CCEA GCSE PHYSICS

PHYSICS



EXAM QUESTION PACK

UNIT P2 HIGHER TIER GPH22 PAPERS

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2016

Science: Physics

Unit 2

Higher Tier

[GPH22]

GPH22

FRIDAY 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 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 Questions **2(b)(ii)** and **4(a)**.

9869

1 **(a)** One kind of earthquake wave is called an L-wave.

In L-waves the particles of the material vibrate perpendicular to the direction of propagation. A particular L-wave has a frequency of **0.002 Hz** and a wavelength of **2500 km**.

(i) Which **one** of the following statements, about L-waves, is true?
Tick (✓) the appropriate box.

L-waves are transverse. ☐

L-waves are longitudinal. ☐

L-waves are neither transverse nor longitudinal. ☐

[1]

(ii) Explain what is meant by a frequency of 0.002 Hz.

_____

_____

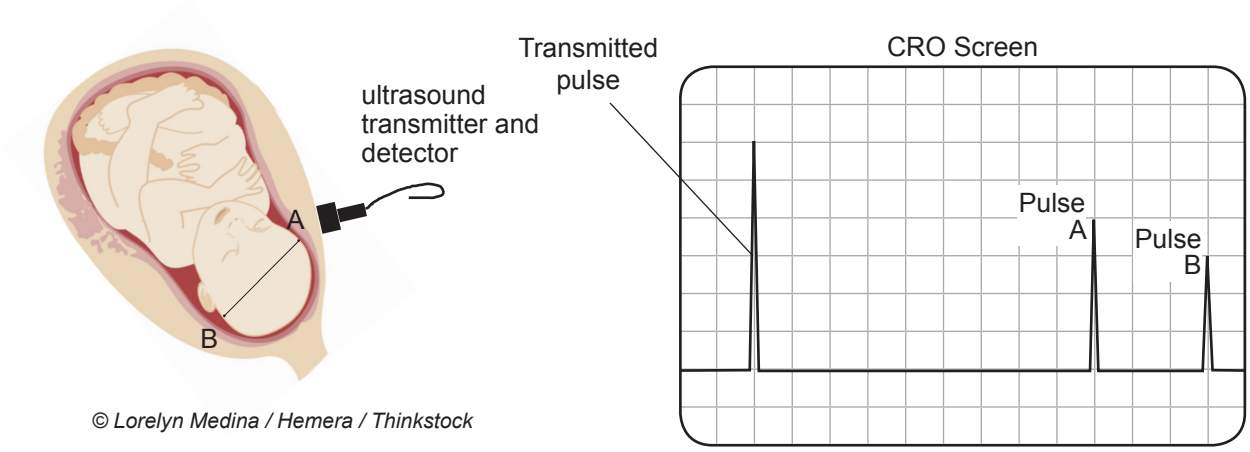
_____ [2]

(iii) Use the information above to calculate the speed of this L-wave. Give your answer in m/s.

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

Speed = _____ m/s [4]

(b) Ultrasound can be used to measure the diameter of the head of a baby in the womb. When ultrasound reaches the baby's head at A, some ultrasound is reflected back to the detector and produces pulse A on the CRO. Some ultrasound passes through the head to point B, and is reflected back to the detector. This reflection produces pulse B on the CRO.



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(i) What name is given to the reflection of a sound wave?

_____ [1]

The CRO is adjusted so that each horizontal division on the diagram above corresponds to a time of 40 microseconds.

(ii) How long is the time interval between the arrival of pulse A and the arrival of pulse B at the detector? Give your answer in microseconds.

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

Time interval = _____ microseconds [2]

[Turn over

(iii) How long does it take for the ultrasound to travel from one side of the baby's head to the other? Give your answer in microseconds.

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

Time to travel from B to A _____ microseconds [1]

Ultrasound travels at a speed of **1500 m/s** in a baby's head.

(iv) Use your answer to part **(iii)** to calculate the width of the baby's head from A to B. Give your answer in cm.
(1 microsecond = 1×10^{-6} s).

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

Width of baby's head = _____ cm [5]

(v) Explain why it is better to use ultrasound rather than X-rays when monitoring the development of a baby in the womb.

_____

_____

_____ [1]

(c) The diagram below shows four of the seven members of the electromagnetic spectrum. **They are not arranged in any particular order.**

Infrared light	**Ultraviolet light**	**Gamma waves**	**Radio waves**

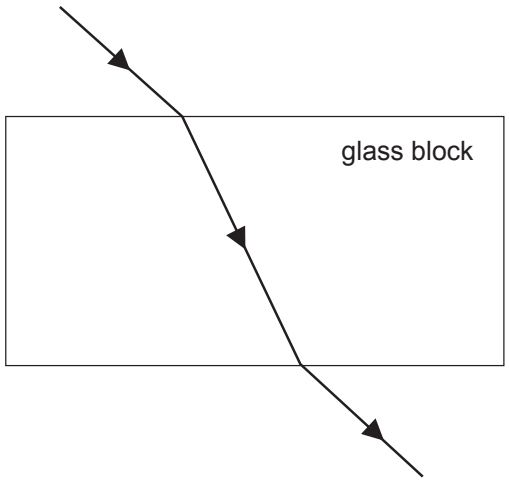
Identify the **three missing members** of the electromagnetic spectrum by writing their names in the appropriate part of the table below.

Name of wave	Wavelength/m
	3×10^{-2}
	6×10^{-7}
	1×10^{-9}

[3]

[Turn over

2 **(a)** The diagram below shows a ray of light passing through a rectangular glass block.



(i) What name is given to the bending of the light when it passes from air into glass?

_____ [1]

(ii) **Using a ruler** draw the normal at the point where the light enters the glass. Label the normal with the letter "N". [1]

(iii) Mark **clearly** on the diagram the angle of incidence in air with the letter "**i**" and the angle of refraction in the glass with the letter "**r**". [1]

(iv) What causes the light to change direction in the way shown in the diagram when it passes from air into glass?

_____

_____

_____ [2]

(b) **(i)** State carefully what is meant by the focal length of a converging lens.

_____

_____

_____ [1]

(ii) Describe **in detail** how you would use **a distant object** to measure the focal length of a converging lens. In your description you must:

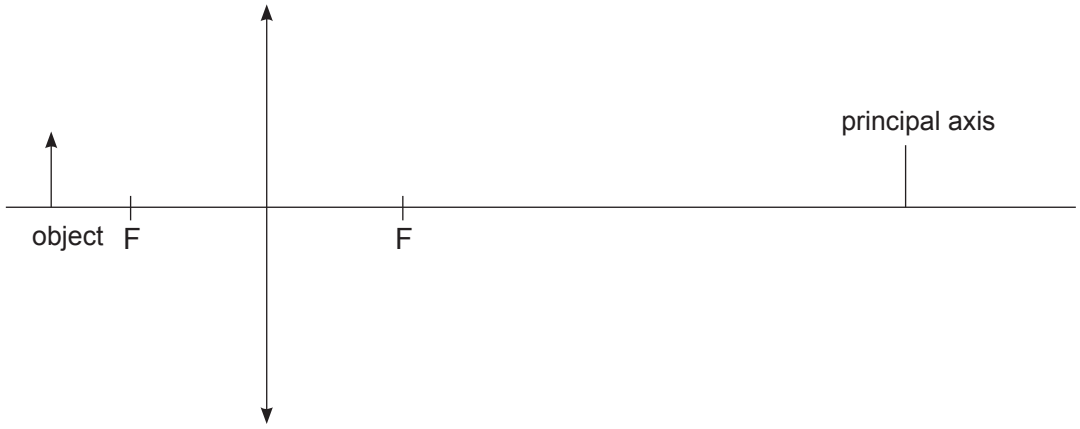
- state the apparatus you use;
- describe fully what you would do;
- state what measurement(s) you must make to find the focal length;
- state what you would do to ensure your measurement of the focal length is as accurate as possible.

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

[6]

[Turn over

(c) The **full scale** diagram below shows a converging lens and an object. Each principal focus is marked with an F.



(i) **Using a ruler**, carefully draw **two** rays on the diagram to find the position of the image.

Label the image with the letter I. [3]

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

The magnification of an image, M, is defined by the equation:

$$M = \frac{\text{height of the image}}{\text{height of the object}}$$

(iii) Calculate the magnification of the image in your ray diagram.

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

Magnification = _____ [2]

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

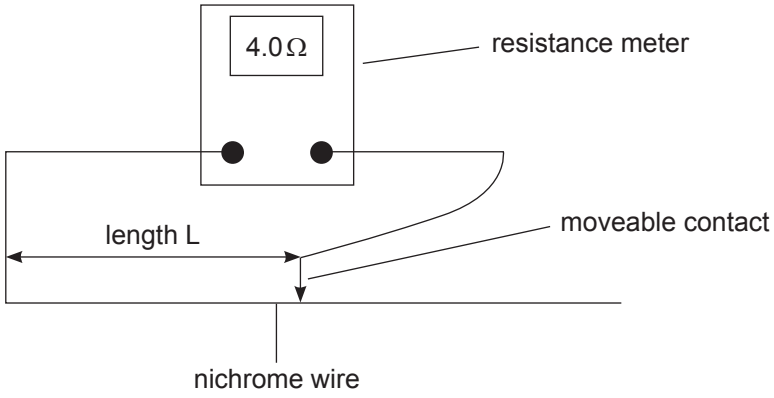
_____

_____

_____ [2]

[Turn over

3 **(a)** A student was given a resistance meter, which measures resistance directly, and a length of nichrome resistance wire.
She connected the circuit shown below and recorded the resistance of various lengths of the wire.

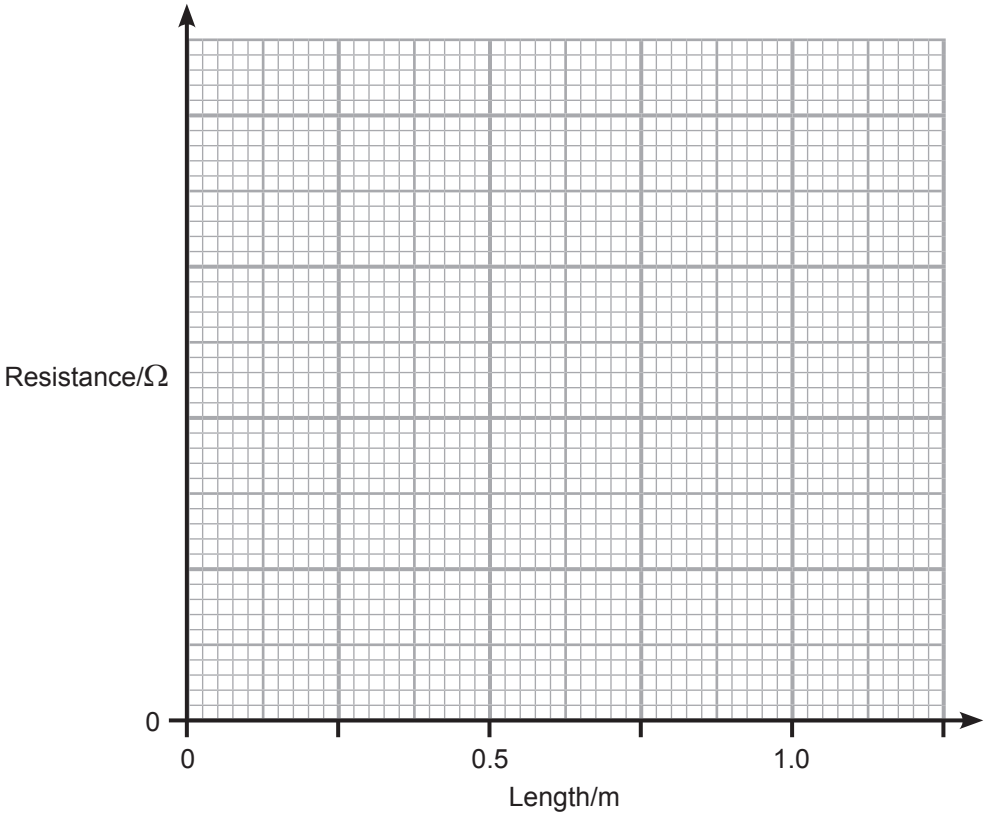


Her results are recorded in the table below.

Length of wire/m	0.00	0.25	0.50	0.75	1.00
Resistance/Ω	0.0	4.0	7.0	12.0	17.0

(i) Using the results in the table and the grid below plot a graph of the points and draw the **line of best fit**.

[4]



(ii) The relationship between the resistance R and length L of the wire is of the form

$$\mathbf{R = k \times L}$$

Explain how you could obtain the value of k from the graph.

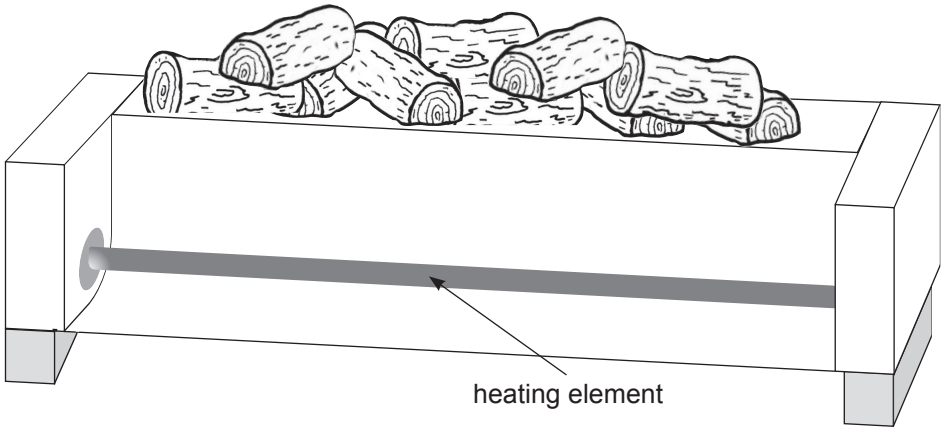
_____ [1]

(iii) **Using your graph** find the value of k and include a unit for it.

k = _____ [2]

[Turn over

(b) Nichrome resistance wire is often used to make the heating elements for electric heaters.



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The heater has an electric power rating of 720 W when operated from a 240 V mains supply.

(i) Calculate the resistance of the nichrome wire used in the heating element.

