OXFORD CAMBRIDGE AND RSA EXAMINATIONS

General Certificate of Secondary Education

SCIENCE: DOUBLE AWARD A PAPER 6 **1983/6**

PHYSICS PAPER 2 **1982/2**

HIGHER TIER

SPECIMEN PAPER 2003 1 hour 30 minutes

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

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers, in blue or black ink, in the spaces on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is 100.
- You will be awarded marks for the quality of written communication where an answer requires a piece of extended writing.

FOR EXAMINER'S USE	
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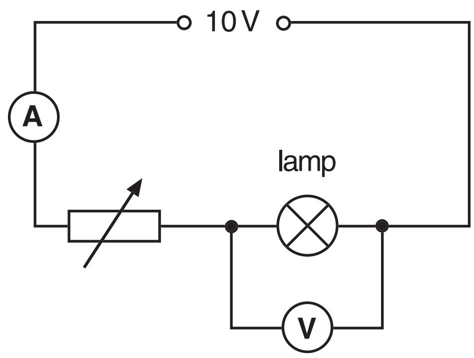
14	
TOTAL	

This question paper consists of 24 printed 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.

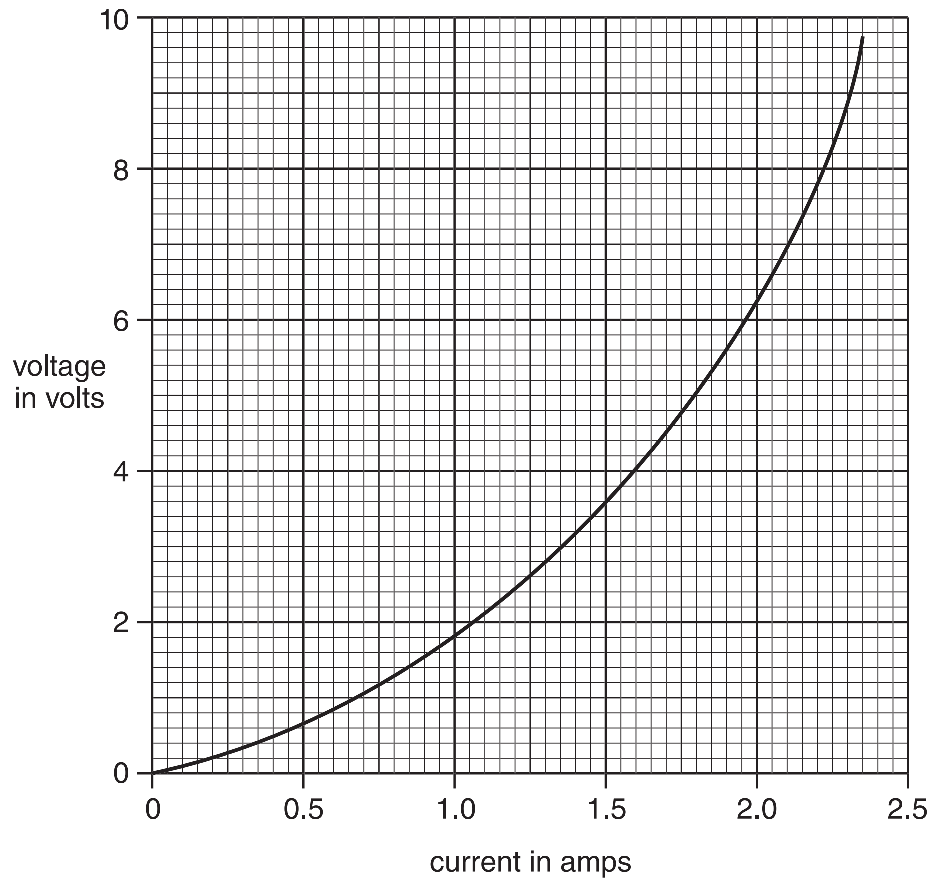
____

____

____ [2]

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

She plots this graph.



(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?

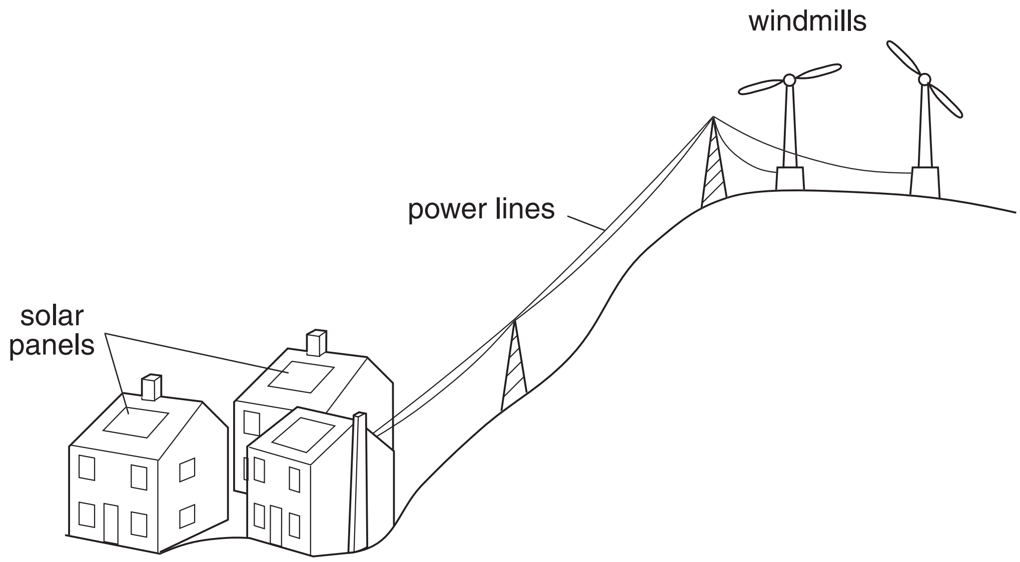
____

____ [1]

[Total: 7]

For Examiner's Use

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.

