OCR
RECOGNISING ACHIEVEMENT

Candidate Name	Centre Number	Candidate Number

General Certificate of Secondary Education

former Midland Examining Group syllabus

SCIENCE: DOUBLE AWARD	PAPER 6	**1794/6**
SCIENCE: PHYSICS	PAPER 2	**1782/2**
SCIENCE: PHYSICS (NUFFIELD)	PAPER 2	**1787/2**

HIGHER TIER

Friday **18 JUNE 1999** Afternoon 1 hour 45 minutes

Candidates answer on the question paper.
Additional materials required:
Ruler (cm/mm), Pencil.

TIME 1 hour 45 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

The marks allocated and the spaces provided for your answers are a good indication of the length of answers required.

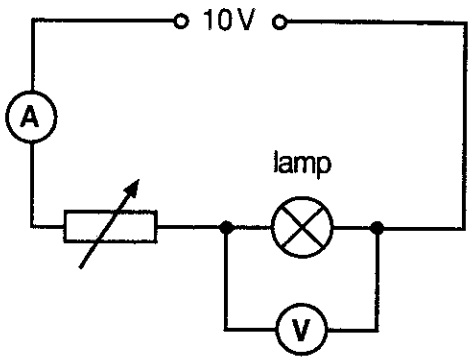
FOR EXAMINER'S USE	
Q1	
Q2	
Q3	
Q4	
Q5	
Q6	
Q7	
Q8	
TOTAL	

This question paper consists of 25 printed pages and 3 blank pages.

[Turn over

1 Sam is investigating how the resistance of a lamp changes as she alters the current through it.

She uses this circuit.



(a) She adjusts the setting of the variable resistor. Explain how this affects the current.

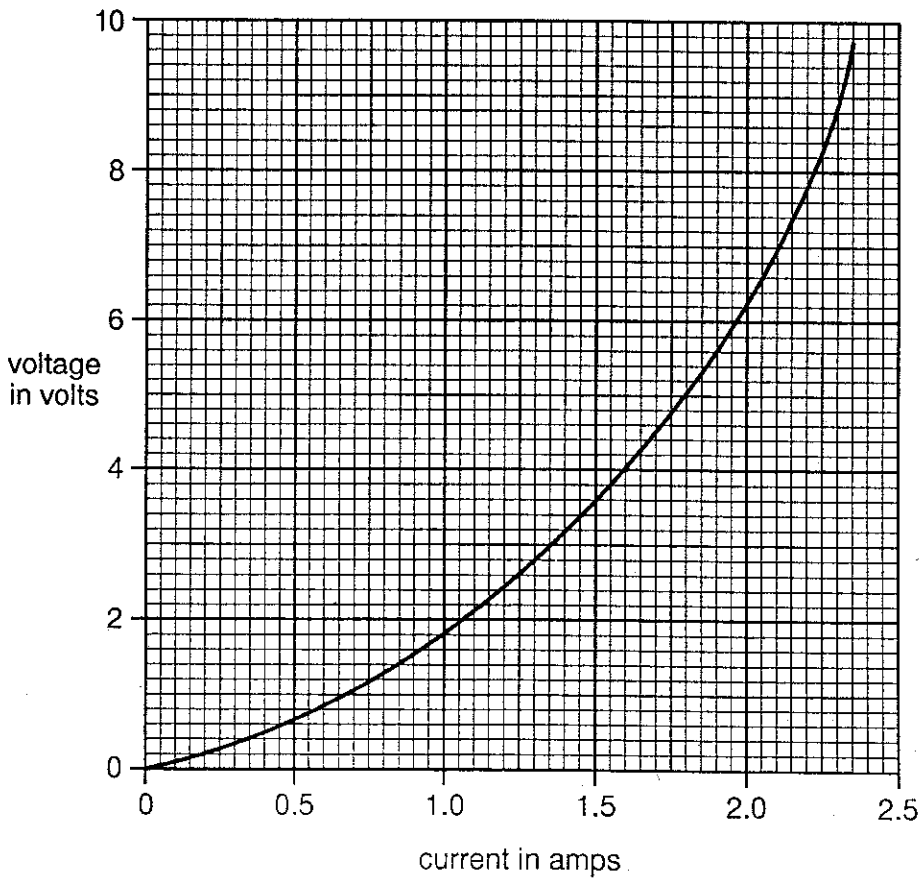
_____

_____

_____ [2]

(b) She records the values of the voltage across the lamp as the current changes.

She plots this graph.



[Question 1 continued on next page

Question 1 – *continued*

(i) Use the graph to find the value of the current when the voltage is 4.0 V.

current = _____ amps [1]

(ii) Calculate the resistance of the lamp when the voltage is 4.0 V.

You **must** show how you work out your answer.

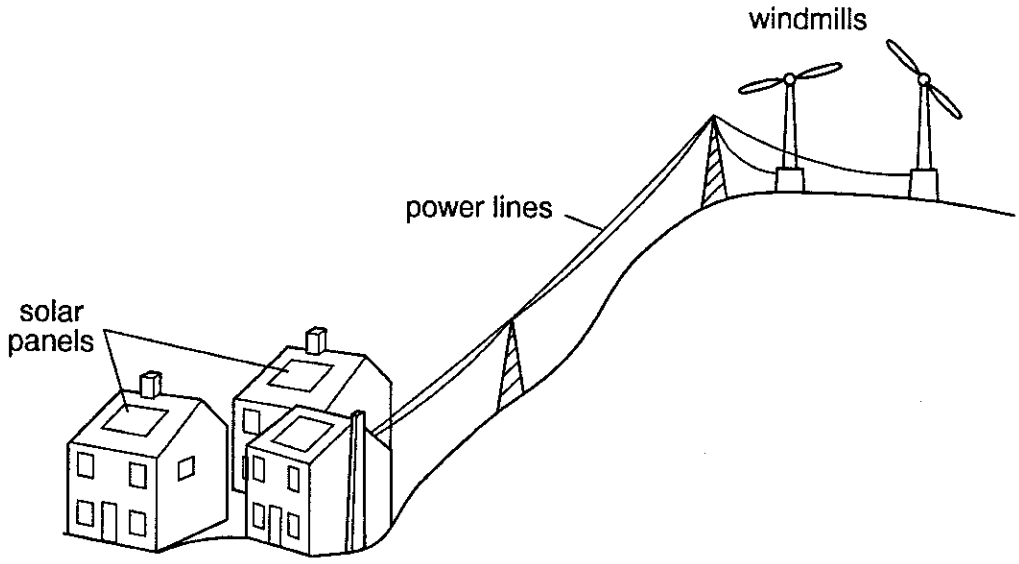
resistance = _____ ohms [3]

(c) How can you tell from the graph that the resistance of the lamp increases between 4.0 V and 8.0 V?

_____

_____ [1]

2 A group of houses uses solar panels and windmills as alternative energy sources.



(a) The panels and windmills are expensive to install.