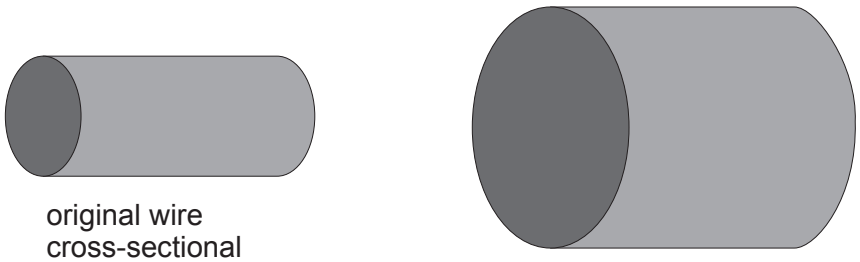
You are advised to show clearly how you get your answer.

Resistance = _____ Ω [4]

(ii) The nichrome wire used is known to have a resistance of 40 Ω per metre of length. What length of wire is required to make the heating element?

Length = _____ m [2]

The production company have decided to use wire of double the cross-sectional area of the previous wire.



original wire cross-sectional area 1 unit

new wire cross-sectional area 2 units

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(iii) What effect will using this new wire have on the resistance of the heating element if the length of the new wire used is the same as that of the original wire?

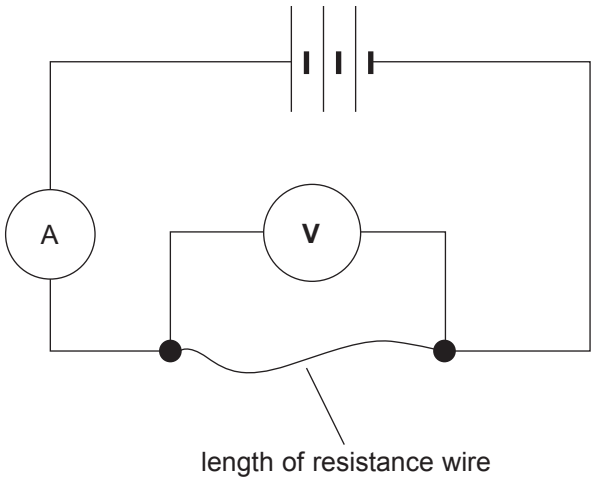
_____ [1]

(iv) To have a heating element of the same resistance as before what length of the new wire compared to the original wire is needed?

_____ [1]

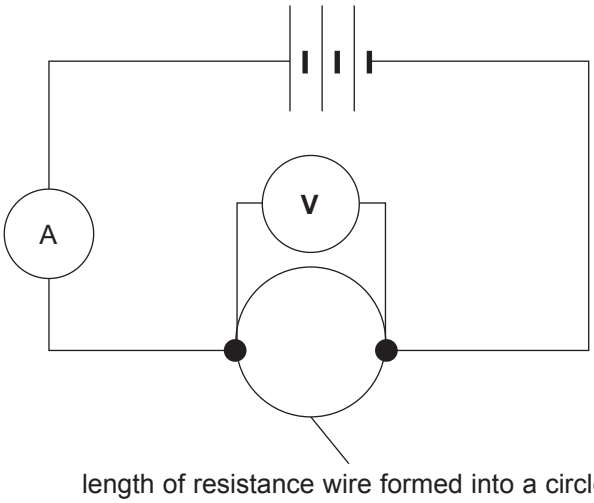
[Turn over

(c) The circuit below was set up.



The ammeter read 0.2A and the voltmeter 4.8V which meant that the wire had a resistance of 24Ω.

The wire was removed and shaped into a circle with the voltmeter connected across the diameter of the circle as shown below.



(i) What would the voltmeter now read?

Voltmeter reading = _____ V [1]

(ii) Explain how you arrived at your voltmeter reading.

_____

_____ [1]

(iii) What would the ammeter now read?
Remember the complete wire had a resistance of 24 Ω.

Ammeter reading = _____ A [1]

(iv) Explain how you arrived at your ammeter reading.

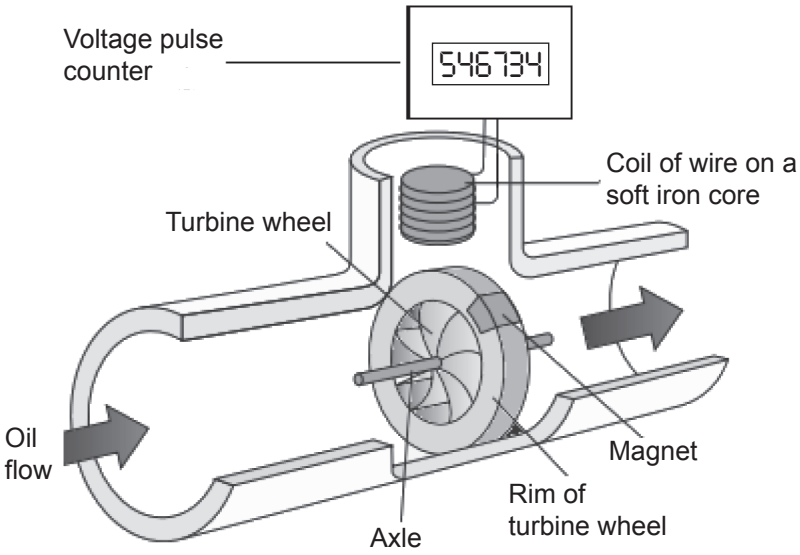
_____

_____

_____ [2]

[Turn over

4 (a) The oil industry pumps crude oil through many kilometres of pipeline. To measure the volume of oil flowing in the pipeline an electromagnetic meter is used. The diagram shows the basic construction of such a meter.



© Cyberphysics http://www.cyberphysics.co.uk/Q&A/KS4/magnetism/EMI/questions_EMI.html

You are asked to explain how the meter works by:

- explaining how voltage pulses are created
- how they are used to measure the rate of flow of oil in the pipeline
- how the voltage pulses are related to the volume of oil per second flowing in the pipeline.

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

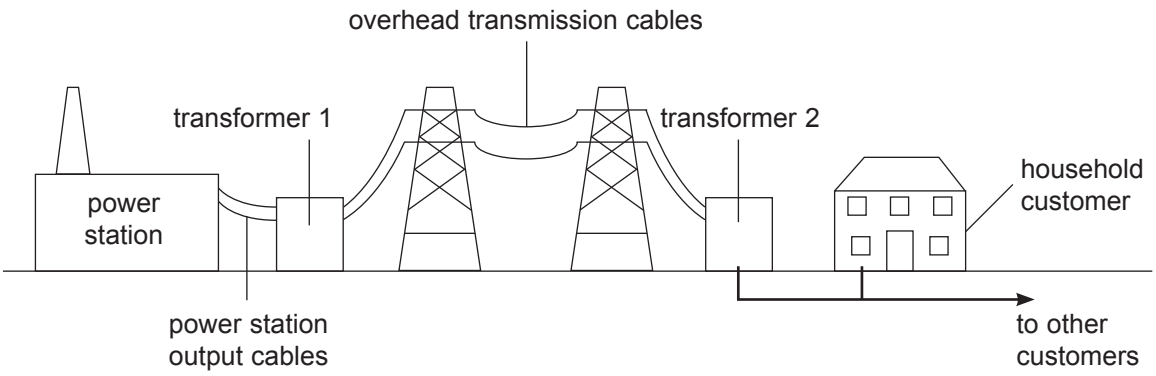
Write your answer on the lined page facing.

DO NOT WRITE IN THIS SPACE

[6]

[Turn over

(b) The diagram below represents the distribution network for electricity from the power station to users such as households.



© CCEA

A power station generates electricity at a voltage of 15 kV.
This is increased to 120 kV by transformer 1.

(i) Calculate the turns ratio $\left(\frac{N_{secondary}}{N_{primary}}\right)$ for transformer 1 used to do this.

Turns ratio = _____ [3]

(ii) When the voltage is increased in this way is the current flowing in the transmission cables a.c. or d.c.?

_____ [1]

(iii) Explain fully what the electricity companies do to reduce energy loss in the transmission cables.

_____

_____

_____

_____

_____ [3]

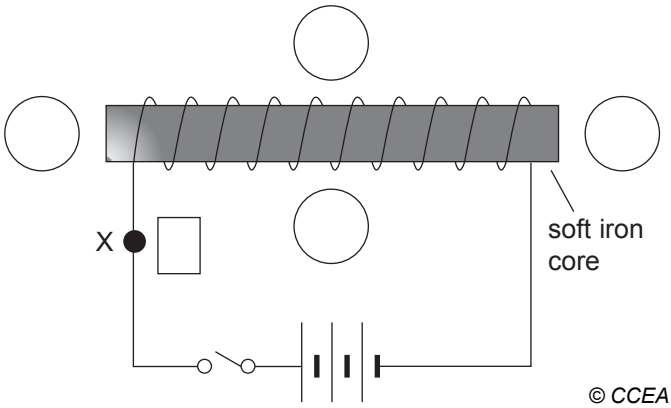
(iv) Describe the role of transformer 2.

_____

_____

_____ [2]

(c) The diagram below shows a simple electromagnet.



© CCEA

(i) The switch is closed. At the point marked X show the direction of the current flow by drawing an arrow in the box beside it. [1]

(ii) On the soft iron core mark clearly the magnetic North and South poles. [1]

(iii) The circles represent the position of a magnetic compass.
Mark an arrow in each of the circles to show the direction of the magnetic field at each position. [2]

(iv) The wire used to wind the coil of the electromagnet is insulated.
Explain why this must be the case.

_____

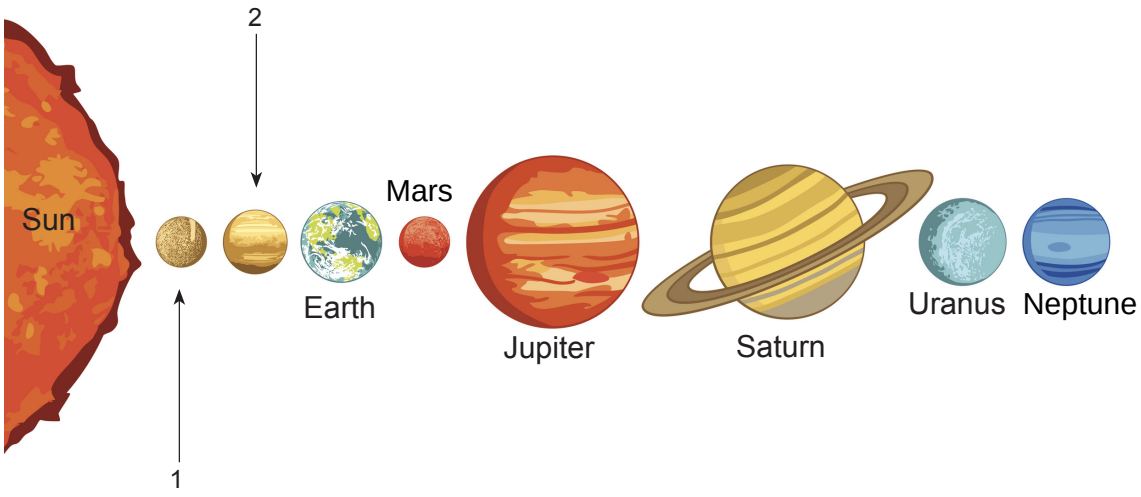
_____

_____

_____ [1]

[Turn over

5 **(a)** The diagram below shows our Sun and the planets that make up the Solar system.



© sntpzh / iStock / Thinkstock

(i) Name the planets marked by numbers.

1 _____ 2 _____ [2]

(ii) The Solar System was probably formed from a large cloud of material known as a nebula. What two pieces of evidence support this view?

1. _____

_____

2. _____

_____ [2]

The Sun's gravity plays a major role in our Solar System.

(iii) Describe how it affects the motion of the planets.

_____

_____ [2]

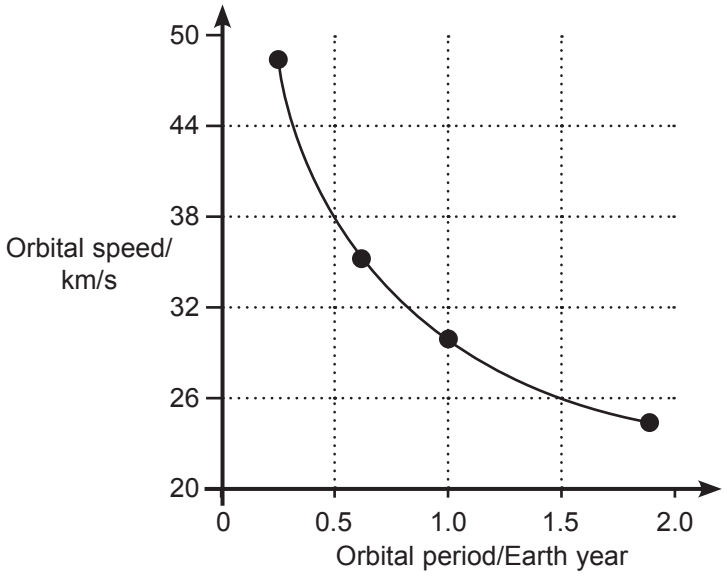
(iv) Describe the role gravity plays in ensuring our Sun remains stable providing energy for many millions of years.

_____

_____

_____ [2]

The graph below shows how the speed of a planet in its orbit, known as its orbital speed, depends on the length of time it takes to complete one orbit, known as its orbital period.



The data is for the four planets nearest the Sun.

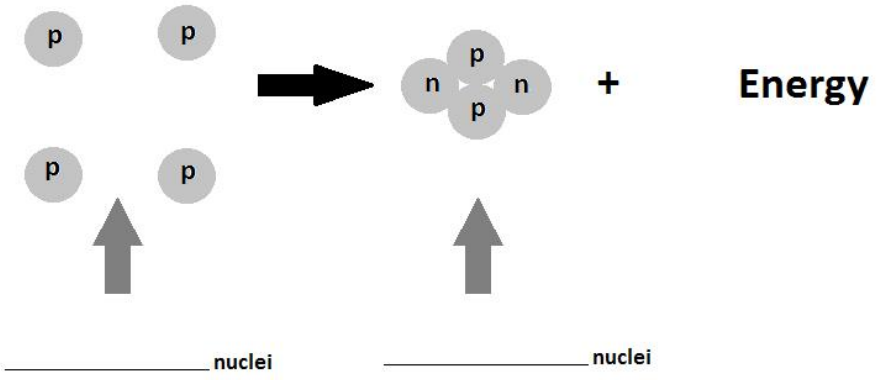
(v) On the graph mark with an arrow the data point that represents the Earth. [1]

[Turn over

(vi) Name the planet that has an orbital period almost twice as long as we have on the Earth.

