Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2013

Science: Physics

Unit P2

Higher Tier

[GPH22]

GPH22

MONDAY 24 JUNE, MORNING

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.
You must answer the questions in the spaces provided. Do not write outside the box, around each page or on blank pages.
Complete in blue or black ink only. **Do not write with a gel pen.**
Answer **all** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 115.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in question **4(a)**.

Examiner Only	
Marks	Remark

1 **(a)** In 60 seconds 15 sea waves pass the end of a pier.

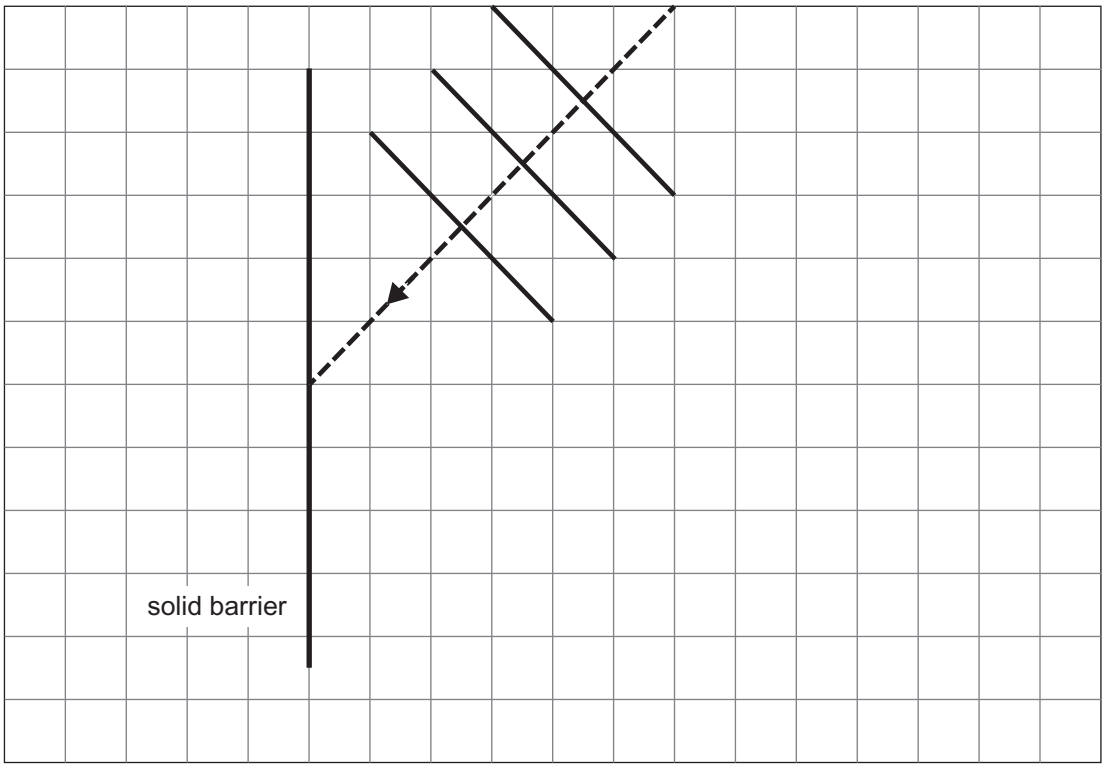
(i) Calculate the frequency of the waves.
You are advised to show clearly how you get your answer.
Remember to provide the unit with your answer.

Frequency = _____ [2]

(ii) The wavelength of the sea waves is 8 m.
Calculate the speed of the waves.
You are advised to show clearly how you get your answer.

Speed = _____ m/s [2]

(b) Below is a diagram showing three wave fronts moving towards a solid barrier.



(i) Complete the diagram to show the reflection of the wave fronts at the barrier.
In your answer you should draw:

- a dotted line with an arrow on it to show the direction of the reflected wave fronts,
- 3 reflected wave fronts. [4]

(ii) Mark on the diagram the wavelength of the incident waves. [1]

(iii) In what way, if at all, do the frequency, wavelength and speed of water waves change when they are reflected? Indicate your answer by placing a tick (✓) in the appropriate boxes.

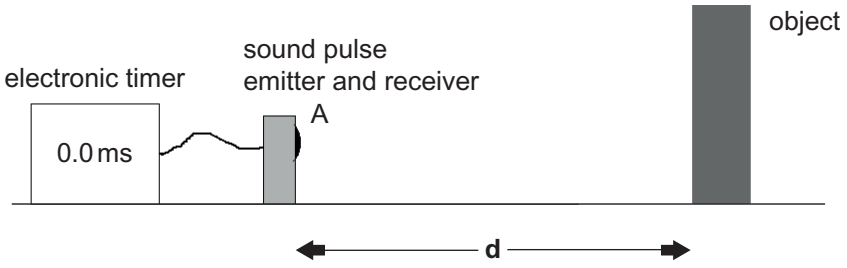
	Increases	Decreases	Unchanged
Frequency			
Speed			
Wavelength			

[3]

Examiner Only

Marks	Remark

(c) To study the reflection of sound from a solid object the apparatus below was used.



A pulse of sound was emitted by the device at A and the time taken for the sound pulse to travel **to the object and back again** (round trip time) was measured.
This was repeated for different distances d.
The results of the investigation are shown in the table below.