Eventually all the money spent on them will be recovered.

Explain why.

_____

_____

_____ [2]

(b) Jan works out the efficiency of one of the windmills.

The energy of the air hitting the blades of the windmills is 20 000 J each second.

The energy transferred to the power lines is 5000 J each second.

Calculate the efficiency of the windmill.

Use the equation below.

You **must** show how you work out your answer.

$$\text{energy efficiency} = \frac{\text{useful energy output}}{\text{total energy input}}$$

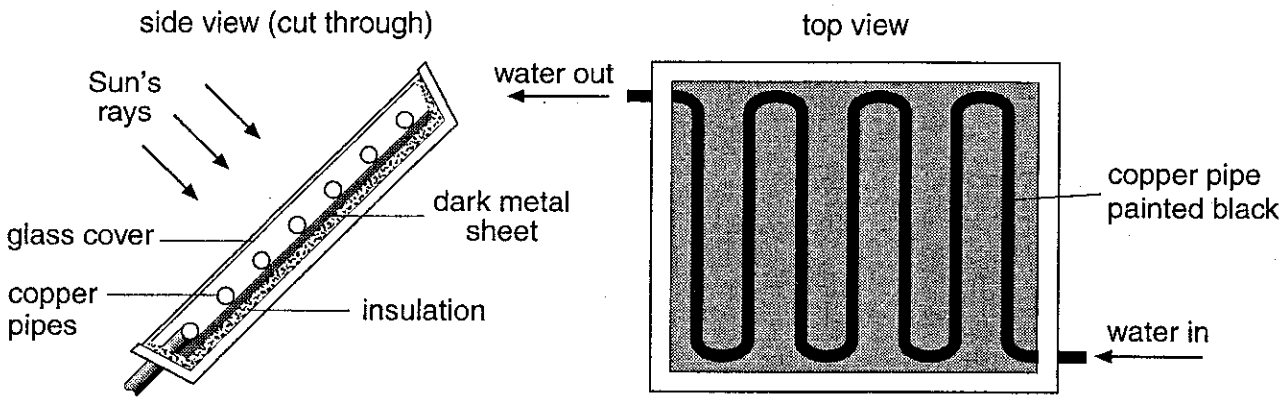
efficiency = _____ [2]

[Question 2 continued on next page

Question 2 – *continued*

(c) Energy can be transferred by **conduction**, **convection**, and **radiation**.

The diagrams show details of a solar panel.



Explain why the water coming out is a lot warmer than the water going in. Use your ideas about energy transfer.

[4]

(d) **(i)** Explain how energy is transferred through a brick wall by conduction. Use your ideas about particles.

[2]

(ii) Materials which are good electrical conductors are also good at transferring energy by conduction. Explain why.

[2]

[Question 2 continued on next page

Question 2 – *continued*

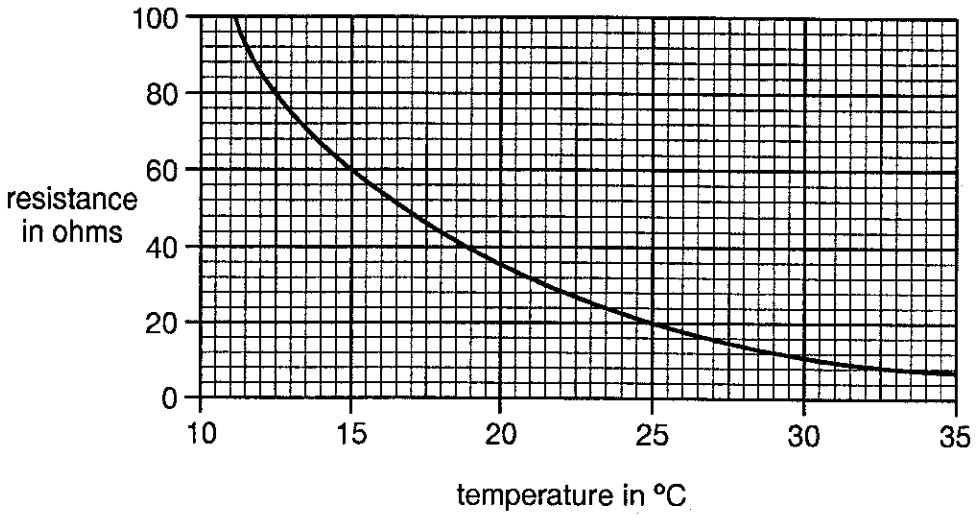
(e) The central heating system in a house pumps hot water around the building.

The temperature inside is monitored and controlled using a sensing circuit.

This controls a switch for the pump.

The sensing circuit contains a thermistor.

The graph shows how the resistance of the thermistor varies with temperature.



(i) Use the graph to find the change in resistance between 15° C and 25° C.

You **must** show how you work out your answer.

change in resistance = _____ ohms [2]

(ii) The sensing circuit is more sensitive to temperature changes below 15° C than above 25° C. Use the graph to explain why.

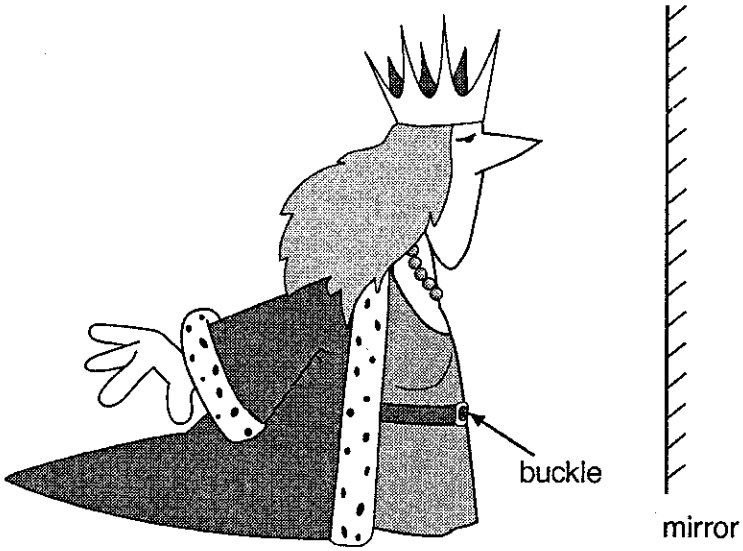
_____

_____

_____ [2]

3 Queen Matilda looks in the castle mirror.

She sees an image of the buckle of her new belt.



