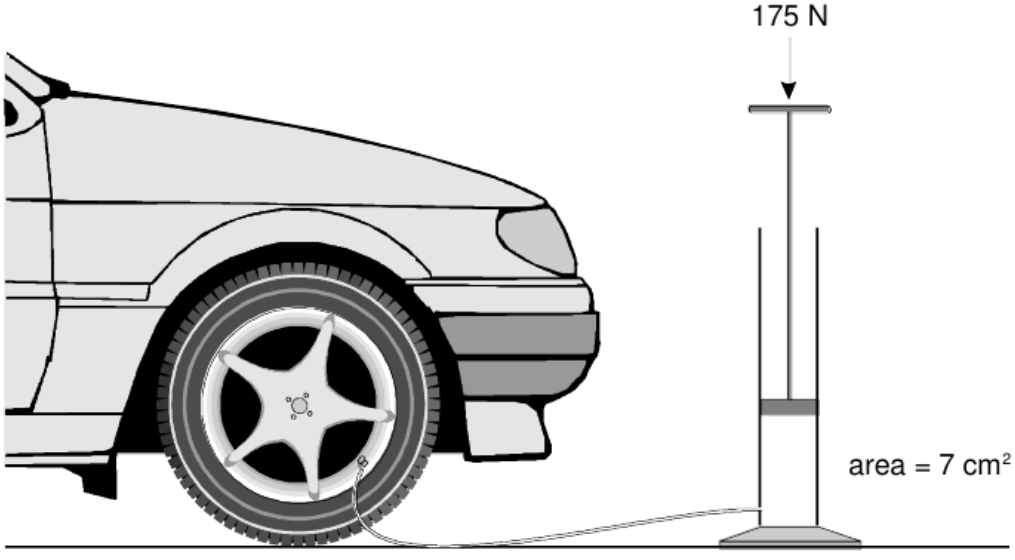
When Tom is ice skating the force of .....

between the skate and the ice is less than when he is walking on a carpet.

1 mark

Maximum 4 marks

3. Karen wants to pump up her car tyre.
Her pump has a piston with an area of 7 cm^2.



Karen pushes the handle down with a force of 175 N.

(a) What pressure does she exert on the air in the pump?

.....

..... N/cm^2

1 mark

(b) The air pressure in the tyre is 27 N/cm^2.
What pressure would be needed **in the pump** in order to pump more air into the tyre?

.....

.....

1 mark

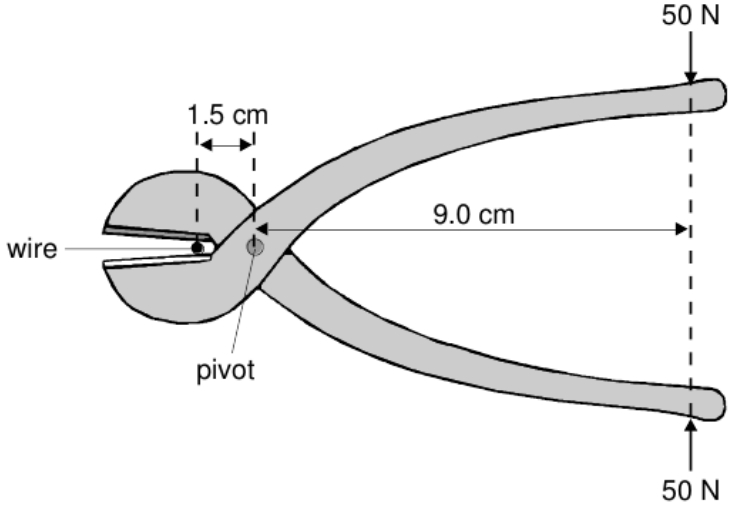
(c) Another of Karen's car tyres exerts a pressure of 30 N/cm^2 on the road. The area of the tyre in contact with the road is 95 cm^2
What is the force exerted by the tyre on the road?

..... N

1 mark

Maximum 3 marks

4. (a) James is cutting a piece of wire with a pair of wire cutters.



James exerts a force of 50 N on each of the handles.

(i) What is the turning moment about the pivot, on **each** handle?
Give the unit.

.....

.....

2 marks

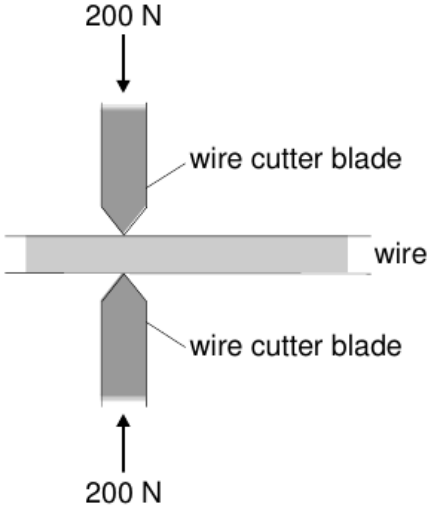
(ii) What force is applied, by **each** blade, on the wire?

.....

..... N

1 mark

(b) Stephanie uses the same pair of wire cutters. The diagram below is an end-on view of the blades as they begin to cut the wire.



Stephanie exerts a force of 200 N on the wire with each blade.
The area of contact of each blade on the wire is 0.0005 cm^2.

(i) What is the pressure of **each** blade on the wire? Give the unit.

.....

.....

2 marks

(ii) As the blades sink deeper into the wire, the pressure of the blades on the wire decreases.
Explain why the pressure on the wire decreases.

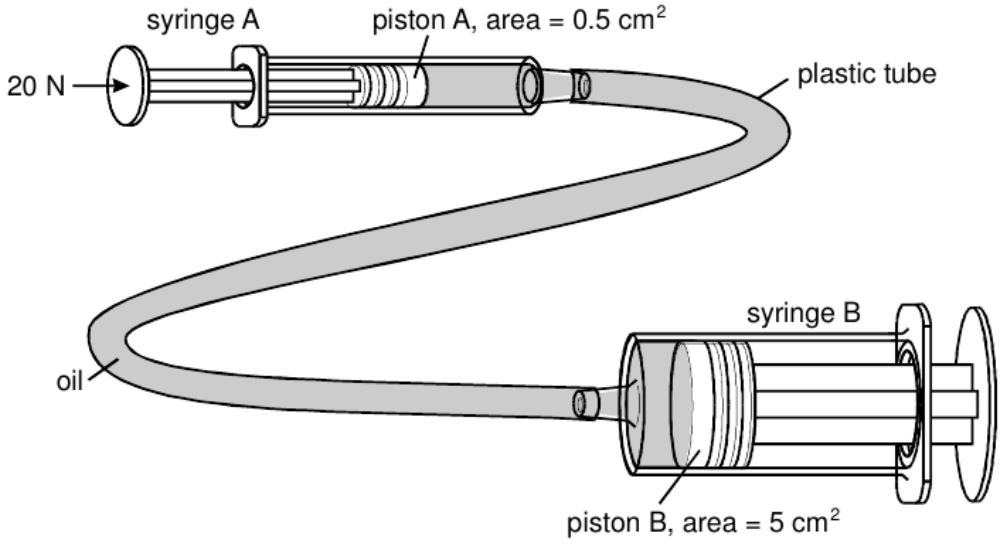
.....

.....

1 mark

Maximum 6 marks

5. (a) Two syringes are connected together as shown in the diagram below.



A force of 20 N is applied to the piston in syringe A.

(i) Calculate the pressure that the piston in syringe A exerts on the oil. Give the units.

.....

.....

1 mark

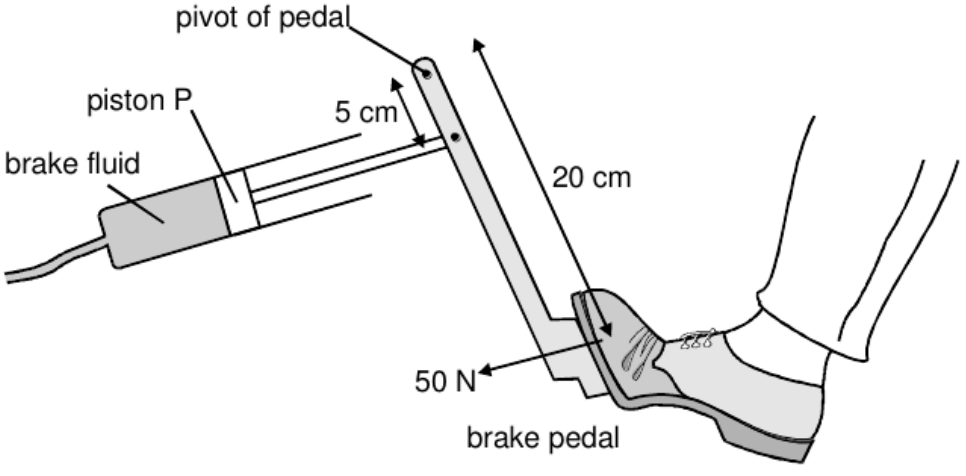
(ii) Calculate the force needed to just prevent the piston in syringe B from moving out. Give the unit.

.....

.....

1 mark

(b) The diagram below shows the brake pedal used to operate the brakes in a car. The foot applies a force of 50 N.



(i) Calculate the force applied to the piston P. Give the unit.

……

……

1 mark

(ii) The brake fluid pushes another piston, Q, which is attached to the car's brakes.
Piston Q has an area which is eight times larger than piston P.

Calculate the force on the car's brakes. Give the unit.

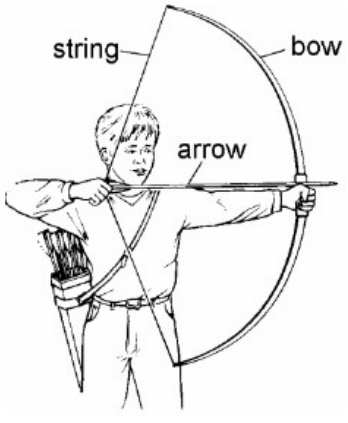
……

……

1 mark

Maximum 4 marks

6. The drawing shows a boy with a bow and arrow. He is holding the **arrow** and pulling it back.



(a) Two horizontal forces act on the arrow. These are the force exerted by the boy's hand and the force exerted by the string. The arrow is **not** moving.

The boy pulls the arrow with a force of 150 N. What is the size of the force exerted by the string on the arrow?

..... N

1 mark

(b) When the boy lets go of the arrow, it starts to move forward.

Explain why it starts to move.

.....

.....

1 mark

(c) The arrow flies across a field and hits a target.

Two forces act on the arrow while it is in the air. Air resistance acts in the opposite direction to the movement, and gravity acts downwards. These two forces **cannot** balance each other, even when they are the same size. Why is this?

.....

.....

1 mark

(d) The arrow has a sharp pointed end. When the arrow hits the target, the sharp point exerts a very large pressure on the target.

Why does a sharp pointed end exert a larger pressure than a blunt end?