Distance d in m	Time for the round trip in ms	Time to travel the distance d in ms
0.2	1.2	
0.4	2.6	
0.6	3.4	
0.8	4.8	
1.0	6.0	

(i) Complete the table above by calculating the time for the pulse of sound to travel the distance d. [1]

(ii) Using the equation below and data from the table calculate the speed of sound.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

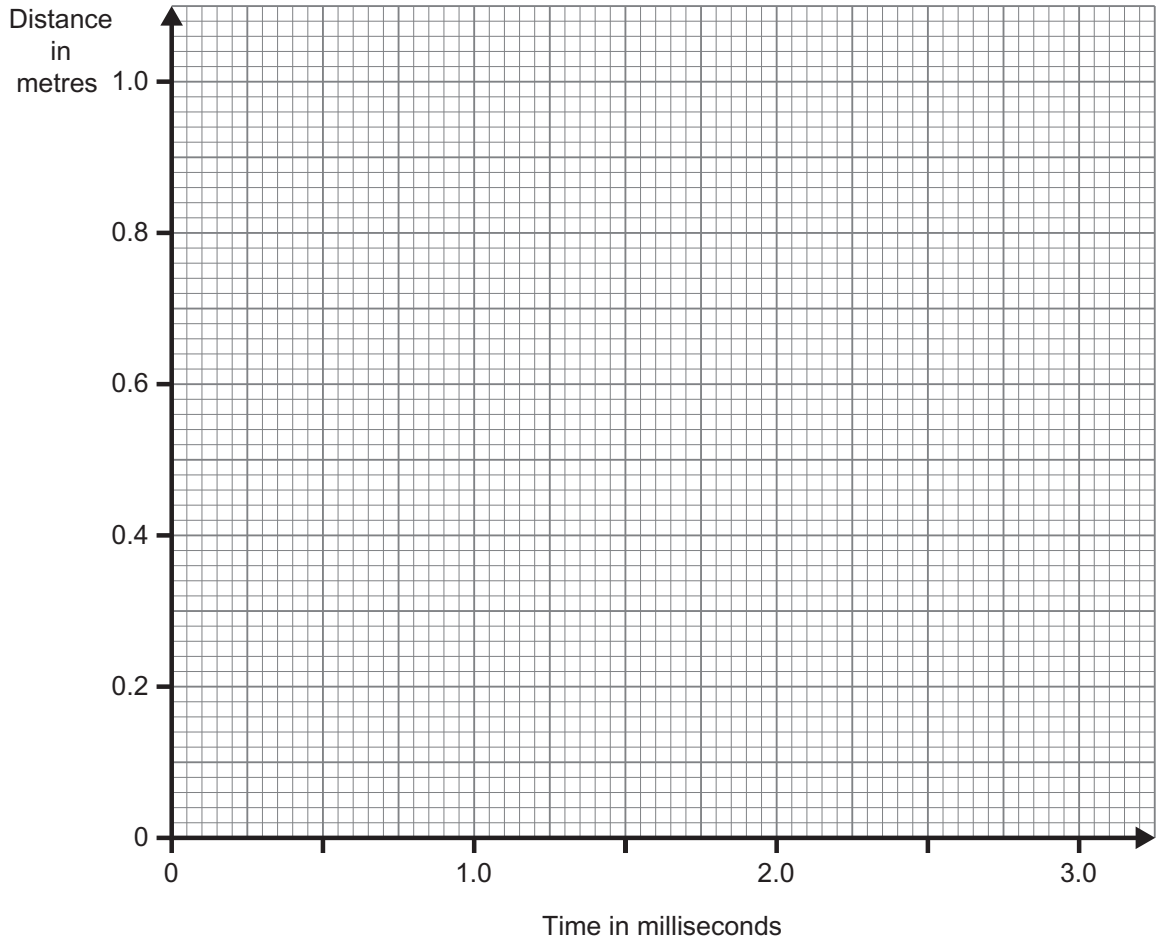
(1 ms = 1 millisecond = 0.001 s)

Speed of sound = _____ m/s [3]

Examiner Only

Marks	Remark

(iii) Using the grid below plot a graph of distance d (*y*-axis) against time to travel the distance d (*x*-axis). Draw a line of best fit through the points. [3]



(iv) The sound emitter was placed at a distance from the object that gave a **round trip** time of 3.0 ms. Using the graph determine the distance d.