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

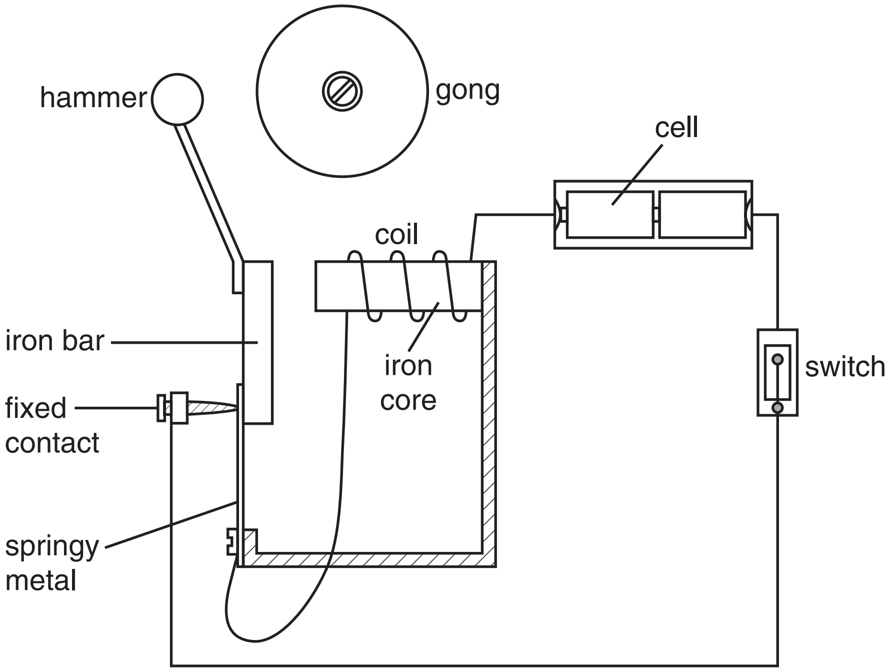
efficiency = ____________________ [2]

[Total: 4]

For Examiner's Use

3 This question is about electromagnetism.

Graham makes a simple electric bell.



He closes the switch.

(a) The hammer moves to the right and hits the gong.

Explain why.

____

____

____ [2]

(b) The hammer now moves back to the left.

Explain why.

____

____

____ [2]

[Total: 4]

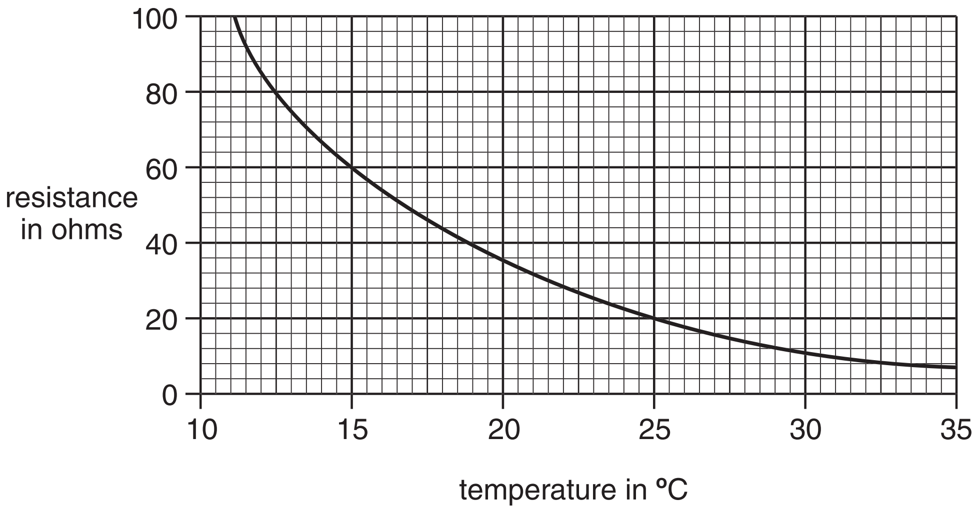
4 The central heating system in a house pumps hot water around the building.

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.



(a) 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]

(b) The sensing circuit is more sensitive to temperature changes below 15°C than above 25°C. Use the graph to explain why.
You will be given credit for the correct use of spelling, punctuation and grammar.

____

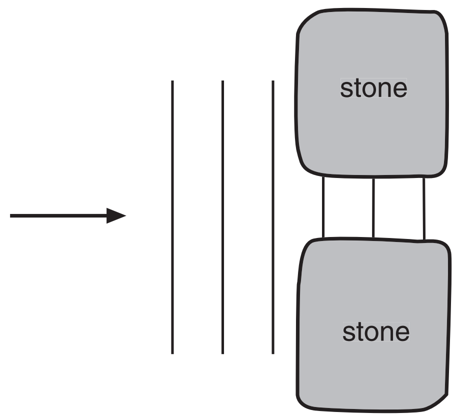
____

____ [3]

[Total: 5]

For Examiner's Use

5 Some water waves pass through a gap between two stepping stones across a small stream.



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

(b) 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.
You will be given credit for the correct use of technical terms and for correct use of spelling, punctuation and grammar.

Factor 1 ______________________________

Effect ______________________________

____

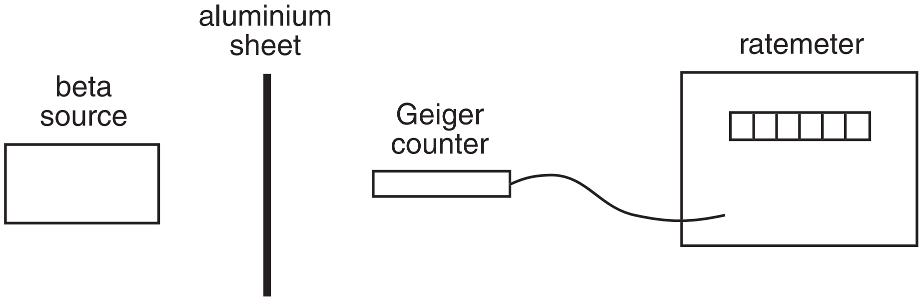
Factor 2 ______________________________

Effect ______________________________

______________________________ [5]

[Total: 7]

6 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.