_____ [1]

(b) Stars like our Sun produce very large amounts of energy.
The diagram below illustrates the nuclear fusion process that produces this energy in many stars.



© Chief Examiner

(i) Identify the nuclei involved in this process.
Write the name in the spaces provided. [2]

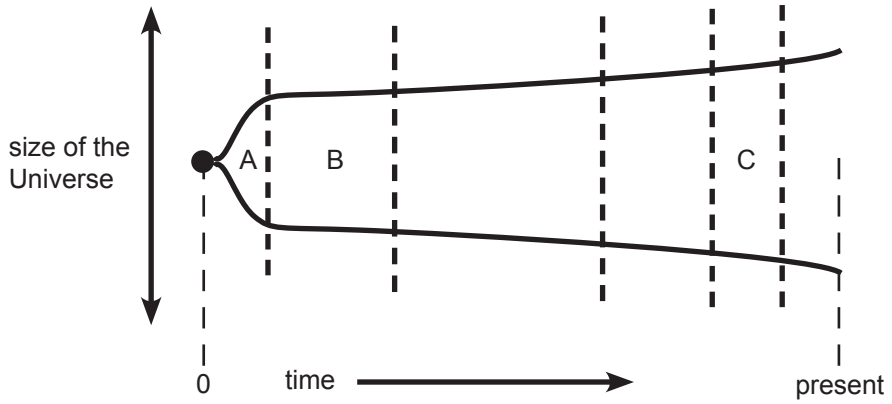
(ii) How do we know that stars are mostly composed of the two gases the nuclei of which are part of the nuclear fusion reaction shown above?

_____

_____

_____ [1]

(c) Most scientists believe in the Big Bang model for the formation and evolution of the Universe.
The diagram below represents how the size of the Universe changed with time.



© CCEA

(i) During the period marked A the Universe expands rapidly. What else is happening at this period?

_____ [1]

(ii) During the period marked B two important nuclear particles were formed. Name them.

_____ and _____ [2]

(iii) During the period marked C hydrogen atoms began to form and electromagnetic radiation was able to pass through the Universe. This radiation has now been detected billions of years after it was first emitted. What name is given to the radiation?

_____ [1]

[Turn over

(iv) The diagram shows that the Universe is continuing to expand.
What observation supports this view?

_____

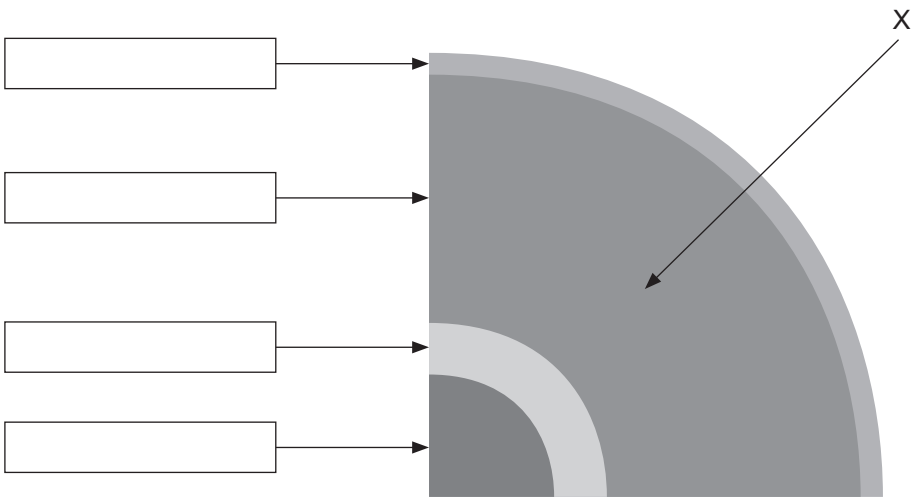
_____

_____ [2]

(v) According to current measurements how long ago did the Big Bang occur?

_____ [1]

6 **(a)** The diagram below shows a cross section through the Earth.



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(i) On the diagram name the four layers into which the Earth is divided. Write your answers in the boxes provided. [4]

(ii) Explain, in detail, what the lithosphere is.

_____

_____

_____ [2]

(iii) The section marked X is the widest section. Describe how the mechanical properties of its rocks change with distance from the centre of the Earth.

_____

_____

_____

_____ [2]

[Turn over

(iv) What two metals are the main constituents of the innermost layers?

_____ and _____ [2]

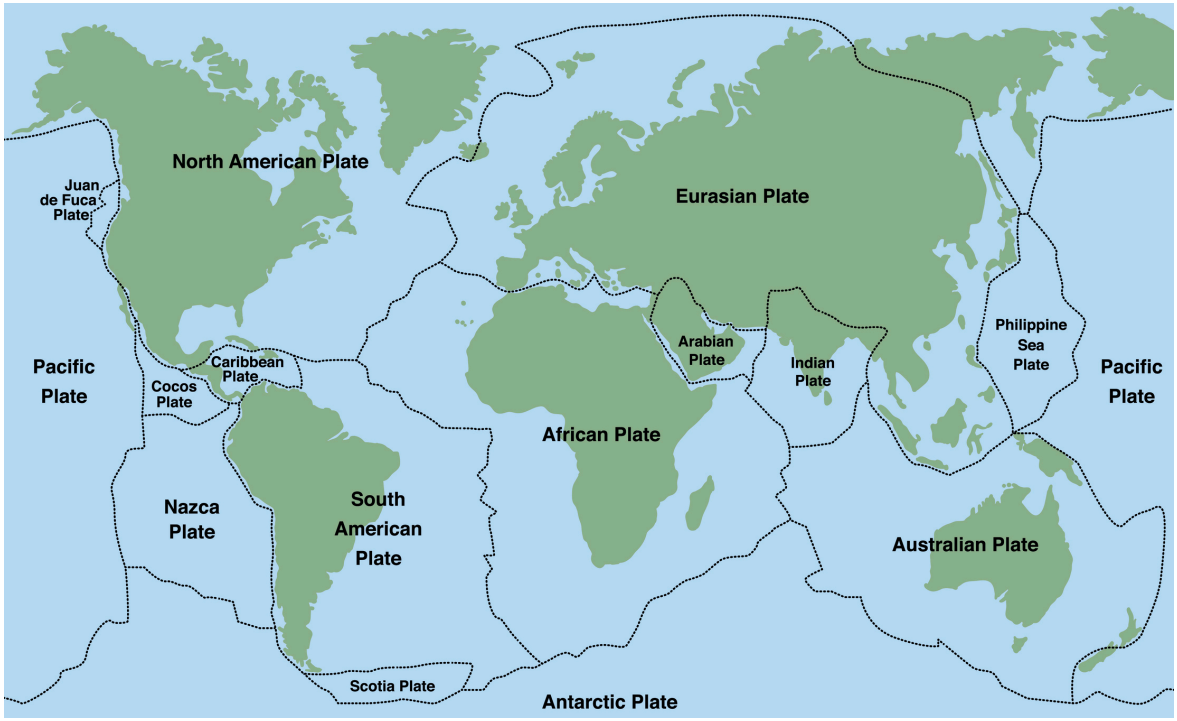
(v) Describe how the two innermost layers differ.

_____

_____

_____ [2]

(b) The rigid outermost shell of the Earth is broken up into sections as shown below. These sections are known as tectonic plates.



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Explain how earthquakes occur at some plate boundaries.

[3]

THIS IS THE END OF THE QUESTION PAPER

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Question Number	**Marks**
1	
2	
3	
4	
5	
6	
Total Marks	

Examiner Number

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Rewarding Learning

General Certificate of Secondary Education
2016

GCSE Physics

Unit 2

Higher Tier

[GPH22]

FRIDAY 24 JUNE, MORNING

MARK SCHEME

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General Marking Instructions and Mark Grids

Introduction
Mark schemes are intended to ensure that the GCSE examination is marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses likely to be worthy of credit. They also set out the criteria that they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these marking instructions.

Quality of candidates' responses
In marking the examination papers, examiners should be looking for a quality response reflecting the level of maturity which may reasonably be expected of a 16-year-old which is the age at which the majority of candidates sit their GCSE examinations.

Flexibility in marking
Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, the examiners should seek the guidance of the Supervising Examiner.

Positive marking
Examiners must be positive in their marking, giving appropriate credit for description, explanation and analysis, using knowledge and understanding and for the appropriate use of evidence and reasoned argument to express and evaluate personal responses, informed insights and differing viewpoints. Examiners should make use of the whole of the available mark range of any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected of a 16-year-old GCSE candidate.

Awarding zero marks
Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Types of mark scheme
Mark Schemes for questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

						AVAILABLE MARKS
1	**(a)**	**(i)**	Transverse		[1]	
		(ii)	0.002 vibrations/waves (pass) (a fixed point) every second } independent marking	[1] [1]	[2]	
		(iii)	v = fλ (must be an equation), e.g. fλ unqualified give [0]	[1]		
			=(0.002) × (2500 × 1000) [1] per bracketed item	[2]		
			= 5000 (m/s)	[1]	[4]	
			(If 10^n error [–1] once only)			
	(b)	**(i)**	echo		[1]	
		(ii)	3 × 40 = 120 microseconds sight of 3 divisions [1]		[2]	
		(iii)	60 (microseconds) ecf from **(ii)**		[1]	
		(iv)	distance = speed × time	[1]		
			= 1500 × 0.00006 ecf for time from **(iii)**	[2]		
			= 0.09 (m)	[1]		
			= 9 (cm)	[1]	[5]	
			(If 10^n error [–1] once only)			
		(v)	X-rays kill/damage (cells) or are harmful to baby/cause cancer/ change in DNA/dangerous or ultrasound does not kill cells or harm the baby/less harmful/safe 'It' implies ultrasound		[1]	
	(c)		microwaves	[1]		
			visible	[1]		
			X-rays	[1]	[3]	20

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AVAILABLE MARKS

2 (a) (i) Refraction [1]

(ii) Normal drawn (and marked N) on both sides, air and glass. [1]
Ok if dotted.

(iii) Angles of incidence and refraction both marked [1]

(iv) Light slows down [2]
Change of speed give [1] Light speeds up give [0]

(b) (i) Distance from the lens or optical centre to principal focus or focal point or where parallel rays incident to lens meet after refraction [1]

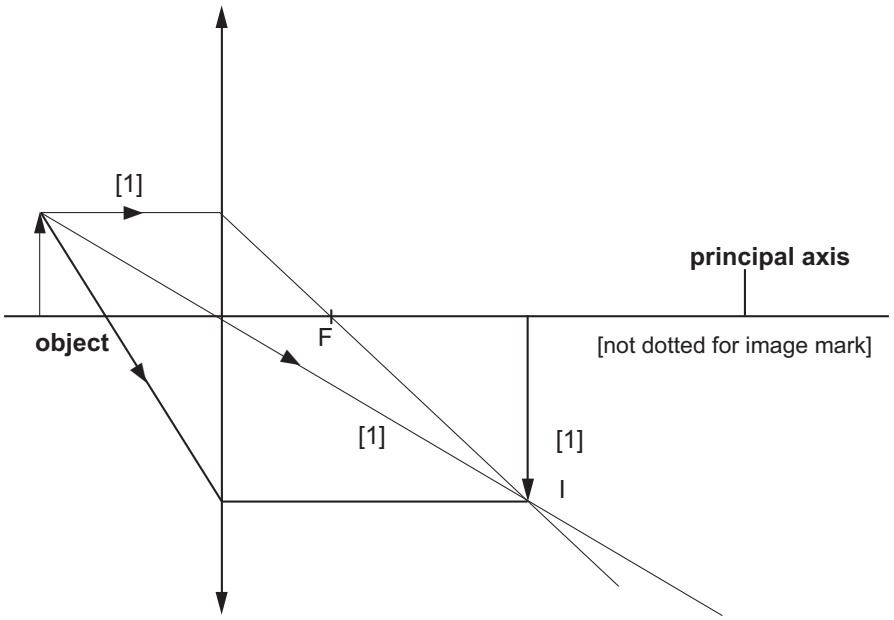
(ii) **Indicative content:**
Lens (in a holder)
Screen/white sheet/wall/paper
Metre rule/ruler/tape measure
Choice of distant object, e.g. a tree, window or object ⩾ 5 m away
Move lens or screen until sharp image formed (focused or clear means sharp)
Measure distance from lens to screen
Repeat and average [both required]

Response	Mark
Candidates describe in detail using good SPG **at least 5 points** shown opposite. The form and style are of a high standard and specialist terms are used appropriately at all times.	[5]–[6]
Candidates describe in detail using good SPG **at least 3 points** shown opposite. The form and style are of a high standard and specialist terms are used appropriately on some occasions.	[3]–[4]
Candidates make some reference to **one of the points** shown opposite using good SPG. The form and style are of a satisfactory standard but there is limited use of specialist terms.	[1]–[2]
Response not worthy of credit	[0]

[6]

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(c) **(i)** Two rays [any 2 of the 3 possible rays] [2]
Top of image marked [1] [3]



(ii) arrows on both rays
conflicting arrows or wrong direction give [0] [1]

(iii) Magnification 1.4 to 1.8
1.3 or 1.9 give [1] **No ecf from ray diagram** [2]

(iv) Real/yes [1]
Light passes through it/can be projected on a screen [1] } independent marking

formed by real rays
Opposite side from object give [0] [2]