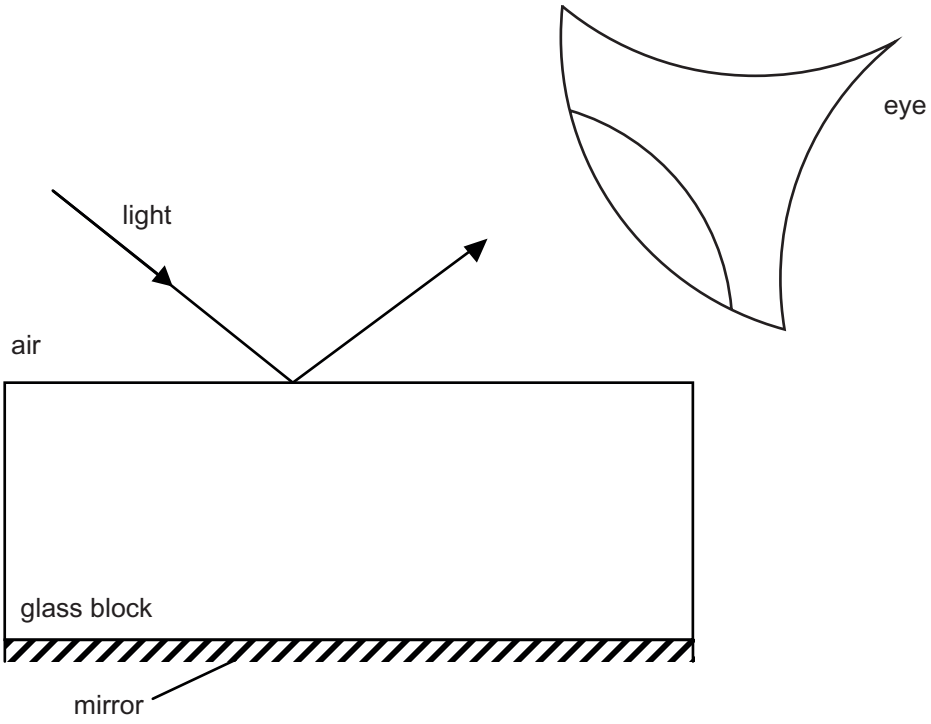
Distance d = _____ m [1]

Examiner Only	
Marks	Remark
Total Question 1	

[Turn over

Examiner Only	
Marks	Remark

2 **(a)** The diagram shows a ray of light incident on a glass block. Some of the light is reflected at the top surface and some of the light passes through the glass and is reflected at the opposite side which has a mirrored surface.



(i) Complete the path of the ray of light through the glass block and back out into the air towards the person viewing it as shown in the diagram. [3]

(ii) State the two conditions required for a ray of light to undergo **total internal reflection** as it moves from one substance to another.

1. _____

_____

2. _____

_____ [2]

Examiner Only	
Marks	Remark

(iii) David was investigating how a ray of light passed through a semicircular glass block. He drew **Diagram 1** below. However he made a number of mistakes.
Using **Diagram 2** draw the correct paths of the two rays that he drew wrongly.

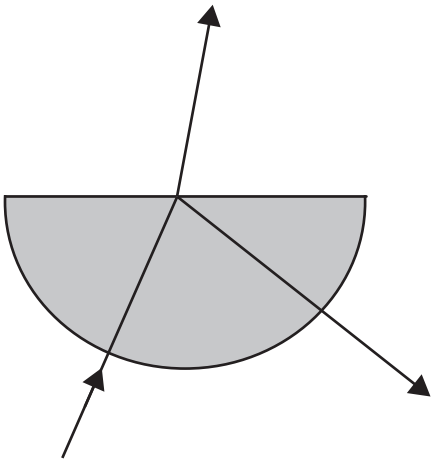


Diagram 1

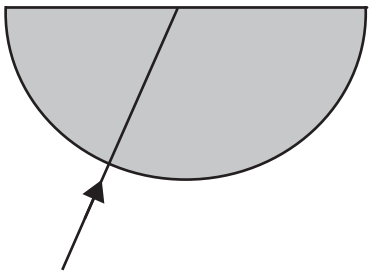
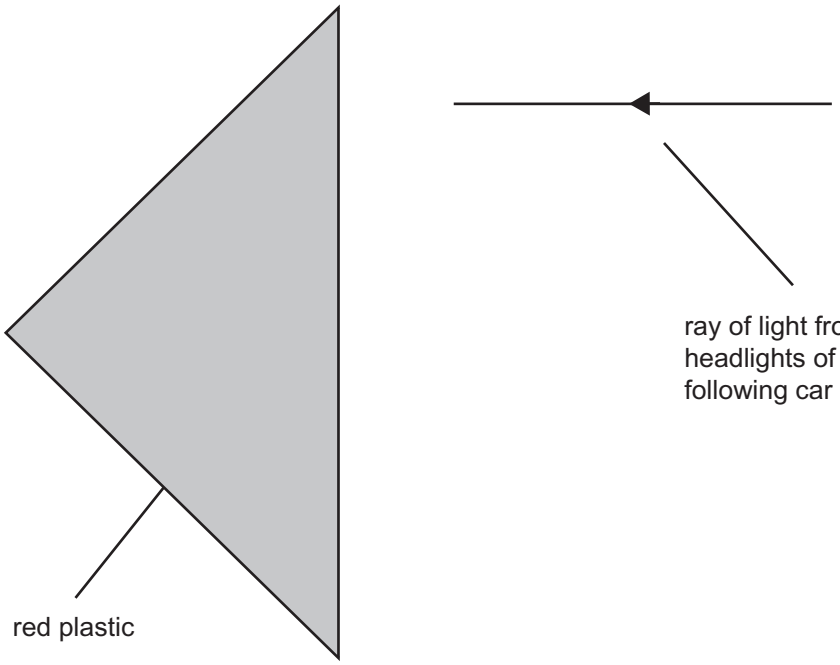


Diagram 2

[2]

(iv) The red reflectors found on cars and bicycles use total internal reflection to allow road users to see the back of another vehicle.
The diagram below shows part of such a reflector.
On the diagram complete the path taken by the ray of light shown.