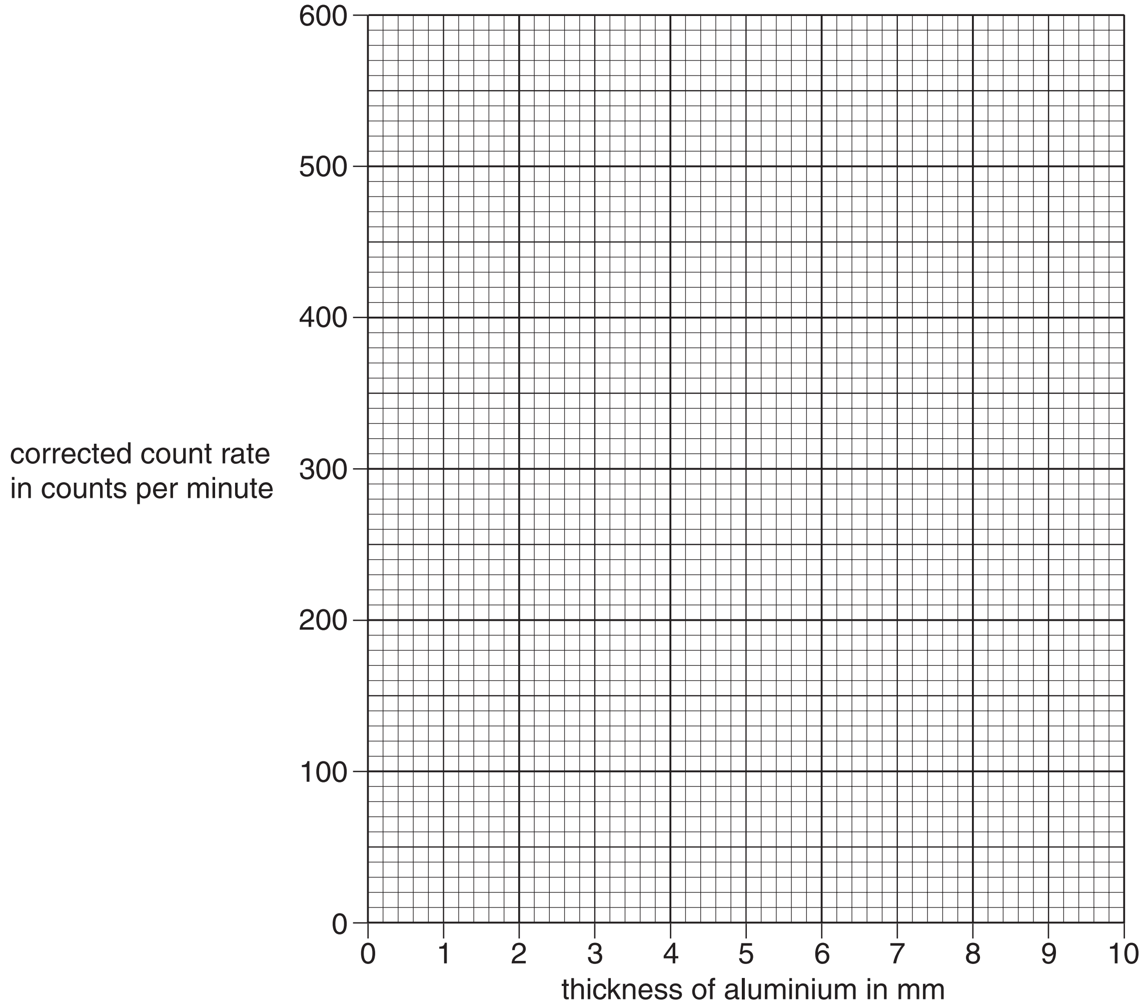
The table shows the results.

thicknesses 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]

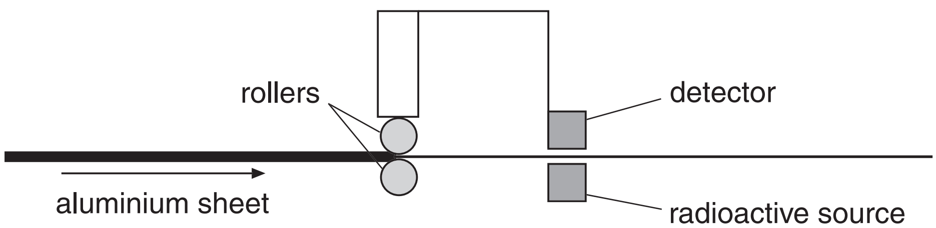
(d) (i) Plot the points on the grid opposite. [1]

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



(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]

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

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

____

____

____ [1]

(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]

[Total: 13]

7 When X-rays were discovered scientists did not realise that they were dangerous. X-rays can cause similar effects on the human body as radiation from radioactive sources.

Suggest some evidence about the effects of X-rays which made scientists change their mind.

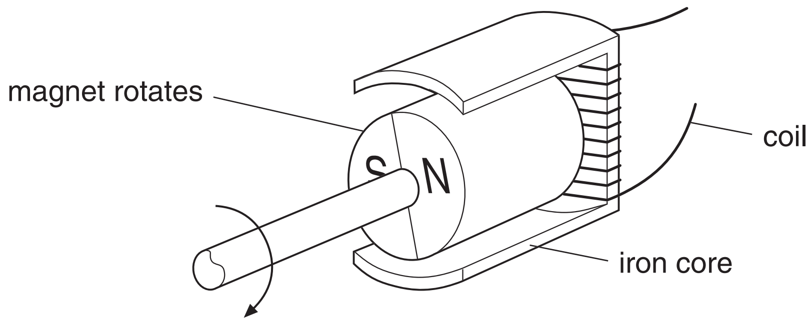
____

____

____ [2]

[Total: 2]

8 **(a)** The diagram shows a model generator.