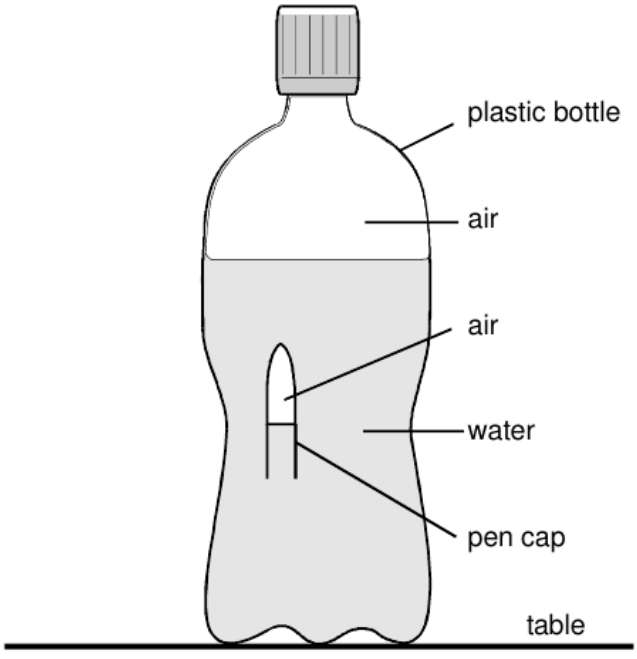
.....

.....

1 mark

Maximum 4 marks

7. A pen cap floats in a plastic lemonade bottle three-quarters full of water.
If you squeeze the bottle the pen cap sinks to the bottom.
If you then let go of the bottle, the pen cap floats to the surface.



(a) When the bottle is squeezed what, if anything, happens to:

(i) the distance between the air molecules inside the bottle?

.....

1 mark

(ii) the distance between the water molecules inside the bottle?

.....

1 mark

(iii) the pressure of the air trapped inside the pen cap?

.....

1 mark

(iv) the volume of the air trapped inside the pen cap?

.....

1 mark

(b) Explain why the pen cap sinks when you squeeze the bottle.

.....

.....

.....

.....

2 marks

Maximum 6 marks

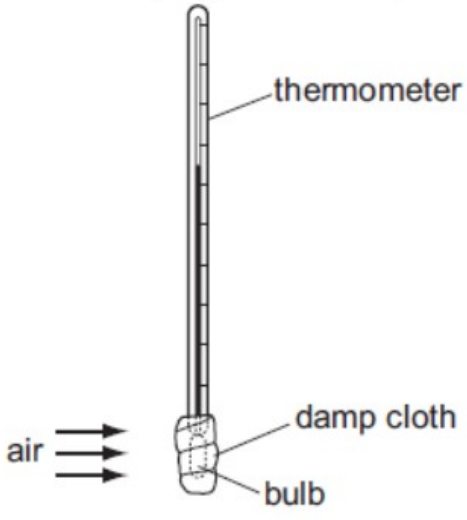
PARTICULATE NATURE OF MATTER

1. Evaporation occurs when molecules escape from a liquid surface into the air above it. During this process the temperature of the liquid falls.

Why does the temperature of the liquid fall?

A. The molecules in the vapour expand because the pressure is less.
B. The molecules left in the liquid have more space to move around.
C. The molecules move more slowly when they escape into the air.
D. The molecules with the highest energies escape into the air.

2. A thermometer bulb is covered by a piece of damp absorbent cloth.



Air at room temperature is blown across the damp cloth.
What happens to the thermometer reading?

A. It remains constant.
B. It rises.
C. It rises then falls.
D. It falls.

3. Some air is trapped inside a small balloon. The average kinetic energy of the air molecules in the balloon is increased.

What remains the same?

A. the density of the air in the balloon
B. the mass of the air in the balloon
C. the temperature of the air in the balloon
D. the volume of the air in the balloon

4. When ice melts to become water, which force must be overcome?

A. the attraction between electrons and the nucleus
B. the attraction between the atoms in a molecule
C. the force between molecules
D. the force of gravity

5. The Brownian motion of smoke particles in air may be observed using the apparatus shown in Fig. 2.1.

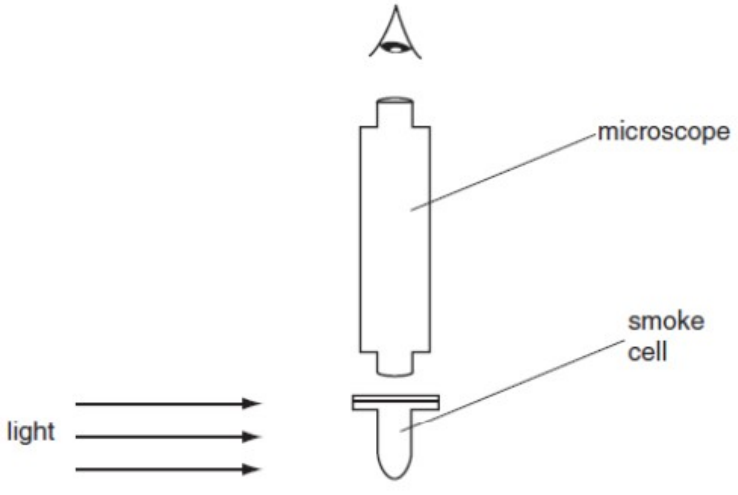


Fig. 2.1

(a) Describe what is seen when viewing a smoke particle through the microscope.

[2]

(b) Suggest and explain what difference, if any, would be observed in the movement of smoke particles when larger smoke particles than those observed in (a) are viewed through the microscope.

[2]

6. A student puts some pieces of a solid hydrocarbon wax into a test-tube. She places this test-tube into a beaker of boiling water until all the solid wax has melted to form a liquid.

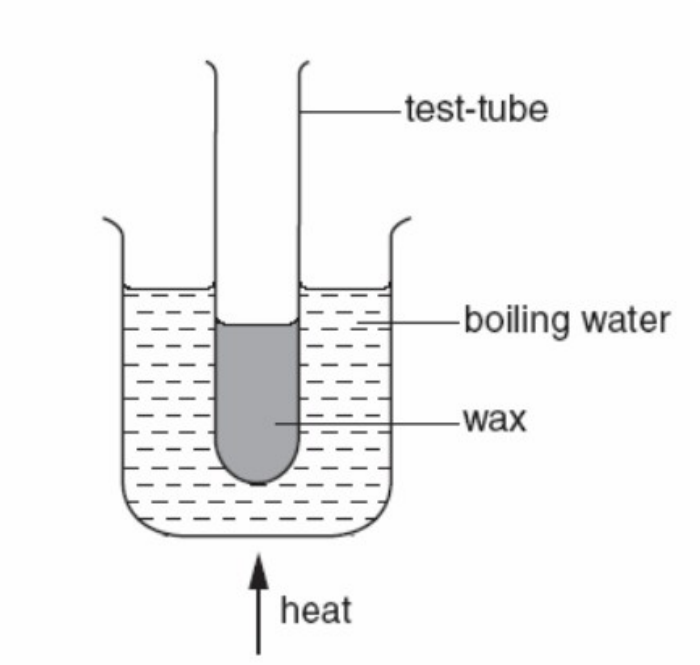


Fig. 8.1

(a) Explain why she heats the wax in this way instead of heating the test-tube directly with a burner.

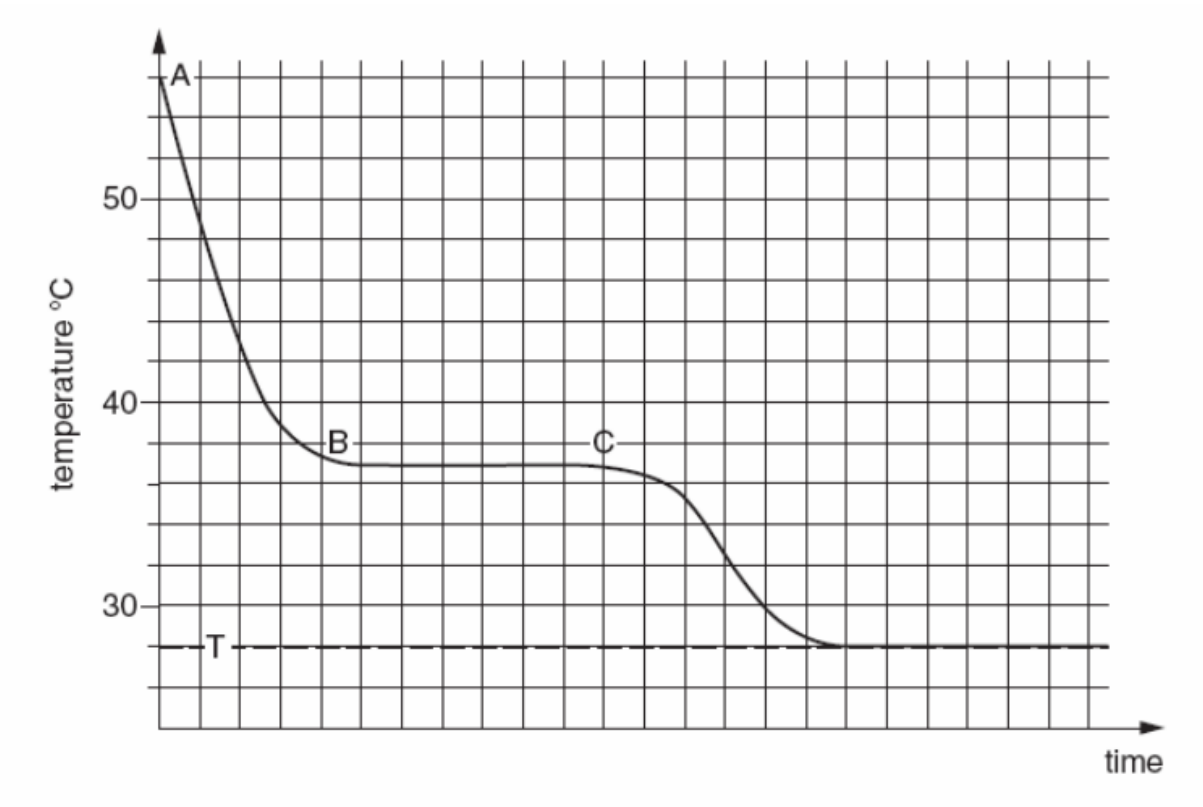
.....

.....

..... [2]

(b) Another student puts a thermometer in the wax in the test-tube then removes the test- tube from the boiling water.

He notes the reading of the thermometer every minute as the wax cools. His results are shown in below.



(i) Using words from the list below complete the following sentences about this
experiment.

cooling **endothermic** **exothermic**

melting **solidifying** **warming**

Between the points **A** and **B** on the graph, the liquid is.....

Between the points **B** and **C** on the graph, the hydrocarbon is.....

This an ..... process. [3]

(ii) Use the graph to find the melting point of this hydrocarbon.

Melting point = ... °C [1]

(iii) How does the shape of the graph show that the hydrocarbon is pure?

.....

..... [1]

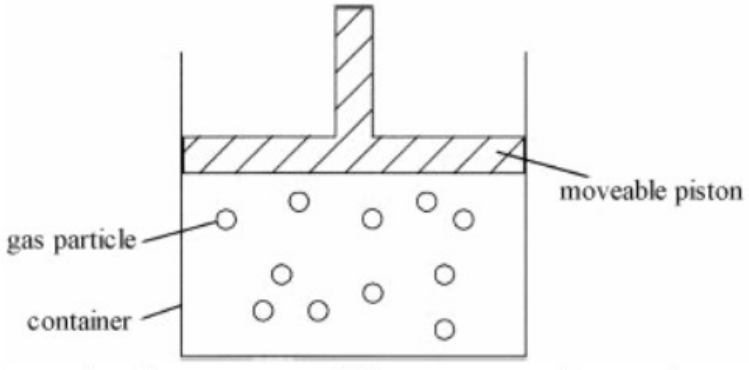
(iv) What is the significance of the final temperature **T**?

