OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE **A181/02**

PHYSICS A

Unit A181: Modules P1, P2, P3 (Higher Tier)

Candidates answer on the question paper
A calculator may be used for this paper

OCR Supplied Materials:
None

Other Materials Required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- A list of useful relationships is printed on page **2**.
- The number of marks for each question is given in brackets **[ ]** at the end of the question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **20** pages. Any blank pages are indicated.

For Examiner's Use		
	Max	**Mark**
1	**6**	
2	**5**	
3	**7**	
4	**3**	
5	**4**	
6	**4**	
7	**5**	
8	**6**	
9	**2**	
10	**4**	
11	**2**	
12	**6**	
13	**6**	
TOTAL	**60**	

TWENTY FIRST CENTURY SCIENCE DATA SHEET

Useful Relationships

The Earth in the Universe

distance = wave speed x time

wave speed = frequency x wavelength

Sustainable Energy

energy transferred = power x time

power = voltage x current

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100\%$$

Explaining Motion

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

momentum = mass x velocity

change of momentum = resultant force x time for which it acts

work done by a force = force x distance moved in the direction of the force

amount of energy transferred = work done

change in gravitational potential energy = weight x vertical height difference

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times [\text{velocity}]^2$$

Electric Circuits

power = voltage x current

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

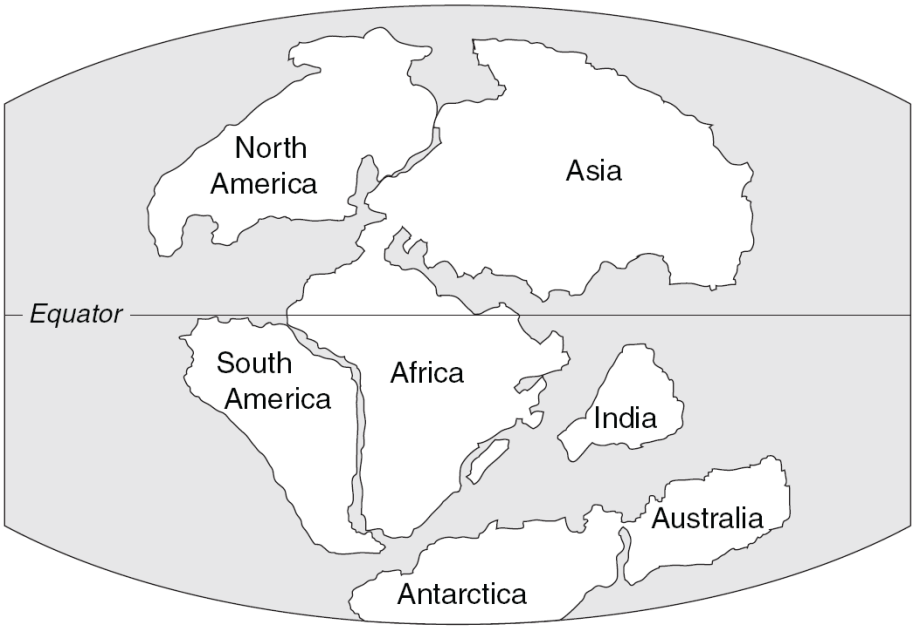
$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

Radioactive Materials

energy = mass x [speed of light in a vacuum]^2

Answer **all** the questions.

1 Wegener proposed his theory of continental drift in 1912.



Wegener's theory was not accepted by geologists when he first suggested it.

Wegener's theory became accepted in the 1960s.

Explain why Wegener thought the continents had moved, why geologists rejected his ideas, and how the theory became accepted.

