



General Certificate of Secondary Education  
2009

## Science: Physics

Paper 1  
Higher Tier

[G7604]



WEDNESDAY 10 JUNE, AFTERNOON

### TIME

1 hour 45 minutes.

### INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Write your answers in the spaces provided in this question paper.  
Answer **all five** questions.

### INFORMATION FOR CANDIDATES

The total mark for this paper is 125.

Quality of written communication will be assessed in question **5(d)(ii)**.  
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

Details of calculations should be shown.

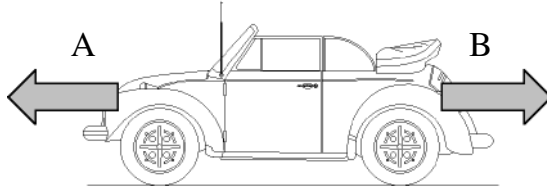
Units must be stated with numerical answers where appropriate.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
<b>Total Marks</b>	

1 (a) (i) What is friction?

\_\_\_\_\_  
\_\_\_\_\_ [2]

The diagram shows a car on a level road.  
The arrows show the two horizontal forces acting on the car.  
The forces are equal.



(ii) What is the resultant of these two forces? \_\_\_\_\_ [1]

(iii) Describe the **two** possible states of motion of this car.

1. \_\_\_\_\_  
2. \_\_\_\_\_ [2]

(iv) If the force B does not change, but force A is increased to 1 200 N, this produces an acceleration of  $0.5 \text{ m/s}^2$ .  
Calculate the size of force B. The mass of the car is 750 kg.  
**You are advised to show clearly how you get your answer.**

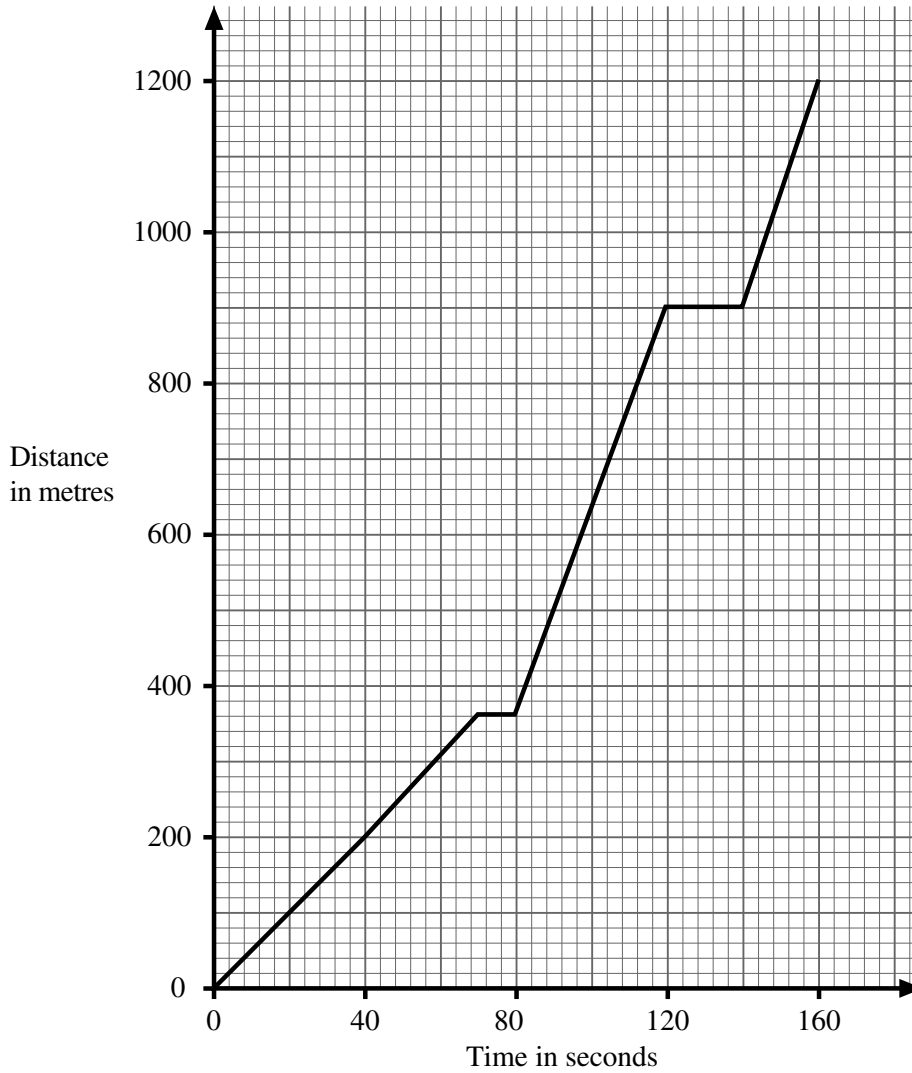
Force B = \_\_\_\_\_ N [3]

(v) The force A remains constant at 1200 N, but as the velocity of the car increases, the acceleration does not remain the same, but begins to decrease. What does this tell you about force B?