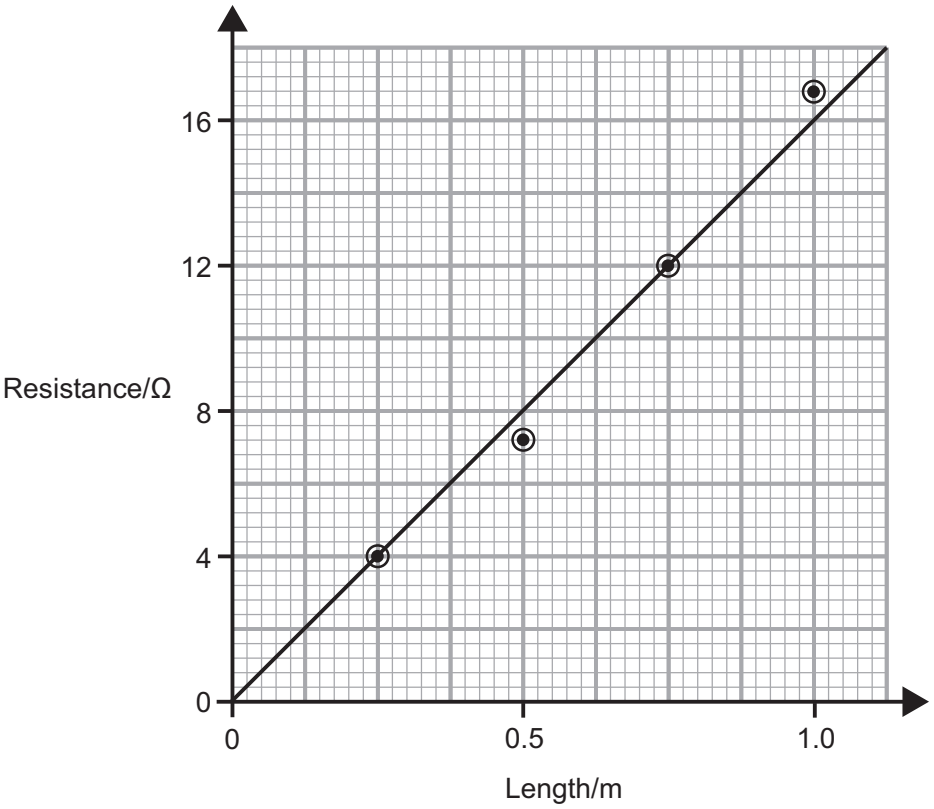
AVAILABLE MARKS

20

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AVAILABLE MARKS

3 **(a)** **(i)** Suitable choice of scale on resistance axis [1]
At least half of the grid used.
Points correctly plotted ± 1 sq [$\frac{1}{2}$] each round UP to a max of [2] [2]
Any (best) line fit through origin ± 1 sq and through one other point [1] [4]



(ii) Find the gradient/put values into equation/k = R/L/divide R by L [1]

(iii) Gradient = rise/run = 16 ±1 consistent with their line } independent marking [1]
Unit = Ω/m or $\frac{\Omega}{m}$ [1] [2]

(b) **(i)** I = P/V **or** 720/240 = 3 (A) (sight of 3(A) give [2]) [2]
[1] [1]

R = V/I **or** 240/3 = 80 (Ω) [2] [4]
[1] [1]
or
$P = V^2/R$ $720 = 240^2/R = 57\,600/R$
[1] [1] for subs [1]

R = 80 (Ω) [1]

(ii) length = 80/40 ecf from **(b)(i)** for R [1]
= 2 (m) [1] [2]

(iii) Resistance is **halved** or half the value of **(b)(i)** ecf from **(b)(i)** [1]

(iv) Length must be **doubled** or twice the value in **(b)(ii) –** ecf [1]

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			AVAILABLE MARKS
(c)	**(i)** 4.8 V	[1]	
	(ii) Cells/battery/power or voltage supply has not changed/parallel circuit. If **(c)(i)** is wrong or missing **(c)(ii)** gets [0]	[1]	
	(iii) = 0.8 (A) No ecf from **(c)(i)**	[1]	
	(iv) Any 2 from 3: **(**In a circle we have) 2 (× 12Ω) resistors in parallel [1] so total resistance is now 6Ω or $\frac{1}{4}$ of original or decreases so the current is larger (is now 4 times) (the original value) [1]	[2]	20

4 **(a)** I**ndicative content:**
The flow of oil causes the wheel to rotate
As magnet passes coil a voltage/current is induced
This is electromagnetic induction
The greater the flow the faster the wheel rotates
This produces more pulses (every second)
The number of pulses in one second can be used to work out the volume per second

Response	Mark
Candidates describe in detail using good SPG **at least 5 points** shown opposite. The form and style are of a high standard and specialist terms are used appropriately at all times.	[5]–[6]
Candidates describe in detail using good SPG **at least 3 points** shown opposite. The form and style are of a high standard and specialist terms are used appropriately on some occasions.	[3]–[4]
Candidates make some reference to **one of the points** shown opposite using good SPG. The form and style are of a satisfactory standard but there is limited use of specialist terms.	[1]–[2]
Response not worthy of credit	[0]

[6]

(b) **(i)** {Ns/Np} = $\frac{120}{15}$ = 8 $\frac{Vs}{Vp}$ with no further working give [1]. [3]
[1] [1] Must be 8 on the answer line $\frac{1}{8}$ give [0]

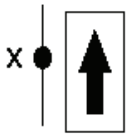
(ii) a.c. [1]

(iii) The voltage (at the power station) is stepped up/increased [1]
This reduces the current (in the transmission cables) [1]
This reduces the energy/power lost (as heat) (in the cables) [1] [3]

(iv) To step the voltage down [1]
To 220 or 230 or 240 V or safe voltage or voltage suitable for appliances [1] [2]

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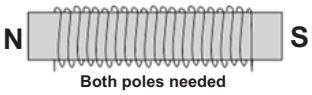
(c) **(i)**



Can be outside box, near X

[1]

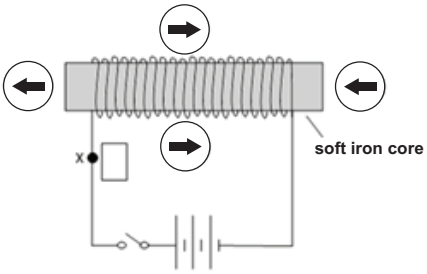
(ii)



(may be inside circles at ends) **No ecf**

[1]

(iii)



No ecf

Any 2 correct arrows will get [2]
(mark each arrow separately to a max of [2])

[2]

(iv) To make the current flow around the iron core
or no short circuit
or so current does not flow in core [1]
To prevent electric shock give [0]

20

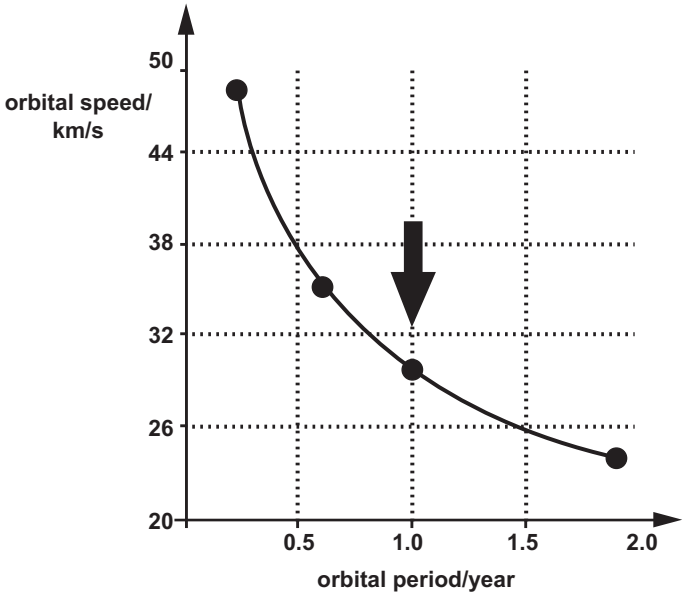
5 **(a)** **(i)** 1 – Mercury 2 – Venus [2]

(ii) Planets (orbit) (the Sun) in **same plane** [1]
Planets (orbit) (the Sun) in **same direction** [1] [2]

(iii) Provides the (centripetal) force [1]
to keep planets **in orbit**/moving around the Sun [1] [2]

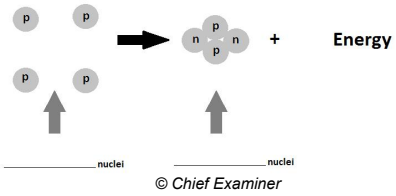
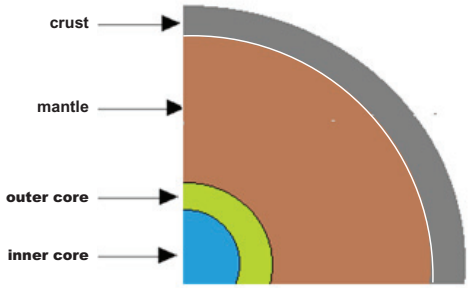
(iv) Counters or balances the outward force [1]
Outward force identified as gas/radiation pressure [1] [2]

(v)



[1]

(vi) Mars [1]

					AVAILABLE MARKS
(b)	**(i)**	 © Chief Examiner H or hydrogen nuclei (not deuterium or tritium) He or helium nuclei		[2]	
	(ii)	Light/spectra (from the stars) Not colour		[1]	
(c)	**(i)**	Cooling or temperature falls		[1]	
	(ii)	Protons [1] and neutrons [1] Not quarks		[2]	
	(iii)	(Cosmic) **microwave background** (radiation)/CMBR or CBMR		[1]	
	(iv)	Red shift of **light** or **radiation** from other **galaxies** or stars in other **galaxies**	[1] [1]	[2]	
	(v)	12–15 billion years ago or 12 000 million–15 000 million or A number between these limits		[1]	20
6	**(a)**	**(i)**	 © CCEA		[4]	
		(ii)	The region comprising of the crust [1] and **upper** [1] mantle Upper or outer required for 2nd mark		[2]	
		(iii)	The upper parts of the mantle the rock is hard/solid Lower down the rock is soft or viscous or beginning to melt	[1] [1]	[2]	
		(iv)	Iron Nickel	[1] [1]	[2]	
		(v)	Outer core is liquid Inner core is solid	[1] [1]	[2]	
	(b)	The plates move (slowly) or collide They stick/get caught Eventually they jump/jerk/lurch/move suddenly		[1] [1] [1]	[3]	15
				Total		**115**

Rewarding Learning

General Certificate of Secondary Education
2015

GCSE: Physics

Unit 2

Higher Tier

[GPH22]

FRIDAY 19 JUNE, MORNING

MARK SCHEME

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General Marking Instructions and Mark Grids

Introduction
Mark schemes are intended to ensure that the GCSE examination is marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses likely to be worthy of credit. They also set out the criteria that they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these marking instructions.

Quality of candidates' responses
In marking the examination papers, examiners should be looking for a quality response reflecting the level of maturity which may reasonably be expected of a 16-year-old which is the age at which the majority of candidates sit their GCSE examinations.

Flexibility in marking
Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, the examiners should seek the guidance of the Supervising Examiner.

Positive marking
Examiners must be positive in their marking, giving appropriate credit for description, explanation and analysis, using knowledge and understanding and for the appropriate use of evidence and reasoned argument to express and evaluate personal responses, informed insights and differing viewpoints. Examiners should make use of the whole of the available mark range of any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected of a 16-year-old GCSE candidate.

Awarding zero marks
Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Types of mark scheme
Mark Schemes for questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

AVAILABLE MARKS

1 (a) (i) EM waves are **transverse** [1]
Reject **some** are transverse
or they are not longitudinal

(ii)

Longer:	Infrared	Microwaves	Radio	[1]
Use:	Heating/ Remote	Cooking/ (Tele)Communications	Communication	[1]
Shorter:	Ultraviolet	X-ray	Gamma	[1]
Use:	Sunbeds/ Forgeries	Diagnose broken bones	Cancer treatment sterilise equipment	[1]

[4]

Dependent marking
Wave must be correct before access to mark for use

(iii) $\lambda = v/f = \frac{3 \times 10^8}{5.5 \times 10^{14}}$ [1] for formula, [1] for subs [2]
$= 5.45 \times 10^{-7}$ (accept 5.5×10^{-7}) [1] or 0.000 000 545 or 0.000 000 55 [2]
unit mark m [1] [4]

(b) Indicative content
1. Sound travels towards wall/microphone
2. Is reflected by the wall/echo/bounces/deflects **back**
3. Distance from microphone to wall
4. Time shown (on timer) or note/record the time
5. Speed = distance divided by $\frac{1}{2}$ time or equivalent or double distance/time
6. (For reliability) repeat or use different distance

Response	Mark
Candidates describe in detail using good spelling, punctuation and grammar **any 5 points** shown above and the precaution is clearly stated. The form and style are of a high standard and specialist terms are used appropriately at all times.	[5]–[6]
Candidates describe in detail using good spelling, punctuation and grammar **3 points** shown above. The form and style are of a high standard and specialist terms are used appropriately at all times.	[3]–[4]
Candidates make some reference to **1 or 2 of the points** shown above using satisfactory spelling, punctuation and grammar. The form and style are of a satisfactory standard and they have made some reference to specialist terms.	[1]–[2]
Response not worthy of credit.	[0]

[6]

(c) (i) Best fit line (be generous), judge by eye [1]

(ii) No – line does not pass through 0,0 **or** origin
or doubling the temperature does not double speed [1]

(iii) 342.8 ± 0.4 [1]

(iv) 330 [1]

(v) The speed of sound at 0 °C [1]

20

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2 **(a)** Ray from head A to eye and ray from chin to eye [1]
Correct arrow on 1 ray conflicting arrows – [0] [1]
So that i = r for both rays (judge by eye) [1]
Minimum length = 5 + 6 = 11 (cm) [1] [4]

(b) **(i)** Dispersion **Not** refraction [1]
Different wavelengths colours refracted by different amounts
or bent **or** travel at different speeds [1] [2]

(ii) Total internal reflection **or** TIR [1]
Angle of incidence (in water) greater than critical angle [1] [2]

(c) **(i)** The object is not distant/object or lamphouse not far enough away
or distance is not large enough [1]

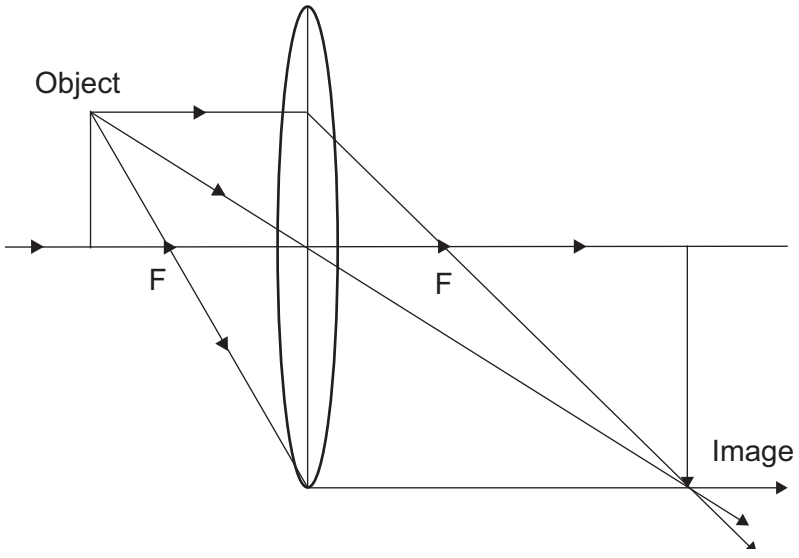
(ii) 10 cm to 10.3 cm give [2], 10.4 give [1] [2]
(As the object becomes more distant) the image is formed
at the focal point/principal focus [1]
Only accesses this if 1 or more marks for first part [3]

