Rewarding Learning

**General Certificate of Secondary Education
2015**

GCSE: Physics

Unit 2

Higher Tier

[GPH22]   *GPH22*

FRIDAY 19 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 boxed area on each page or on blank pages.
Complete in blue or black ink only. **Do not write with a gel pen.**
Answer **all six** 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 **1(b)** and question **3(a)(ii)**.

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1 (a) A student was asked to state a property of electromagnetic waves and gave the answer below.

> "*All electromagnetic waves are longitudinal waves and travel at the same speed in a vacuum.*"

(i) What is wrong with this statement?

_____

_____

_____ [1]

Visible light is a member of the electromagnetic wave family.

(ii) Name two other members of the electromagnetic wave family.
One should have a wavelength **longer** than visible light and one should have a wavelength **shorter** than visible light.
Give a use for each electromagnetic wave.

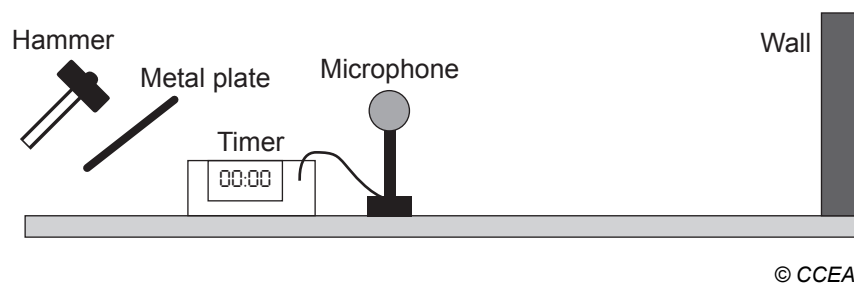| Wavelength **longer** than visible light	Wavelength **shorter** than visible light
Name	Name
Use	Use

[4]

[Turn over

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(iii) Green light has a frequency 5.5×10^{14} Hz.
The speed of light is 3.0×10^8 m/s.
Calculate the wavelength of green light.

You are advised to show clearly how you get your answer.
**Remember to include a unit with your answer.**

Wavelength = _____ [4]

(b) To measure the speed of sound the following experiment is carried out.
A single sound is made by striking a metal plate with a hammer as shown below.
The microphone is connected to an electronic timer. When the sound first
reaches the microphone the timer starts and it stops when the sound next
reaches the microphone.

© CCEA

Describe the path taken by the sound made by the hammer striking the metal plate.
State the measurements that must be taken and how the speed of sound can be calculated from these measurements.
You should also state what must be done to obtain a more reliable result for the speed of sound.

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

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_____ [6]

(c) The speed of sound in air varies with the temperature of the air.
This variation is shown in the graph below.
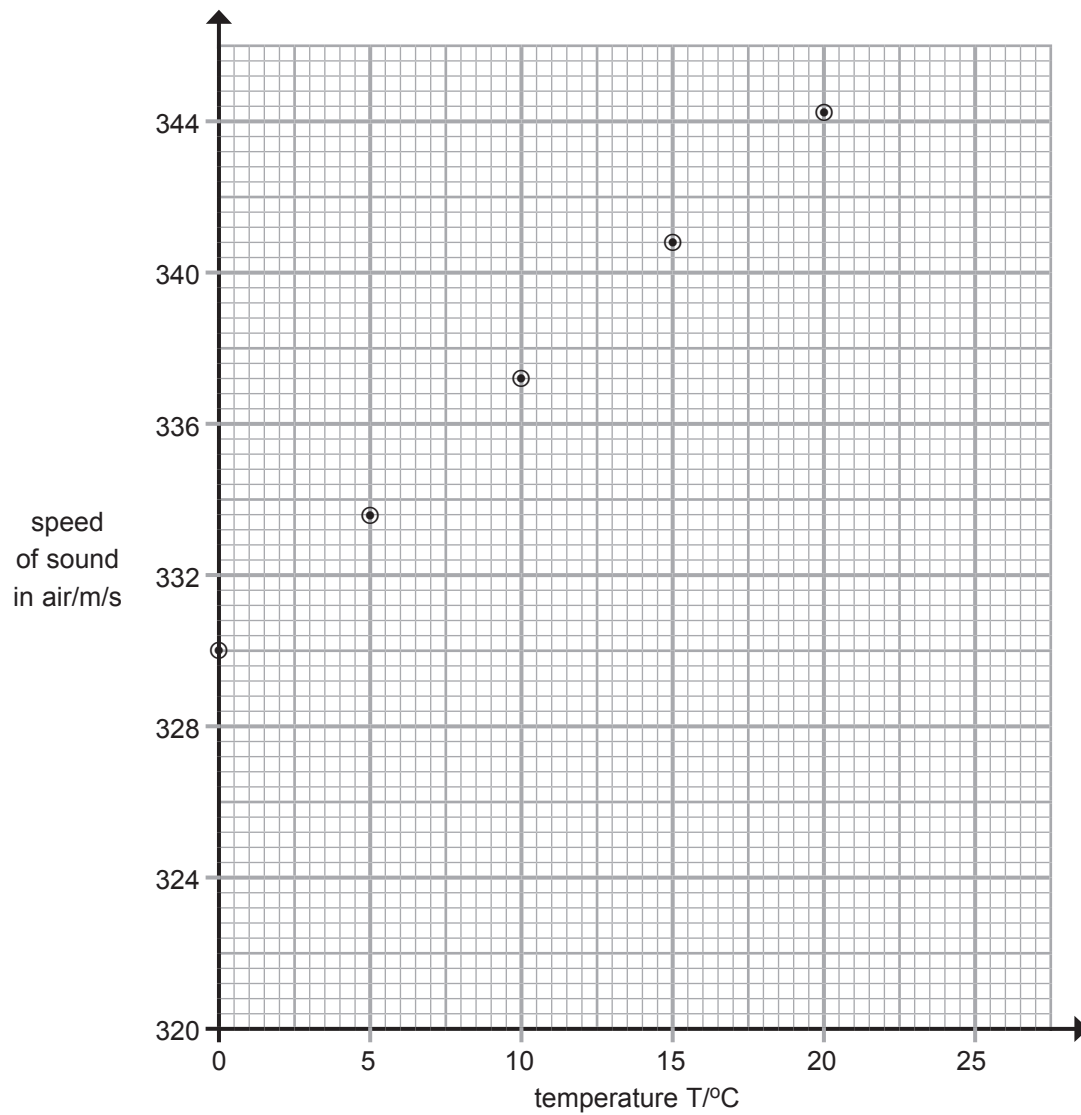
(i) Draw the line of best fit through the plotted points. [1]