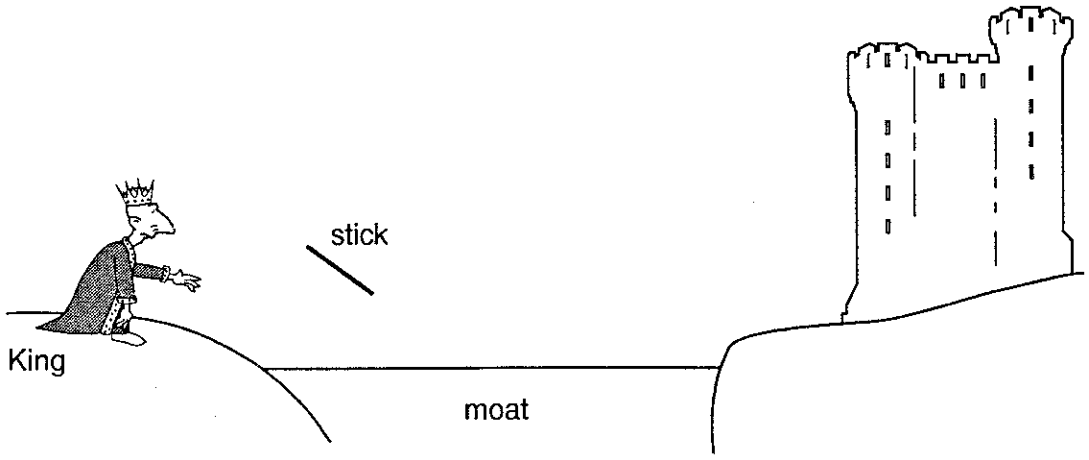
(a) (i) Write an **X** on the diagram to mark the **exact** position of this image. [2]

(ii) Draw, on the diagram, a ray of light from the buckle that reaches her eye after reflection from the mirror. [2]

[Question 3 continued on next page

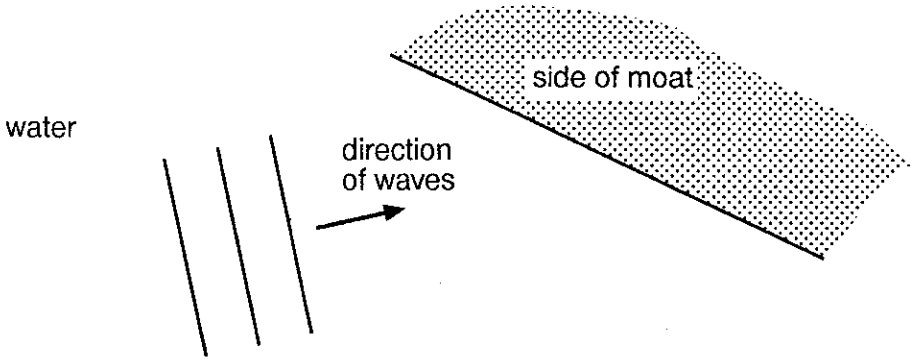
Question 3 – *continued*

(b) King Stephen is throwing sticks into the moat. The moat is full of water.



The diagram below shows some of the waves which reach the far side of the moat.

Finish the diagram to show what happens to these **three** waves after they reflect off the side of the moat.

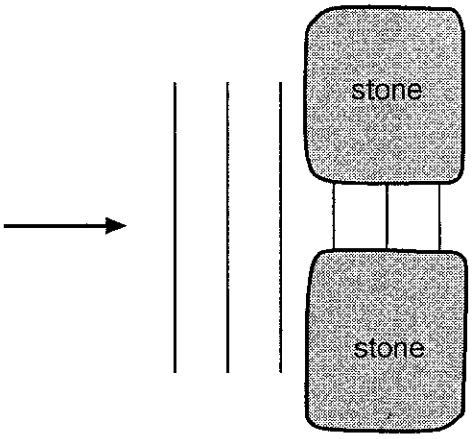


[3]

[Question 3 continued on next page

Question 3 – *continued*

(c) Some of the waves pass through a gap between two stepping stones.



(i) Finish the diagram to show what happens to these waves after they pass through the gap. [2]

(ii) Write down **two** factors that affect the amount of diffraction of the waves.

For each factor, describe how **increasing** it affects the amount of diffraction.

Factor 1 _____

Effect _____

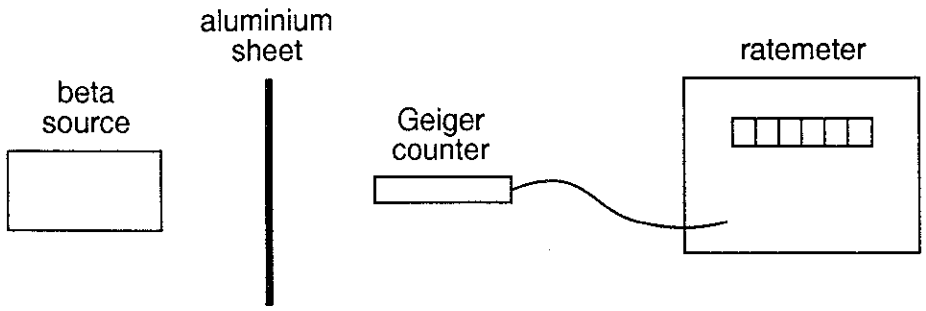
_____

Factor 2 _____

Effect _____

_____ [4]

4 Kate's teacher wants to find how much beta radiation passes through different thicknesses of aluminium.



First he measures background radiation.

It gives a reading of 60 counts per minute on the ratemeter.

(a) Suggest **two** possible sources of background radiation.

1 _____

2 _____ [2]

(b) Write down **two** safety precautions that he should take when using the beta source.

1 _____

2 _____ [2]

He now records the count rate for different thicknesses of aluminium.

The table shows the results.

thickness of aluminium in mm	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
actual ratemeter reading in counts per minute	560	310	180	120	90	75	60	60
corrected count rate in counts per minute	500	250						