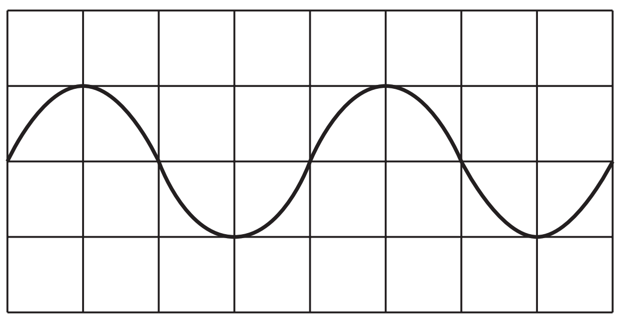
(i) What happens in the coil of wire when the magnet rotates?

____ [1]

(ii) Why does this happen?

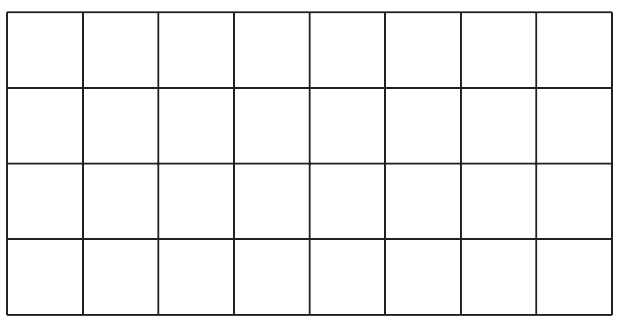
____ [1]

(b) 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.



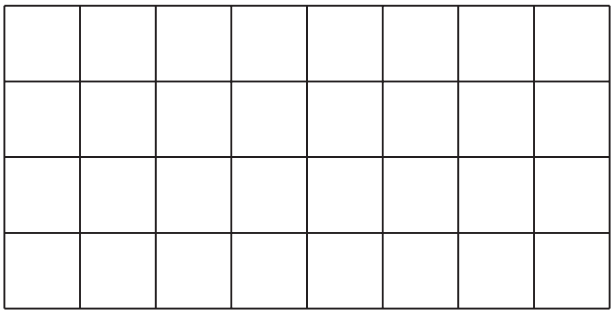
Draw new traces for each of the following changes.
(Assume the settings of the oscilloscope remain the same).

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



[2]

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



[2]

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

____

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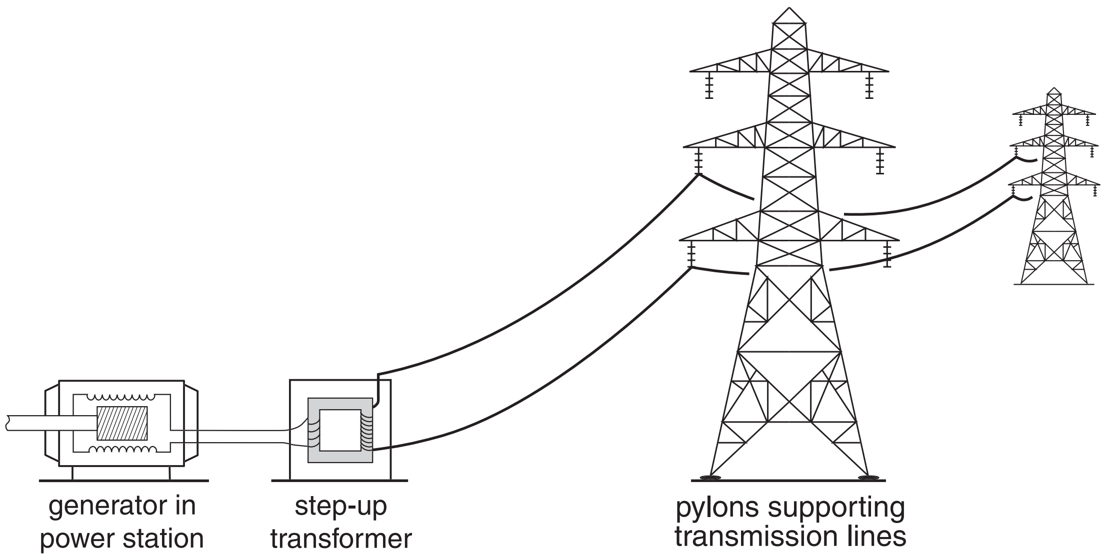
____ [1]

(d) The output from the 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 transmission.
You will be given credit for the correct use of technical terms and for correct use of spelling, punctuation and grammar.

____

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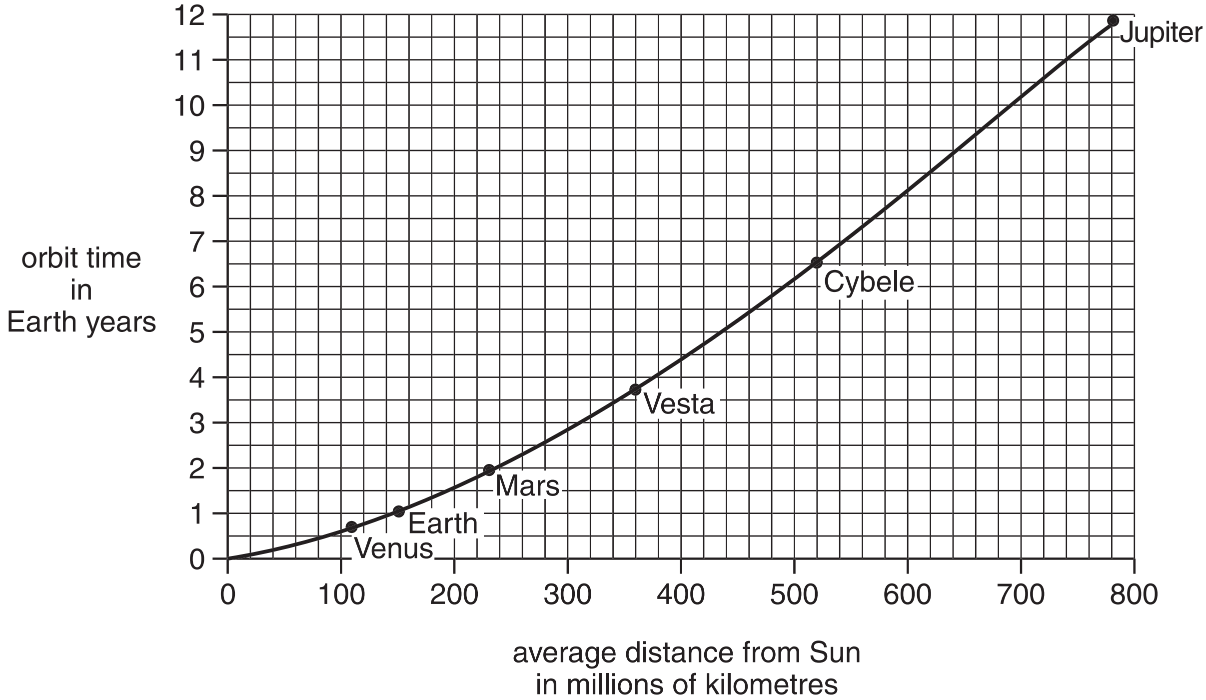
____ [5]