.....

..... [1]

[Total 8m]

7. (a) The diagram shows particles of a gas in a container.
The piston can be moved up or down the container.



(i) Describe the motion of the gas particles in the container.

.....

.....

.....

(2)

(ii) Explain how the motion of the gas particles produces a pressure inside the container.

.....

.....

.....

(2)

(iii) What would happen to the pressure if you pushed the piston downwards?

.....

(1)

(b) When the gas in the container is heated the piston moves upwards.
Tick the **three** correct statements.

The gas particles get bigger.	☐
The mass of gas particles stays the same.	☐
The gas particles move faster.	☐
The gas particles move further apart.	☐
The temperature of the gas decreases.	☐

(3)

(c) During a long car journey, the air pressure in the tyres increases.

Explain why.

.....

.....

.....

.....

(3)

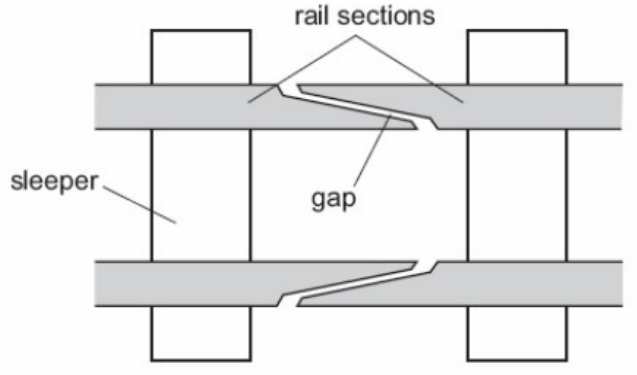
(Total 11 marks)

THERMAL EXPANSION

1. To mark the lower fixed point of a Celsius scale on a thermometer, the thermometer should be placed in

A. pure alcohol.
B. pure distilled water.
C. pure melting ice.
D. pure mercury.

2. At regular intervals along a railway line there is a gap between the rail sections.



What is the reason for the gap between the rail sections?

A. to allow for expansion of the rail sections during hot weather
B. to allow for vibrations of the rail sections as the train passes over them
C. to allow rain water to drain from the rail sections
D. to keep the wheels of the train and carriages on the rail sections

3. To mark the lower fixed point of a Celsius scale on a thermometer, the thermometer should be placed in

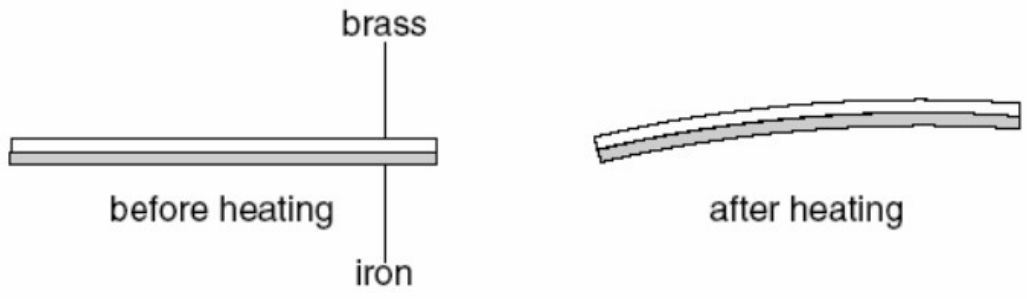
A. pure alcohol.

B. pure distilled water.

C. pure melting ice.

D. pure mercury.

4. Fig 10.1 shows a bimetal strip before and after being heated.



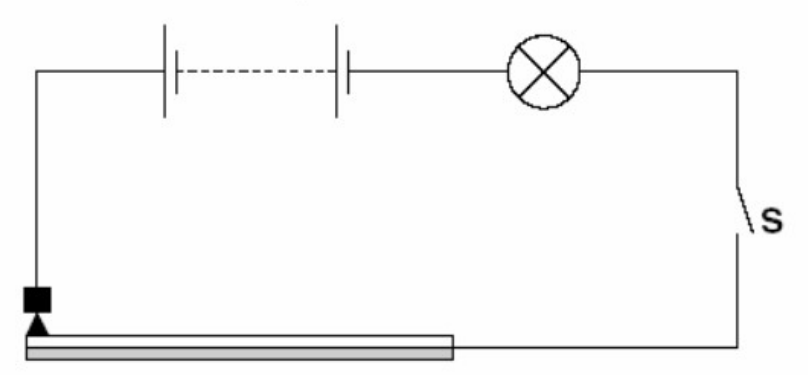
(a) Explain why the strip bends when it is heated.

.....

.....

..... [2]

(b) Fig. 10.2 shows a similar strip in a circuit.



(i) Explain why the lamp flashes on and off when switch **S** is closed.

.....

.....

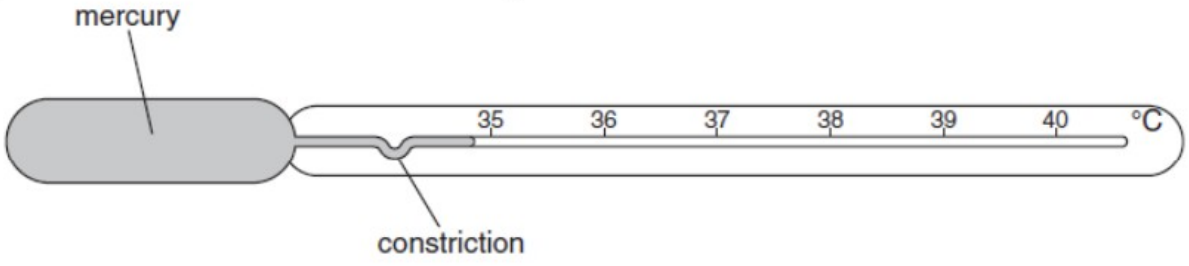
..... [3]

(ii) Suggest a use for such a circuit.

..... [1]

[Total 6m]

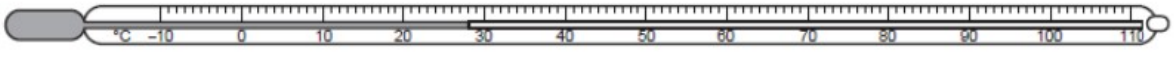
5. A clinical thermometer is shown in figure below.



State and explain a feature of the clinical thermometer that improves the thermometer's sensitivity.

[2]

6. The figure below shows a laboratory thermometer.



(a) (i) State the range of the thermometer.

..... [1]

(ii) State one change in the design of the thermometer to increase its range.

[1]

(b) (i) Describe how the behaviour of a more sensitive thermometer is different from a less sensitive thermometer.

[1]

(ii) State one change in the design of the thermometer to make it more sensitive.

[1]

(c) Describe how a clinical thermometer differs from a laboratory thermometer. A diagram may be included in your answer.

[3]

[Total 7 marks]

7. (a) Equal volumes of a gas held at constant pressure, a liquid and a solid undergo the same temperature rise.
(i) State which of the three, solid, liquid or gas,

1. expands the most, ...

2. expands the least. .....

(ii) Explain why the pressure of the gas must be kept constant for this comparison.

.....

.....[2]

(b) Fig. 5.1 shows.

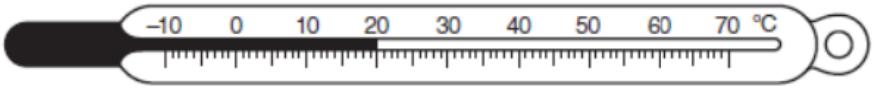


Fig. 5.1

(i) State two properties of alcohol which make it suitable for use in a thermometer.

1. .....

.....

2. .....

.....[2]

(ii) State two changes to the design of this thermometer which would make it more sensitive.

1. .....

.....

2. .....

.....[2]

(c) Explain why it is an advantage for the glass surrounding the alcohol in the bulb of the thermometer to be very thin.

.....

.....[1]

[Total: 7]

8. (a) The figure below shows a liquid-in-glass thermometer.

(i) Name a suitable liquid to use in the thermometer.
.....

(ii) State the reading on the thermometer. ..... °C

(iii) Explain why a narrow capillary tube is used.

.....

..... [3]

(b) The thermometer bulb is put in melting ice.
(i) Explain why the liquid moves in the capillary tube.

.....

.....

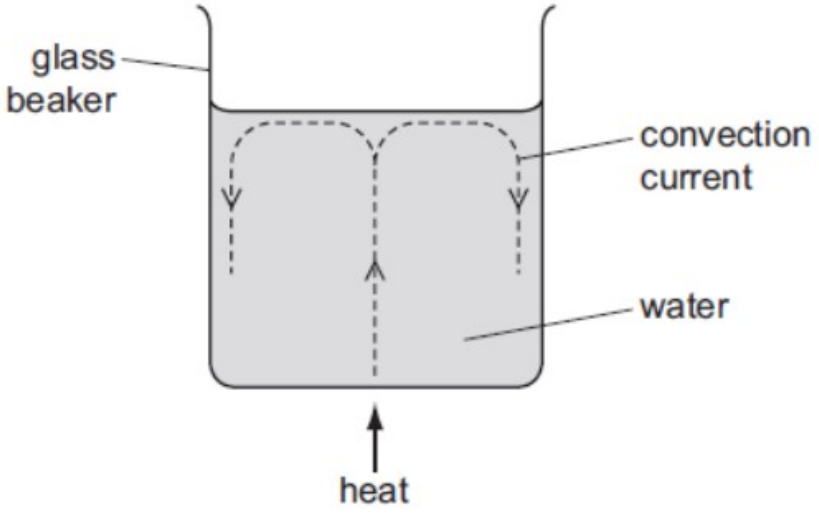
.....

(ii) Mark on the diagram the new position of the liquid. [3]

[Total 6m]

HEAT TRANSFER

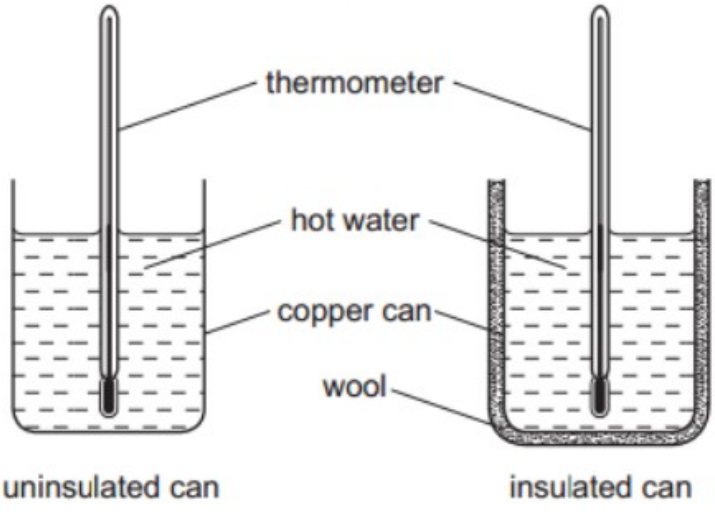
1. A glass beaker contains water. When the centre of the base of the beaker is heated, a convection current is set up.