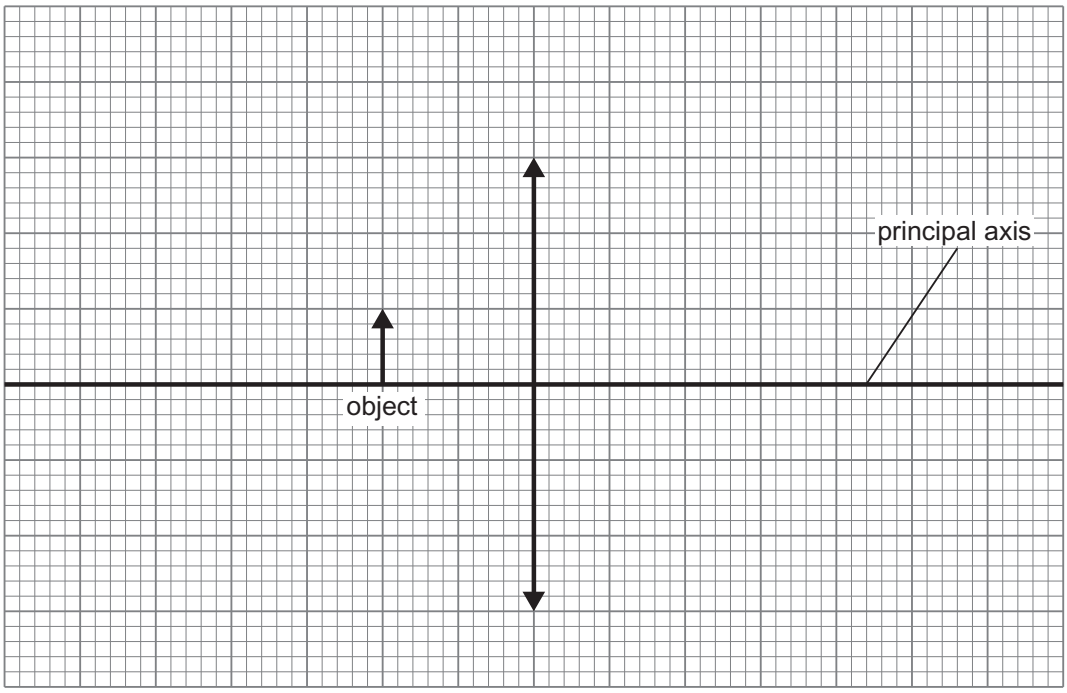


[2]

Examiner Only	
Marks	Remark

(b) The **full scale** diagram below shows a converging lens and an object. **The lens has a focal length of 3 cm.**

Examiner Only	
Marks	Remark



(i) Mark and label with the letter **F** the position of the principal focus (focus) to the right of the lens. [1]

(ii) The lens is being used as a magnifying glass.
Using a ruler, draw **two** rays on the diagram to find the position of the image. **Label the top of the image with the letter I.** [3]

(iii) Place arrows on the rays to show their direction. [1]

(iv) Is this image real or virtual? Explain your answer.

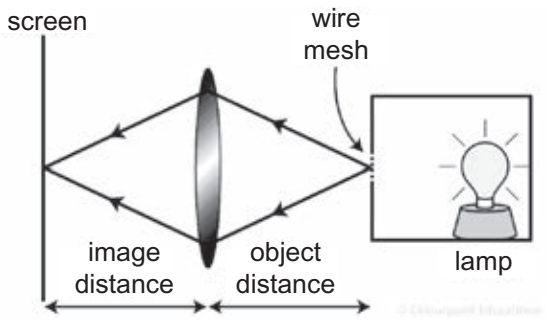
_____

_____ [2]

(v) Mark with the letter **E** the approximate position you should place your eye to view the image. [1]

[Turn over

(c) To investigate the properties of the image formed by a converging lens Mary set up the apparatus shown below. She placed an object at various distances from the lens. The object is a wire mesh illuminated by a lamp. For each distance she then moved the screen until a sharp image of the object was seen on the screen.



Mary measured the height of the object and then she measured the height of the image obtained at the various positions. She calculated the magnification of the image using the formula:

$$\text{Magnification} = \frac{\text{Height of image}}{\text{Height of object}}$$

The table below shows her results.

Object distance in cm	Image distance in cm	Magnification
25	100	4
30	60	2
35	46.7	1.3
40	40	1
45	36	0.8

(i) By examining Mary's measurements deduce another method of calculating the magnification produced by the lens.
Support your answer by showing appropriate calculations.

Magnification =

[2]

(ii) What happens to the size of the image when the object is placed **further** than 40 cm from the lens?