✎ *The quality of written communication will be assessed in your answer to this question.*

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..... **[6]**

[Total: 6]

2 Read the article.

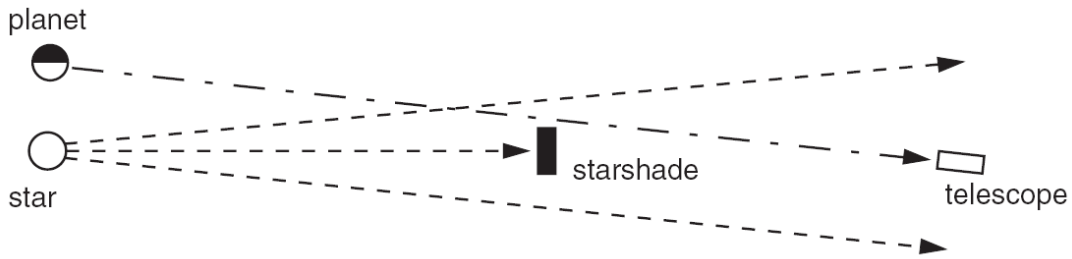
'Starshade' could help us see planets around other stars

An idea for an orbiting 'starshade' could help astronomers in the search for alien life.

The giant 'starshade' would be launched into space together with a space telescope, and would orbit the Earth at a distance of around 1 million kilometres. The 'starshade' and the telescope would be around 15 000 kilometres apart from each other.

Small thruster rockets, fired by remote control from Earth, would allow scientists to move the 'starshade' in front of a star they wanted the telescope to look at. The 'starshade' would allow light reflected from planets orbiting the star to be seen.

Scientists would be able to use the reflected light to analyse the planet's atmosphere for chemicals such as oxygen, water and methane. The presence of these chemicals could be interpreted as signs of life.



(a) Read the following statements.

Put a tick (✓) in the box next to each of the three correct statements.

The ‘starshade’ will block light from certain stars.	☐
The ‘starshade’ will be fixed to a space telescope.	☐
The ‘starshade’ is designed to block light from distant planets.	☐
The telescope is designed to study planets in our Solar System.	☐
The light from a planet is much dimmer than the light from its star.	☐
The light from a distant planet may show the gases in its atmosphere.	☐

[3]

(b) Most telescopes are on the Earth's surface.

This telescope and 'starshade' will be put into orbit a long way from the Earth.

Which of these statements are correct reasons for doing this?

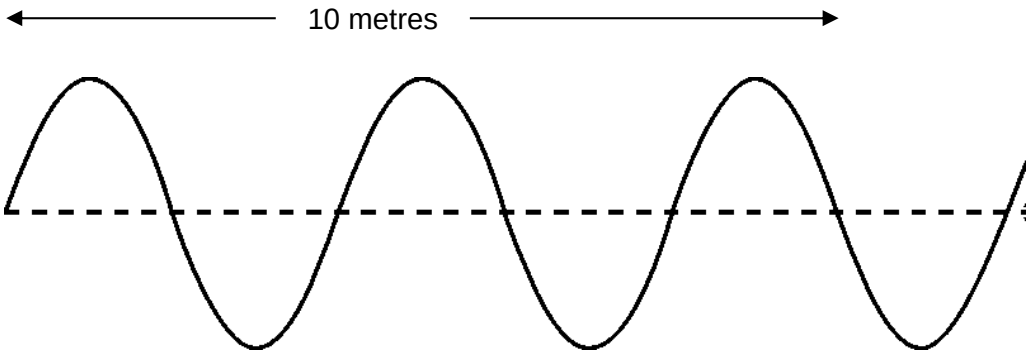
Put a tick (✓) in the box next to each of the **two** correct statements.

There will be no light pollution.	☐
The 'starshade' will not corrode or rot.	☐
Telescopes do not need power to stay in orbit.	☐
They will be closer to the distant planets that they need to observe.	☐
The Earth's atmosphere absorbs part of the electromagnetic spectrum.	☐

[2]

[Total: 5]

3 The diagram shows a wave.



(a) Calculate the wavelength of this wave.