Which statement explains this?

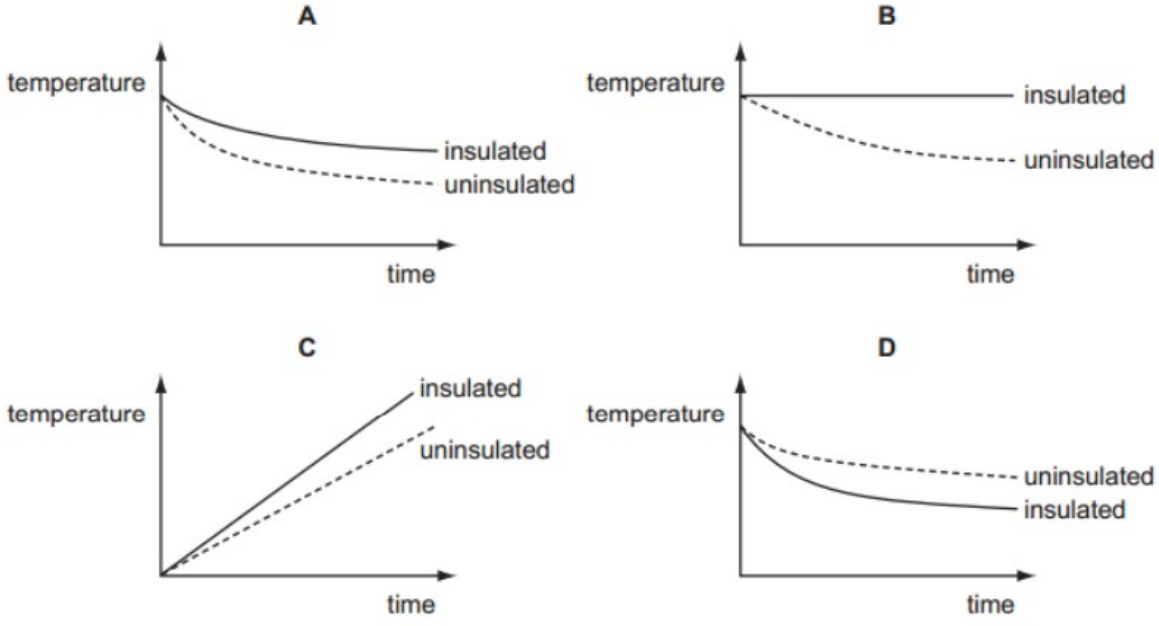
A. The evaporation of water causes water molecules to rise to the surface.
B. The expansion of water molecules causes them to rise to the surface.
C. The water above the heat source rises because it becomes less dense.
D. The water at the sides sinks because it becomes less dense.

2. Two identical copper cans are filled with boiling water.



One can is insulated with wool. The temperature of the water in each can is taken every minute for several minutes. Graphs of the results are plotted.

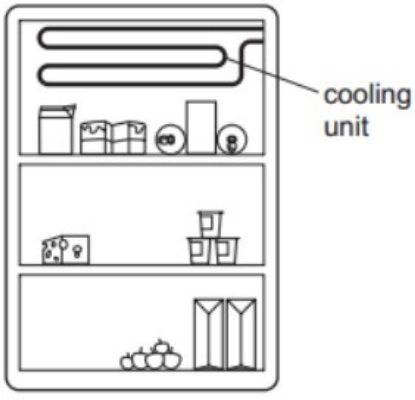
Which graph shows the results obtained?



3. In a vacuum flask, which methods of heat transfer are prevented by the vacuum?

A conduction only
B convection only
C conduction and convection only
D conduction, convection, and radiation

4. The diagram shows a cooling unit in a refrigerator.



Why is the cooling unit placed at the top?

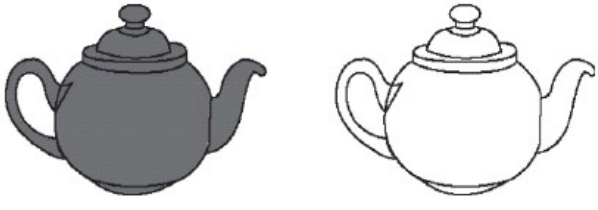
A. Cold air falls and warm air is displaced upwards.

B. Cold air is a bad conductor so heat is not conducted into the refrigerator.

C. Cold air is a good conductor so heat is conducted out of the refrigerator.

D. Cold air remains at the top and so prevents convection.

5. Two metal teapots are identical except that one is black on the outside and the other is white on the outside, as shown below.



The teapots each contain the same amount of hot water.

State and explain which teapot will cool down more quickly.

.....

.....

6. Logs of wood are burning in a camp-fire on the ground. A person is sitting nearby.

(a) (i) State two types of energy that the burning logs possess.

1. .....

2. .....

(ii) State the main method of heat transfer by which energy from the fire reaches the person sitting nearby.

.....

[3]

(b) A spark jumps out of the fire.

(i) State the name of the type of energy that the spark possesses due to its movement.

.....

(ii) The spark lands on the person's hand.

State which method of heat transfer causes the person to feel the spark.

.....

(iii) The pain caused by the spark makes the person stand up.

1. State the type of energy that has increased, now that he is standing.

.....

2. State the type of energy stored in his body that enabled him to stand.

.....
[4]

7. The main parts of a cold store are shown in Fig. 4.1.

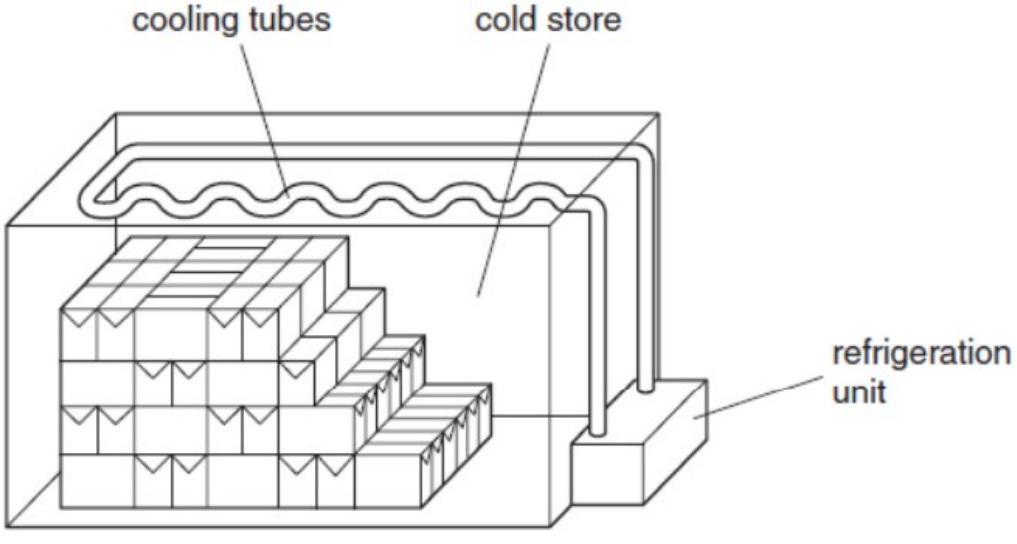


Fig. 4.1

(a) Explain why the cooling tubes are positioned at the top of the store.

[1]

(b) Suggest why the refrigeration unit is outside the cold store.

[2]

(c) The walls are made of thick thermally-insulating material.
Why is it important to have the walls made like this?

[2]

(d) Even when the refrigeration unit is running continuously, there comes a time when the temperature in the store stops falling, and remains constant.
Explain why this happens.

8. Fig. 7.1 shows a refrigerator in which a liquid absorbs thermal energy from the cold compartment and evaporates. As the vapour is compressed by the pump, work is done on it. The vapor condenses, giving out thermal energy to the surroundings through the cooling fins on the back of the refrigerator.

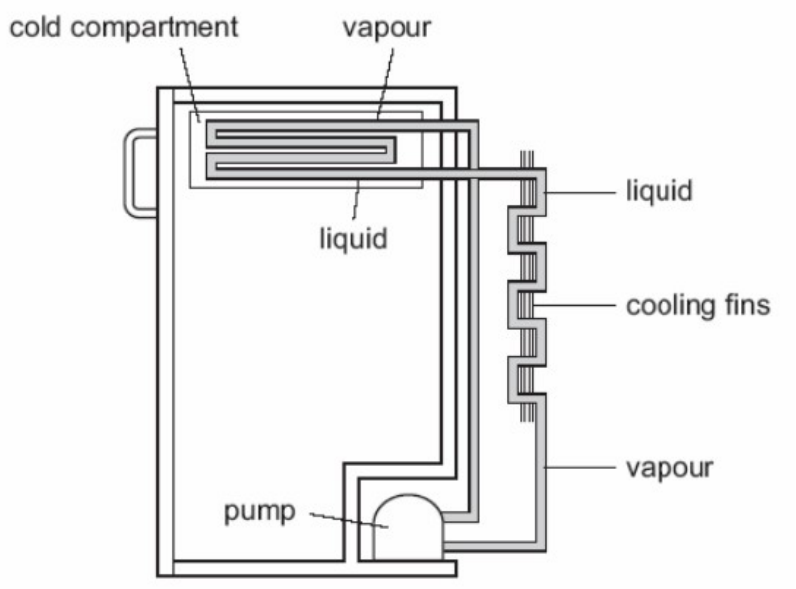


Fig. 7.1

(a) Explain the difference between boiling and evaporation.

[3]

(b) Explain why the pump compresses the vapour much more than it could compress a liquid.

[2]

(c) Explain the effect that a refrigerator has on the temperature of the air surrounding it.

[1]

(d) The pump is rated at 220 V, 110W.
(i) Calculate the working current of the pump.
Show your working.

[3]

(ii) Calculate the working resistance of the pump.

[2]
[Total 11m]

9. Three horizontal rods are placed with one end just above a Bunsen flame. The other end of each rod is coated with wax, as shown in Fig. 3.1.

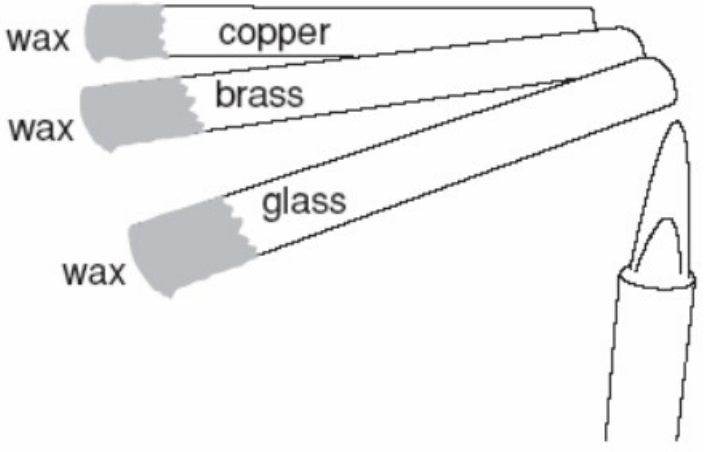


Fig. 3.1

Describe how you would use the apparatus to discover which rod is the best conductor of heat.

.....

.....

.....

.....

.....