(iii) 20 cm [1]

(iv) Diminished/smaller/small/decreases [1]

(d) **(i)** parallel to PA and refracted through F
Through OC and not refracted
Image marked if not convergent, [–1]
or inverted arrowhead
or I but ↑ arrow wrong way round – [0]

} Only gets access to final mark if both rays correct



[3]

(ii) Arrows shown left to right – conflicting arrows give [0] [1]
One correct arrow and no conflicts – [1]/[1]

(iii) Inverted/upside down/laterally inverted [1]
not "not erect"

(iv) Projector/enlarger [1]

AVAILABLE MARKS

20

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AVAILABLE MARKS

3 **(a)** **(i)** Lamp in series with ammeter and variable PSU
(or battery with rheostat) [1]
Voltmeter in parallel with lamp [1]
Symbols correct for ammeter, voltmeter and bulb [1]
Complete circuit [1] [4]

(ii) Indicative Content:
1. Switch on PSU/battery/Close switch/or indication circuit is on
2. Record current } find a measure OR { reading on ammeter
3. Record voltage } { reading on voltmeter
4. In a table or plot graph
5. Adjust rheostat or PSU voltage
6. Take a range current and voltage measurements

Response	Mark
Candidates describe in detail using good spelling, punctuation and grammar **any five points** in the Indicative Content. The form and style are of a high standard and specialist terms are used appropriately at all times.	[5]–[6]
Candidates describe in detail using good spelling, punctuation and grammar **at least three** of the points in the Indicative Content. The form and style are of a high standard and specialist terms are used appropriately most of the time.	[3]–[4]
Candidates describe in detail using good spelling, punctuation and grammar **at least one** of the points in the Indicative Content. The form and style are of a satisfactory standard and they have made some reference to specialist terms.	[1]–[2]
Response not worthy of credit.	[0]

[6]

(iii) $R = \frac{1.2}{0.2}$ or $R = V/I$ [1] = 6 Ω [1] [2]

from graph temperature = 1425 ± 25 °C [1] [3]
No need to look at graph

(b) **(i)** Series [1]

(ii) No. of cells = $\frac{240}{0.75}$ = 320 sight of [1]
(Area =) 320 × 18 [1]
= 5760 (cm^2) [1] [3]

(iii) No. of panels = $\frac{3200}{100}$ = 32 sight of [1]
(Area =) 32 × 5760 (ecf from **(ii)**) = 184 320 (cm^2) [1]
= 18.4(32) (m^2) [1] [3]

(PoT error [–1] only)

20

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4 **(a)** **(i)** Iron [1]

(ii) step-up [1]
magnetic/flux or magnetic field/magnetism [1]
step-up [1]
energy/heat/power **not** electricity [1] [4]

(iii) V = P/I (or equivalent) [1]
$= \frac{720}{0.05}$ (= 14400) 720 × 3 = 14400 × 0.5 [3] [2] [3]
worth [3]

(iv) $N_s/N_p = V_s/V_p$ [1]
$Ns = (14400 \times \frac{200}{240})$ [1]
Ns = 12000 (turns) [1] [3]

(b) **(i)** (Inducing a voltage in coil) requires changing flux/magnetic field [1]
a.c. supplies changing current/steady d.c. does not
or changing direction **or** magnitude supply changing current [1] [2]

(ii) No need to break circuit **or** no need to break leads
Can measure very high current
or Safer [1]

(iii) Bigger or increased (current) (reading obtained) [1]

(c) **(i)** N(orth) to right of coil, S(outh) to left of coil
Only needs one pole [1]

(ii)

AB	**Y(es)**	**Up**
BC	**N(o)**	
CD	**Y(es)**	**Down**

Left blank or None

[1]
[1]
[1]
[3]

[1] per row

(iii) No effect/None [1]

20

AVAILABLE MARKS

					AVAILABLE MARKS
5	**(a)**	**(i)**	1 – Asteroids; 2 – Neptune; 3 – Venus; 4 – Saturn $\left[\frac{1}{2}\right]$ each round up	[2]	
		(ii)	**Rocky planet** – Mercury, Earth or Mars or Venus **Gaseous planet** – Jupiter or Uranus or Saturn or Neptune Both required	[1]	
		(iii)	1. Hydrogen 2. Helium H and He (Accept symbols)	[1]	
		(iv)	(Nuclear) fusion Correct spelling	[1]	
	(b)		Geocentric – planets and Sun revolve around the Earth/Earth at centre but in Heliocentric planets revolve around the Sun/Sun at centre.	[1]	
	(c)	**(i)**	The (Catholic) Church/The Pope	[1]	
		(ii)	Retrograde/apparent looping motion of the planets; Venus is sometimes closer to Earth than Mars/phases for Venus and Mars/planets Phases of Moon Any **one**	[1]	
	(d)		Flight time too long for a human lifetime (accept today's spacecraft too slow) Spacecraft could not carry sufficient food stocks. Spacecraft could not carry sufficient fuel stocks. Little to no chance of return to Earth should a problem arise. Long time delay in relaying of signals/messages between Earth and craft. Any **two** points Any acceptable realistic answer	[2]	
	(e)		Sequence order 2 1 4 3 Any 2 correct consecutive gets [1]/[3] Any 3 correct consecutive gets [2]/[3]	[3]	
	(f)		(Cosmic) **microwave** background (radiation) **or** C**M**B(R) **or** CMB	[1]	
	(g)		Light [1] from galaxies [1] has a longer wavelength/red end of spectrum [1] galaxy is moving away [1]	[4]	
	(h)		Universe **continues** to expand Temperature drops **or** getting colder 1st point essential before access to 2nd point Planets going cold [0]	[2]	20

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					AVAILABLE MARKS
6	(a)	(i)	From the top: crust mantle inner core outer core	[4]	
		(ii)	Nickel and iron	[2]	
		(iii)	Outer core Do not accept numbers	[1]	
		(iv)	The crust [1] and upper mantle [1] Accept **outer** mantle Accept **lower** crust	[2]	
	(b)		The plates move and rub against each other They stick/catch There is a sudden movement/jerk/jolt/lurch/**sudden** release of pressure	[3]	
	(c)		Friction (between plates) (heats and) melts the rock/crust/plates Magma/lava	[3]	15
				Total	**115**

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2014

GCSE Physics

Unit 2

Higher Tier

[GPH22]

GPH22

MONDAY 23 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.
Write your answers in the spaces provided in this question paper.
Complete in blue or black ink only. **Do not write in pencil or 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 **2(c)** and Question **5(a)**.

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32GPH2201

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Examiner Only	
Marks	Remark

1 **(a)** Mobile phones involve receiving and transmitting waves which some people think might be harmful to health.
All new mobile phones in the UK must be tested and given a SAR (specific absorption rating). The SAR value is a measure of the energy absorbed by the head while a mobile phone is being used.

The table gives the SAR value, **for adults**, for three different mobile phones.
To be sold in the UK, a mobile phone must have a SAR value lower than 2.0 W/kg.

Mobile phone	SAR value in W/kg
X	0.15
Y	0.85
Z	1.85

(i) Give **two** reasons why there might be a significant risk to very young children using mobile phone **Z**.

1. _____

_____

2. _____

_____ [2]

(ii) Other than keeping the length of the call as short as possible, what precaution might a user of a mobile phone take to minimise the risk of absorbing too much radiation?

_____ [1]

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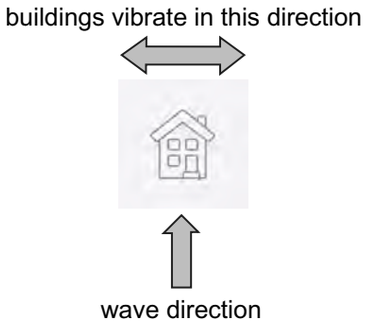
Examiner Only	
Marks	Remark

(b) Complete the table below to show what happens when light waves are **refracted as they travel from air into glass**.
Choose your answer from increases, decreases or stays the same.

	increases/decreases/stays the same
Frequency	
Wavelength	
Speed	

[3]

(c) Seismic (earthquake) waves travel through the earth to the surface. When they arrive there they cause buildings on the surface to vibrate. One type of seismic wave, called an S-wave, causes buildings on the surface to vibrate parallel to the Earth's surface.



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(i) Seismic waves are either longitudinal or transverse. What type of wave is a seismic S-wave?

_____ [1]

(ii) Explain the reason for your answer to part **(c)(i)**.

_____

_____ [2]

[Turn over

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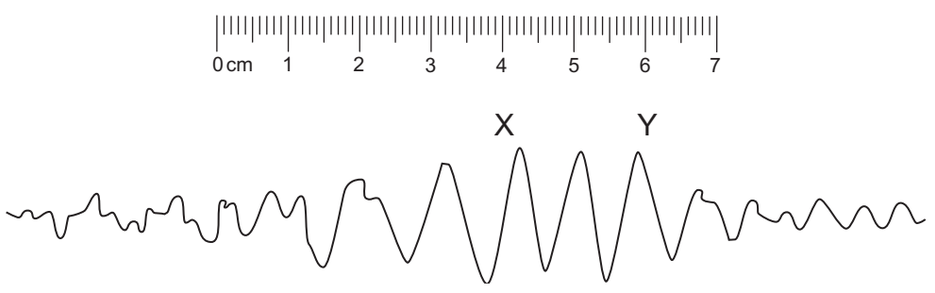
Examiner Only	
Marks	Remark

(iii) An S-wave has a speed of 3.5 km/s in the Earth's crust and its frequency is 1.3 Hz. Calculate its wavelength. Give your answer in metres.

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

Wavelength = _____ m [4]

The vibrations caused by earthquakes are detected by a seismometer.
The graph produced is called a seismograph.
The **full-scale** diagram below shows a seismograph.



(iv) Using the ruler shown in the diagram measure the horizontal distance between the peaks X and Y. Each 1 cm on the scale represents a time of 0.8 s.
Convert your measured distance to a time and use your answer to calculate the frequency of the seismic wave in the region XY.
Remember the region XY shows two complete waves.

Frequency = _____ Hz [4]

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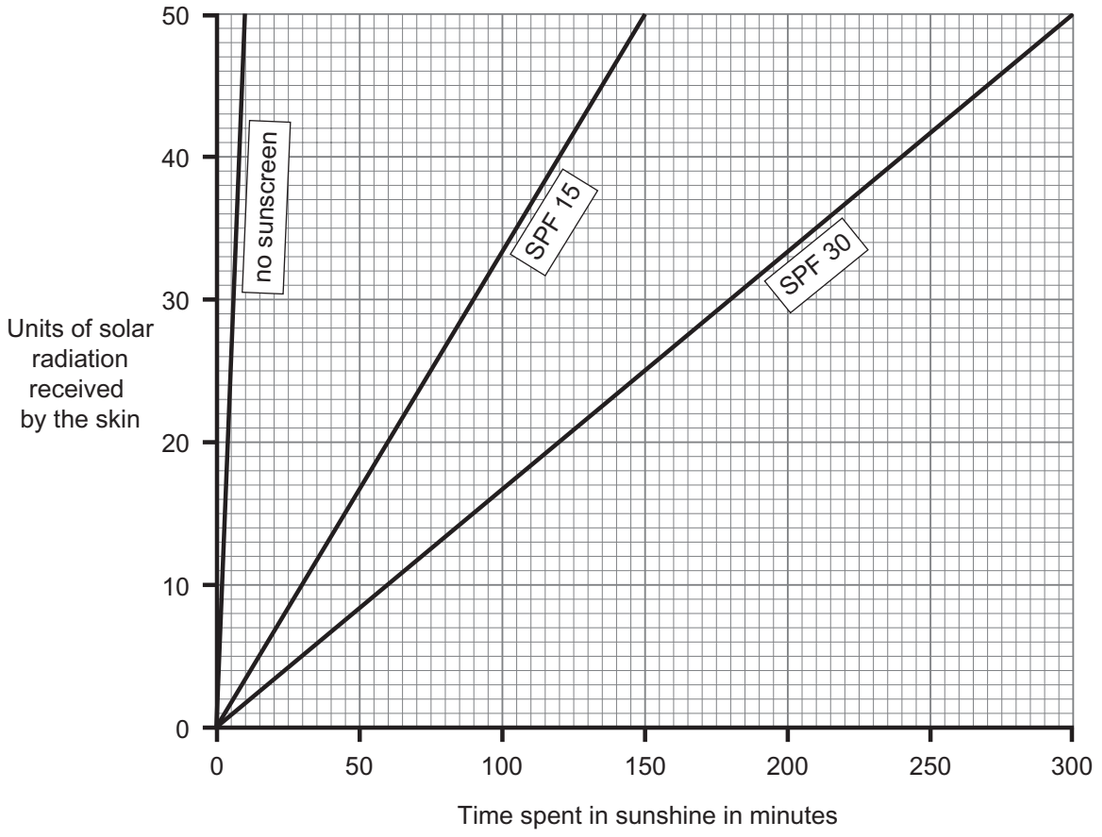
(Question 1 continues overleaf)

[Turn over

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Examiner Only	
Marks	Remark

(d) The longer you sunbathe, the more ultraviolet solar radiation your skin receives.
Sunscreen lotions absorb some of this radiation. The lotions are given a skin protection factor (SPF) number.
The graph shows how the amount of radiation received by a person's skin is related to how long they are outside on a sunny day.
The skin gets sunburn if it receives 50 units of solar radiation.



(i) How much longer can you stay in the sunshine if you use a lotion with SPF 30 rather than one with SPF 15 before you get sunburn?

_____ minutes [1]

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For those who use sunscreen lotions, **the length of time they can stay in the sun before they get sunburn is directly proportional to the SPF factor of the sunscreen lotion used**.

(ii) By considering the relationship between the SPF factor and the maximum time spent in the sun, calculate what minimum SPF factor is required for someone who wants to stay in the sun for 2 hours without getting sunburn.