wavelength = ... m **[1]**

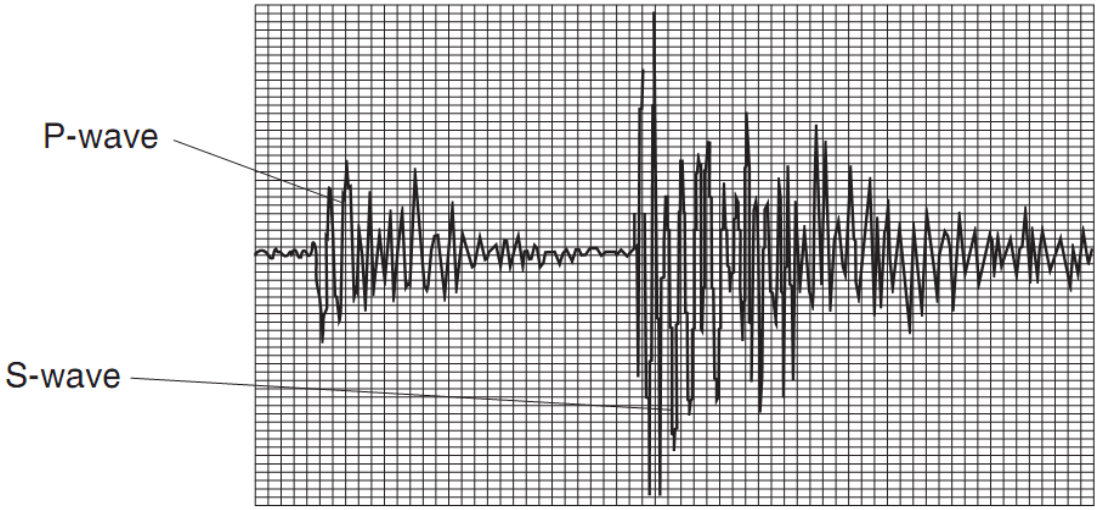
(b) Another wave has a wavelength of 5 metres.

Calculate its frequency if it has a speed of 4 m/s.

frequency = ... Hz **[2]**

(c) The diagram shows a recording from an earthquake detector.

It has detected a P-wave and an S-wave from an earthquake.



The P-wave travels at a speed of 8000 m/s, and the S-wave travels at 3000 m/s.

The two waves started at the same time from an earthquake 360 km away from the detector.

(i) Calculate the time delay between the arrival of the two waves at the detector.

delay = …… s **[2]**

(ii) Use the graph to explain why the delay between the arrival of the two waves can help save lives in the event of an earthquake.

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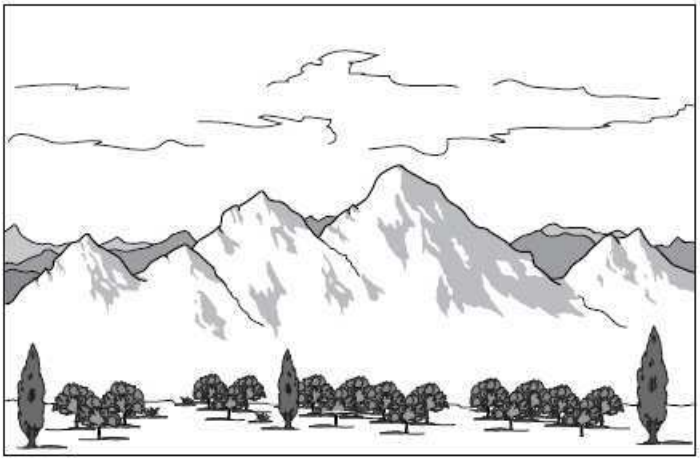
[Total: 7]

4 Scientists think that mountains must be forming all the time.



Some of the statements below are used to explain this.

A Mountains are part of the Earth's crust.

B Erosion causes mountains to be worn down.

C The Earth is older than its oldest rocks.

D If no new mountains were formed the continents would be flat.

E Mountains exist today.

F Mountains are only formed on drifting continents.

Three of the statements, when taken together, explain why mountains must be forming all of the time.

Write down the letters of these statements.

..... and ..... and ..... **[3]**

[Total: 3]

5 The properties of microwaves mean that they are used for many purposes.

(a) Which of the following statements about microwaves are true?

Put a tick (✓) in the box next to each **correct** statement.