\_\_\_\_\_ [1]

Examiner Only	
Marks	Remark

- (b) The driver of the car takes it on a journey.  
The distance–time graph for this journey is shown below.



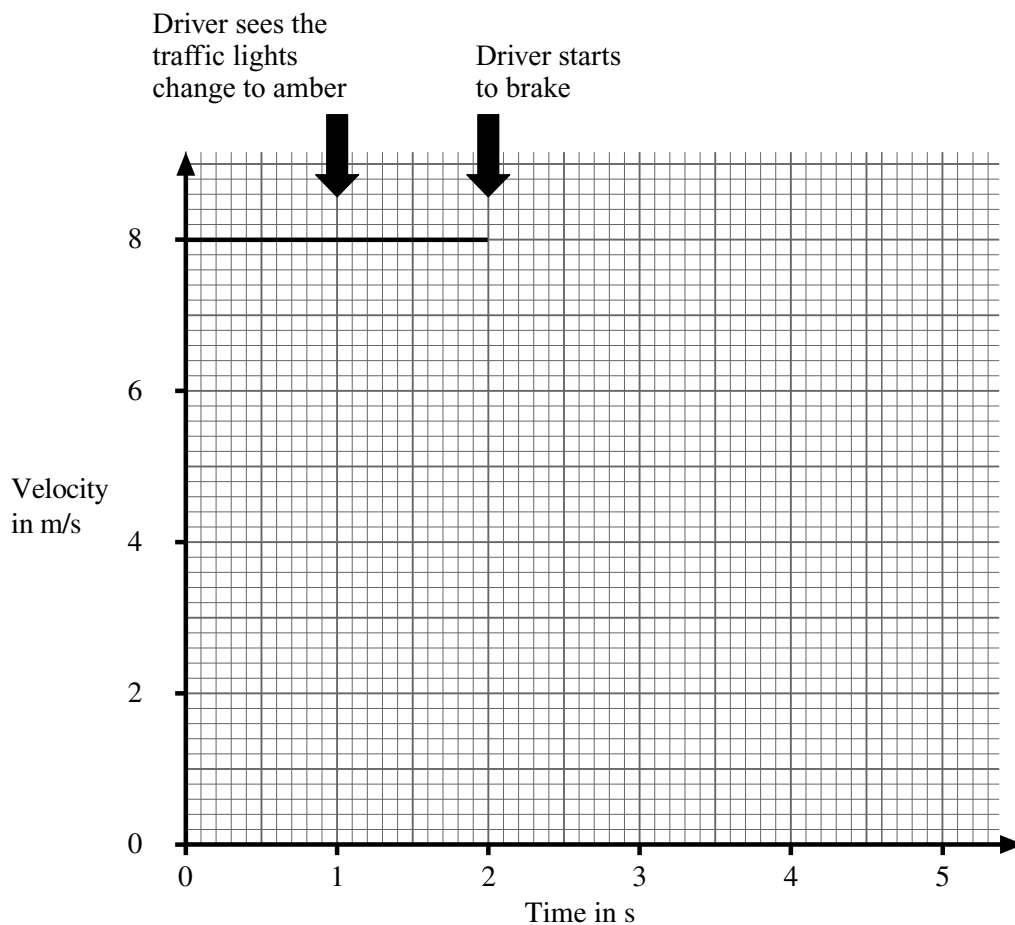
- (i) Calculate the average speed of the car for the whole journey.  
**You are advised to show clearly how you get your answer.**  
Remember to include the correct unit in your answer.

Average speed = \_\_\_\_\_ [4]

- (ii) Draw, on the grid above, what the distance–time graph would look like, if the driver had driven the same journey in the same time, at a **constant speed**. [3]

Examiner Only	
Marks	Remark

- (c) On another journey, when the car is approaching a road junction, the traffic lights change to amber and the car brakes. The graph below shows part of the velocity–time graph as it brakes.



- (i) The driver sees the lights change to amber at a time of 1 s and applies the brakes 1 s later. What distance does the car travel during this time of 1 s?

Distance travelled = \_\_\_\_\_ m [2]

- (ii) The car stops 3 s after the brakes are first applied. Continue the velocity–time graph until the car has stopped. You may assume that the deceleration of the car is constant. [2]

Examiner Only	
Marks	Remark

**(iii)** Calculate the deceleration of the car.

**You are advised to show clearly how you get your answer.**

$$\text{Deceleration} = \text{_____ m/s}^2 \text{ [2]}$$

**(iv)** Calculate the distance travelled by the car from the time when the driver sees the traffic lights change to amber until it comes to rest.