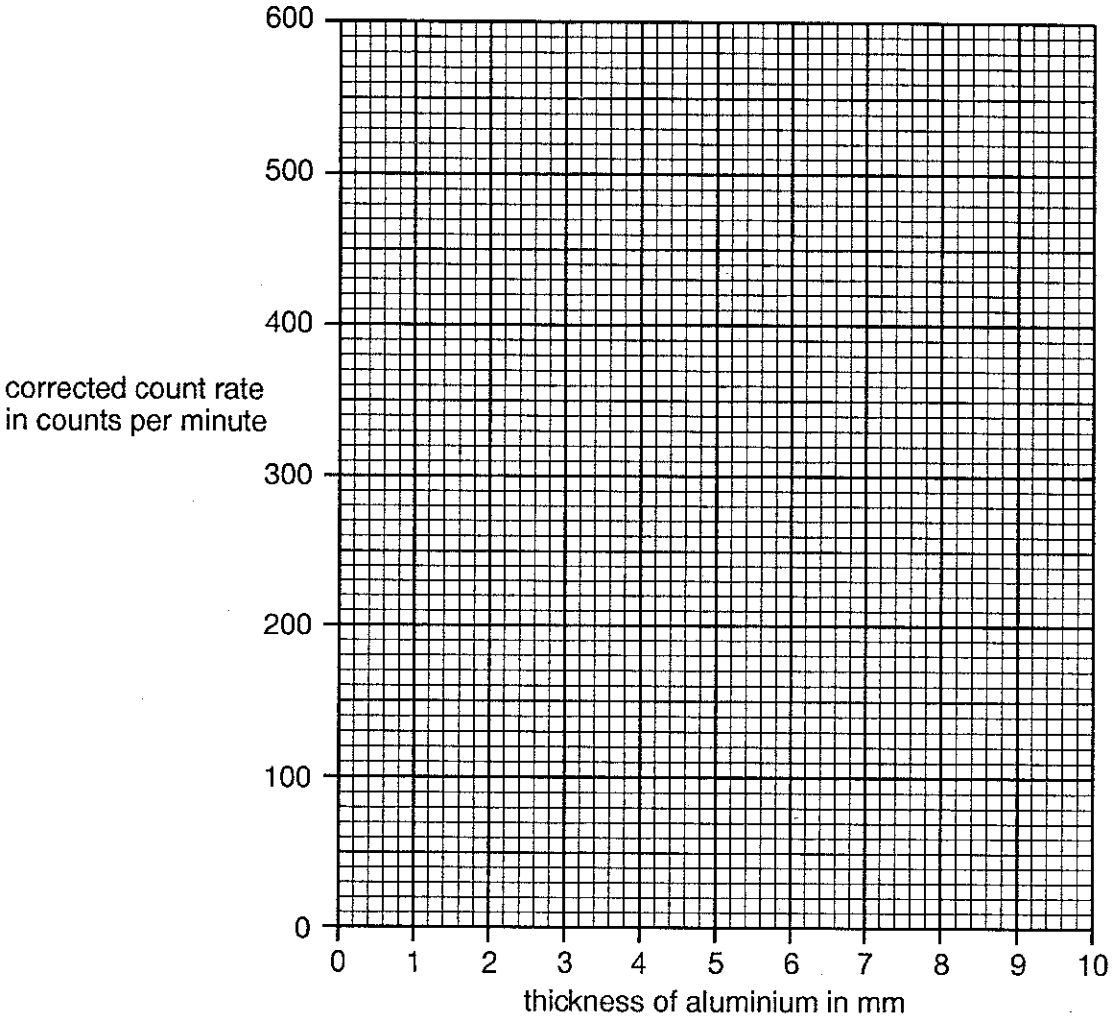
(c) Finish the table. There are **six** gaps. [1]

(d) **(i)** Plot the points on the grid opposite. [1]

(ii) Finish the graph by drawing the best curve. [1]

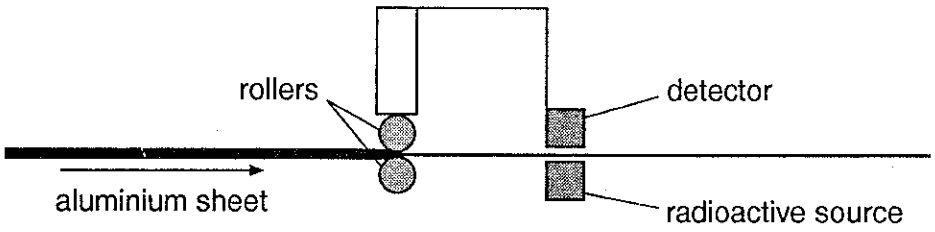
[Question 4 continued on next page

Question 4 – *continued*



(e) Aluminium is rolled into sheets twenty millimetres thick in a rolling mill.

A radioactive source and a detector are used to check the thickness of the sheet as it leaves the rollers.



(i) Why is beta radiation **not** suitable for checking twenty millimetre sheet?

_____

_____ [1]

(ii) Suggest **one** type of radiation which could be used to check the thickness of twenty millimetre sheet.

_____ [1]

[Question 4 continued on next page

Question 4 – *continued*

(iii) The radioactive isotope used has a half-life of 5.3 years.

Explain what is meant by the term **half-life.**

_____

_____

_____ [2]

(iv) One rolling mill uses 20 mg of this isotope as the source.

What will be the mass of **this** radioactive isotope in the source 10.6 years later?

mass = _____ mg [1]

(v) It would not be sensible to use, in the rolling mill, a radioactive isotope with a half-life much shorter than 5.3 years. Explain why.

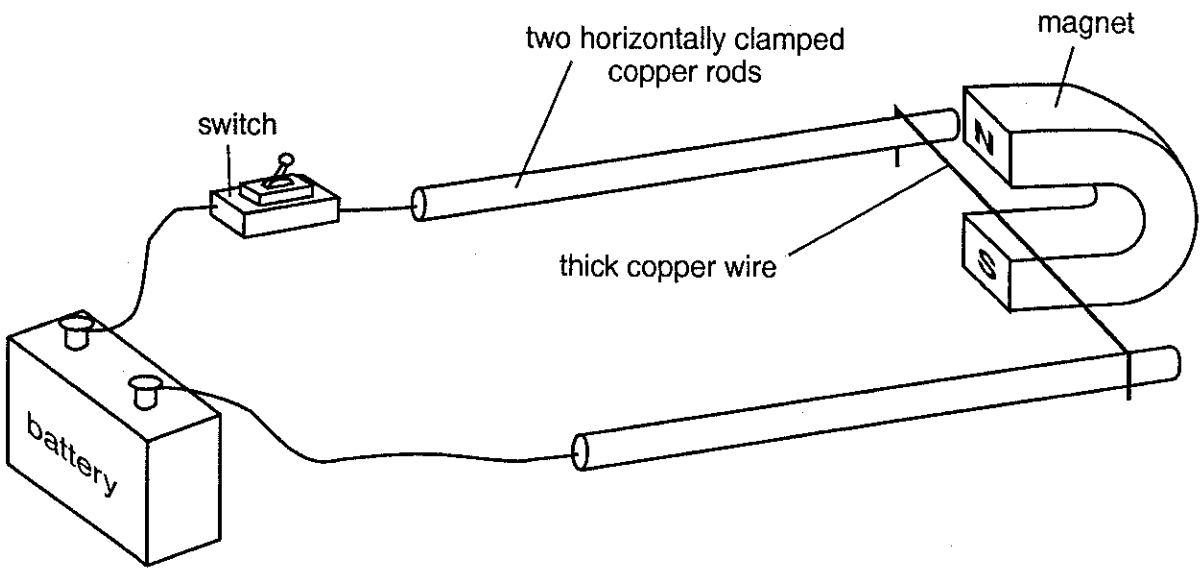
_____

_____

_____ [2]

5 This question is about electromagnetism.

(a) Michael is investigating how a short length of copper wire can be made to move in a magnetic field. He uses this apparatus.



He places the magnet so that the wire is midway between the poles.

He writes down these observations.