Microwaves can be used to heat food by causing particles to vibrate.	
Microwaves are ionising radiation.	
The screen on a microwave oven lets light through but blocks microwaves.	
Mobile phones produce microwaves.	
Microwaves are blocked by the ozone layer.	
The higher the intensity of microwaves in a microwave oven, the less the food is heated.	

[3]

(b) Microwave photons transfer less energy than light photons.

However, microwaves can be used to cook many foods but light cannot.

Explain why.

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..... **[1]**

[Total: 4]

6 This question is about carbon dioxide in the atmosphere.

The table shows how the concentration of carbon dioxide in the atmosphere has changed in the past 100 000 years.

years before present	100 000	80 000	60 000	40 000	20 000
carbon dioxide concentration in parts per million	240	190	213	210	222

(a) Scientists say that the concentration of carbon dioxide in the atmosphere has been approximately constant for hundreds of thousands of years.

Discuss whether this statement is true, with reference to the data in the table.

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..... **[2]**

(b) In the present time, the concentration of carbon dioxide in the atmosphere is 360 parts per million.

Explain why this evidence convinces some scientists that the level of carbon dioxide in the atmosphere has risen significantly in recent times.

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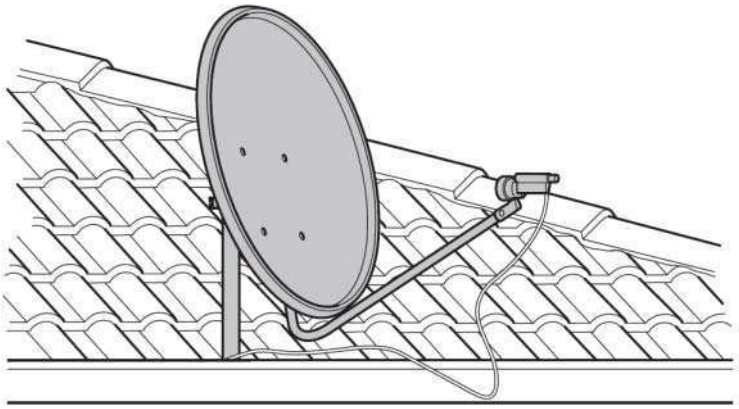
[Total: 4]

7 Microwaves carry TV signals from satellites to our homes through the atmosphere.



(a) A dish on the roof of a house guides the microwaves onto a receiver.

Here are some statements about the signals picked up at the receiver.

Put a tick (✓) in the box next to each statement to show whether it is **true** or **false**.

statement	true	false
The dish increases the intensity of the waves absorbed by the receiver.		
Microwave signals are very strongly absorbed by air molecules.		
The dish removes noise picked up by the waves from the satellite.		
The dish is made of metal because it is a good reflector of microwaves.		

[2]

(b) Adam is investigating the energy of photons.

He measures the amount of energy that beams of radio, microwaves, infrared and visible light deliver to a detector.

He predicts that there will be more energy in the infrared beam than the radio beam.

Adam bases this prediction on the frequency of the different beams.

Here are his results.

electromagnetic radiation	**energy detected in beam in microjoules**
radio	71
microwave	95
infrared	60
visible light	120

Discuss Adam's prediction.

Suggest why the results might be like this.

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..... **[3]**

[Total: 5]

8 This question is about global warming and ozone.

Many people get confused between 'the greenhouse effect' and 'holes in the ozone layer'.

Explain the difference between the two and the scientific processes involved in each.

✎ *The quality of written communication will be assessed in your answer to this question.*