**You are advised to show clearly how you get your answer.**

$$\text{Distance travelled} = \text{_____ m [3]}$$

Examiner Only

Marks Remark

- 2 (a) (i) Write down an equation to describe what physicists mean by the word **efficiency**.

Efficiency = \_\_\_\_\_ [1]

- (ii) The **useful output energy** from an electrical generator is 150 kJ and the **wasted output energy** is 450 kJ. Use your knowledge of the principle of conservation of energy to calculate the efficiency of the generator.

**You are advised to show clearly how you get your answer.**

Efficiency = \_\_\_\_\_ [3]

Examiner Only

Marks

Remark

(b) (i) Below are seven different energy resources.

biomass coal gas geothermal  
hydroelectric nuclear wind

Classify these resources by writing the name of each of them in the appropriate column in the table below.

Renewable and dependent on the energy of the Sun	Renewable and independent of the energy of the Sun	Non-renewable

[4]

(ii) There is increasing interest in the use of bio-fuels for energy. Bio-fuels are frequently obtained from the oil-bearing seeds of crops like rape and maize. What form of energy is stored in bio-fuels?

\_\_\_\_\_ [1]

(iii) Explain carefully why bio-fuels can be thought of as renewable sources of energy.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [3]

Examiner Only	
Marks	Remark

(c) In a swimming competition, an athlete swims 400 m, at a steady speed of 0.8 m/s against an opposing force of 450 N.

- (i) Write down an equation which will enable you to calculate the work done by this athlete.

Work done = \_\_\_\_\_ [1]

- (ii) Use the equation in part (i) to calculate the work done by the athlete.

**You are advised to show clearly how you get your answer.**

Work done = \_\_\_\_\_ J [2]

- (iii) The swim lasts for 500 seconds. Use your answer to part (ii) to calculate the power of the athlete.

**You are advised to show clearly how you get your answer.**

Power = \_\_\_\_\_ W [3]

(d) From the early 20th century until the present day there was a very significant rise in the amount of carbon dioxide gas in the earth's atmosphere, due to increasing use of fossil fuels. This has caused a rise in the average temperature of the atmosphere. This effect is called global warming.

- (i) Explain how a rise in the level of atmospheric carbon dioxide has brought about global warming.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ [3]

Examiner Only	
Marks	Remark



There is increasing interest in the use of renewable energy resources such as solar and wind energy for electricity generation. The major advantage of these energy resources is that they reduce carbon dioxide pollution.

- (ii) State why it would be unwise for a country to generate electricity using solar and wind energy alone.

\_\_\_\_\_ [1]

- (e) The German government intends to close down all its nuclear power stations and build no more. France produces a high proportion of its electricity using uranium and plans to build more nuclear power stations.

- (i) Give **one** reason why a government might want to close down its nuclear power stations and **one** reason why another government might want to build more nuclear power stations.

Reason for closing down \_\_\_\_\_

\_\_\_\_\_

Reason for building more \_\_\_\_\_

\_\_\_\_\_ [2]

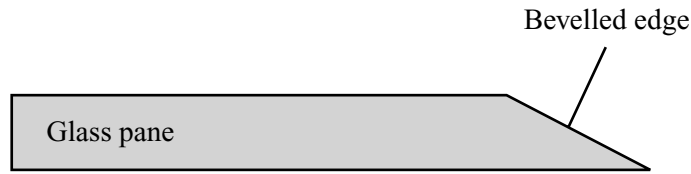
- (ii) At the end of their useful lives, all power stations are decommissioned. Why is decommissioning a nuclear power station particularly expensive?

\_\_\_\_\_ [1]