We can only make the copper wire move along the rods if:
1) the switch is closed and
2) the poles of the magnet are above and below the wire, not on each side of it.

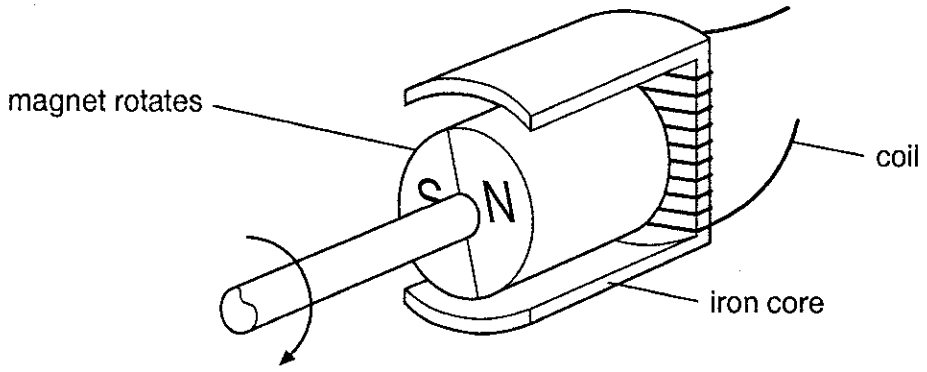
Explain these **two** observations. Use your ideas about electromagnetism.

[4]

[Question 5 continued on next page

Question 5 – *continued*

(b) The diagram shows a model generator.



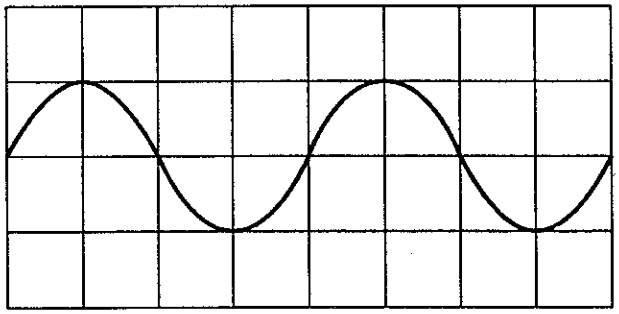
(i) What happens in the coil of wire when the magnet rotates?

_____ [1]

(ii) Why does this happen?

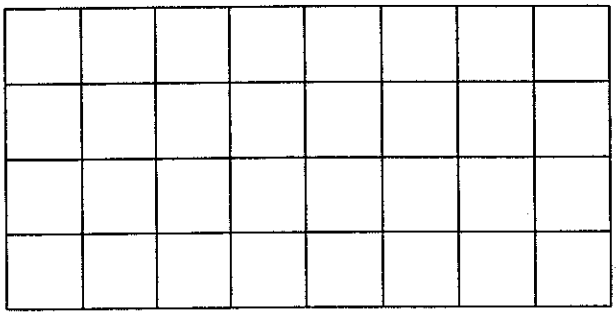
_____ [1]

(c) The ends of the coil are connected to a cathode ray oscilloscope (CRO). The diagram shows the trace on the screen as the magnet rotates.



Draw new traces for each of the following changes.
(Assume the settings of the oscilloscope remain the same).

(i) The magnet rotates at the same speed but in the opposite direction.

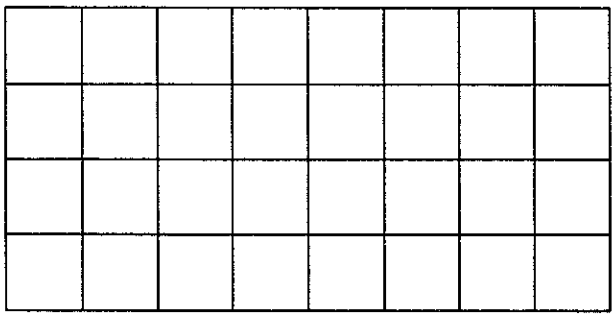


[2]

[Question 5 continued on next page

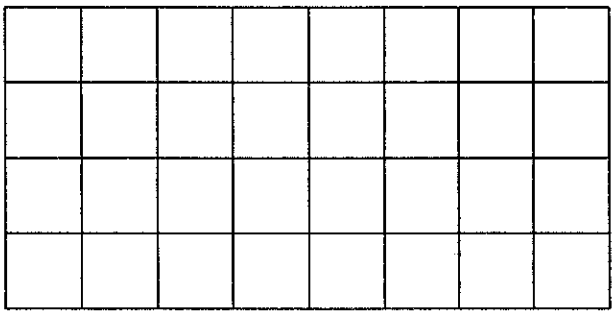
Question 5 – *continued*

(ii) The magnet rotates at the same speed, in the same direction as the original, but the number of turns of the coil is doubled.



[2]

(iii) The magnet rotates at twice the speed, in the same direction, with the original number of turns of the coil.



[2]

(d) Explain why **iron** is used as the core in the model generator.

_____

_____

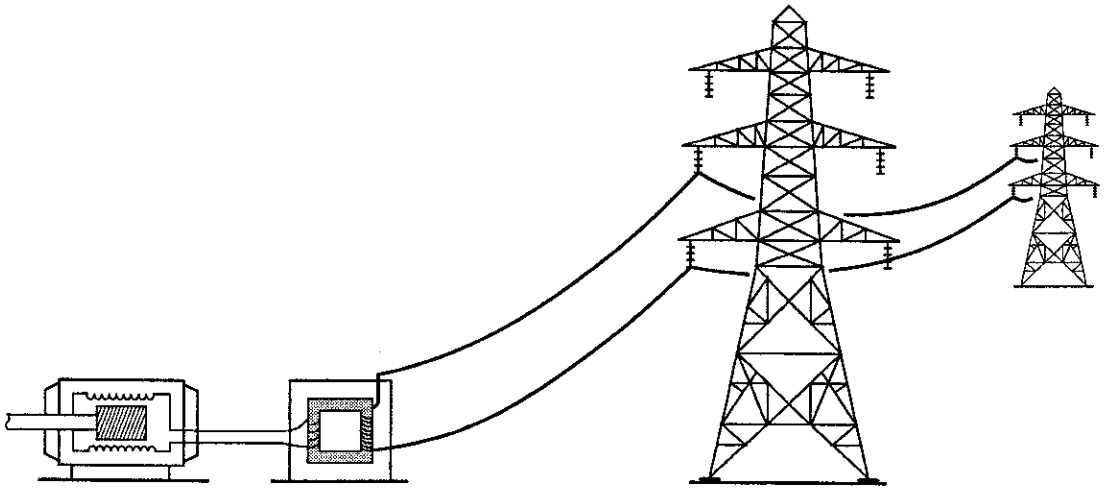
_____ [1]

[Question 5 continued on next page

Question 5 – *continued*

(e) The output from a power station generator is connected to a step-up transformer.