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(ii) Is the speed of sound directly proportional to the temperature?
Explain your answer.

_____

_____

_____

_____ [1]

(iii) Using your graph determine the speed of sound at 18 °C.

Speed of sound = _____ m/s [1]

The relationship between the speed of sound **V** and the temperature **T** is given
by the equation

$$V = A + BT$$

A and **B** are constants and **T** is the temperature in °C.

(iv) Using the graph, what is the value of the constant **A**?

A = _____ m/s [1]

(v) What is the physical meaning of the constant **A**?
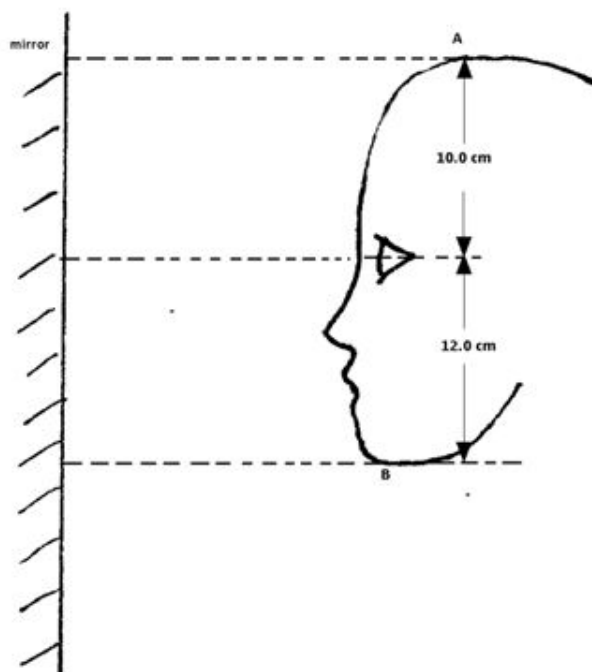
_____

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_____ [1]

[Turn over

2 **(a)** The diagram shows a girl standing in front of a vertical plane mirror. To see all of her face she does not require a mirror the length of the one shown.


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On the diagram draw, **carefully and accurately**, rays of light that show she is able to see the top of her head A and her chin B using a mirror of minimum length and state what this minimum length is.