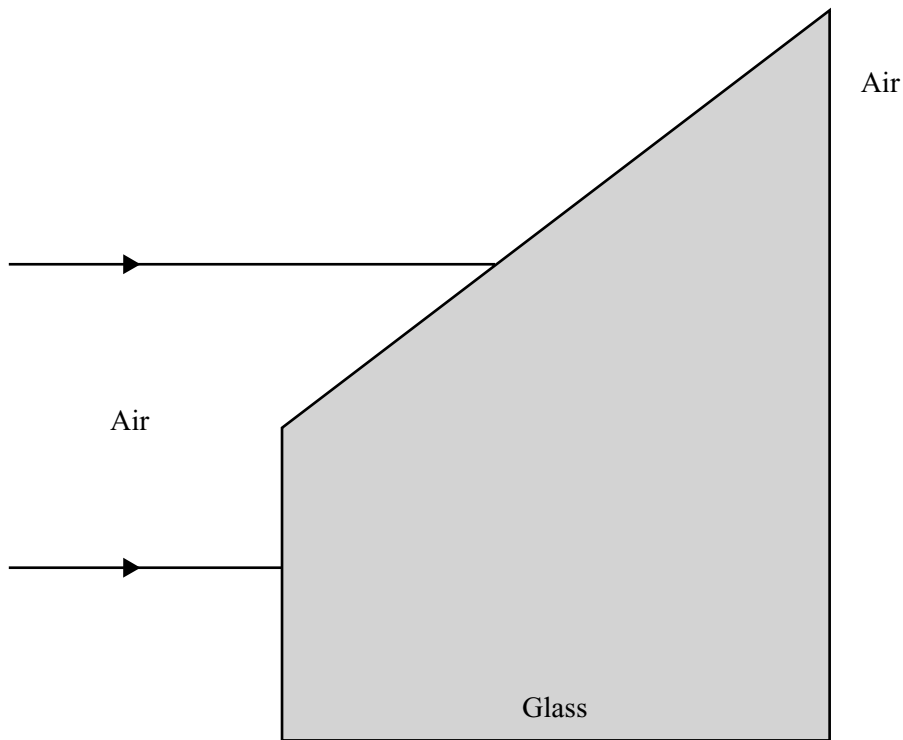
Examiner Only	
Marks	Remark

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- 3 (a) A pane of glass is sometimes bevelled at the edges. The diagram below shows what this means.



The next diagram shows an enlarged view of the pane of glass at its bevelled edge. Two rays of white light are shown striking the glass.



Complete the diagram to show how the bevelled edge of the glass can produce a coloured beam of light, while the main pane of glass produces no colours. Label the rays with appropriate colours. [5]

Examiner Only	
Marks	Remark

(b) (i) What is meant by the diffraction of a wave?

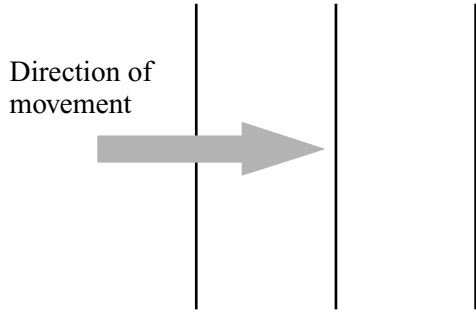
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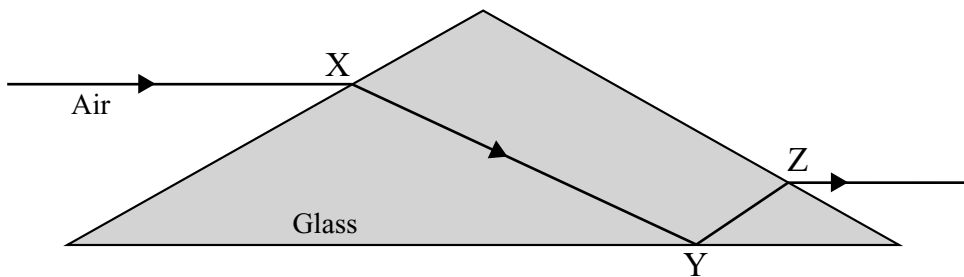
[1]

The diagram below represents wavefronts moving from left to right.



(ii) Complete the diagram by drawing an object in the path of the wavefronts, which would make the wave diffract and show the shape of the wavefronts after they have passed through the object. [2]

(c) The diagram shows the path of a ray of **red** light passing through a glass prism.



(i) Name the process happening to the ray at the point X. [1]

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Examiner Only	
Marks	Remark

- (ii) There is no light emerging from the prism at Y.  
Name the process happening to the light at Y.

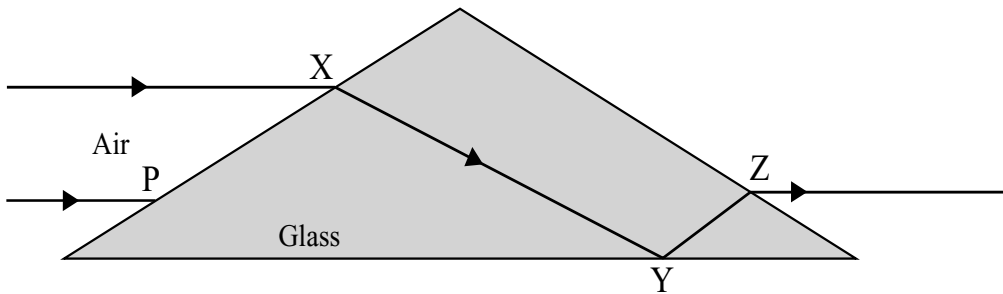
\_\_\_\_\_ [1]

- (iii) How does the speed of light change, if at all, as it passes the point Y and as it passes the point Z?

As it passes Y \_\_\_\_\_

As it passes Z \_\_\_\_\_ [2]

A second ray of **red** light strikes the prism at the point P as shown below.