The transformer is connected to transmission lines.

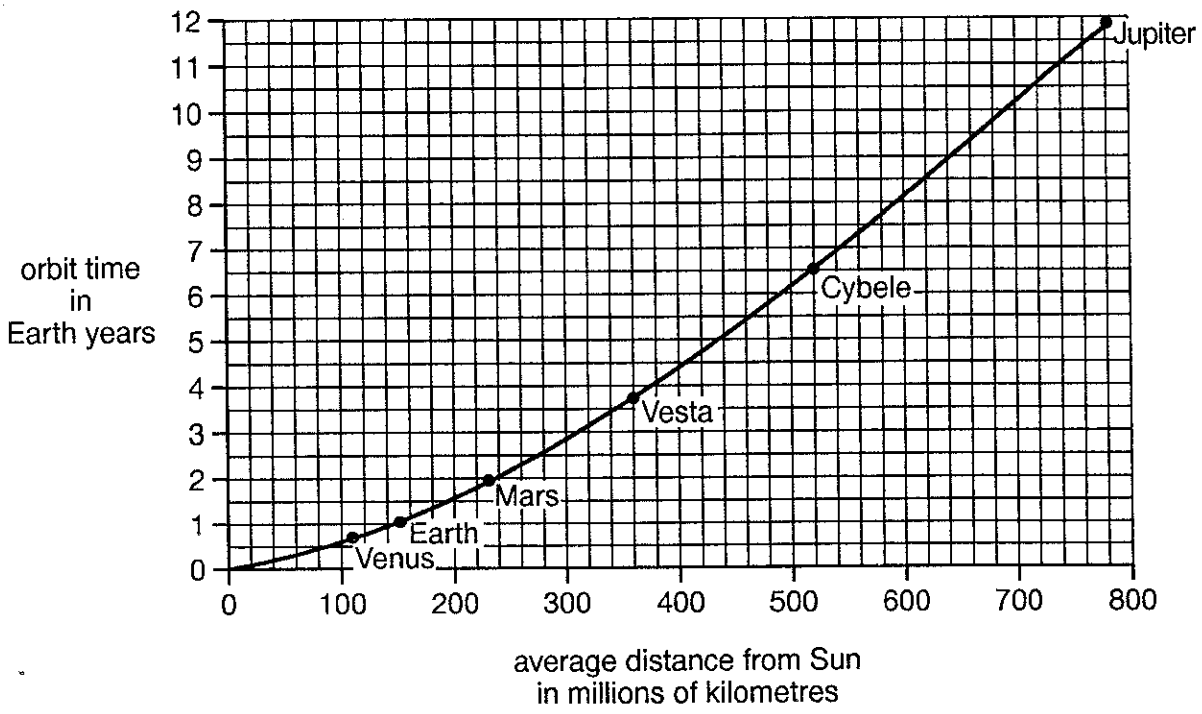


Explain why a step-up transformer is needed. Use your ideas about power losses in transmision.

[4]

6 The graph shows the orbit time and average distance from the Sun of some planets and some asteroids.

Asteroids are sometimes called minor planets.



(a) Suggest why Jupiter takes longer than Mars to orbit the Sun.

_____

_____

_____ [2]

(b) The asteroid Ida is in orbit at an average distance of 430 million km from the Sun.

Use the graph to find out how long it takes to orbit the Sun.

You **must** show clearly, **on the graph**, how you got your answer.

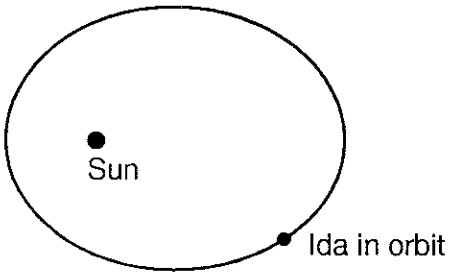
orbit time = _____ Earth years [2]

[Question 6 continued on next page

Question 6 – *continued*

(c) The orbit of Ida about the Sun is, in fact, elliptical.

This means its speed varies during the orbit, like a comet.



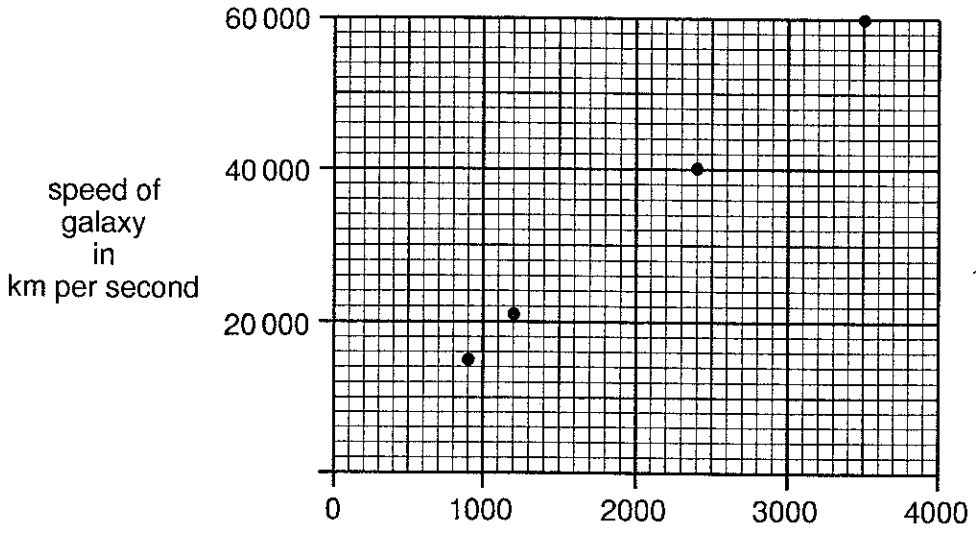
(i) Write an **X** on the diagram to mark the place where Ida will be travelling at its highest speed. [1]

(ii) Explain why it will be travelling at its highest speed at this place.

_____

_____ [1]

(d) The light from stars in distant galaxies is observed to be **red shifted**. Measurements of red shift allow astronomers to calculate the speed that the galaxies are travelling **away** from us. The graph shows how the speed that galaxies move away from us varies with their distance from us.



(a light year is the distance travelled by light in one year)

(i) What is meant by **red shift**?

_____

_____ [1]

[Question 6 continued on next page

Question 6 – *continued*

(ii) What type of shift would be observed in the light from stars travelling **towards** us?

_____ [1]

(iii) What does the graph suggest about the link between the speed of a galaxy and its distance from us?

_____

_____ [1]

(iv) A galaxy moves away from us at 30 000 km/s.

Use the graph to estimate how far away the galaxy is.

You **must** show clearly **on the graph** how you got your answer.

distance = _____ millions of light years [2]

(v) How long would it take light to travel this distance?

time = _____ millions of years [1]

(vi) The galaxy, moving at 30 000 km/s is travelling at one tenth (0.1) of the speed of light. Assuming that all matter in the Universe was originally in one place, how long has it taken for the galaxy and us to be this distance apart?