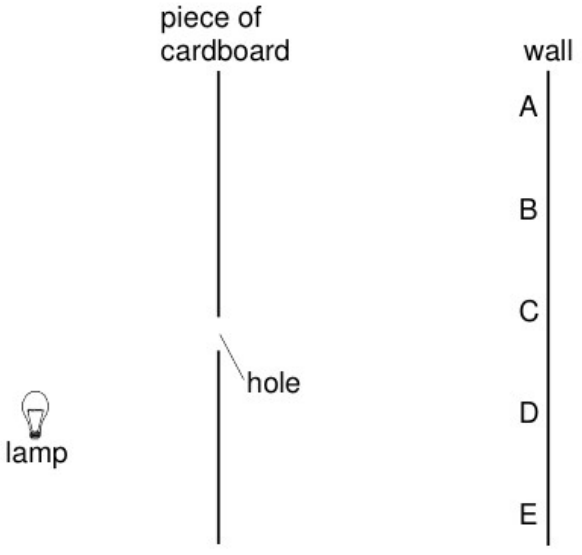
[2]

RECTILINEAR PROPAGATION AND REFLECTION OF LIGHT

1. State the property of light associated with formation of shadows.

(1mk)

2. The diagram shows a lamp and a piece of cardboard. The piece of cardboard has a hole in it. Light from the lamp passes through the hole and forms a bright spot on a wall.



(a) (i) Which point on the wall, A B, C, D or E, is lit up by the lamp?

.....

1 mark

(ii) Explain why the **other** points on the wall are **not** lit up by the lamp.

.....

.....

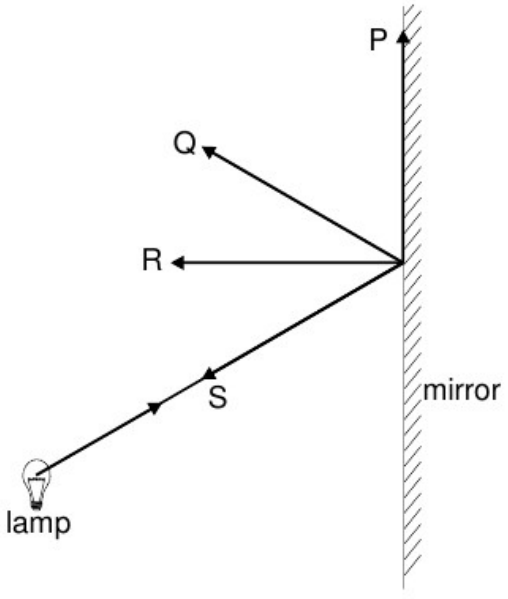
1 mark

(b) A piece of clear green plastic is placed over the hole.
What is the colour of the light which shines on the wall?

.....

1 mark

(c) The diagram shows a ray of light from a lamp hitting a mirror.



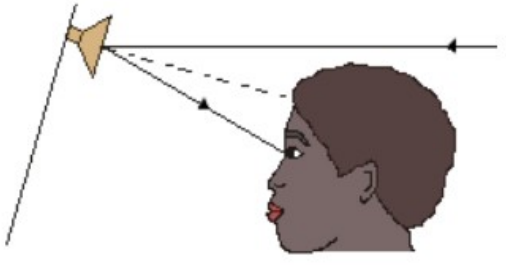
Which arrow, P, Q, R or S, shows the reflected ray?

.....

1 mark

Maximum 4 marks

3. (a) The diagram shows a motorist looking into her driving mirror.



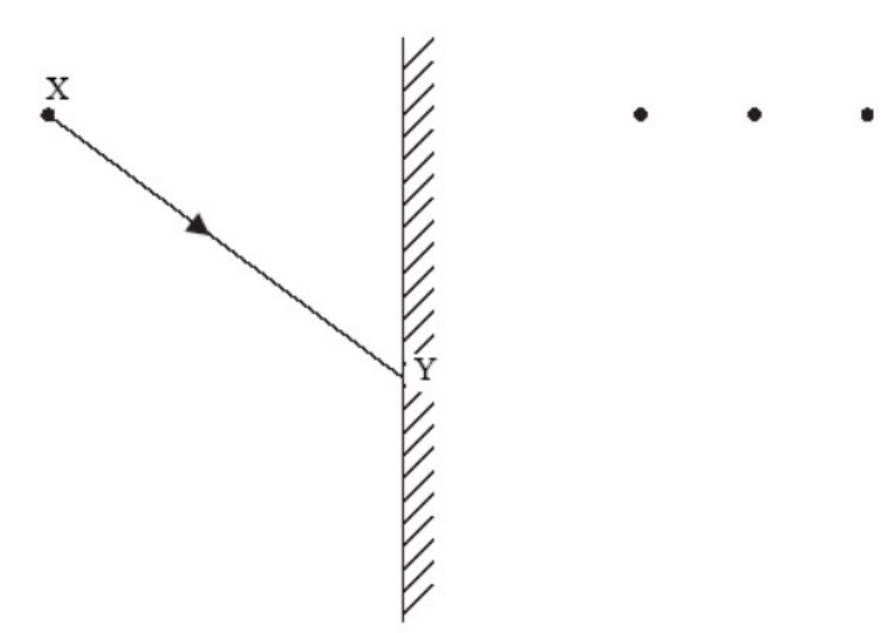
(i) Mark on the diagram: the letter 'I' to show the incident ray and the letter 'r' to show the angle of reflection.

(2 marks)

(ii) Name the dashed line shown in the diagram.

(1 mark)

4. The diagram below shows an object X placed in front of a plane mirror. A ray of light is drawn coming from the object X and striking the mirror at Y. After striking the mirror the ray of light is reflected.



(a) (i) Which of the three dots represents the correct position of the image of X? Label this dot Z.

..... **(1)**

(ii) Draw a line to represent the reflected ray at Y.**(2)**
(b) Mark on the diagram, for the ray XY at the mirror,
(i) The angle of incidence and label it *i*; **(1)**
(ii) The angle of reflection and label it *r*. **(1)**

(c) Is the image at Z real or virtual?

.....

(1)
[Total 6m]

5. James shone a ray of light at a mirror as shown below.

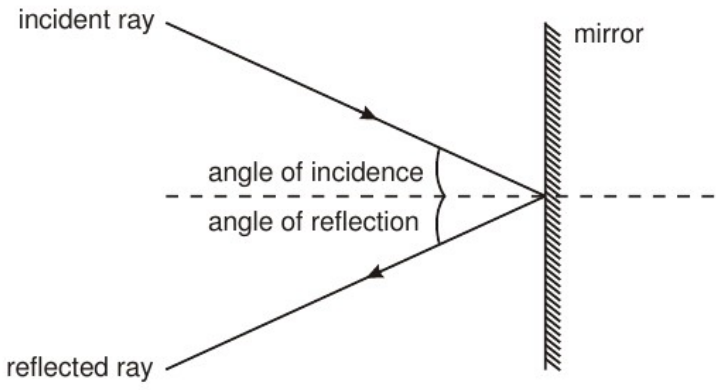


diagram 1

He measured the angle of **reflection** for different angles of incidence.
His results are shown below.

angle of **incidence** (°)	30	40	50	60	70
angle of **reflection** (°)	30	40	50	65	70

(a) Which angle of reflection was **not** measured accurately?

.....°

How can you tell this from the table?

.....

.....

1 mark

(b) James set up a different experiment as shown below.

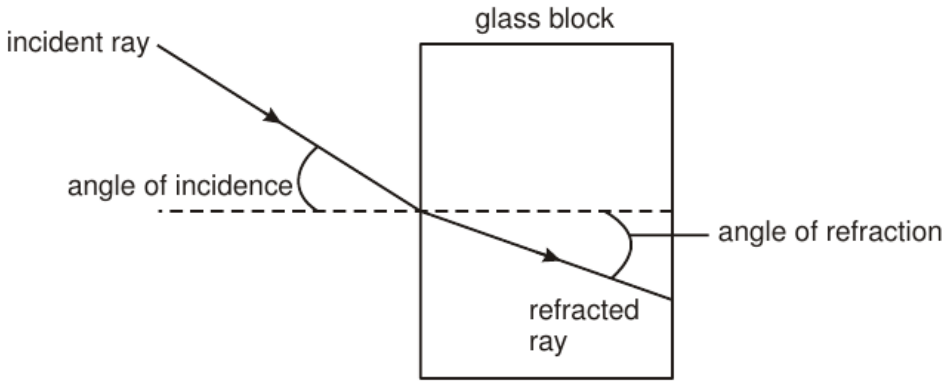
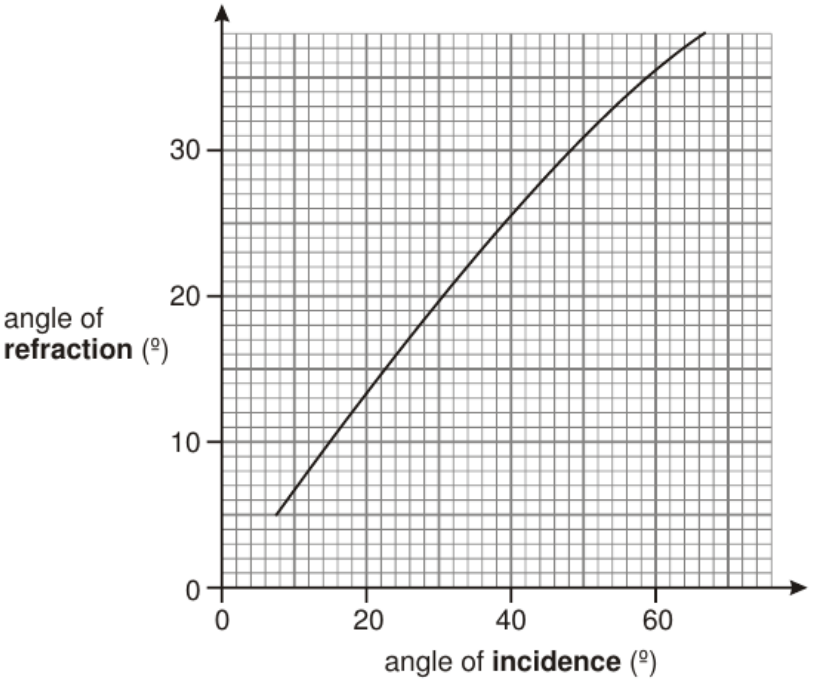


diagram 2

He measured the angle of **refraction** for different angles of incidence.

His results are shown in the graph.



Use the graph to answer the questions below.

(i) When the angle of **refraction** is 20°, what is the angle of **incidence**?

.....°

1 mark

(ii) What conclusion could James draw from his graph?
Complete the sentence below.

When light passes from air into glass, the angle of **incidence** is

always ..... the angle of **refraction**.

1 mark

(c) **On diagram 2,** draw a line to continue the refracted ray as it leaves the glass block.

1 mark

maximum 4 marks

6. The diagram shows a plane mirror used by a dentist to see the back of a patient's tooth.

(a) Use a ruler to draw a ray of light on the diagram to show how the dentist is able to see the tooth labelled **Z**.