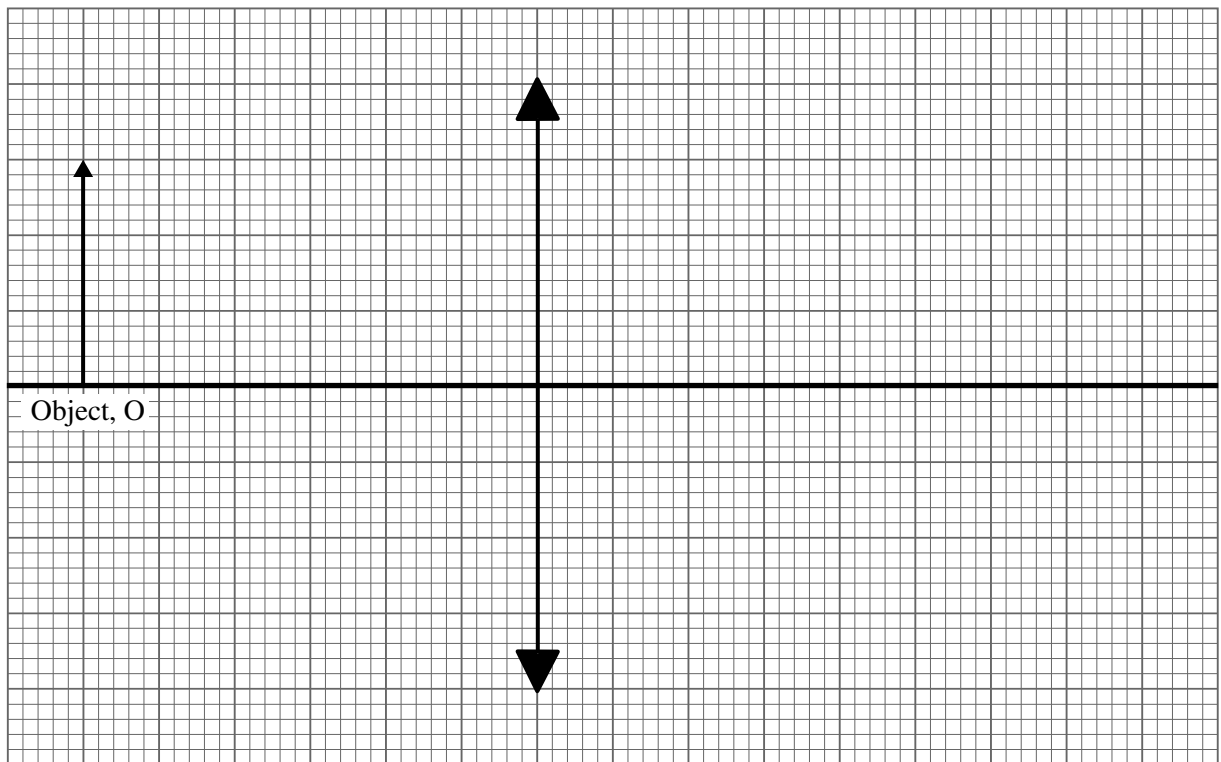
- (iv) On the diagram, using a ruler, continue the path of the second ray through and out of the glass prism. [2]

- (d) A camera lens has a focal length of 2 cm.

- (i) Draw a diagram to illustrate the meaning of this statement. [2]

Examiner Only	
Marks	Remark

This camera is used to photograph an object, O, which is 3.0 cm high and is placed 6.0 cm from the camera lens as shown in the diagram below.



(ii) Mark and label, on the **full scale** diagram, the positions of the two focal points of the lens. [1]

(iii) Using a ruler, draw rays on the diagram to find the position and size of the image. Mark and label the image formed and put arrows on the rays to show their directions. [5]

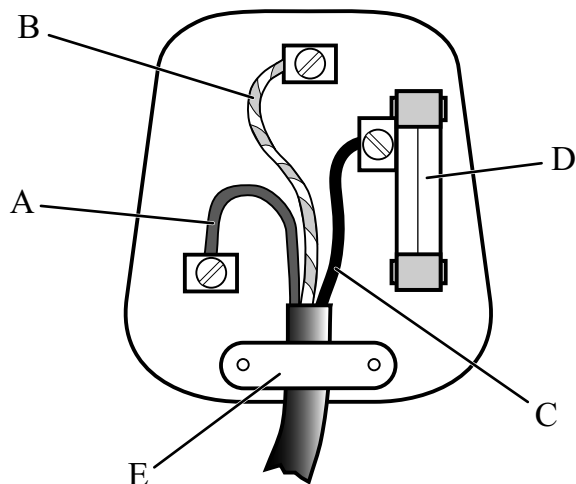
(iv) What type of image is formed in this case?  
 \_\_\_\_\_ [1]

(v) The diagram is full scale. How far from the lens should the film be so as to produce a sharp photograph?  
 Distance of the lens from the film = \_\_\_\_\_ cm [1]

(vi) How tall is the image?  
 Height of the image = \_\_\_\_\_ cm [1]

Examiner Only	
Marks	Remark

- 4 (a) The diagram below shows a fused 13 A plug. Five parts are labelled A, B, C, D and E.