Minimum length of mirror = _____ cm [4]

(b) Rainbows are a common sight when the sun shines following a rain shower. Water droplets in the atmosphere are responsible for the colours seen. At X the sunlight is separated into many colours. The diagram shows only the red and violet light rays.
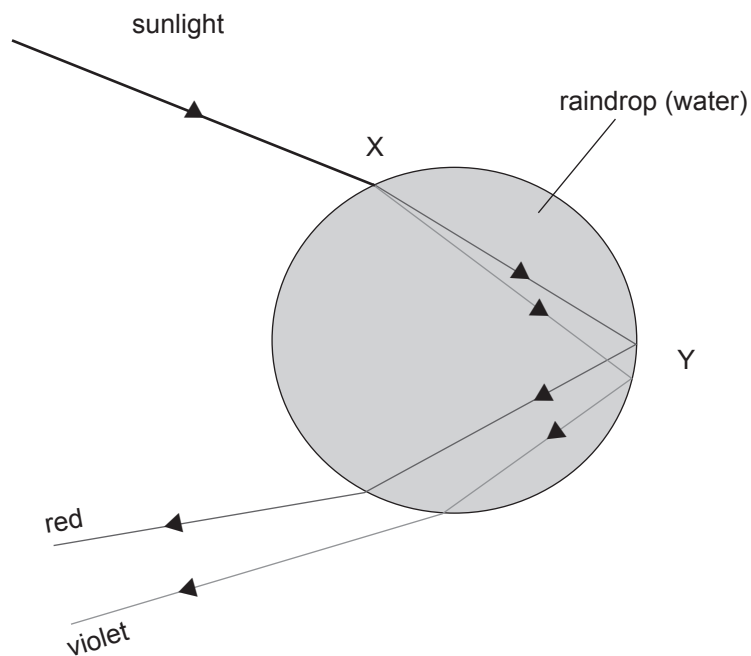
(i) What is this effect called?
State **briefly** why it happens.

_____

_____

_____ [2]

(ii) At Y **no light** emerges from the raindrop.
State what this effect is called and state briefly why it happens.

_____

_____

_____ [2]
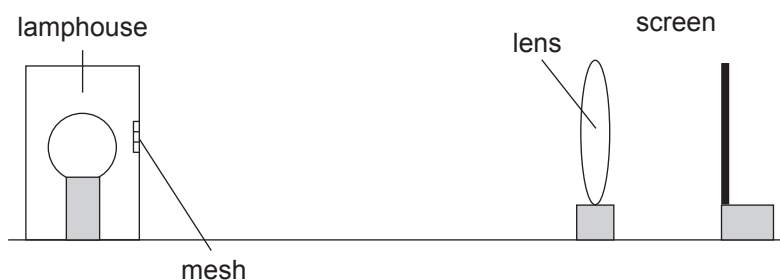
[Turn over

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(c) To measure the focal length of a converging lens a student set up the apparatus shown below.

lamphouse   screen
                                     lens

mesh

© CCEA

The lamphouse with the mesh is used as the object.
She placed the object 20 cm from the lens and moved the screen until she produced a sharp image on the screen.

(i) The distance between the lens and screen is **not** the focal length. Explain why.

_____

_____ [1]

She placed the object at greater and greater distances from the lens. The graph opposite shows her results.

(ii) What value for the focal length of the lens does the graph suggest? Explain your answer.