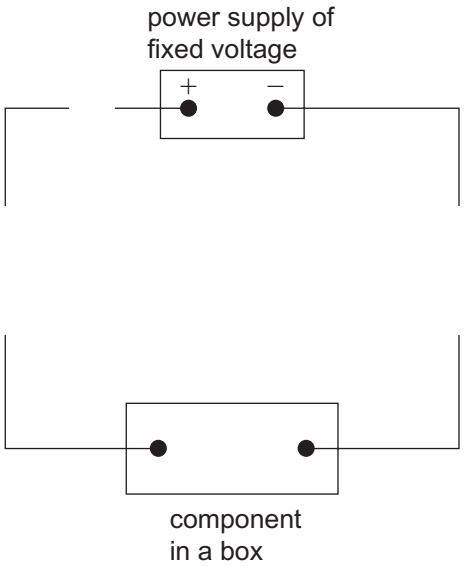
_____ [1]

Examiner Only	
Marks	Remark
Total Question 2	

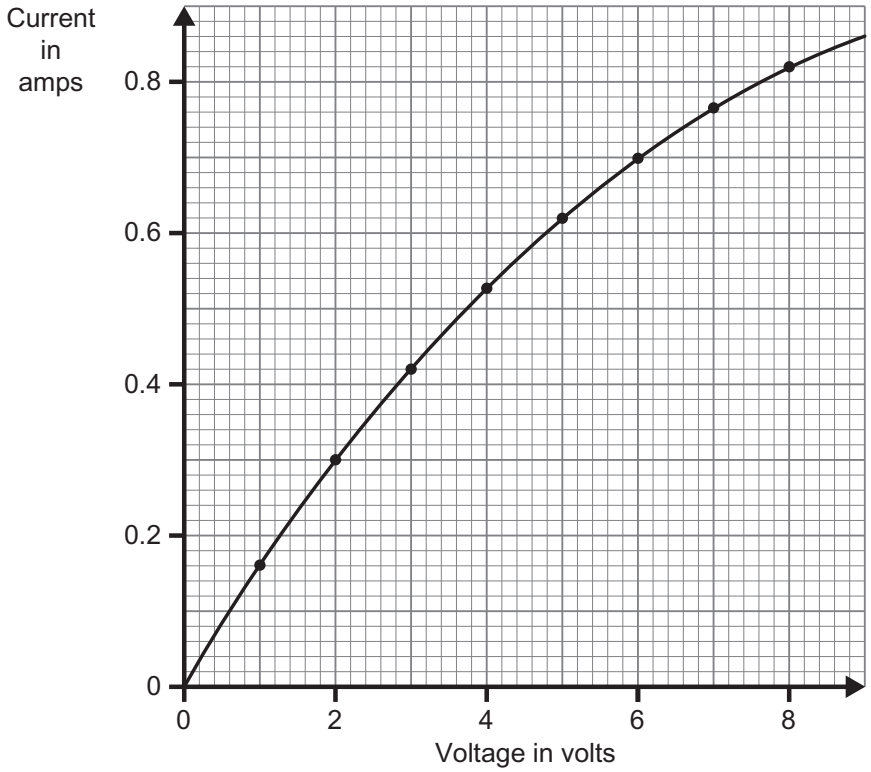
Examiner Only	
Marks	Remark

3 **(a)** Zoe was given a sealed box containing a component that conducts electricity.
Two terminals attached to the box allowed her to connect it to a circuit.
To find out what the component was she decided to investigate how the current passing through the component depended on the voltage across it.

(i) Complete the circuit diagram below by inserting a switch, an ammeter, a voltmeter and a variable resistor that would allow Zoe to obtain a series of values of the voltage and the current. [4]



The results of her investigation are shown in the graph below.



(ii) Using the graph calculate the resistance of the component when the voltage across it is 5 V.

Resistance = _____ Ω [2]

(iii) Is the current proportional to the voltage? Explain your answer.

_____

_____ [2]

(iv) Does the resistance of the component remain constant as the voltage and current are changed? Explain your answer.

_____

_____ [2]

(v) What type of component is inside the box?

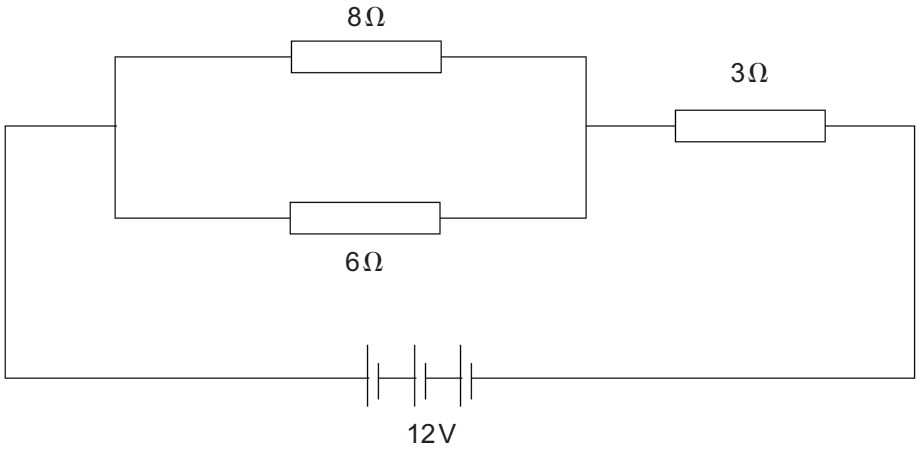
_____ [1]

Examiner Only	
Marks	Remark

[Turn over

(b) The circuit below contains a number of resistors.

Examiner Only	
Marks	Remark



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

Total resistance = _____ Ω [3]

(ii) Calculate the current flowing in the $3\,\Omega$ resistor.
You are advised to show clearly how you get your answer.