[Total: 12]

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

Asteroids are sometimes called minor planets.



(c) 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 Ida to orbit the Sun.

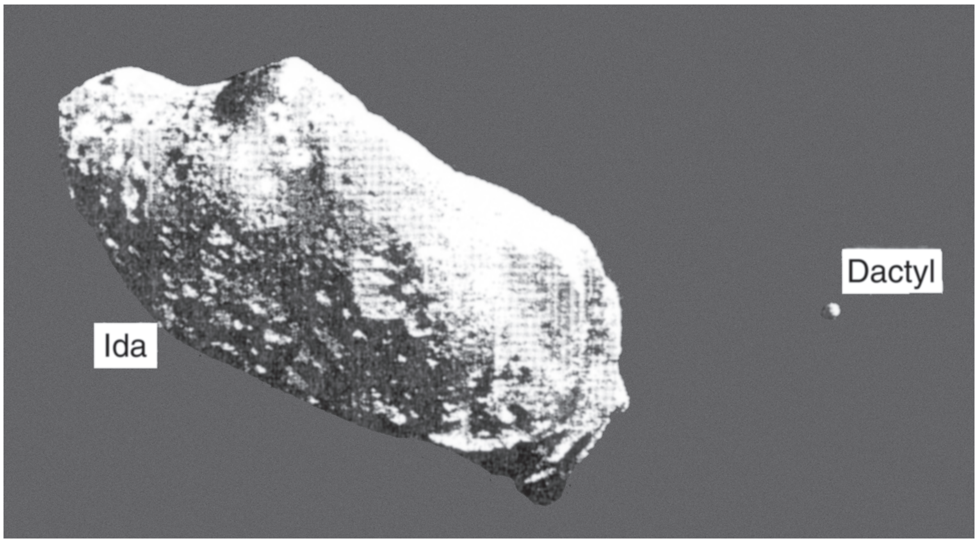
You **must** show clearly, **on the graph**, how you got your answer.

orbit time = ____________________ Earth years [2]

[Turn over

For Examiner's Use

(b) The spacecraft, Galileo, recently discovered that Ida has a tiny moon called Dactyl.



Explain why Dactyl orbits Ida.

____ [1]

(c) Look carefully at the picture of Ida.
Scientists looking at this picture suggest that Ida has no atmosphere.

Give as much evidence as you can from your observations which supports their suggestion.
You will be given credit for the correct use of spelling, punctuation and grammar.

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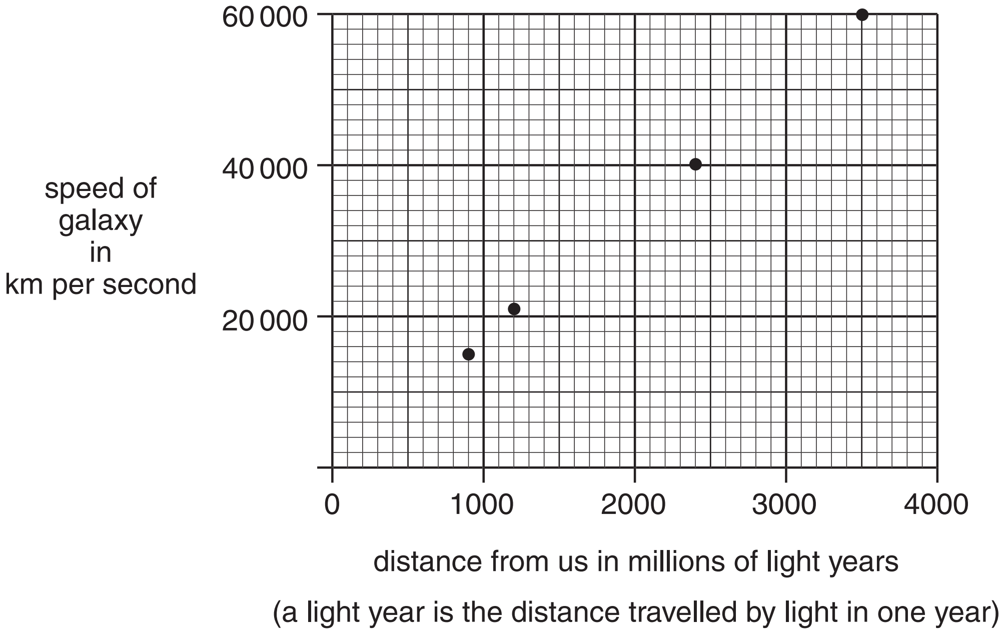
____

____ [4]

(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.



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

____

____ [1]

(ii) 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]

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

time = ________________________ millions of years [1]

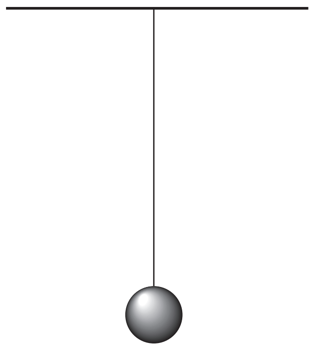
(iv) The galaxy, moving at 30 000 km/s is travelling at one tenth (0.1) of the speed of light. Assuming that all matter in the Universe was originally in one place, and the speed of the galaxy is constant, how long has it taken for the galaxy and us to be this distance apart?