Focal length = _____ cm

Explanation _____

_____

_____

_____

_____ [3]

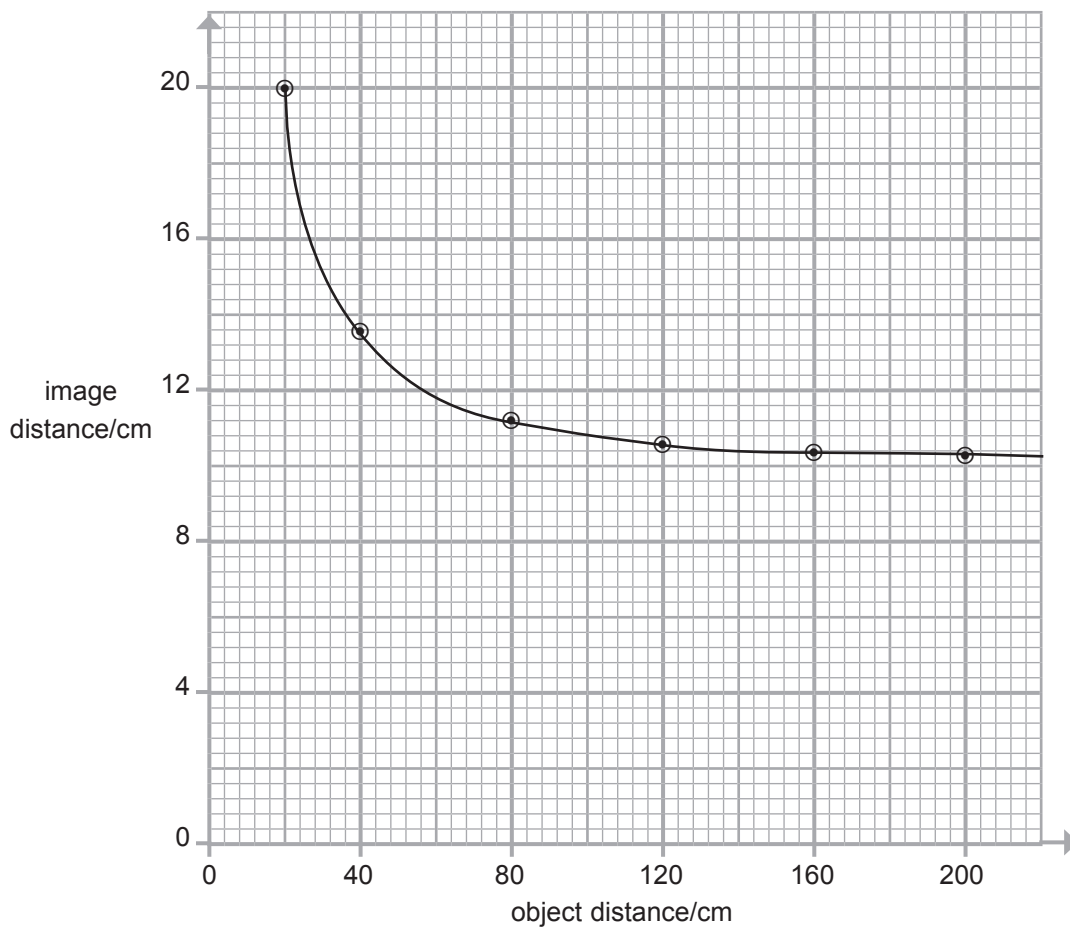9309

The image formed on the screen can be different in size compared to the object. The magnification of the image is defined by

$$\text{magnification} = \frac{\text{size of image}}{\text{size of object}} \quad \text{or} \quad \frac{\text{image distance}}{\text{object distance}}$$

(iii) Using the graph determine the position of the object when it is the same size as the image.

_____ cm [1]

(iv) For object distances greater than 20 cm, what does the graph tell us about the size of the image compared to the size of the object?
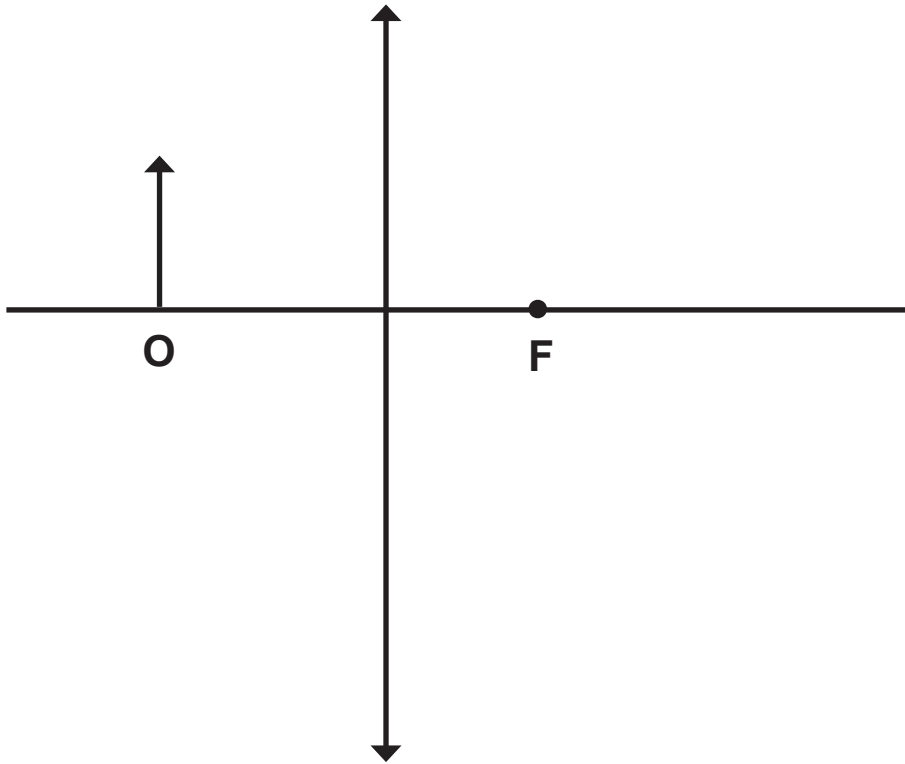
_____ [1]

[Turn over

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(d) A converging lens is used to produce an image that is magnified and real.

    (i) Complete the ray diagram to show how this is achieved. The principal focus has been marked **F** and the object has been marked **O**.