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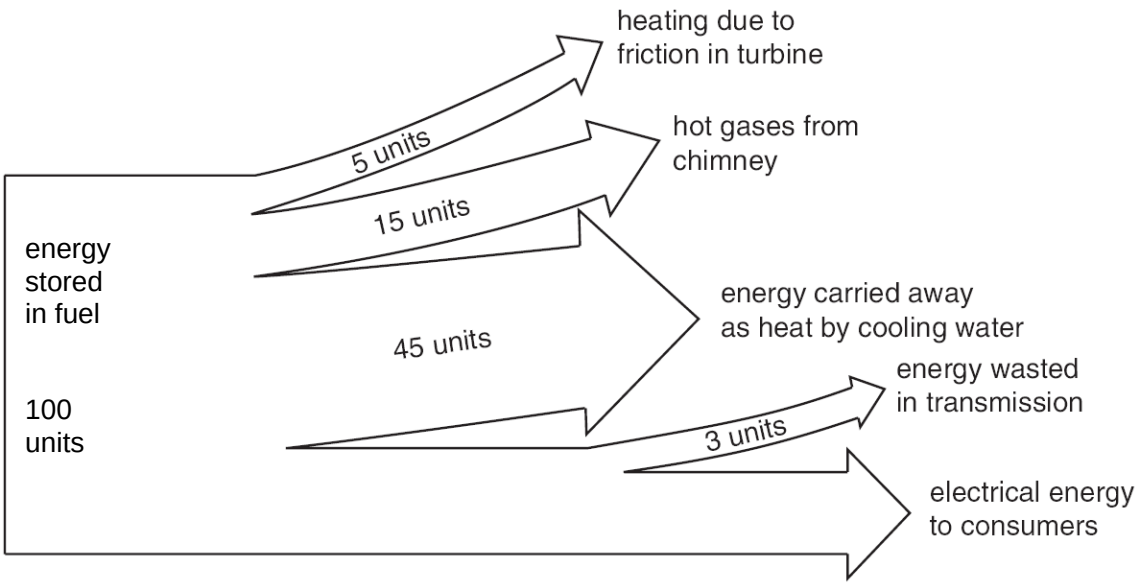
[Total: 6]

9 Generating and distributing electricity is not 100% efficient.

Look at this diagram for electricity generation by a fossil fuel power station.



(a) How many units of electricity go to the consumers?

answer …… units **[1]**

(b) What is the efficiency of the power station?

Put a (ring) around the correct answer.

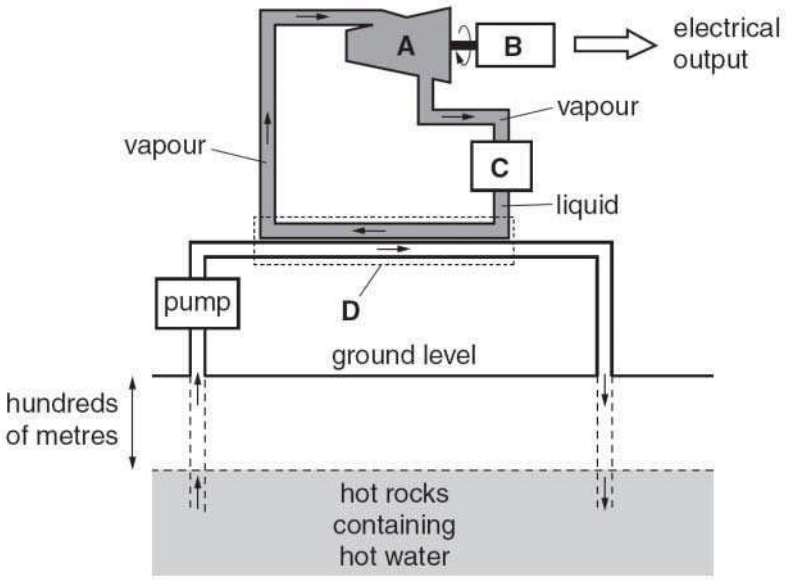
3% **35%** **45%** **54%** **65%**

[1]

[Total: 2]

10 (a) The diagram shows one type of geothermal power station.

The power station gets its energy from hot rocks deep underground.



The following statements describe the energy flow in a geothermal power station.

They are not in the correct order, and they are not all correct.

V A condenser, **C**, turns vapour into a liquid.

W A magnet rotates inside the turbine, producing a voltage across a coil of wire.

X Vapour turns a turbine, which turns a generator.

Y Hot water passes along pipes into a heat exchanger, **D**, where it boils an organic liquid.