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

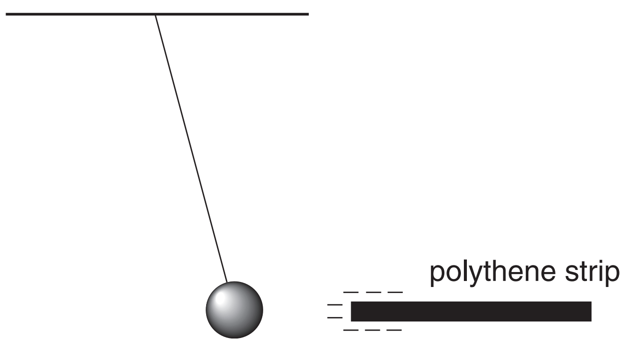
time taken = ____________________ millions of years [2]

[Total: 13]

10 **(a)** Ben hangs a small light plastic ball on a nylon thread.
The ball has a metal coating.
It is **not** charged.



He rubs a strip of polythene with a cloth.
The strip becomes negatively charged.
He brings the strip close to (but not touching) the ball.
The ball moves towards the strip.



Explain why the ball moves towards the strip even though it is not charged.
Drawing on the diagram may help your answer.

____

____

____

____ [3]

(b) Ben now touches the ball briefly with an earthed wire.
He then removes the negative polythene strip.
The ball becomes positively charged.
Use your knowledge about movement of electrons to explain why the ball is now positively charged.

____

____

____ [2]

[Total: 5]

For Examiner's Use

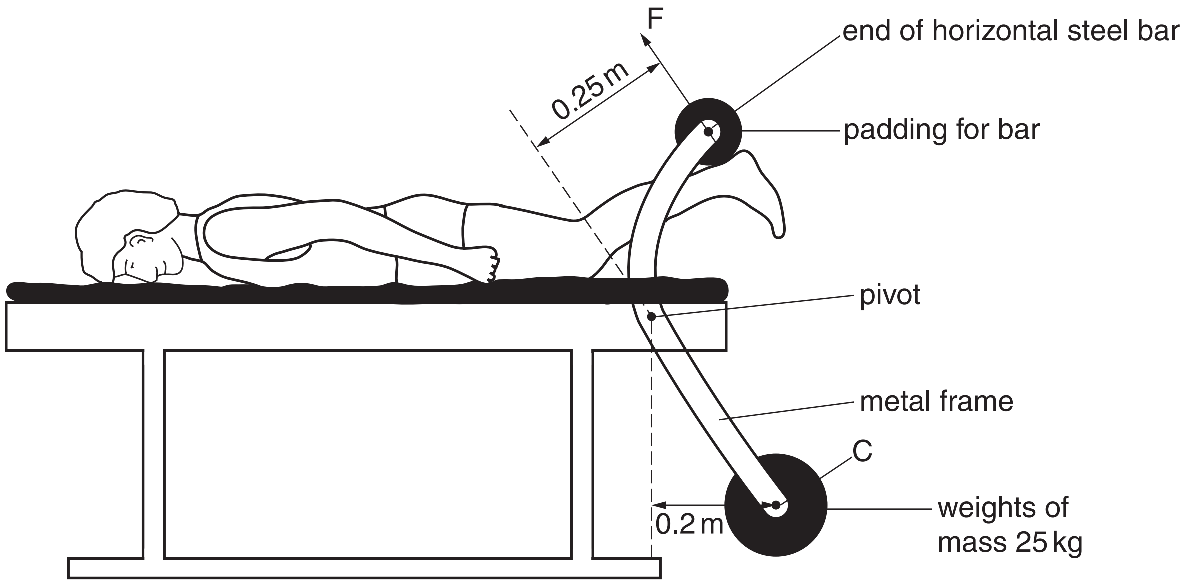
11 David uses the exercise machine below.
His heels apply a force to the padded bar. This lifts the heavy weights.

For this question the following equations will be useful.

moment of a force = force × perpendicular distance to pivot

sum of clockwise moments = some of anticlockwise moments

The weight of 1 kg is 10 N.



(a) The heels press against the pad with a force F and cause a turning effect about the pivot. The force of gravity due to the weights act through their centre, at C.

Calculate the value of F when the weights are in the position shown in the diagram.
You **must** show how you work out your answer.

F = ______________ N [3]

(b) Explain why does it become harder to lift the weights when they move to the right.

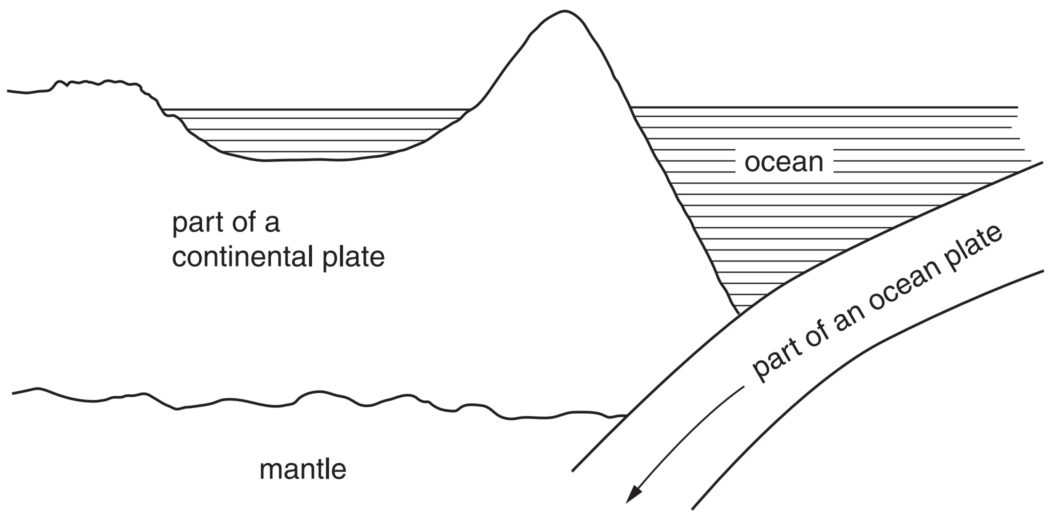
____

____ [2]

[Total: 5]

12 This question is about the movements of the Earth's plates and earthquake waves.

The diagram represents a zone where an ocean plate meets a continental plate.