- (i) Complete the table to identify the wires connected to the three pins of the plug.

Wire connected to:	Live pin	Neutral pin	Earth pin
Letter (A, B or C)			

[1]

- (ii) What names are given to the parts labelled D and E?

D \_\_\_\_\_

E \_\_\_\_\_ [2]

A washing machine has a metal frame. A fault occurs so that the live wire connected to the motor is detached and makes contact with the metal frame.

- (iii) Explain fully how the fuse and the earth wire in the plug above **work together** to prevent a person touching the frame being electrocuted.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ [4]

Examiner Only

Marks Remark

- (b) Mrs Henderson is investigating the use of electricity in her home. She reads her electricity meter at the end of the week and records her readings in a table. The difference between the reading at the end of week 2 and the end of week 1 is the number of units used in week 2 and so on.

Below is an incomplete copy of her table.

Week	1	2	3	4	5	6
Meter reading	12143	12270	12399	12556	12681	
		Units used during week 1	Units used during week 2	Units used during week 3	Units used during week 4	Units used during week 5
		127	129		125	144

- (i) Complete the table by entering the numbers in the appropriate boxes. [2]
- (ii) What do the units in the above table measure? Tick (✓) the correct answer below.

Units in the table above measure	Tick (✓) the correct box
Electrical power	
Electrical energy	
Electrical current	

[1]

Electricity costs 11 pence per unit.

- (iii) What is the cost of a kilowatt-hour of electricity? \_\_\_\_\_ [1]

- (iv) Calculate the cost of electricity in Mrs Henderson's home in week 2.

**You are advised to show clearly how you obtain your answer.**

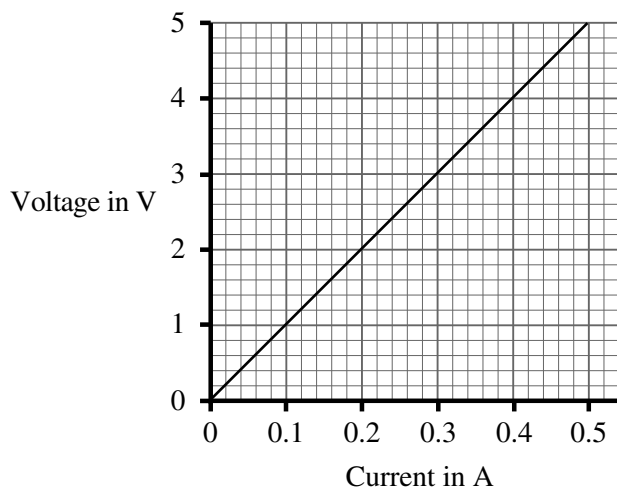
Cost of electricity = £ \_\_\_\_\_ [2]

Examiner Only

Marks Remark



- (c) Desmond carries out an investigation into the relationship between the current flowing in a metal wire and the voltage across it. A graph obtained from Desmond's results is shown below.



- (i) What does this graph show about the relationship between current and voltage for this metal wire?

\_\_\_\_\_ [1]

- (ii) During the experiment Desmond switched off the current between one reading and the next. Why was this necessary?

\_\_\_\_\_ [1]

- (iii) On the same grid, carefully draw the straight line which Desmond would have obtained for a wire of **double** the resistance. [2]

Examiner Only	
Marks	Remark

(d) The resistance of a piece of wire depends on several factors.

Does the resistance of a metal wire:

- (i) increase, decrease or remain the same when its length increases?  
Tick (✓) the correct answer below.

<b>When the length increases, the resistance of a copper wire</b>	<b>Tick (✓) the correct box</b>
increases	
decreases	
remains the same	

[1]

- (ii) increase, decrease or remain the same when its cross section area increases? Tick (✓) the correct answer below.

<b>When the cross section area increases, the resistance of a copper wire</b>	<b>Tick (✓) the correct box</b>
increases	
decreases	
remains the same	

[1]

- (iii) A piece of cotton thread and a copper wire have the same length and cross section area.

Which one of the following statements about them is true?

Tick (✓) the correct answer below.