Z Water is pumped from hot rocks deep underground.

Choose the correct statements and write the letters in the correct order in the boxes below.

[1]

(b) The Government is planning to build a new power station.

The table gives some information about three different types of power station.

type of power station	efficiency	cost of generating electricity per kWh in pence	environmental factors
coal	38%	2 to 3	produces carbon dioxide
nuclear	34%	2 to 2.5	produces radioactive waste
wind	35%	4 to 5.5	can damage local wildlife (eg birds)

Which type of power station would you recommend building?

Justify your choice, using **only** information from the table.

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..... **[3]**

[Total: 4]

11 A kettle transfers much more energy in a day than a light bulb, but both have the same mains voltage.

Explain how this is possible when the kettle is on for a few minutes only, while the light bulb is on for several hours.

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..... **[2]**

[Total: 2]

12 One way of supplying electricity to the country is with nuclear power stations.

Some people are very concerned about the risk to the public from the waste produced in these power stations, while other people think the risk is very low.

The Government will have to make decisions on this, but these decisions may be controversial.

Explain why people have different views on the risk from nuclear waste, and why any decision made by the Government may be controversial.

✎ *The quality of written communication will be assessed in your answer to this question.*

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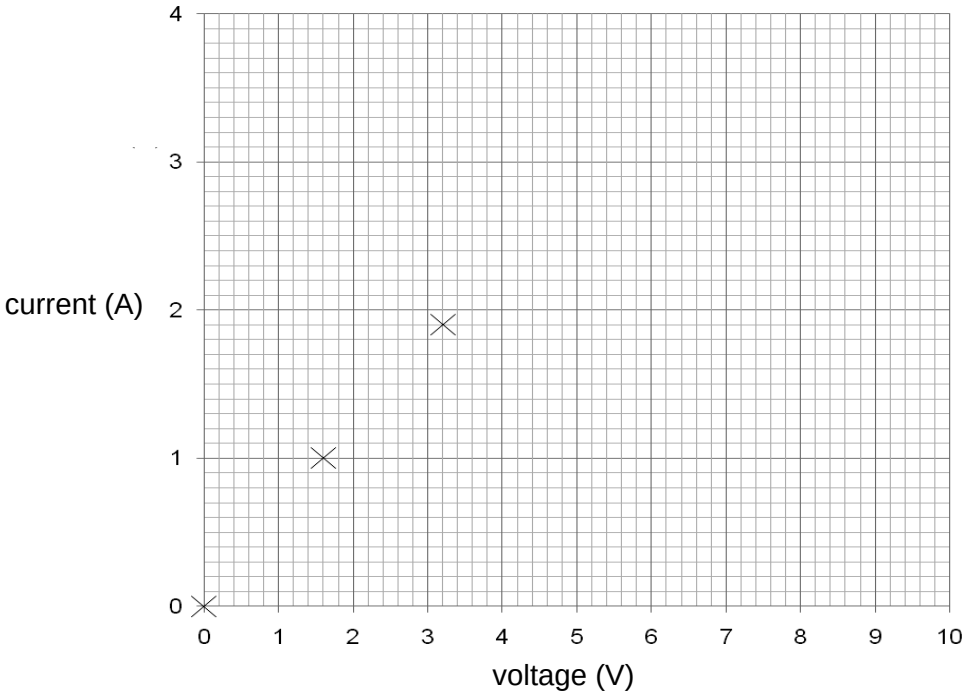
[Total: 6]

13 Mary and John are doing an experiment to measure the power in a wire.

They measure the electrical current through a wire at different voltages.

voltage in V	0	1.6	3.2	6.2	8.0	9.4
current in A	0.0	1.0	1.9	3.0	3.3	3.4

(a) Plot the data onto the graph. The first three points have been plotted for you.



[1]

(b) Draw a best fit curve for the data, and describe the pattern shown.

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..... **[3]**

(c) Use your graph to find the electrical power of the lamp when the voltage is 5 V.

power = ... W **[2]**

[Total: 6]

[Paper Total: 60]

END OF QUESTION PAPER

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