Examiner Only	
Marks	Remark

Current = _____ A [2]

[Turn over

(c) Jack rubs a plastic comb on his jacket sleeve and it gains a negative electrical charge. He then uses the comb to pick up small pieces of paper as shown in the photograph.

© C. Norman Young Jr., The Science Notebook

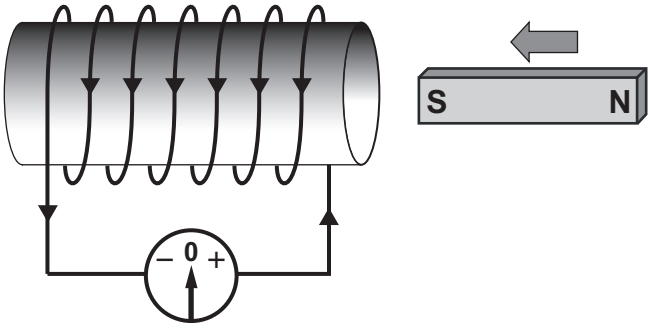
Explain, in detail, how the comb acquires a negative charge and how it is able to pick up small pieces of paper. Remember the pieces of paper are **not** electrically charged.

[4]

Examiner Only	
Marks	Remark
Total Question 3	

Examiner Only	
Marks	Remark

4 **(a)** The diagram below shows a bar magnet and a coil of wire. The coil of wire is connected to a sensitive ammeter which reads zero when the pointer is in the middle.



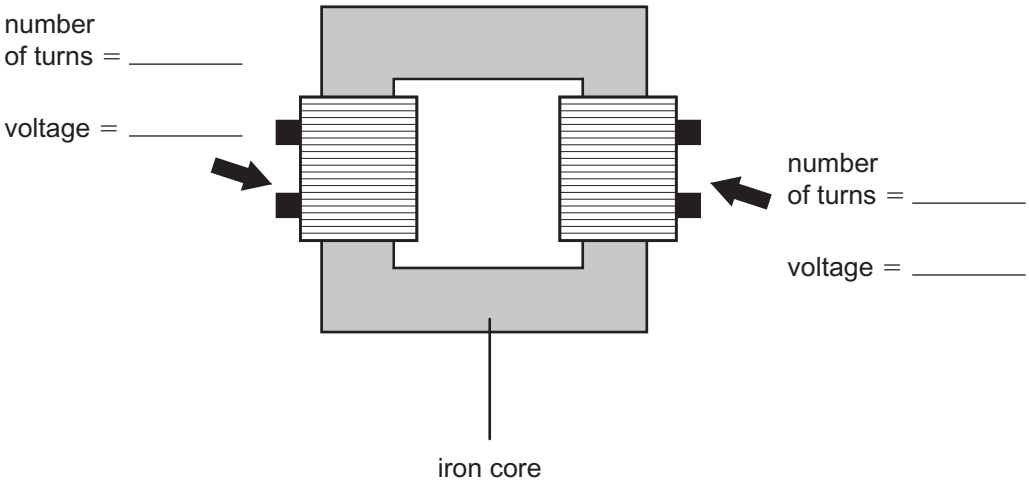
Describe, carefully, what is observed when the magnet is moved **slowly** into the coil from the right, held there **stationary** for a few seconds before being removed **quickly** again to the right.

In this question you will be assessed on your written communication skills including the use of specialist science terms.

[6]

Examiner Only	
Marks	Remark

(b) A transformer has two coils, one of 100 turns and the other of 400 turns. The transformer is required to change the input voltage from 6 V to 24 V.



(i) Label the diagram with the number of turns on each coil and indicate **clearly** to which of the coils the 6 V and the 24 V should be connected. [2]

(ii) Complete the table below by identifying the type of voltage, alternating a.c. or direct d.c. Tick (✓) the correct box.

	a.c.	**d.c.**
6 V input voltage		
24 V output voltage		

[2]

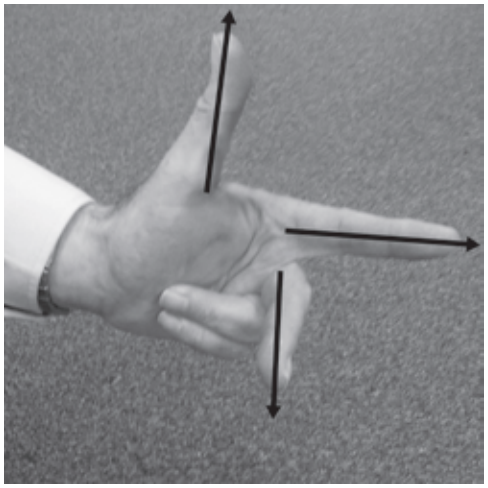
(iii) Power stations in Northern Ireland generate electricity at a voltage of 25 kV.
It is then stepped up to 115 kV before it is connected to the overhead transmission cables.
Explain fully why this is done.

_____

_____ [2]

(c) Fleming's Left Hand rule is illustrated in the diagram below.

Examiner Only	
Marks	Remark



© K Henderson / CCEA

(i) Label each arrow with the quantity it represents. [3]

The diagram below shows a wire carrying a current.
The wire is placed between the poles of a magnet.

© Photodisc / Thinkstock

(ii) In what direction does the wire experience a force due to the current?