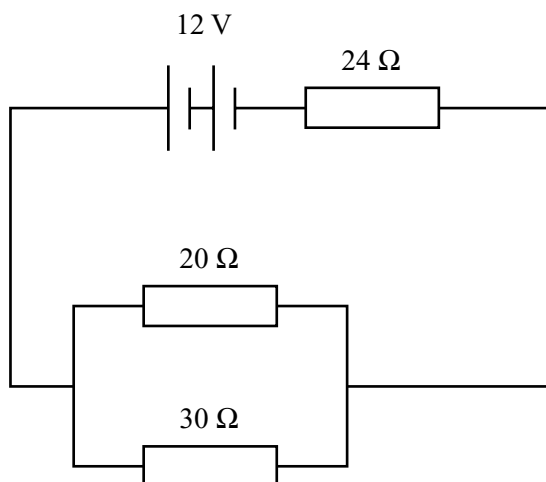
<b>The copper wire's resistance is</b>	<b>Tick (✓) the correct box</b>
bigger than that of the cotton thread	
smaller than that of the cotton thread	
about the same as that of the cotton thread	

[1]

Examiner Only

Marks Remark

- (e) Three resistors are connected to a battery as shown in the circuit below.



- (i) Calculate the total resistance of this circuit.  
**You are advised to show clearly how you get your answer.**

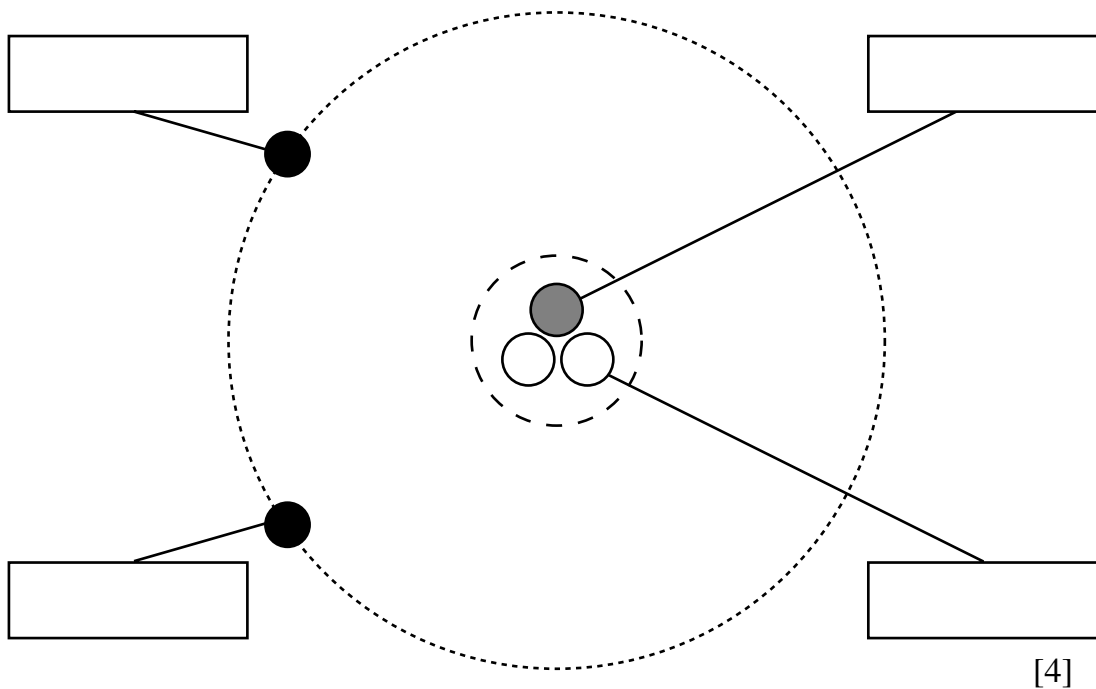
Resistance = \_\_\_\_\_  $\Omega$  [2]

- (ii) Calculate the voltage across the  $24\ \Omega$  resistor.  
**You are advised to show clearly how you get your answer.**

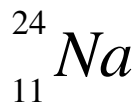
Voltage = \_\_\_\_\_ V [3]

Examiner Only	
Marks	Remark

- 5 (a) The diagram below represents a neutral atom of a helium isotope. Write the names of the particles indicated, in the boxes.



- (b) The nucleus of an atom of an isotope of sodium (chemical symbol Na) is represented as shown below.



(i) What is the mass number of this nucleus? \_\_\_\_\_ [1]

(ii) What information does the mass number give us?

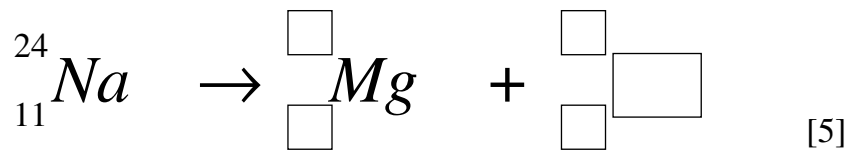
\_\_\_\_\_ [1]  
\_\_\_\_\_

(iii) Sodium has several isotopes. In terms of the particles that make up the nucleus, what do they all have in common?