You **must** show how you work out your answer.

time taken= _____ millions of years [2]

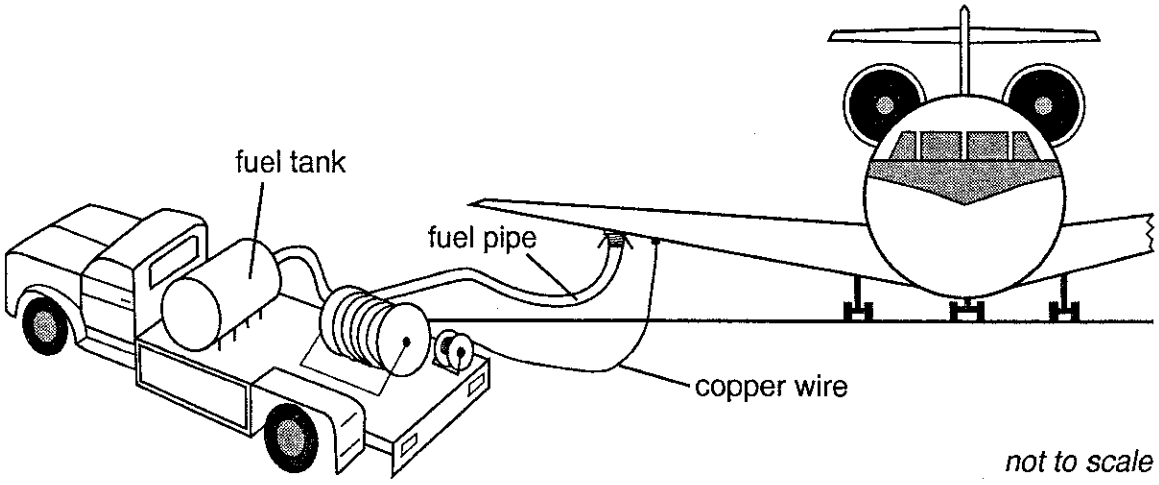
(vii) What is the significance of this value?

_____

_____ [1]

7 This question is about electrostatic charge.

The picture shows an aircraft being refuelled.



not to scale

(a) Explain how electrostatic charge can build up during refuelling.

_____

_____

_____ [2]

(b) During refuelling, a copper wire is connected between the aircraft and the tanker.

Without the wire a charge would build up on the aircraft.

(i) Why is a build-up of charge on the aircraft dangerous?

_____

_____ [1]

(ii) A build-up of charge can produce a large voltage between the aircraft and the tanker.

Explain, in terms of energy, what is meant by **voltage.**

_____

_____ [1]

(iii) With the wire attached, the charge passes safely back to the tanker.

Why does the charge now pass back to the tanker?

_____

_____ [1]

[Question 7 continued on next page

Question 7 – *continued*

(c) It takes 20 minutes to refuel the tanker.

The wire connecting the aircraft to the tanker is thin because the current is **very** small.

A charge of 0.12 mC moves round the circuit.

Calculate the average current in the wire during refuelling.

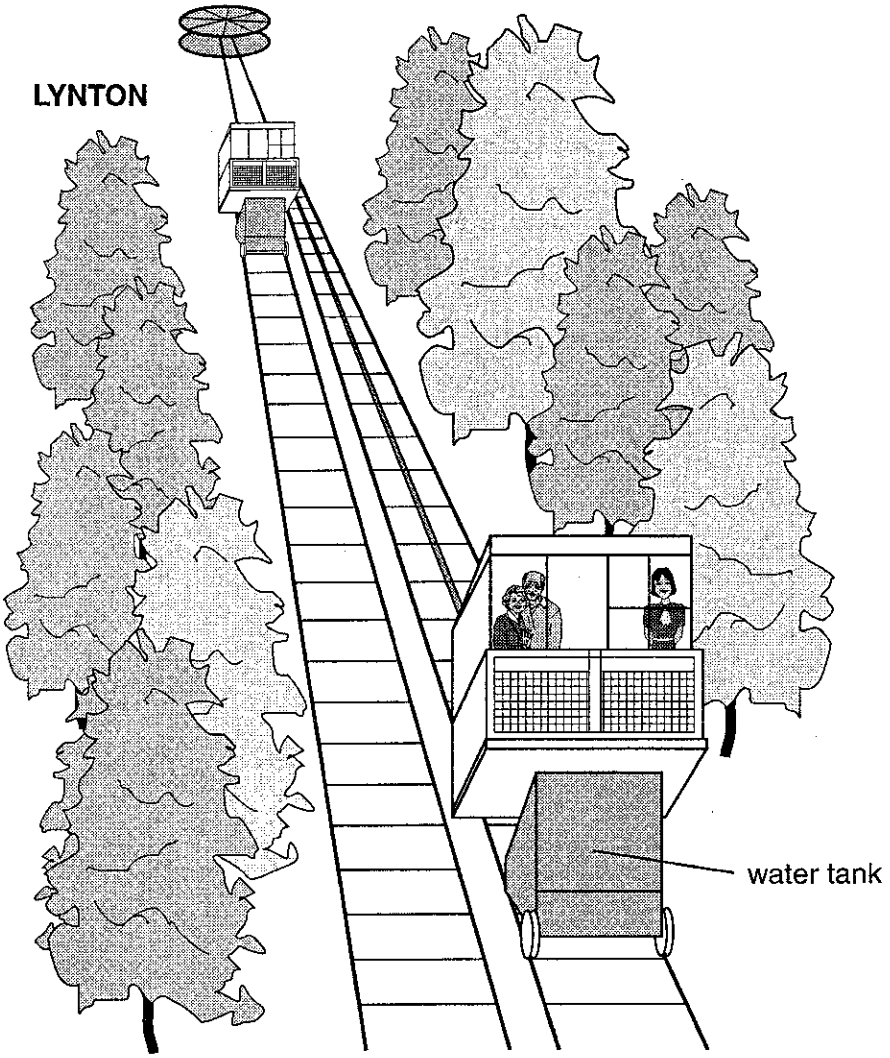
You **must** show how you work out your answer.

current = _____ mA [3]

8 The towns of Lynton and Lynmouth, in Devon, are joined by a cliff railway.

Two cars are joined by a thick cable passing over a large pulley.