(3)

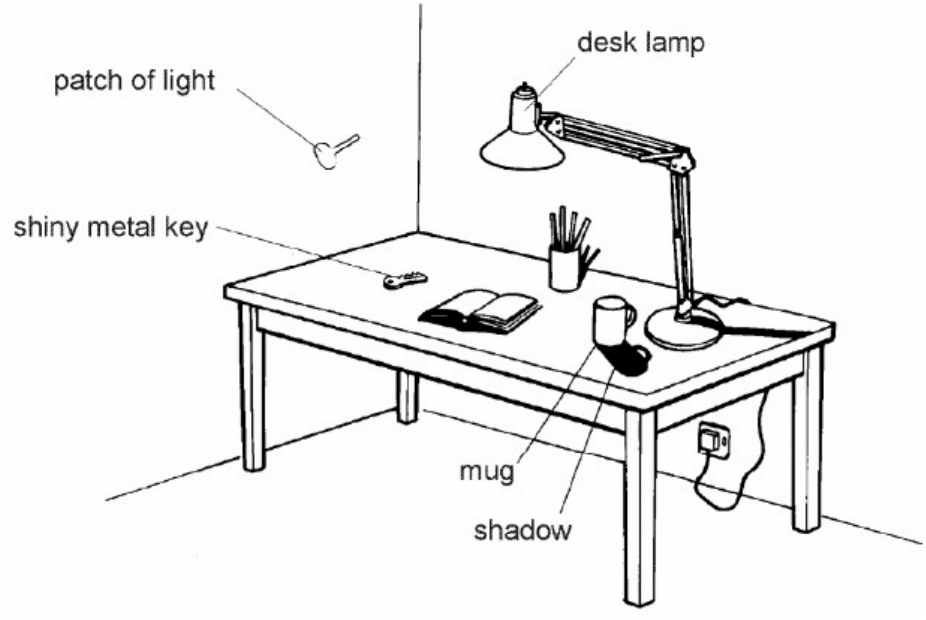
(b) Describe the image formed by a plane mirror.

.....

.....

(2)
(Total 5 marks)

7. It is night-time and the desk lamp is on. Light shines onto the key.



(a) (i) Draw **one** ray of light on the diagram to show the light shining from the lamp onto the key. Use a ruler.
Put an arrow on the ray to show the direction of the light.

2 marks

(ii) There is a patch of light on the wall. This light has been reflected from the key. Draw a reflected ray of light on the diagram.
Use a ruler.

1 mark

(b) There is a dark shadow on the table beside the mug.
Explain how this shadow is formed.

.....

.....

1 mark

Maximum 4 marks

ELECTROSTATICS

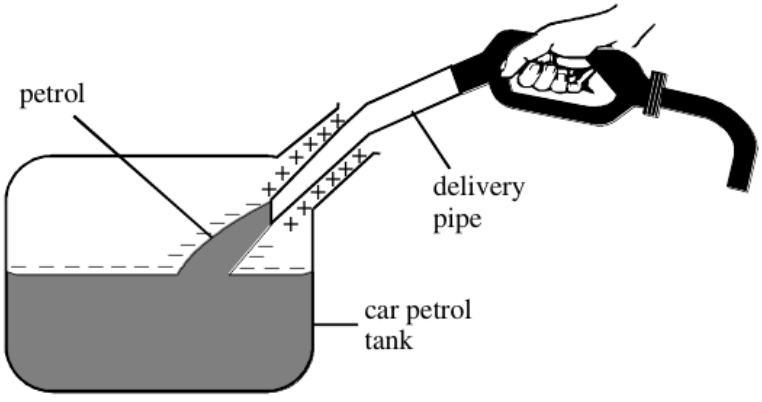
1. (a) Electrostatic charges can be produced by the process of friction.

(i) Which charged particle is transferred from one material to the other in this process?

.....

(1)

(ii) When petrol is pumped through pipes, electrostatic charges can build up.



Explain why this is dangerous.

.....

.....

.....

.....

(2)

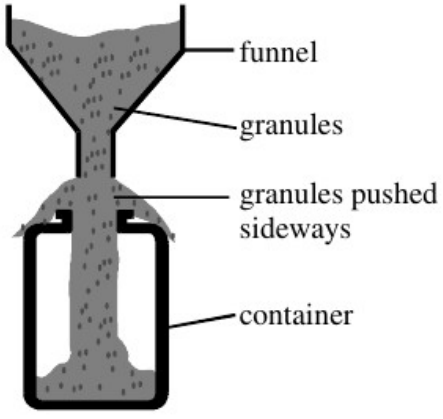
(iii) What can be done to prevent the build up of electrostatic charges?

.....

.....

(1)

(b) The diagram shows coffee granules being poured through a funnel into a container. As the granules move through the funnel they gain an electrostatic charge. This causes some of the granules to miss the container.



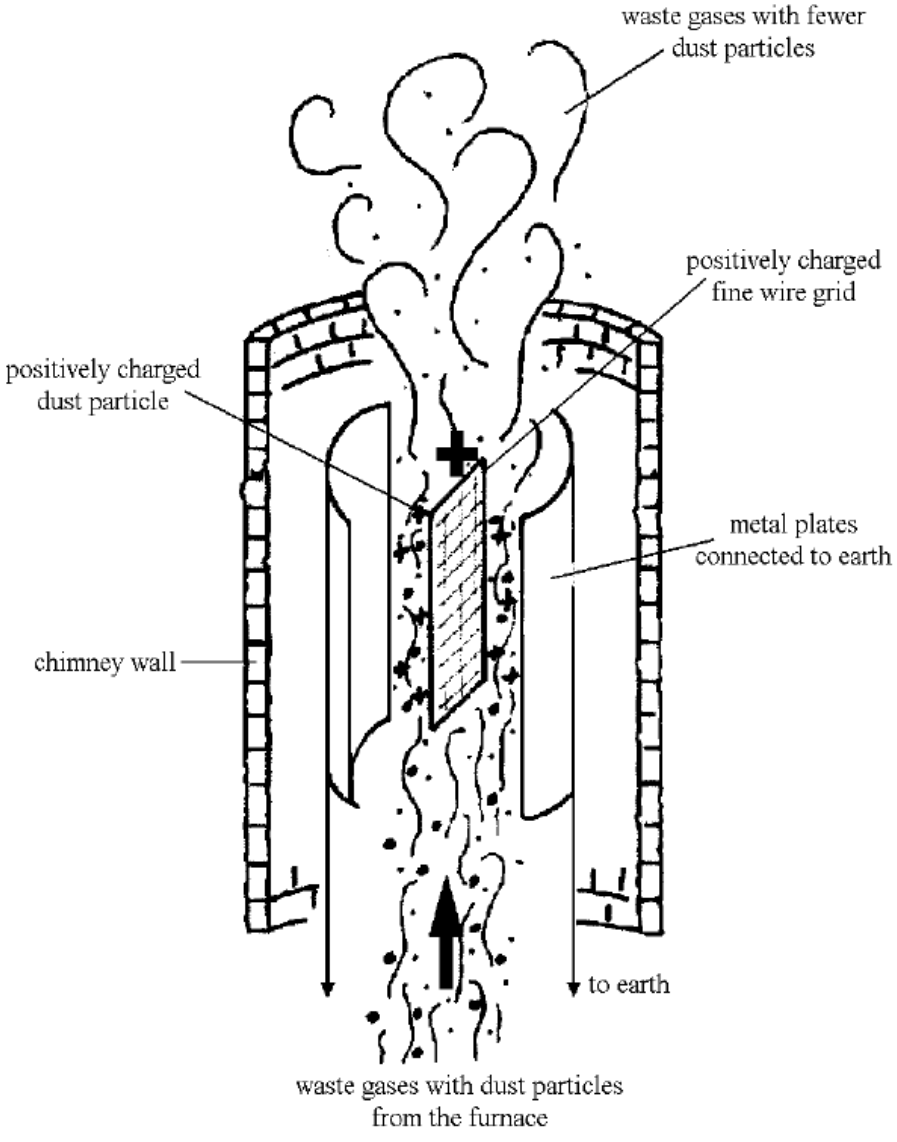
Explain, in terms of charges, why some of the granules are pushed out sideways and miss the container.

2. (a) Use words from the box to complete the passage below.

attract	**electrons**	**electrostatic repel**	**friction**	**protons**

When Jacquie takes off her woollen jumper she hears a crackling sound and sees small flashes of light. It is thought that the ..... between her jumper and blouse is producing ..... charges. The jumper becomes positively charged because ..... are being removed from it. Because the jumper and blouse have opposite charges they ..... each other and this makes it difficult for the jumper to be removed.

(b) The diagram shows the inside of a simple electrostatic precipitator. This is a device for removing dust from the waste gases in chimneys of factories and power stations. As the dust particles move up past the fine wire grid they gain a positive charge.



(i) Show, with an arrow, the direction of movement of the positively charged particles between the grid and the earth plate.

(1)

(ii) Explain why the positively charged particles move in the direction you have shown.

.....

.....

.....

.....

(2)

(iii) From time to time the earthed metal plates are hit with a hammer.

Suggest a reason for this.

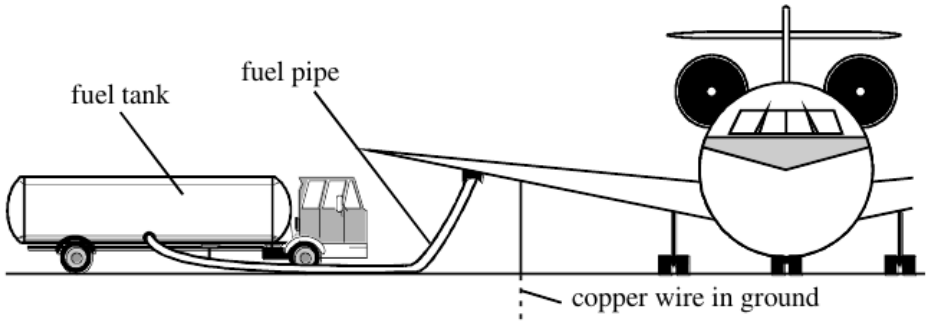
.....

.....

(1)

(Total 8 marks)

3. Electrostatic charge is important when aircraft are refuelled.



(a) Electrostatic charge can build up as fuel is pumped through the fuel pipe. Explain how this happens.

.....

.....

(2)

(b) Why is the build up of electrostatic charge on the aircraft dangerous?

.....

(1)

(c) During refuelling a copper wire is attached between the wing and the ground. How does this prevent the build-up of electrostatic charge on the wing?

.....

.....

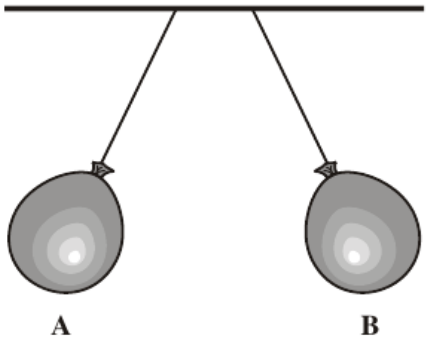
(2)
(Total 5 marks)

4. (a) Tick **two** boxes to show the best electrical conductors.

plastic	☐
copper	☐
glass	☐
water	☐
silver	☐

(2)

(b) The diagram shows two charged balloons hanging from a support on nylon threads.



(i) Draw one arrow on each balloon to show the directions of the forces which make the balloons move apart.

(2)

(ii) Balloon **A** is positively charged.

What is the sign of the charge on balloon **B**?

.....

Explain your answer.

.....

.....