                                                      [3]

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

  (iii) Apart from being real and magnified what else describes the image? The position of the image is **not** what is required.

                                                          [1]

  (iv) State one application of the lens used in this way.

                                                          [1]

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(Questions continue overleaf)

3 **(a)** **(i)** Draw a **circuit diagram** showing the apparatus you would set up to obtain the current–voltage characteristic (I–V graph) for a filament lamp.

Use the correct circuit symbols.

[4]

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(ii) Describe in detail how you would carry out this experiment. In your answer you should explain what is done to obtain a series of measurements of current and voltage.

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

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_____ [6]

[Turn over

The graph below shows how the resistance of the filament inside the lamp changes with temperature.
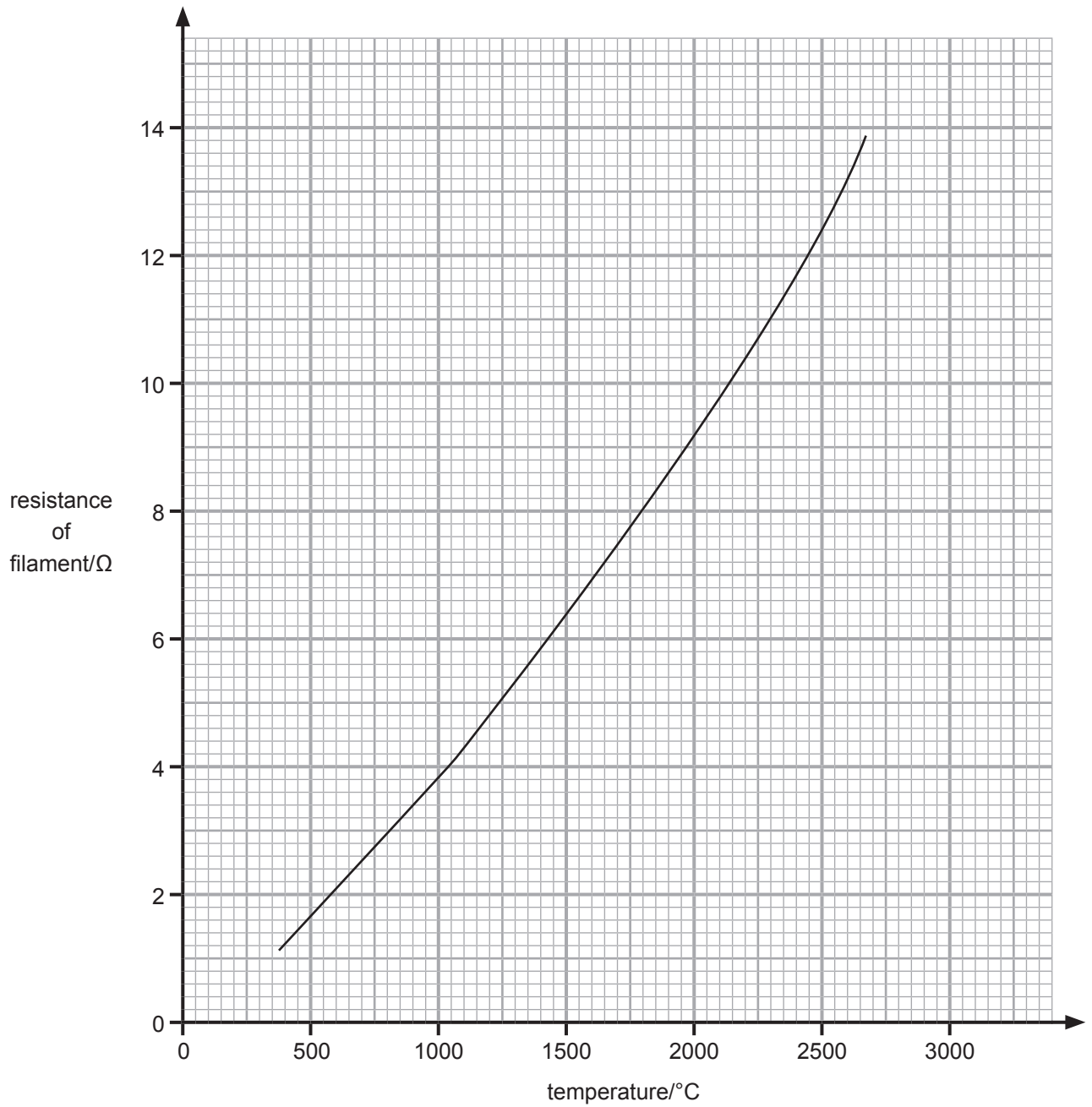
(iii) Use the graph to find the temperature of the filament when the voltage across it is **1.2 V** and the current flowing through it is **0.2 A**.