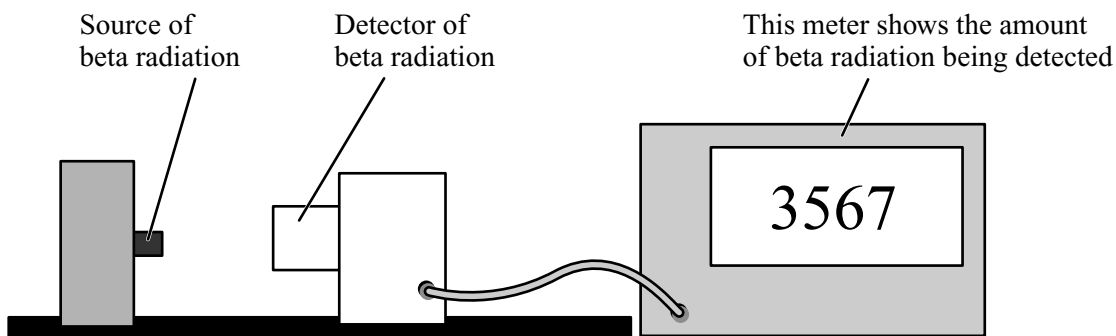
\_\_\_\_\_ [1]

Examiner Only	
Marks	Remark

- (iv) This isotope of sodium is unstable and disintegrates by beta decay. Complete the decay equation for this by writing the appropriate numbers and symbol in the empty boxes.



- (c) A substance, which emits beta radiation, is placed close to a detector as shown below. You are given a number of aluminium squares, each 1 mm thick. The aim of the investigation is to find out what least thickness of aluminium is needed to prevent the beta radiation reaching the detector. This thickness is known as the **range**.



- (i) Describe, briefly, how you would carry out this investigation. How would you know when you have reached the range of beta radiation in aluminium?

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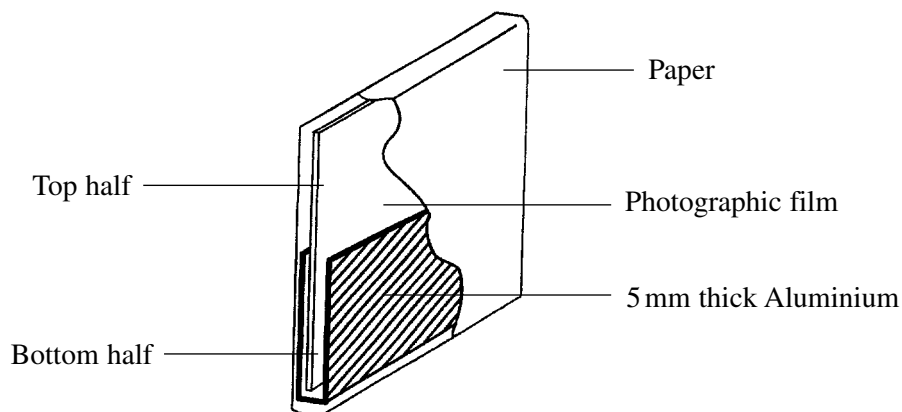
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[3]

Examiner Only

Marks Remark

People who work with radioactive materials wear a small badge. It allows the amount of radiation, to which they have been exposed to be measured. The diagram below shows the structure of the badge.



The photographic film will be affected by any radiation passing through the paper and the aluminium. In a particular instance it was found that the top half of the photographic film was affected by radiation but the bottom half was not.

- (ii) In this instance, was the worker exposed to alpha ( $\alpha$ ) radiation or beta ( $\beta$ ) radiation? Explain your answer.

Type of radiation \_\_\_\_\_

Explanation \_\_\_\_\_

\_\_\_\_\_ [2]

- (iii) If the worker had been exposed to gamma ( $\gamma$ ) radiation, what effect would this have on the photographic film? Explain your answer.

Effect \_\_\_\_\_

\_\_\_\_\_

Explanation \_\_\_\_\_

\_\_\_\_\_ [2]

Examiner Only	
Marks	Remark

(d) (i) State the meaning of half-life of a radioactive substance.

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[1]

The volume of blood in a person's body can be measured using radioactivity. A small quantity of a radioactive substance is injected into the body. After an hour a small sample of blood is taken and its radioactivity is measured. The volume of blood can then be calculated.

(ii) Three radioactive substances are available. One has a half-life of 5 seconds, one has a half-life of 30 minutes and the third has a half-life of 1 year. Which one is best suited to this technique and why?  
Explain, briefly, why the other two are not suitable.

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[4]

Quality of written communication [1]

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**THIS IS THE END OF THE QUESTION PAPER**

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Examiner Only	
Marks	Remark