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

SPF = _____ [2]

Examiner Only	
Marks	Remark
Total Question 1	

[Turn over

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DO NOT WRITE ON THIS PAGE

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Examiner Only	
Marks	Remark

2 **(a)** A camera is used to take a picture of a tall object.
The image is formed on the light sensitive surface of the camera.

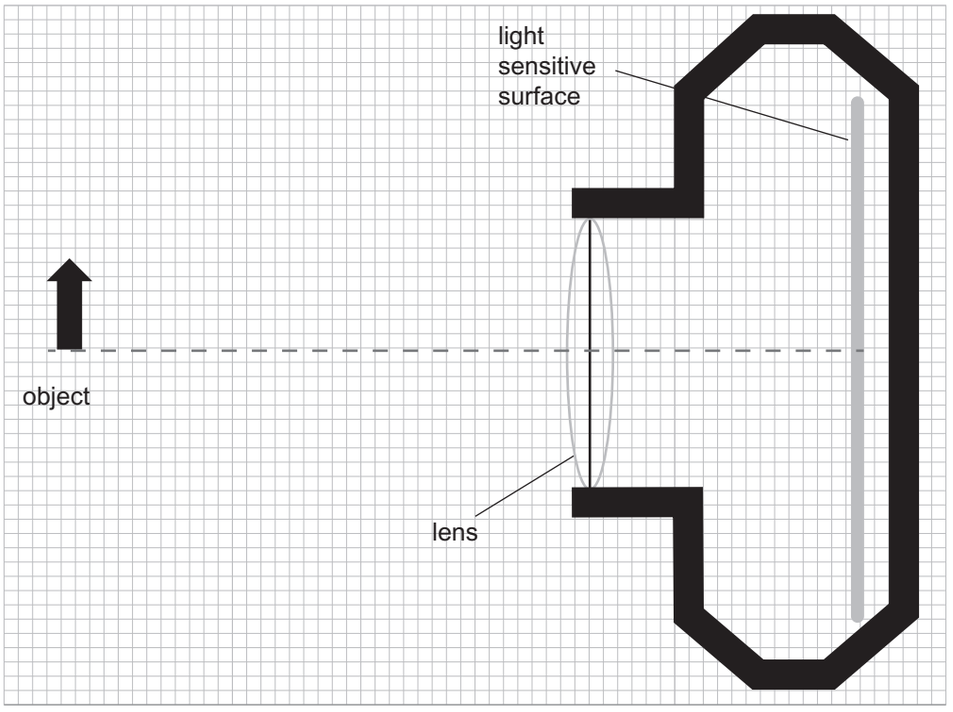
(i) Give **three** properties of the image on the light sensitive surface.

1. _____

2. _____

3. _____ [3]

(ii) On the **full-scale** diagram below, draw **two rays <u>using a ruler</u>** from the top of the object to show where the image is formed on the light sensitive surface. Remember to put arrows on your rays to show the direction in which the light is travelling and mark clearly the image.



[4]

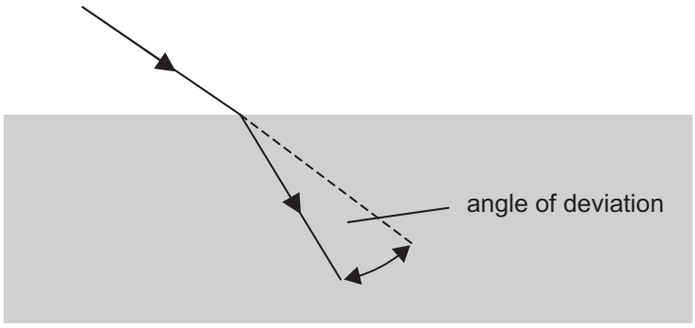
(iii) Using a ruler, measure the focal length of the lens.
Give your answer in mm.

Focal length = _____ mm [2]

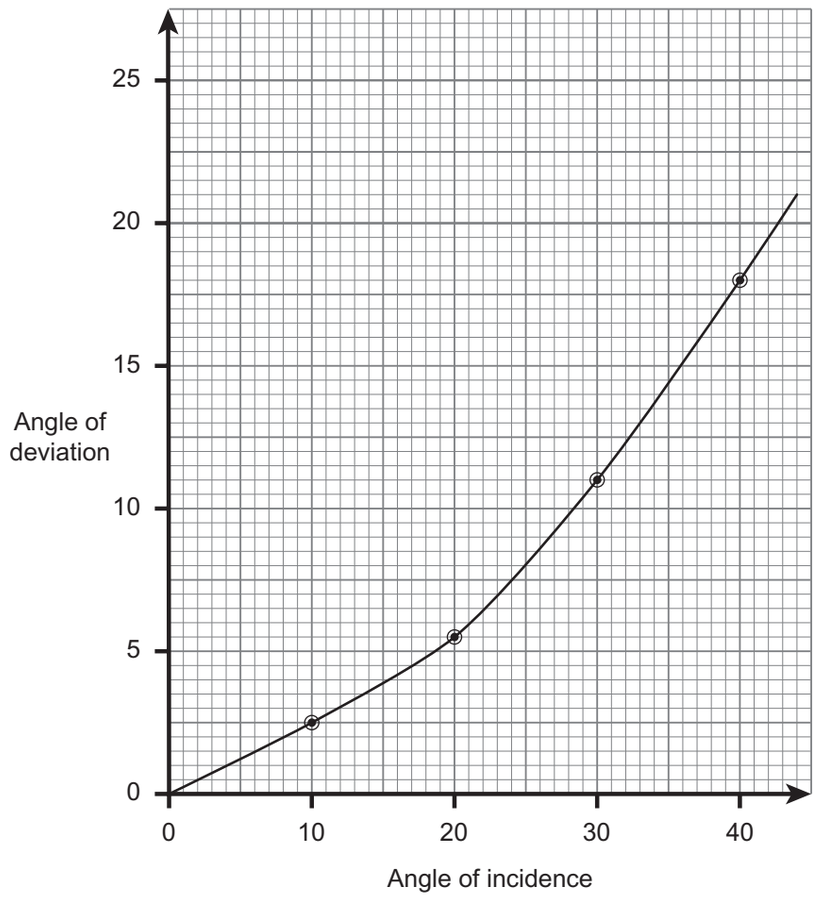
[Turn over

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(b) When a ray of light is passed through a glass block it is refracted. The diagram shows a ray of light passing through a glass block. The angle of deviation is the angle between the incident ray and the refracted ray.



As part of a physics lesson Joanne used the set-up shown above to measure the angle of deviation for a range of angles of incidence. The results she obtained are plotted on the grid below.



Examiner Only	
Marks	Remark

8588

32GPH2210

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(i) As shown on the grid Joanne drew a curve through the points. She then came to the conclusion that the angle of deviation was proportional to the angle of incidence.
Explain why this conclusion was wrong.

_____

_____

_____ [2]

(ii) Using values, taken from the graph, for the angles of deviation when the angle of incidence is 20° and 40° carry out two calculations that show the angle of deviation is **not** proportional to the angle of incidence.
Explain how your calculations support this correct conclusion.

Explanation _____

_____

_____ [3]

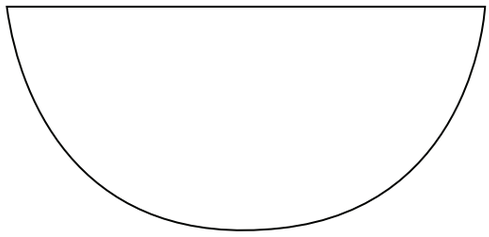
Examiner Only	
Marks	Remark

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(c) Describe, in detail, how you would measure experimentally the critical angle for glass using a semicircular glass block.
You may complete the diagram to help your answer.

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

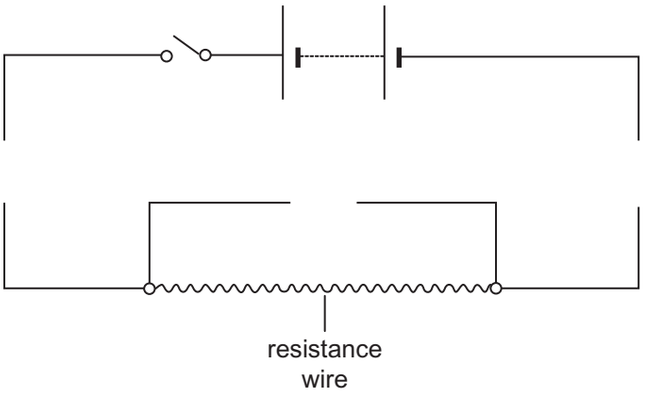


[6]

Examiner Only	
Marks	Remark
Total Question 2	

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3 A pupil wishes to measure the resistance of a length of resistance wire. They are given the following incomplete circuit diagram.



(a) To help ensure reliable results the pupil decides to take three sets of values for current and voltage for each length of wire.

(i) Using the correct circuit symbols complete the above circuit to show how a voltmeter, an ammeter and a variable resistor should be connected. [3]

(ii) During the investigation the pupil only closes the switch when taking a set of readings. One reason for doing this is to help conserve the energy of the battery but there is also another important reason. State what this other reason is and explain why this is good experimental practice.

_____

_____

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

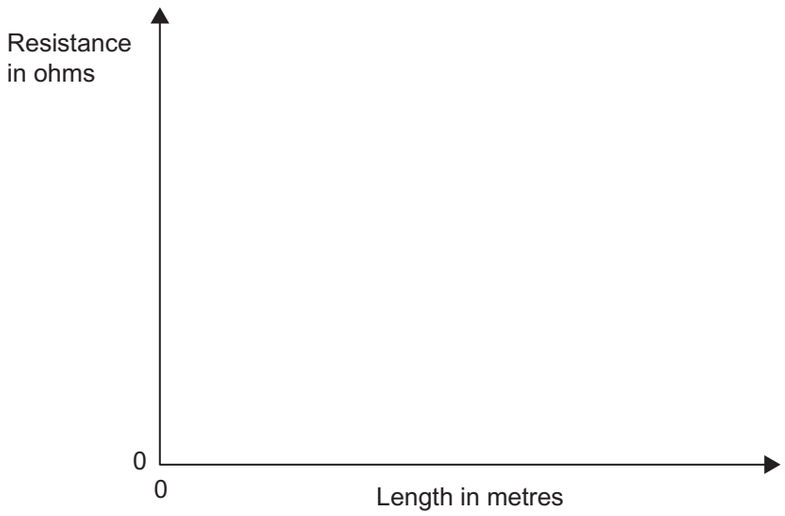
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The pupil used the circuit to measure the resistance of different lengths of wire of the same material.

Examiner Only	
Marks	Remark

(iii) On the axes below draw the graph he would expect to get when he plotted his results. [1]



(iv) An 80 cm length of this wire was found to have a resistance of 12 Ω.
Calculate the resistance of a 60 cm length of the same wire.

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

Resistance = _____ Ω [2]

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(v) Calculate the resistance of a piece of this wire of length **120 cm** and area of cross section **half** of that of the one in part **(iv)**.

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

Resistance = _____ Ω [2]

Examiner Only	
Marks	Remark

[Turn over

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Examiner Only	
Marks	Remark

(b) The picture below shows an electric toaster and the label attached to it.



Electric Toaster

240 V | 960 W

© iStock/Thinkstock

(i) Using the information from the label, as given above, calculate the current flowing in the toaster when it is in use.

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

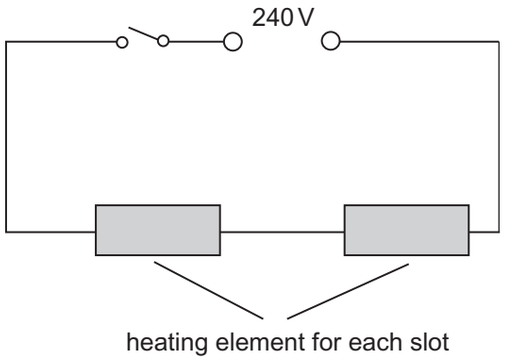
Current = _____ A [3]

(ii) Calculate the resistance of the wire used in the toaster.

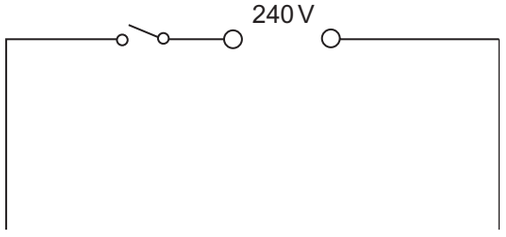
You are advised to show clearly how you get your answer.

Resistance = _____ Ω [3]

(c) The toaster shown in the picture, which can take two slices of bread, always has both toasting slots switched on when in use. This wastes electrical energy for a lot of people who wish to make only one slice of toast. The diagram below shows the basic circuit for the toaster.



By rearranging the heating elements and adding additional switches it is possible to make a toaster to toast either one or two slices of bread as required.
Complete the diagram below to show how the circuit could be arranged.



[2]

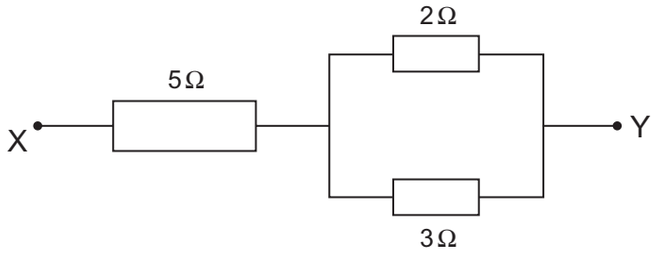
Examiner Only	
Marks	Remark

[Turn over

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(d) Calculate the total resistance between points X and Y of the resistor network shown below.

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



Total resistance = _____ Ω [2]

Examiner Only	
Marks	Remark
Total Question 3	

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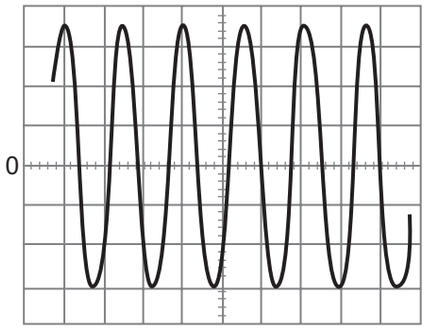
Examiner Only	
Marks	Remark

4 **(a)** Electrical signals can be either a.c. or d.c.
What is meant by the abbreviations a.c. and d.c.?