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

Temperature = _____ °C [3]

[Turn over

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(b) The photograph shows a solar panel on the roof of a house. This is made up of a number of photocells. The photocells produce electricity directly from sunlight.
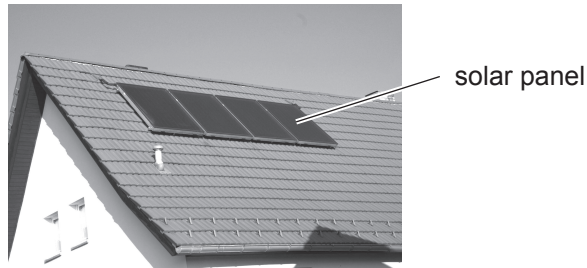
© Zoonar RF/ Thinkstock

The information below is part of the manufacturer's specification of a single photocell.

Peak voltage	0.75 V
Peak current	420 mA
Area of photocell	18 cm²

Each photocell behaves like a tiny battery.
The solar panel consists of many photocells and produces an output of **240 V**.

(i) In what way are the photocells connected electrically to produce an output of **240 V**?

_____ [1]

(ii) By first finding the number of photocells needed to produce a peak voltage of **240 V**, calculate the minimum area of this solar panel. Give your answer in cm².

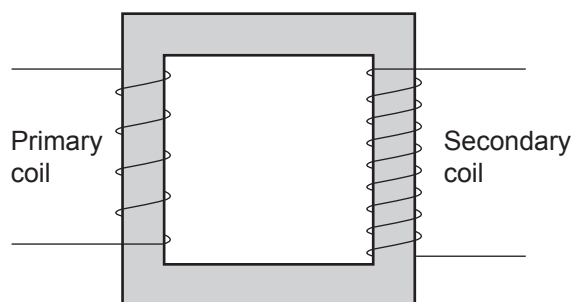Minimum area of panel = _____ cm² [3]

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(iii) In the brightest conditions each solar panel can produce **100 W** of electrical power. Calculate the area of the roof which must be covered with solar panels if the total output power is to be **3.2 kW**.

Give your answer in m^2.

Remember 1 m^2 is an area measuring 100 cm $\times$ 100 cm.

Area = _____ m^2 [3]

4 **(a)** The diagram below represents a transformer.

(i) From what material is the core of the transformer made?
Tick (✓) the correct box.

Copper ☐   Iron ☐   Plastic ☐   Steel ☐   [1]

(ii) Complete the sentences below about transformers.

1. A _____ transformer gives a higher voltage at the secondary coil than at the primary coil.

2. The purpose of the core is to increase the _____.

3. In an electricity transmission system, there is a _____ transformer between the generator and the grid. This transformer allows the power to be transmitted at a lower current and therefore reduces the amount of _____ lost in the power lines.

[4]

A transformer has 200 turns in its primary coil.
The power supplied to the primary coil is 720 W.
The voltage across the primary coil is 240 V.
The current in the secondary coil is 0.05 A.
Assume the transformer has an efficiency of 100%.

(iii) Show that the voltage across the secondary coil is 14 400 V.

[3]

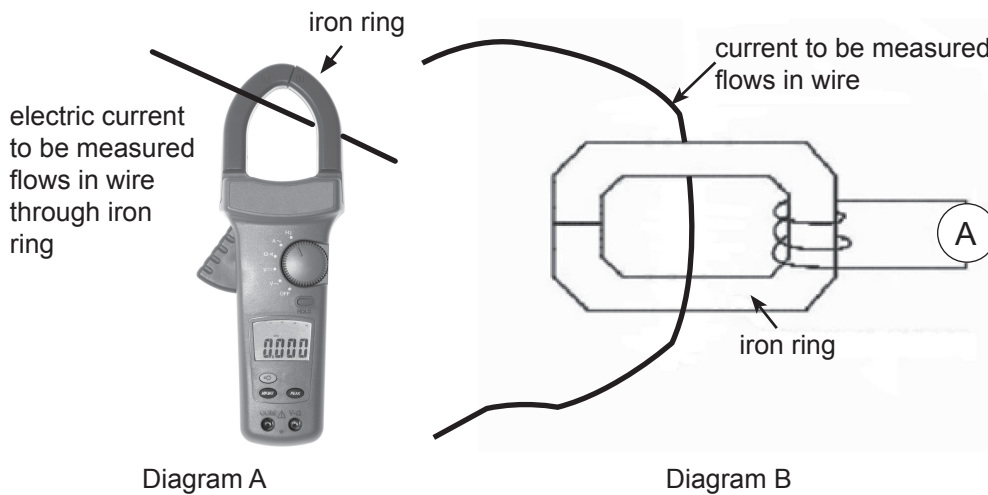**(iv)** Calculate the number of turns in the secondary coil.