The cars have water tanks under them. These tanks are filled from the river Lyn at the top and emptied out at the bottom of the cliff in Lynmouth.



not to scale

LYNMOUTH

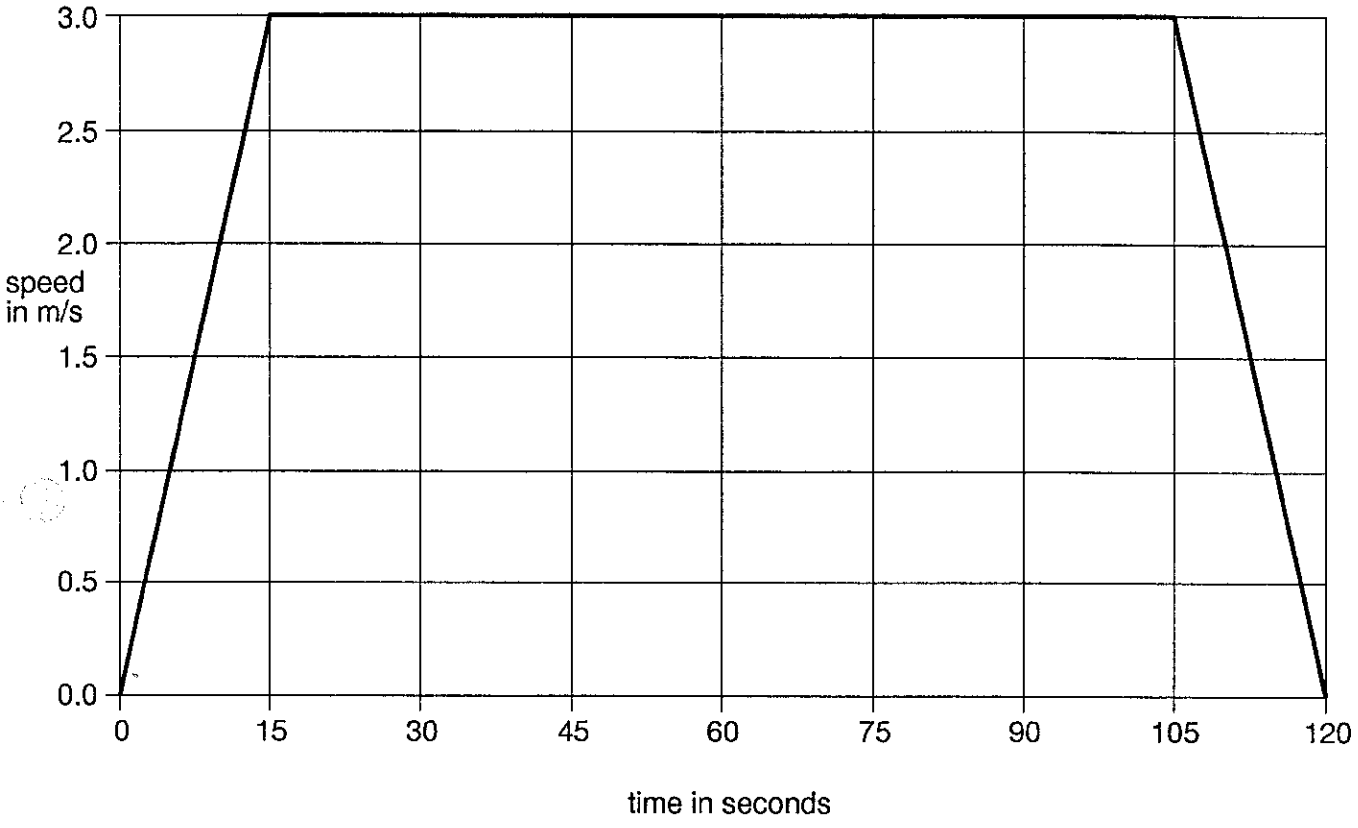
The diagram shows the cars at the stations. The water tank under the top car is filled with water. The brakes are released.

Then the water tank under the bottom car is emptied. The top car is now heavier than the bottom car. It goes down the rails, pulling the bottom car up.

[Question 8 continued on next page

Question 8 – *continued*

(a) The graph shows how the speed of the upper car changes as it descends.



Use the graph to calculate the total distance travelled by the upper car as it descends.

You **must** explain how you work out your answer.

distance = _____ unit _____ [4]

[Question 8 continued on next page

Question 8 – *continued*

(b) The top car loses potential energy as it goes down the cliff.

The station at Lynton is a height of 150 m above Lynmouth.

The mass of a fully loaded car is 10 000 kg.

Calculate the potential energy lost by a fully loaded car between the top and bottom of the cliff.

Use the equation below. You **must** show how you work out your answer. (Gravitational field strength is 10 N/kg.)

change in gravitational potential energy = mass × gravitational field strength × height moved

loss in potential energy = _____ unit _____ [3]

(c) Both cars weigh the same when full of water.

Water is now released from the tank of the lower car, but it takes a few seconds before the cars begin to move. Explain why.

_____

_____

_____

_____ [2]

(d) The water to fill the tanks comes from the river Lyn which flows near Lynton. Explain why the cliff railway is an environmentally friendly user of energy resources.

_____

_____

_____

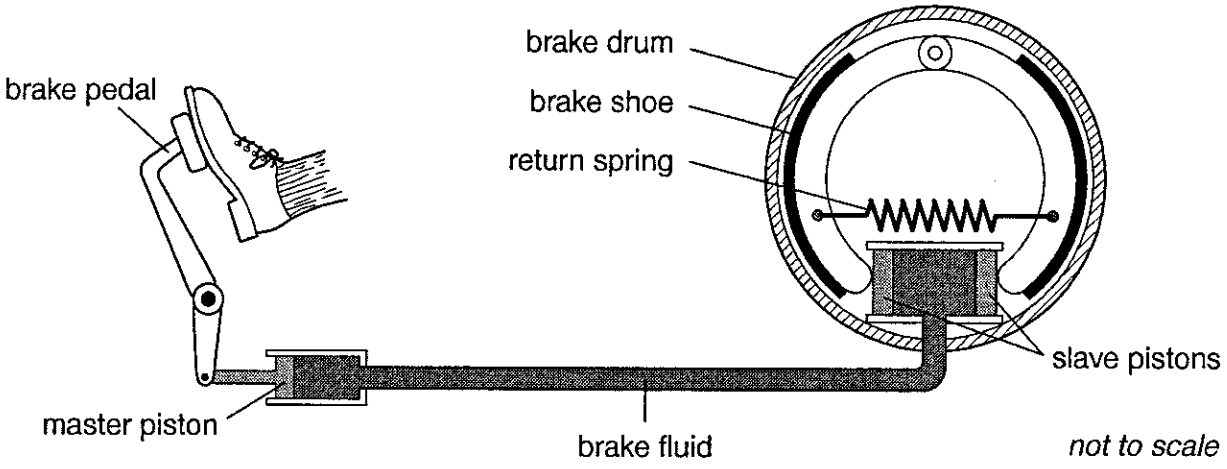
_____ [2]

Question 8 continued on next page

Question 8 – *continued*

(e) Both the cliff railway and cars have braking systems.

The diagram represents a car braking system.



Explain how the car braking system works. Use your knowledge of pressure in liquids.

[4]