(i) a.c. _____ [1]

(ii) d.c. _____ [1]

(b) An electrical signal is connected to a CRO (cathode ray oscilloscope) and a student makes a sketch of the waveform obtained, as shown below.



(i) How can you tell from the sketch that the electrical signal is a.c.?

_____

_____ [1]

(ii) How can you tell from the sketch that the electrical signal has a constant frequency?

_____

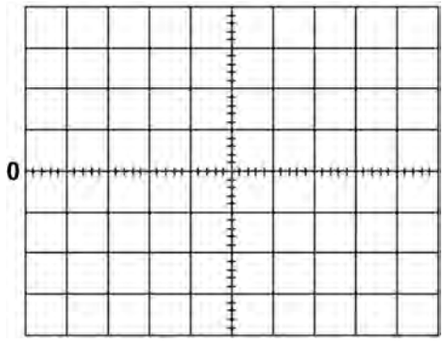
_____ [1]

[Turn over

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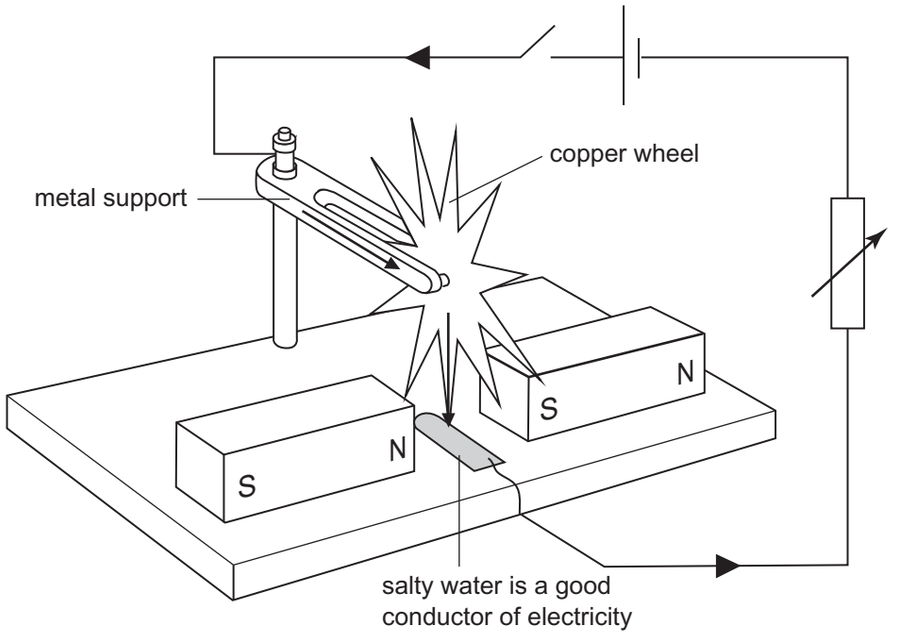
Examiner Only	
Marks	Remark

(iii) Sketch below a graph to show what the student might see on the CRO screen if the voltage was a **changing d.c.**



[2]

(c) Below is a sketch of a piece of apparatus which can be seen in some science museums. It consists of a star-shaped wheel made of copper which can rotate in the vertical plane, with one point of the wheel dipping into a pool of salty water. A wire from the salty water to the cell completes the circuit.
When the switch is closed, a current flows in the direction shown, by the arrows, through the copper wheel.



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A magnetic field, perpendicular to the spoke dipping into the salty water, is provided by two magnets, one on either side of the wheel.

(i) Describe and explain fully what would be observed happening to the wheel when the switch is closed.

Description: _____

_____ [2]

Explanation: _____

_____ [2]

When the switch is closed the variable resistor is adjusted so that the current flowing in the wheel is increased.

(ii) What effect, if any, would this have on the wheel?

_____ [1]

The switch is opened and both magnets are now turned round so as to reverse the direction of the magnetic field at the spoke dipping into the salty water.

(iii) The switch is closed again. In what way, if at all, would the behaviour of the copper wheel be different from your answer to **(i)**?

_____ [1]

Examiner Only	
Marks	Remark

[Turn over

(d) Transformers are used to reduce the 240 V mains voltage to run electric fences on farms in Britain.

One of the transformer coils has 480 turns, the other coil has 160 turns.

(i) What is the number of turns on the primary and secondary coils?

Number of turns on the primary coil = _____

Number of turns on the secondary coil = _____

[2]

(ii) Calculate the output voltage of the transformer.

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

Output voltage = _____ V [6]

Examiner Only	
Marks	Remark
Total Question 4	

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Examiner Only	
Marks	Remark

5 **(a)** The photograph below shows a nebula.
It is believed that our solar system was formed from a nebula. The bright spots are stars.



© Science Photo Library

Describe what a nebula consists of and explain the stages that a nebula goes through as it forms a star.

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

[6]

[Turn over

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Examiner Only	
Marks	Remark

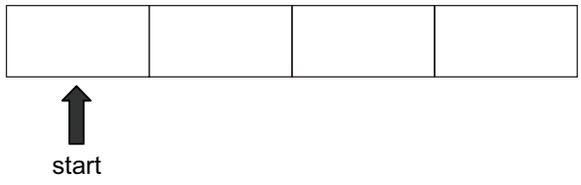
(b) (i) The Big Bang model for the formation and evolution of the Universe involves a number of stages. These are described in the numbered statements shown below.
Place the stages in the order in which physicists believed they occurred.
Write your answers in the boxes provided.

1. neutrons and protons are formed

2. further expansion and cooling of the Universe allows hydrogen nuclei to form

3. further expansion and cooling allowing electrons to combine with neutrons and protons to form atoms of hydrogen

4. rapid expansion and cooling of the Universe



[2]

(ii) What is cosmic microwave background radiation?

_____

_____

_____

_____

_____ [1]

(iii) What is the origin of cosmic microwave background radiation?

_____

_____

_____ [2]

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(c) Gravity has played and continues to play an important part in the Universe.
Describe three of the roles that gravity plays in the shaping of the Universe.

1. _____

_____

_____

2. _____

_____

_____

3. _____

_____

_____

[3]

Examiner Only	
Marks	Remark

[Turn over

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(d) Several ideas have been put forward about the final fate of the Universe.
For each one listed below give a brief description of what might happen to the Universe.

(i) Big Freeze _____

_____

_____

_____

_____

(ii) Big Crunch _____

_____

_____

_____

_____

(iii) Big Bounce _____

_____

_____

_____

_____

[6]

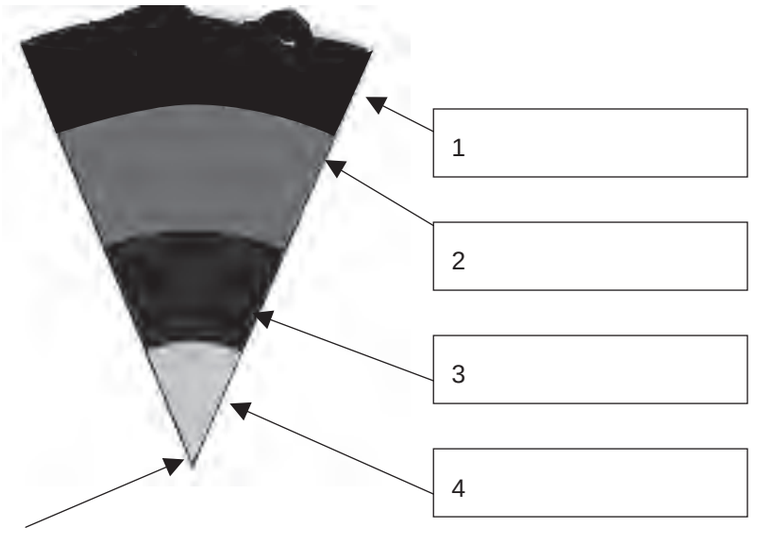
Examiner Only	
Marks	Remark
Total Question 5	

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Examiner Only	
Marks	Remark

6 **(a)** The Earth is divided into layers.
These layers have different properties and compositions.

(i) On the diagram below label each of the layers marked by arrows.
Write the name in the box provided.



[4]

(ii) Name the layer or layers which are solid.

_____ [2]

(iii) Iron is one of the two main elements that are present in layer 4.
Name the other element.

_____ [1]

(iv) What are layer 1 and the upper part of layer 2 collectively known as?

_____ [1]

[Turn over

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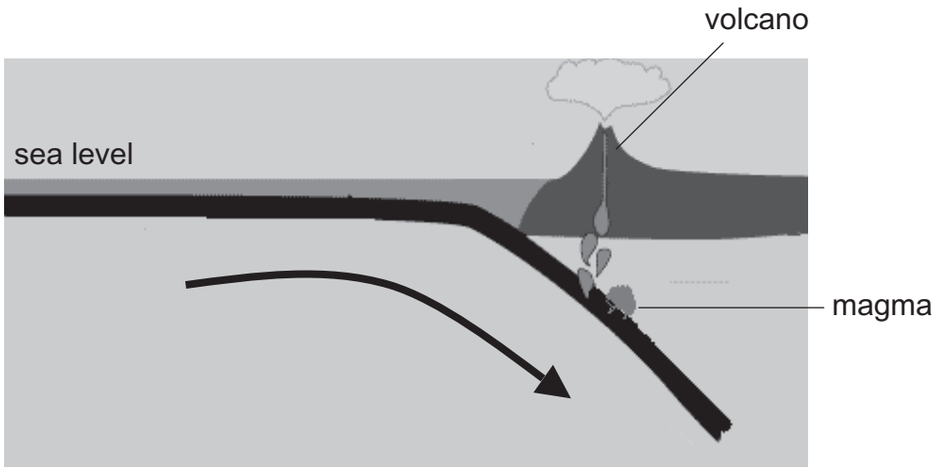
(b) One cause of earthquakes is explosive volcanic eruptions.
The other cause is associated with tectonic activity.
Explain what tectonic activity is and how it produces earthquakes.

_____

_____

_____ [2]

(c) Most volcanoes are also produced as a result of tectonic activity.
The diagram below shows what happens.



Adapted from: © The Why Files – University of Wisconsin - Madison

(i) Describe what is shown happening in this diagram.

_____

_____

_____ [3]

(ii) What energy is required to form magma shown in the diagram and what is the source of this energy?

_____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 6	

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Question Number	**Marks**
1	
2	
3	
4	
5	
6	
Total Marks	

Examiner Number

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Rewarding Learning

General Certificate of Secondary Education
2014

GCSE Physics

Unit 2

Higher Tier

[GPH22]

MONDAY 23 JUNE, MORNING

MARK SCHEME

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General Marking Instructions and Mark Grids

Introduction
Mark schemes are intended to ensure that the GCSE examination is marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses likely to be worthy of credit. They also set out the criteria that they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these marking instructions.

Quality of candidates' responses
In marking the examination papers, examiners should be looking for a quality response reflecting the level of maturity which may reasonably be expected of a 16-year-old which is the age at which the majority of candidates sit their GCSE examinations.

Flexibility in marking
Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, the examiners should seek the guidance of the Supervising Examiner.

Positive marking
Examiners must be positive in their marking, giving appropriate credit for description, explanation and analysis, using knowledge and understanding and for the appropriate use of evidence and reasoned argument to express and evaluate personal responses, informed insights and differing viewpoints. Examiners should make use of the whole of the available mark range of any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected of a 16-year-old GCSE candidate.

Awarding zero marks
Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Types of mark scheme
Mark Schemes for questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

						AVAILABLE MARKS
1	(a)	(i)	Very close to legal limit (for adults), so smaller SAR for children **or** Children get a larger dose/children's skulls are thinner/children's bodies are still developing/children's brains are smaller/absorbs more energy/smaller body mass		[2]	
		(ii)	Use an earphone/earpiece (to keep mobile phone far from head)		[1]	
	(b)		**Refraction** Frequency Same Wavelength Decreases } lower or smaller Speed Decreases }		[3]	
	(c)	(i)	Transverse		[1]	
		(ii)	Vibrations/oscillate	[1]		
			Perpendicular/at 90° to direction of energy transfer/wave direction	[1]	[2]	
		(iii)	$\lambda = v/f$ (or equivalent)	[1]		
			$\lambda = 3500/1.3$ ([1] for conversion from km to m)	[2]		
			$\lambda = 2690$ (m)	[1]	[4]	
			(If no/incorrect conversion from km/s, then maximum of [2]–[3])			
		(iv)	Distance XY = 1.6 to 1.8 cm time interval = 1.28 to 1.44 s	[2]		
			Period = 0.64 to 0.72	[1]		
			Frequency = 1/0.64 **or** 1/0.72 giving 1.39 to 1.56 (Hz)	[1]	[4]	
	(d)	(i)	150 minutes		[1]	
		(ii)	Maximum time = K × SPF or 300 = K × 30 so K = 10	[1]		
			120 minutes = 10 × SPF so SPF = 12	[1]		
			Alternatively (if hours used)			
			5 = k × 30 so K = 50/30 =1.67	[1]		
			2 hours = 1.67 × SPF so SPF = 12	[1]	[2]	20
2	(a)	(i)	Diminished	[1]		
			Inverted	[1]		
			Real	[1]	[3]	
		(ii)	Ray from top of object			
			• through optical centre undeviated to light sensitive surface	[1]		
			• parallel to PA refracts to top of image on light sensitive surface	[1]		
			• image correctly identified on light sensitive surface	[1]		
			All rays ruled and at least ONE correct arrow (and no contradictions)	[1]	[4]	
		(iii)	25 ±1 (mm) give [2]			
			22, 23, 27, 28 (mm) give [1]		[2]	

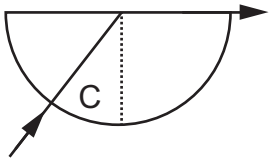
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(b) (i) It is not a straight line [2] **or** doubling of values not present [2]
Is a curve [2] [2]

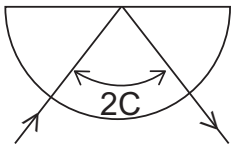
(ii) Calculations such as 5.5/20 = 0.28 and 18/40 = 0.45 [2]
Not a constant ratio $\frac{40}{20} = 2$ and $\frac{18}{5.5} = 3.3$ [1] [3]

$20 \times 2 = 40$ $5.5 \times 2 = 11$

(c) Indicative content



Trace outline and mark normal
Mark centre of straight edge
Direct ray at curved edge of glass block/or at midpoint of straight edge
Move ray/increase angle
Until refracted ray emerges along edge
Critical angle is between incident ray and normal
Give credit for information on diagram