(2)

(iii) One way of charging a balloon is by rubbing it on a woollen jumper.

An aluminium rod held in the hand cannot be charged in this way.

Explain why not.

.....

.....

(2)

(c) (i) State **two** ways in which static electricity can be put to good use.

1 .....

2 .....

(2)

(ii) State **two** ways in which static electricity can be harmful or annoying.

1 .....

2 .....

(2)

(Total 12 marks)

5. (a) Jason holds a polythene rod and rubs it with a dry cloth.
The rod becomes electrically charged.

(i) Describe what happens when he holds the charged rod near some small pieces of paper.

.....

.....

.....

.....

(2)

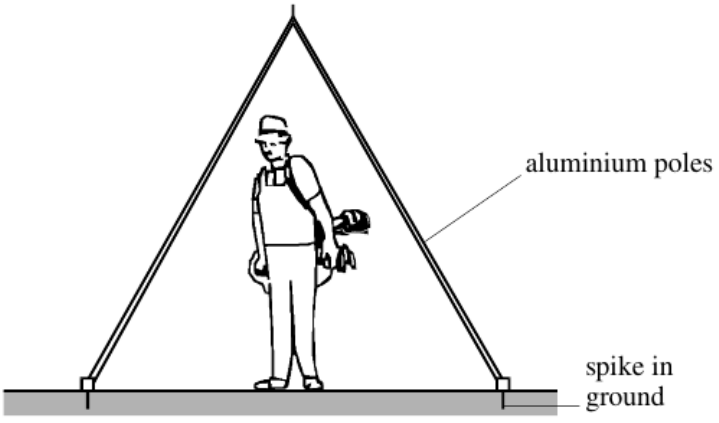
(ii) He holds other rods made from different materials and rubs them with the same cloth.

Complete the table by placing a tick in the correct column for each material to show whether it is found to be charged or not.

Material	Charged	Not Charged
polythene	✓	
copper		
steel		
plastic		

(2)

(b) A device to protect a golfer from lightning is shown.



Explain how the aluminium poles stop lightning from striking the golfer.

.....

.....

.....

(2)
(Total 6 marks)

6. (a) A perspex ruler is rubbed with a cloth.
The ruler becomes positively charged.

Explain how it becomes positively charged.

.....

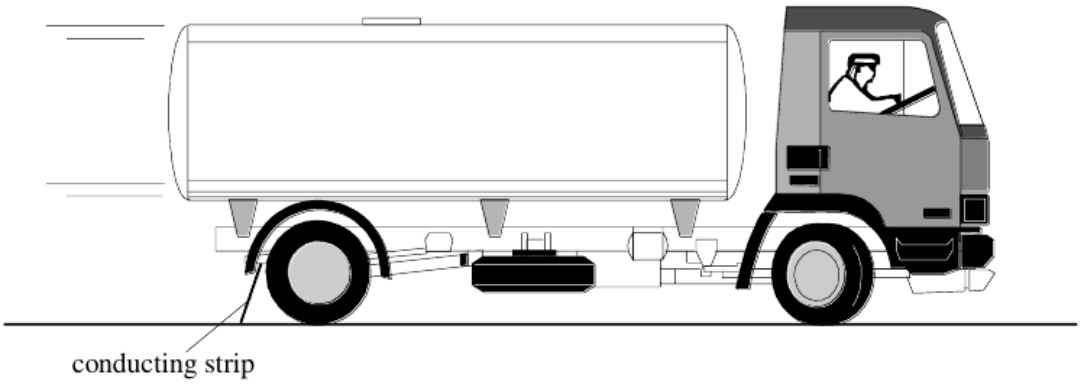
.....

.....

.....

(2)

(b) Static electricity can be dangerous.



For safety reasons, some oil and petrol tankers are fitted with a conducting strip. When the tanker is moving, it is important that the conducting strip is in contact with the ground.

Explain how the conducting strip increases safety.

.....

.....

.....

.....

.....

.....

(3)
(Total 5 marks)

7. (a) An aircraft in flight becomes charged.
The aircraft tyres are made of rubber that conducts electricity.
Suggest what happens to the charge on the aircraft when it lands.

.....

.....

.....

.....

(2)

(b) The charge on an aircraft is 2.0×10^{-4} C.
It passes through the tyres in 0.5 s.
Calculate the current in the tyres when the charge is passing through them.

.....

.....

.....

.....

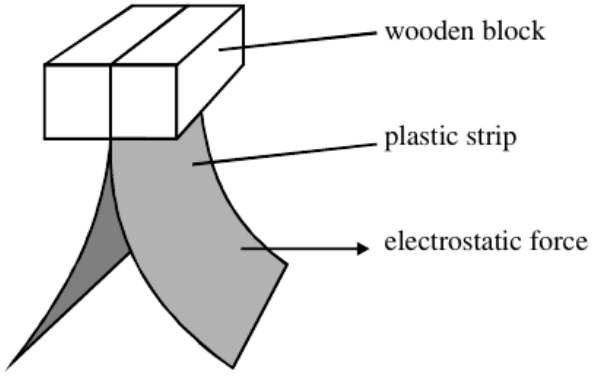
.....

.....

.....

(3)
(Total 5 marks)

8. When two thin strips of plastic are rubbed with a duster they move away from each other.
The arrow shows the electrostatic force on one of the strips.



(a) Draw an arrow to show the direction of the electrostatic force on the other strip.

(1)

(b) Compare the sizes of the electrostatic forces on the strips.

.....

.....

(1)

(c) Explain why the strips move away from each other.

.....

.....

(2)

(d) (i) What particles are transferred between materials when an object becomes charged by rubbing?

.....

(1)

(ii) These particles carry a negative charge. What is the sign of the charge on objects that lose these particles?

.....

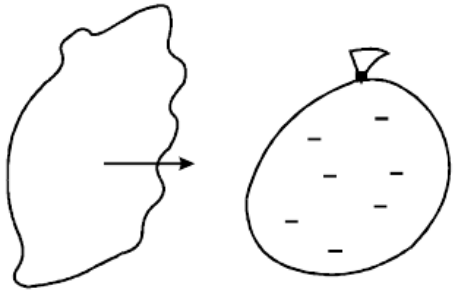
Give a reason for your answer.

.....

.....

(1)
(Total 6 marks)

9. (a) After a balloon is rubbed with a duster, the two attract each other.



(i) Draw an arrow that shows the electrostatic force on the balloon.

(1)

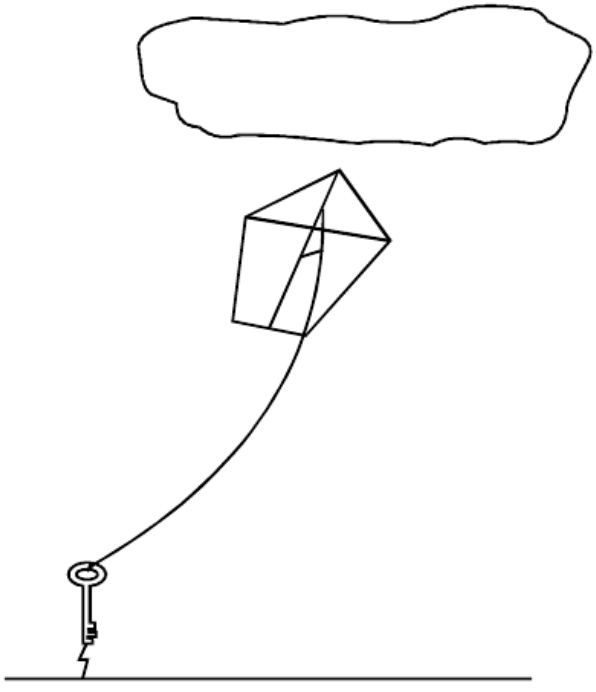
(ii) Explain, in terms of charges, why the balloon and the duster attract each other.

.....

.....

(2)

(b) When Benjamin Franklin was trying to find out about electricity, he flew a kite under a thunder cloud.
He tied a metal key to the bottom of the kite string.
A spark passed from the metal key to the ground.



Franklin thought that electricity was a fluid that could move through things.

(i) What evidence did he have that electricity can move?

.....

(1)

(ii) Where did he think the electricity came from?

.....

(1)

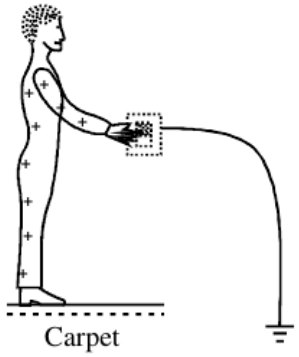
(iii) How would we now explain how electricity travelled along the kite string?

.....

(1)

(Total 6 marks)

10. (a) A man becomes positively charged by walking across a nylon carpet.



When he touches an earthed light switch, he feels a shock as he loses excess charge.

Explain how he loses the excess charge.

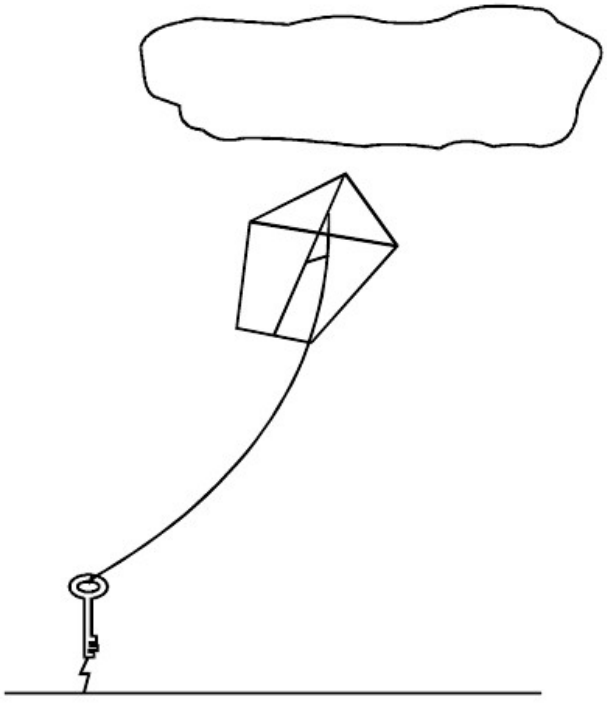
.....

.....

.....

(2)

(b) Benjamin Franklin flew a kite in a thunderstorm. He tied a metal key to the bottom of the kite string. A spark passed from the key to the ground.



He thought that electricity was a fluid that could pass through objects.
Since then we have discovered that atoms contain charged particles.

How would we now explain the flow of electricity through the wet kite string and the metal key?

CELLS AND SIMPLE CIRCUITS

1. Figure 3 below shows a laclanche cell.

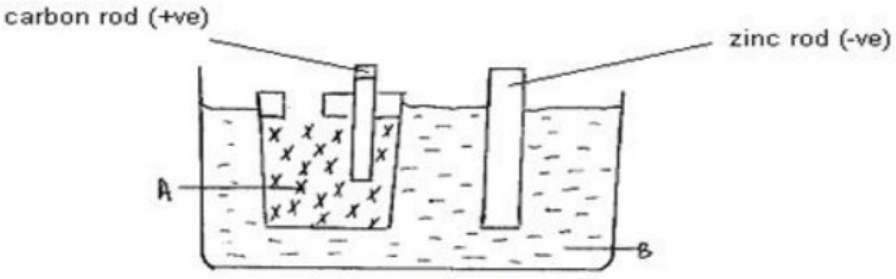


Fig.3

Name the chemical substances in the parts labeled. (2mks)

A.....