You are advised to show clearly how you get your answer

Number of turns = _____ [3]

(b) A clamping ammeter, such as that shown below, is a device which measures electrical current. It consists of an iron ring that can be opened and closed around a current carrying wire as shown in diagram A. A coil wound on the ring is connected to a meter as shown in diagram B.

iron ring

electric current to be measured flows in wire through iron ring

current to be measured flows in wire

A

iron ring

Diagram A

Diagram B

© Zoonar RF/ Thinkstock

(i) Explain why this type of ammeter will not work if a steady d.c. is flowing in the wire under test, but will work with a.c.

_____

_____

_____

_____ [2]

(ii) Suggest an advantage this type of ammeter might have over the ammeters found in school laboratories.

_____

_____

_____ [1]

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(iii) What would be the effect on the reading on the meter if the current carrying wire is wrapped several times around the iron ring?
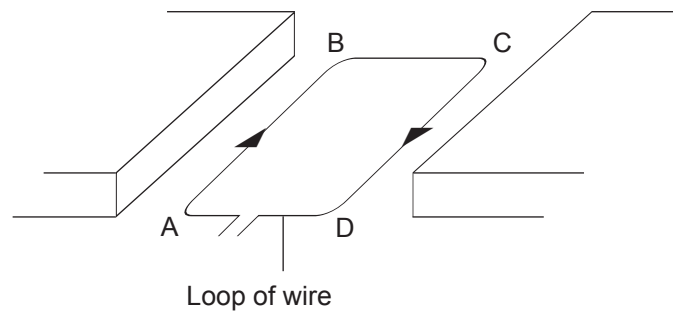
_____

_____

_____ **[1]**

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(c) The diagram below shows a loop of wire placed between the poles of a magnet. An electric current flows in the loop in the direction shown. As a result of this some parts of the loop may experience a force.

Loop of wire

The magnetic field acts horizontally **from right to left**.

(i) Mark on the diagram above the north and south poles of the magnet. [1]

(ii) Use Fleming's Left Hand Rule to complete the table below to show which sections of the wire loop experience a force and the directions in which the forces act.

Section of the loop	Force acting? Yes or No	Direction of the force, if any
AB		
BC		
CD		

[3]

(iii) A student reverses both the direction of the current in the loop and the polarity of the magnet. What effect, if any, will these **combined** changes have on the direction of the forces on the loop?
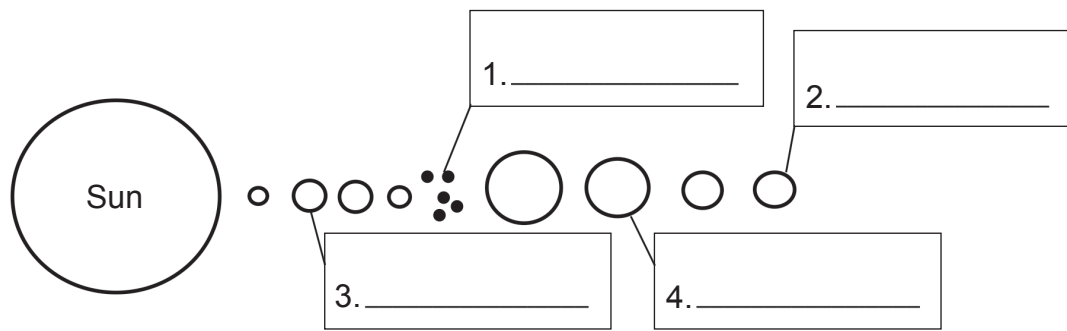
_____

_____ [1]

5 The diagram below, which is not to scale, represents our Solar System.

1. _____

2. _____

Sun

3. _____

4. _____

(a) (i) Name those features of the Solar System indicated.
Write the names in the boxes. [2]

(ii) Other than those you have labelled name one rocky and one gaseous planet.

Rocky planet _____

Gaseous planet _____ [1]

(iii) Name the two main gases found in our Sun.

1. _____ 2. _____ [1]

(iv) Name the process by which energy is produced in our Sun.

_____ [1]

[Turn over

(b) What is the difference between the Heliocentric and Geocentric models of the Solar System?

_____

_____

_____

_____

_____ [1]

(c) The Heliocentric model of the Solar System was suggested in the early 17th century when Galileo Galilei used a telescope to observe the planets.

   (i) At the time, who were the main objectors to the Heliocentric model?

     _____ [1]

   (ii) Name one observation that could be explained by the Heliocentric model but not the Geocentric.