_____ [1]

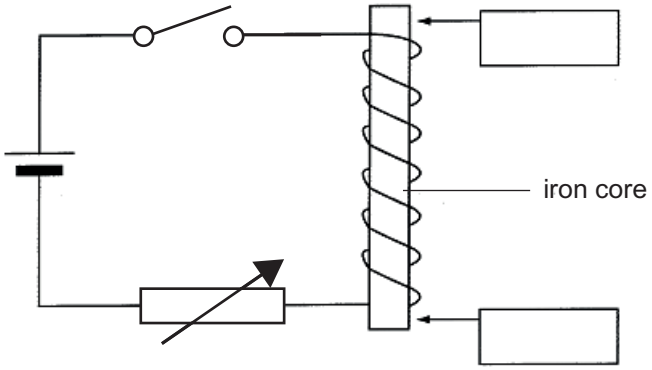
(iii) Describe how the force would change, if the current used was alternating (a.c.).

_____

_____ [1]

[Turn over

(d) To investigate the strength of the magnetic field produced by the current in a coil, Gail set up the apparatus shown below.



(i) Gail closes the switch. What should she now do to change the current in the coil?

_____

_____ [1]

(ii) On the diagram, in the boxes provided, mark the polarity of the magnetic field produced when a current flows in the coil. [1]

(iii) The iron core is replaced by a wooden rod.
What effect does this have on the strength of the magnetic field?

_____

_____ [1]

Examiner Only	
Marks	Remark
Total Question 4	

Examiner Only	
Marks	Remark

5 **(a)** **(i)** What two elements are the main constituents of stars?

_____ [1]

(ii) Name the process responsible for energy production in stars.

_____ [1]

(iii) Stars continue to produce energy for a very long time.
What two forces are in balance to maintain their stability?

_____

_____ [1]

(b) Describe and explain, briefly, the **nebular model** for the formation of the solar system. In your answer you should give **one** piece of evidence that supports the model.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [4]

[Turn over

Examiner Only	
Marks	Remark

(c) Read the paragraph below.

With a traditional optical telescope, the space between the stars and galaxies is completely dark. A radio telescope detects radio waves coming from space. A very sensitive radio telescope can detect a faint signal, coming from all directions, that is not associated with any star, galaxy, or other object.

Source: Wikipedia (amended).

(i) What name is given to the faint signal referred to in the passage above?

_____ [1]

(ii) What is the explanation put forward by astronomers to explain this faint signal?

_____

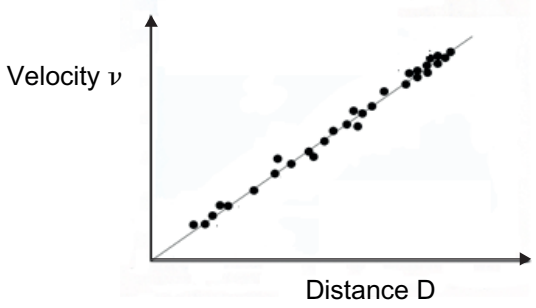
_____ [1]

(d) **(i)** Galaxies are moving apart. What observation provides information for this conclusion?

_____

_____ [1]

Each dot on the graph below represents a galaxy. The distance D from our galaxy (Milky Way) to each galaxy is plotted on the *x*-axis and the velocity v with which the galaxy is moving away is plotted on the *y*-axis.



(ii) Describe what this graph tells us about the motion of the galaxies.

Examiner Only	
Marks	Remark

_____

_____ [2]

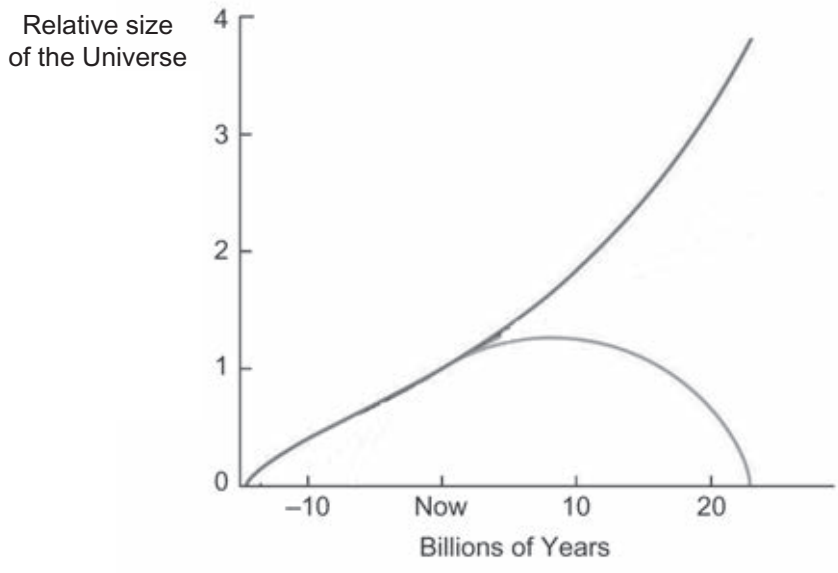
The distance to galaxies is measured in light years.
The relationship between the velocity v and the distance D is known as Hubble's Law and is written in the form $v = HD$.
The velocity v is measured in km/s and the distance D in millions of light years.
H is a constant known as Hubble's constant and its value is 25 km/s per million light years.