(a) In the diagram the ocean plate is slowly moving downwards under the continental plate.

What happens to the rock in the ocean plate as it moves into the mantle?

____ [1]

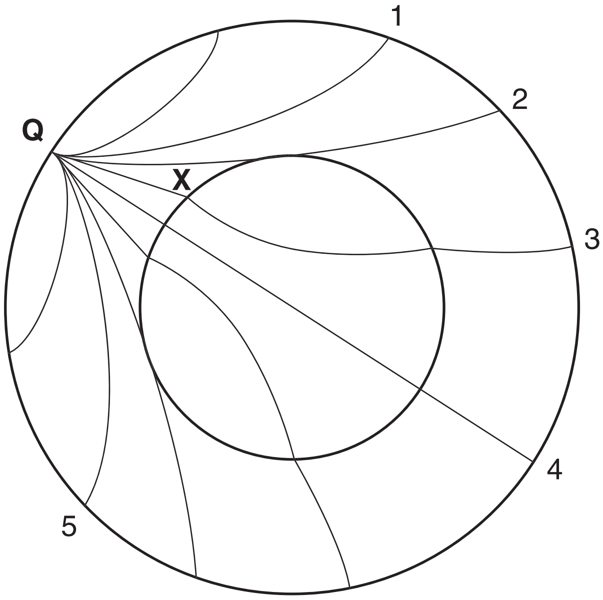
(b) Why does the ocean plate move under the continental plate?

____

____ [1]

For Examiner's Use

(c) The diagram shows a cross-section of the Earth.
There is an earthquake at place **Q**.
Sensitive detectors at positions **1, 2, 3, 4** and **5** are designed to pick up two types of earthquake waves. These types are called **P** and **S** waves.



(i) Finish these sentences.

P waves are ______________________ waves which can be detected at

positions ______________________ .

S waves are ______________________ waves which can be detected at

positions ______________________ . [4]

(ii) The path of one of the earthquake waves changes direction at the point marked **X**.

What is the name given to this change of direction of waves?

______________________________ [1]

(iii) Explain why the wave path changes direction at **X**.

____

____

____ [2]

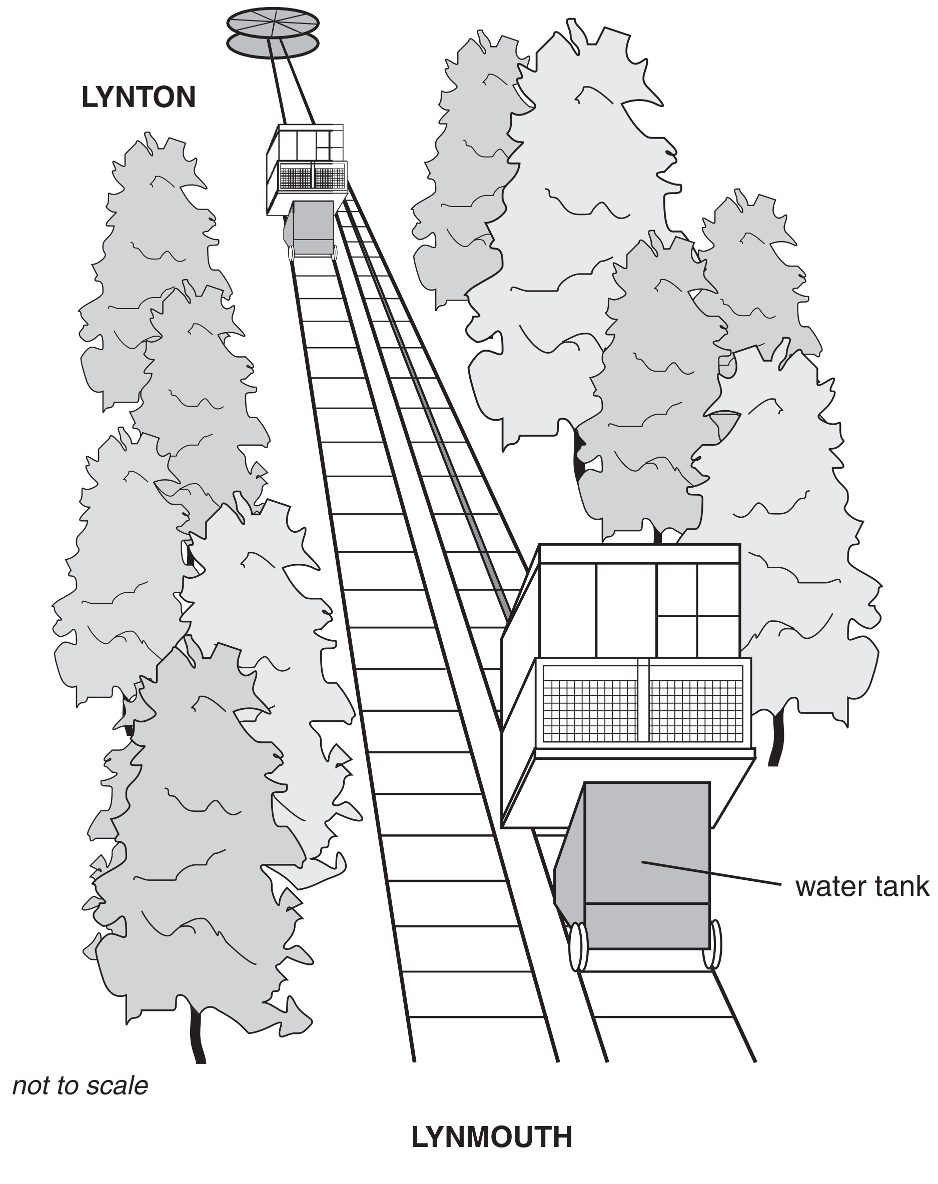
[Total: 9]

For Examiner's Use

13 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.