     _____

     _____ [1]

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(d) Spacecraft have been sent to explore our own Solar System. However, if manned space flights are to be used to explore the outer regions of our Solar System, or beyond it, it will require the use of Space Stations. Give two reasons why this will be the case.

Reason 1:

_____

_____

_____

_____

Reason 2:

_____

_____

_____

_____ [2]

(e) The most widely accepted model for the formation of the Universe is that of the "Big Bang".

Below is a list of statements or events relating to the formation of the Universe but they are not in the correct sequence. Place them in the correct sequence by writing a number, 1 first to 4 last, in the box beside them.

Event	Sequence Order
Neutrons and protons are formed	
Rapid expansion and cooling occurs	
Further expansion and cooling occurs, allowing hydrogen atoms to form	
More expansion and cooling occurs, allowing hydrogen nuclei to form	

[3]

(f) When astronomers scan the sky they can detect a radiation which supports the "Big Bang" theory.

What name is given to this radiation?

_____ [1]

(g) Evidence for the expansion of space (Universe) comes from "Red Shift" measurements.

Explain what "Red Shift" means and how it supports the idea that space (Universe) is expanding.

_____

_____

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_____ [4]

(h) One model for the future of the Universe is that of the "Big Freeze".
Briefly explain what will happen within the Universe should this model prove to be accurate.

_____

_____

_____

_____

_____ [2]

[Turn over

6 (a) The diagram below shows the basic structure of the Earth and its interior.

1.

2.

3.

4.
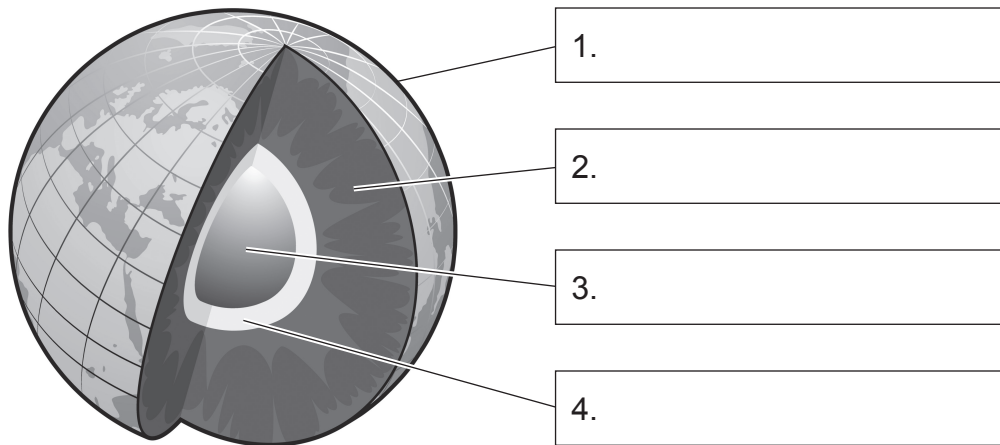
© daver2002ua/ iStock/ Thinkstock

(i) Write the names of those parts in the boxes which are attached to them. **[4]**

(ii) What two elements are main constituents of the region marked 3?

1. _____   2._____

[2]

(iii) Which region is believed to be in a liquid state?

_____ **[1]**

(iv) What is the lithosphere?

_____

_____

_____ **[2]**

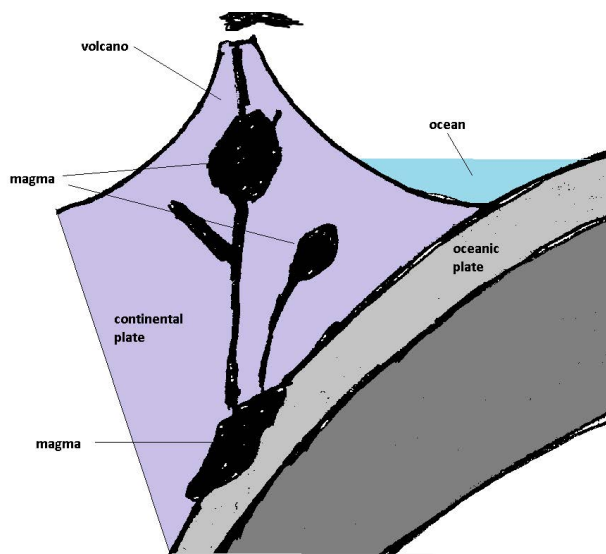**(b)** Describe how the tectonic plate model explains earthquakes.

_____

_____

_____

_____ [3]

(c) Volcanoes can be the result of plate movement.
The diagram below shows one such situation when an oceanic plate collides
with a continental plate.

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Explain how the plate movement can result in a volcanic eruption.

_____

_____

_____

_____

_____ [3]

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