B.....

2. State the major difference between a dry cell and a wet cell.

(1mk)

3. Explain the difference between a primary and secondary cell or battery

[2m]

4. Sally made an electrical circuit.
It contained two lamps, a variable resistor and a battery joined in series.

(a) (i) Draw the circuit diagram.

(3)

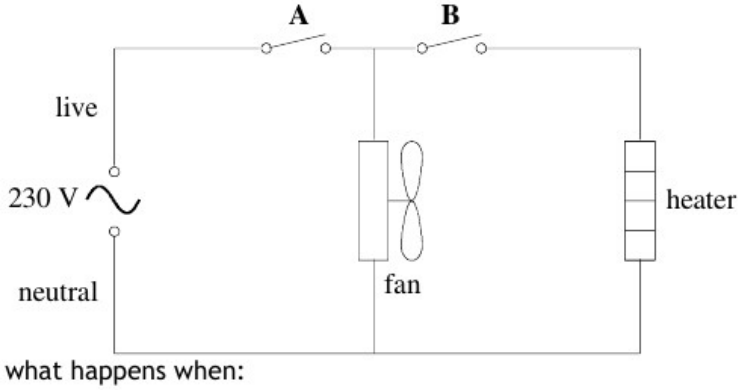
(ii) Use a word from the box to complete the following sentence.

kinetic	potential
thermal	

In the circuit some electrical energy is changed to ..... energy.

(1)

(b) An electric fan can blow out hot or cold air.
The circuit diagram for the heater is shown below,



Suggest what happens when:

(i) Switch A is closed and switch B is open

.....

(1)

(ii) Switch A is open and switch B is closed

.....

(1)

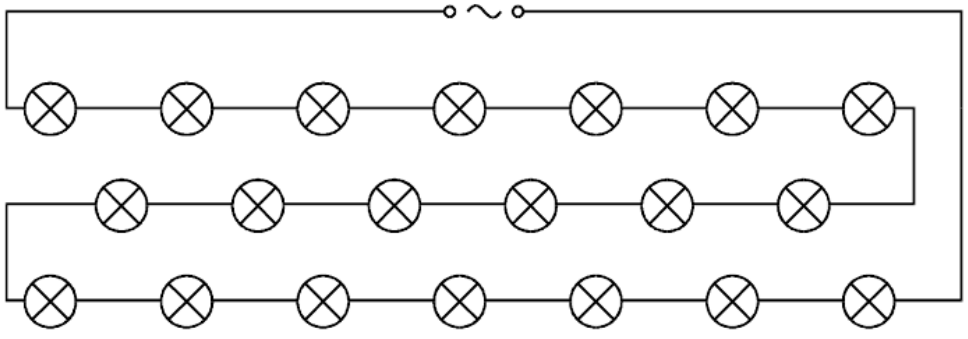
(iii) Switch A and switch B are both closed

.....

(1)

(Total 7 marks)

5. (a) Some Christmas tree lights are connected in series. A typical arrangement consists of twenty lamps connected to the power supply.



(i) If the filament in one of the lamps breaks, all the other lamps go out. Why is this?

.....

.....

(1)

(ii) How does the brightness of the lamps change if another five similar lamps are connected in series?

.....

(1)

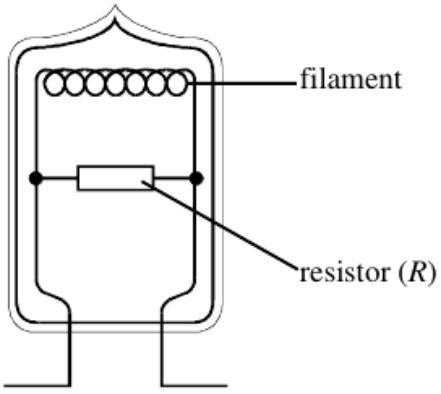
(iii) Why does the brightness change in the way you have described in part (ii)?

.....

.....

(1)

(b) Some Christmas tree lights use lamps which have a resistor placed across the filament. This is shown in the diagram.



(i) In this case when a filament breaks the other lamps in the series circuit remain on. Why is this?

.....

.....

(1)

(ii) In a different set of lights, the value of the resistor *(R)* is much bigger than the resistance of the lamp filament. Explain what happens to the other lamps in this series circuit when one lamp filament breaks.

.....

.....

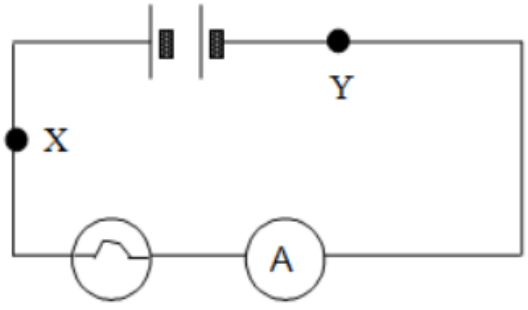
.....

.....

(2)

(Total 6 marks)

6. In the circuit shown below, the ammeter reads 2A.



What would the ammeter read if it were moved to position?

(a) X; ..... [1m]

(b) Y ..... [1m]

7. Fig. 8.1 represents the circuit that operates two of the lamps on a car.

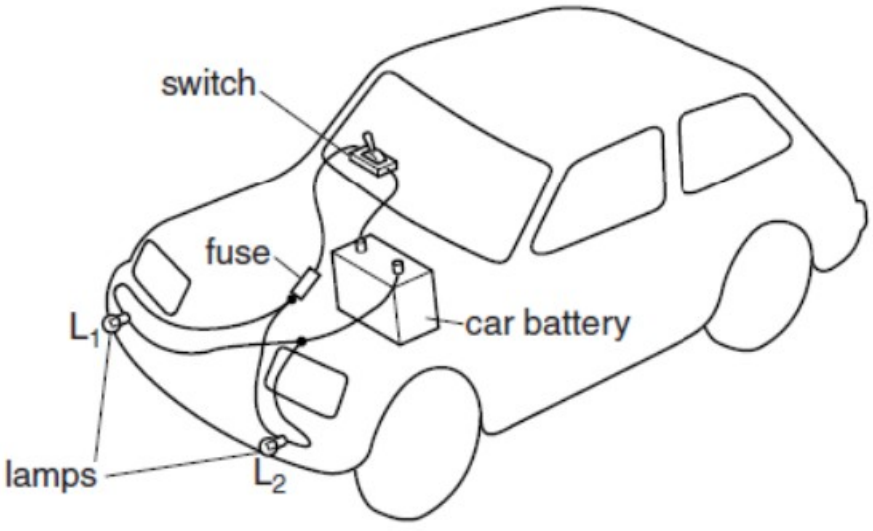


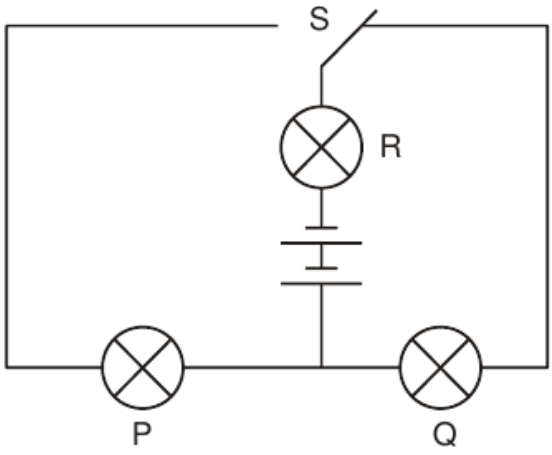
Fig. 8.1

In the space below, draw the circuit diagram for this circuit, using conventional symbols.

[3]

8. (a) The diagram below shows a circuit with a two-way switch, S.

Rosie puts the switch in the position shown below.



Complete the table below to show if the bulbs are on **or** off.
Write **on** or **off** for each bulb.

bulb	on or off
P	
Q	
R	

1 mark

(b) Give the name of the part that provides energy for the circuit.

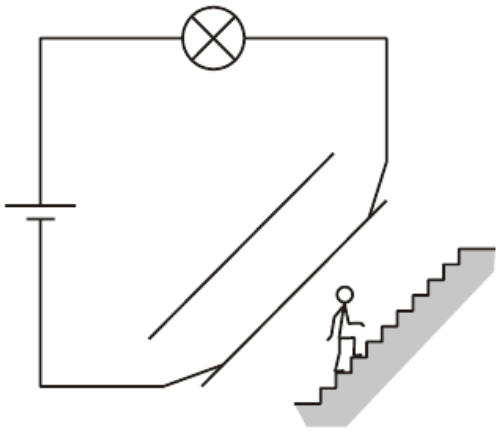
.....

1 mark

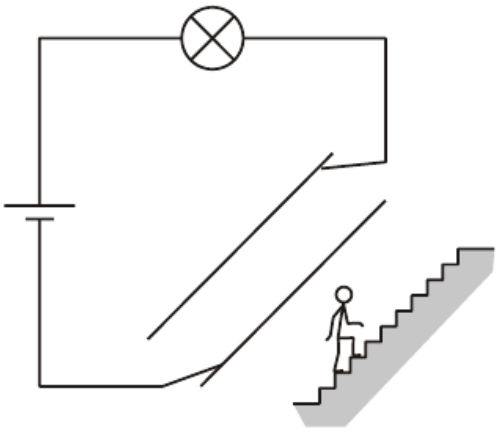
(c) The diagrams below show a light-bulb over a staircase of a model house.

There is a two-way switch at the bottom of the stairs and another two-way switch at the top.

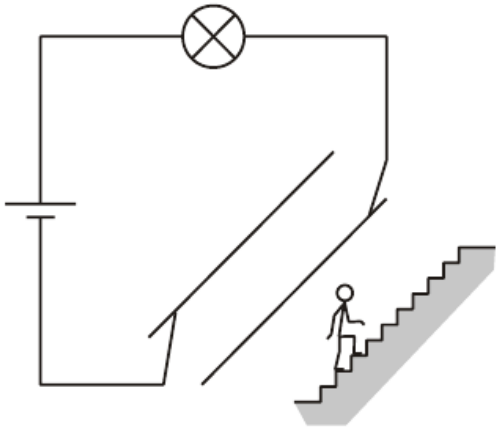
Under each diagram, tick **one** box to show if the bulb is **on** or **off**. The first one has been done for you.



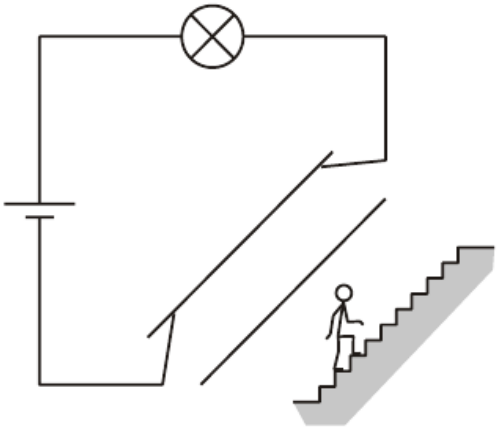
on	✓
off	



on	
off	



on	
off	



on	
off	

2 marks

maximum 4 marks