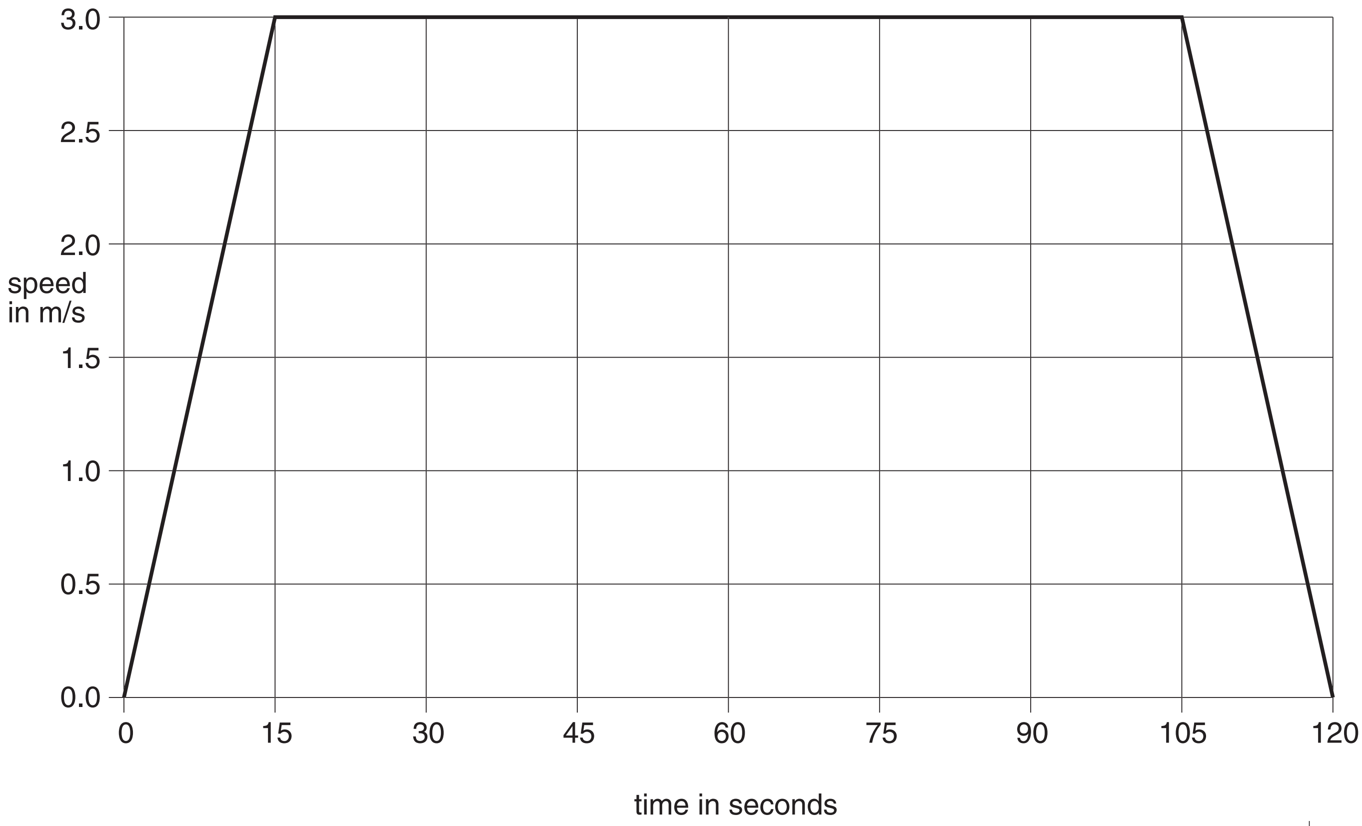
The cars have water tanks under them. These tanks are filled from the river Lyn at the top and emptied out at the bottom of the cliff in Lynmouth.



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.

(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]

(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 ___________ [2]

(c) 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]

[Total: 8]

For Examiner's Use

14 Scientists have studied the skies for a long time.

Look at the information in the table.

Object	How it appears in the sky
Sun	sweeps steadily across the sky during the daytime
star A	sweeps steadily across the sky during the night time
star B	sweeps steadily across the sky during the night time
Venus	moves differently across the sky during the night time
TV satellite	sweeps quickly across the sky during the daytime

Scientists have collected evidence and made theories to explain what can be seen in the sky.

At one time, people believed that the Earth was the centre of the universe and that the Sun orbited the Earth.

In the early sixteenth century a scientist called Copernicus studied how planets moved in the sky. He came to the conclusion that the Earth and the planets orbited the Sun. He told other scientists by writing a book, it took 13 years before the book was published.

Another scientist, Galileo, read Copernicus' book many years later. He found that the book helped him explain some of his investigations. Galileo also believed that the planets went around the Sun.

Unfortunately in the early seventeenth century the Catholic Church still thought that the Earth was the centre of the universe. Galileo was sentenced to house arrest for his beliefs.

(a) It took a long time for Copernicus to be able to tell others of his ideas.
Nowadays it is much faster to tell other scientists of a new idea.

Suggest why.

____

____

____[2]

(b) Sometimes scientists like Galileo cannot get other people to believe their ideas.

Suggest **two** reasons why.

____

____

____[2]

(c) When Galileo and Copernicus were studying how planets and stars moved in the sky, they used telescopes. These telescopes were not very powerful.

Today the idea that the Earth moves around the Sun is firmly accepted. One of the reasons is that there is much more evidence available now than in the sixteenth and seventeenth centuries.

Suggest why scientists have been able to gather much more evidence now than in the past.

____

____

____

____ [2]

[Total: 6]