(iii) The Hercules galaxy is 670 million light years from the Milky Way. Calculate the velocity at which this galaxy is moving away from us.

Velocity = _____ km/s [2]

[Turn over

(e) The final fate of the Universe is not really known.
The graph below shows two possible fates for the Universe, the Big Freeze and the Big Crunch.



(i) On the graph label which curve corresponds to each of these possible fates. [2]

(ii) Many astronomers believe that the final fate of the Universe will be the "Big Freeze".
What is meant by the term Big Freeze?

_____

_____

_____ [2]

(iii) What force plays an important role in the Big Crunch model and how does it bring about the Big Crunch?

_____

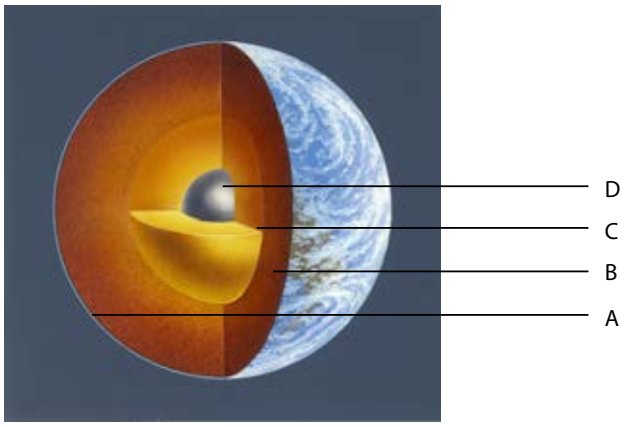
_____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 5	

Examiner Only	
Marks	Remark

6 **(a)** The Earth is made up of a number of layers. **Diagram A** below shows the main four layers.



© David A Hardy / Science Photo Library

Diagram A

(i) Complete the table below.

	Name of layer	Solid or Liquid	Composition
A			
B			
C	Outer core	Liquid	Nickel and Iron
D	Inner core		

[6]

[Turn over

Diagram B below is a map of the Earth. The dots show the location of Earthquakes and Volcanoes.

Examiner Only	
Marks	Remark

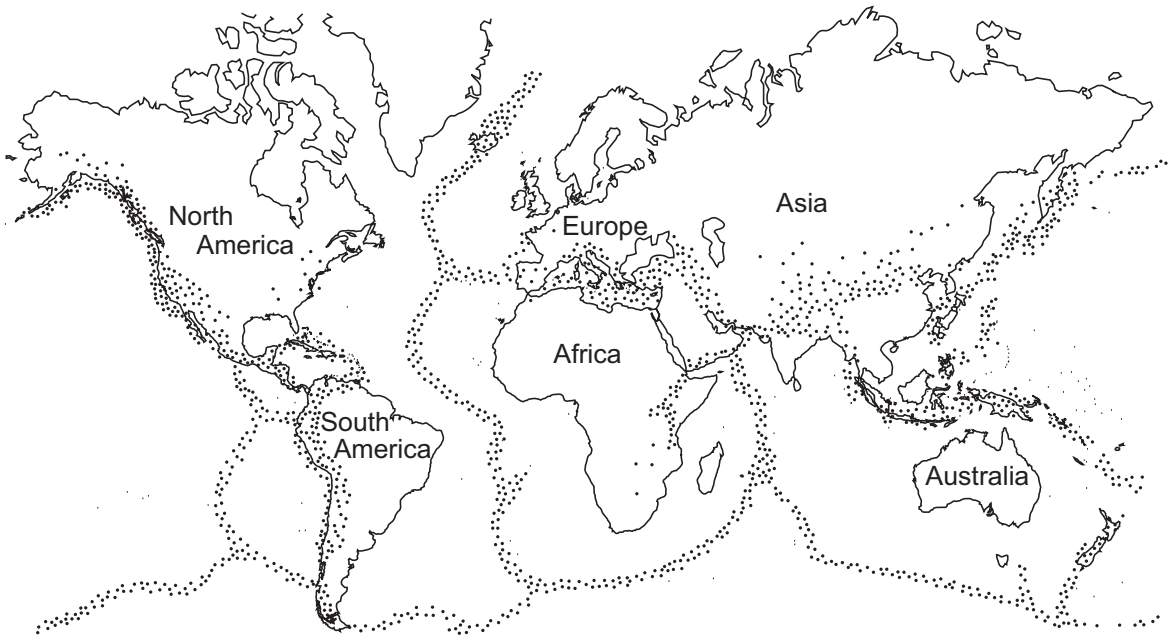


Diagram B

(ii) What does **Diagram B** suggest about the structure of the topmost layer of the Earth?

_____

_____

_____ [1]

(iii) How does the structure of the Earth suggested by **Diagram B** explain **earthquakes**?

_____

_____

_____

_____

_____ [3]

(iv) How are **volcanoes** explained by this structure of the Earth?

_____

_____

_____

_____

_____ [3]

(b) **Diagram 1** below shows how the continents might have looked many millions of years ago.
Diagram 2 below shows how they look today.

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Diagram 1

© Hemera / Thinkstock

Diagram 2

Describe the process which brought about this change.

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 6	

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Question Number	**Marks**
1	
2	
3	
4	
5	
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Total Marks	

Examiner Number