Trace outline
Mark centre of straight edge
Direct ray at curved edge of glass block/or at midpoint of straight edge
Move ray/increase angle
Until total internal reflection seen
Angle between incident and emergent is 2C
Give credit for information on diagram

NB if ray is shown or mentioned as entering the block from straight edge give [0]

Response	Mark
Candidates describe in detail using good spelling, punctuation and grammar **at least 5 of the points** shown above and the precaution is clearly stated. The form and style are of a high standard and specialist terms are used appropriately at all times.	[5]–[6]
Candidates describe in detail using good spelling, punctuation and grammar **at least 3 of the points** shown above. The form and style are of a high standard and specialist terms are used appropriately at all times.	[3]–[4]
Candidates make some reference to **1 of the points** shown above using satisfactory spelling, punctuation and grammar. The form and style are of a satisfactory standard and they have made some reference to specialist terms.	[1]–[2]
Response not worthy of credit	[0]

[6]

AVAILABLE MARKS

20

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						AVAILABLE MARKS
3	(a)	(i)	Ammeter in series with wire	[1]		
			Variable resistor in series with wire	[1]		
			Voltmeter in parallel with wire	[1]	[3]	
			If any **one** symbol wrong max [2]			
		(ii)	To prevent the wire heating/allow wire to cool	[1]		
			Heat affects the resistance	[1]	[2]	
			Burning/safety [0] Fair test [0]			
		(iii)	Straight line graph through origin		[1]	
		(iv)	60/80 of 12	[1]		
			9 (Ω)	[1]	[2]	
		(v)	2 × length = 2 × 9 = 18 $\frac{1}{2}$ × area = 2 × 9 = 18 } 36 Ω ecf from **(iv)**	[1] [1]	[2]	
	(b)	(i)	P = IV **or** I = P/V	[1]		
			960 = 240 × I	[1]		
			I = 960/240 = 4 (A)	[1]	[3]	
		(ii)	R = V/I **or** $P = V^2/R$	[1]		
			= 240/4 $960 = 240^2/R$	[1]		
			= 60 (Ω) $R = 240^2/960 = 57\,600/960 = 60$ (Ω)	[1]	[3]	
	(c)		Elements joined in parallel	[1]		
			A switch in series with at least one element	[1]	[2]	
			Must be a working circuit			
	(d)		**Parallel** $\frac{1}{R} = \frac{1}{2} + \frac{1}{3} = \frac{5}{6}$ $R = \frac{6}{5} = 1.2$	[1]		
			Total resistance = 5 + 1.2 = 6.2 (Ω)	[1]	[2]	20

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						AVAILABLE MARKS
4	**(a)**	**(i)**	Alternating (current)		[1]	
		(ii)	Direct (current)		[1]	
	(b)	**(i)**	(Trace repeatedly) crosses time axis **or** (Trace repeatedly) changes from + to –		[1]	
		(ii)	The time or distance interval between peaks (or troughs) is constant wavelength [0]		[1]	
		(iii)	Line always on same side of time axis (must be correct before 2nd mark possible) [1] but showing changing voltage [1]		[2]	
	(c)	**(i)**	Description: Spoke in salty water kicks outwards [1] Copper wheel rotates/spins [1] (Copper wheel rotates anticlockwise gets [2]/[2])		[2]	
			Explanation: [1] **Current** carrying spoke is in a magnetic field [1] Experiences a force **or** force acts outwards **or** to right [1]		[2]	
		(ii)	Wheel turns faster		[1]	
		(iii)	Wheel now rotates in opposite direction **or** clockwise or changes direction (ecf from **(c)(i)**)		[1]	
	(d)	**(i)**	Primary coil = 480 turns [1] Secondary coil = 160 turns [1]		[2]	
		(ii)	$\frac{N_p}{N_s} = \frac{V_p}{V_s}$ [1] $\frac{480}{160} = \frac{240}{V_s}$ [4] $V_s = \frac{240}{3} = 80\,(V)$ [1]		[6]	20

Allow ecf from **(i)**, i.e. an answer of 720 V

No formula – no marks unless subs correct

If formula – [2] per side of the turns ratio

Turns ratio $\frac{1}{3}$ or $\frac{3}{1}$ [1] if no further credit possible

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AVAILABLE MARKS

5 **(a)** Indicative content

1. Gases
2. Hydrogen (and helium and dust)
3. Gravity shrinks the gas cloud
4. A large clump forms at the centre
5. Centre heats up or temperature rises
6. Nuclear fusion starts

Separate points
gravity causes it to spiral
pressure increases
density increases

Response	Mark
Candidates describe in detail using good spelling, punctuation and grammar **at least 5 points** shown above and the precaution is clearly stated. The form and style are of a high standard and specialist terms are used appropriately at all times.	[5]–[6]
Candidates describe in detail using good spelling, punctuation and grammar **at least 3 points** shown above. The form and style are of a high standard and specialist terms are used appropriately at all times.	[3]–[4]
Candidates make some reference to **one of the main points** shown above using satisfactory spelling, punctuation and grammar. The form and style are of a satisfactory standard and they have made some reference to specialist terms.	[1]–[2]
Response not worthy of credit.	[0]

[6]

(b) **(i)** Order from the left: **4 1 2 3** [2]
Two in the correct order award [1]

(ii) Heat radiation/microwaves filling the Universe/space or it seen from all directions [1]

(iii) (CMBR is radiation) left over from an early stage in the development [1]
of the Universe or Big Bang [1]

(c) Keeps planets in orbit round a star or moon/comets etc – not satellites
Pull stars into large collection – formation of galaxies.
Provides the stability in stars (by countering the outward forces.)
Pulls nebulae into stars/planetary systems.
This is about shaping the Universe/planetary atmospheres/planetary shapes so giving objects a weight is not acceptable. [3]

(d) **(i)** Big Freeze – Universe will simply expand forever or galaxies gradually getting so far away that they fade in the distance [1] or then stars burn out and **everything gets cold and dark forever**. [1]
2nd mark

(ii) Big Crunch – expansion would eventually stop [1] – gravity pulls galaxies back and the Universe would collapse [1] or to a singularity

(iii) Big Bounce – says the Universe repeatedly expands and collapses and then expands again [1] or another Big Bang [6]

20

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					AVAILABLE MARKS
6	**(a)**	**(i)**	1 = crust 2 = mantle 3 = outer core Terms must be exact 4 = inner core [1] each	[4]	
		(ii)	Crust or 1, Mantle or 2, Inner core or 4 Three given, one wrong, max [1]. Four given, [0] Crust and mantle give [1] Inner core worth [1]	[2]	
		(iii)	Nickel	[1]	
		(iv)	Lithosphere	[1]	
	(b)		Tectonic activity means the Earth plates move [1] Earthquake is due to them **suddenly** moving, jolt, jerk, lurch after being stuck [1]	[2]	
	(c)	**(i)**	One or two plate(s) is/are moving or one goes under the other plate or subduction [1] Magma molten rock is formed as they move against each other [1] This magma rises/released/erupts to the surface to form a volcano [1]	[3]	
		(ii)	Heat Friction	[2]	15
				Total	**115**

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)**.

8007.05**R**

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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.

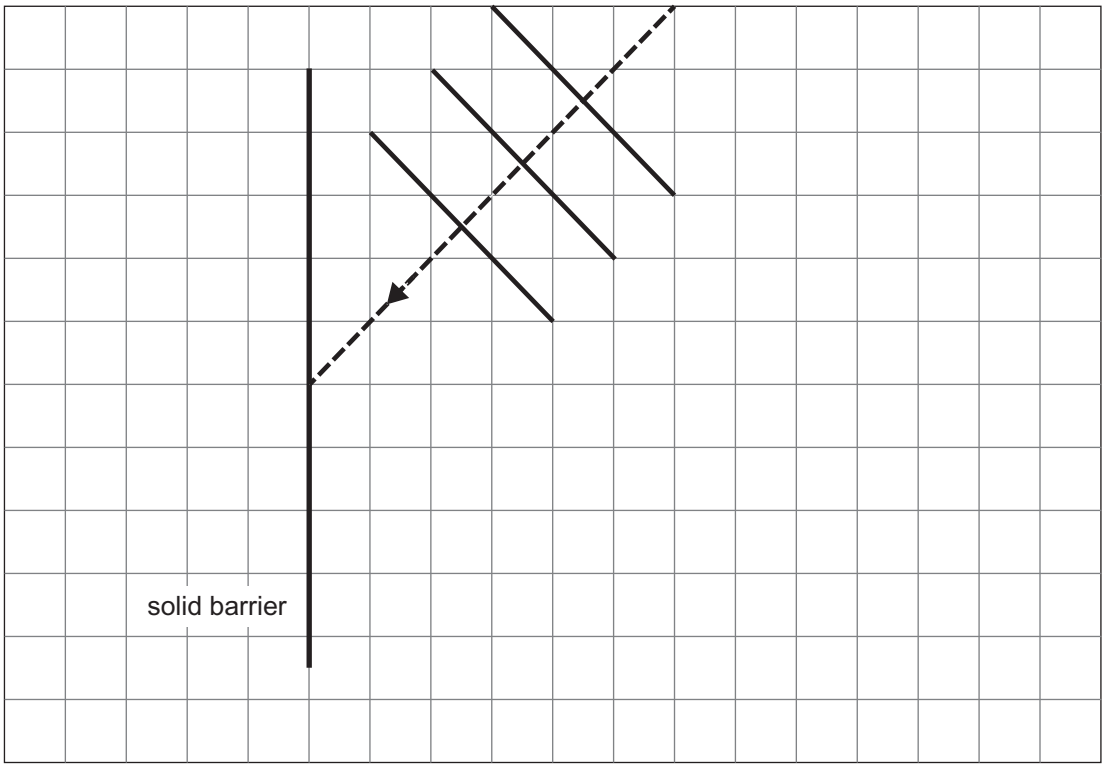
Frequency = _____ [2]

(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]

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(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

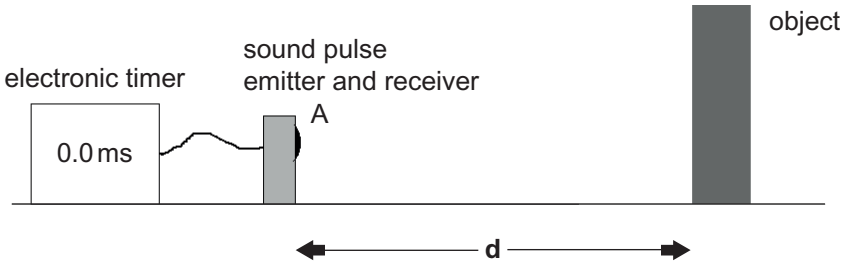
Marks	Remark

[Turn over

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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.

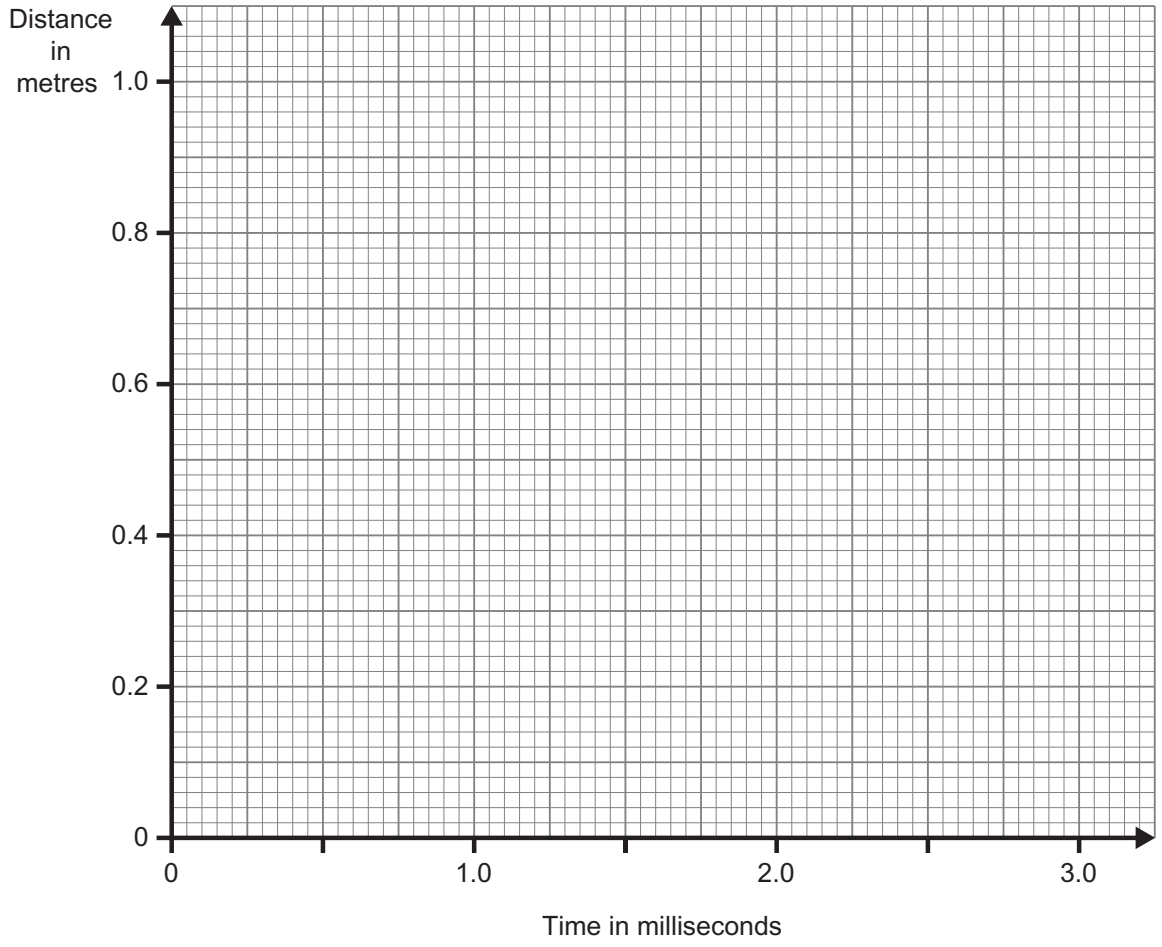
$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

(1 ms = 1 millisecond = 0.001 s)

Speed of sound = _____ m/s [3]

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(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]

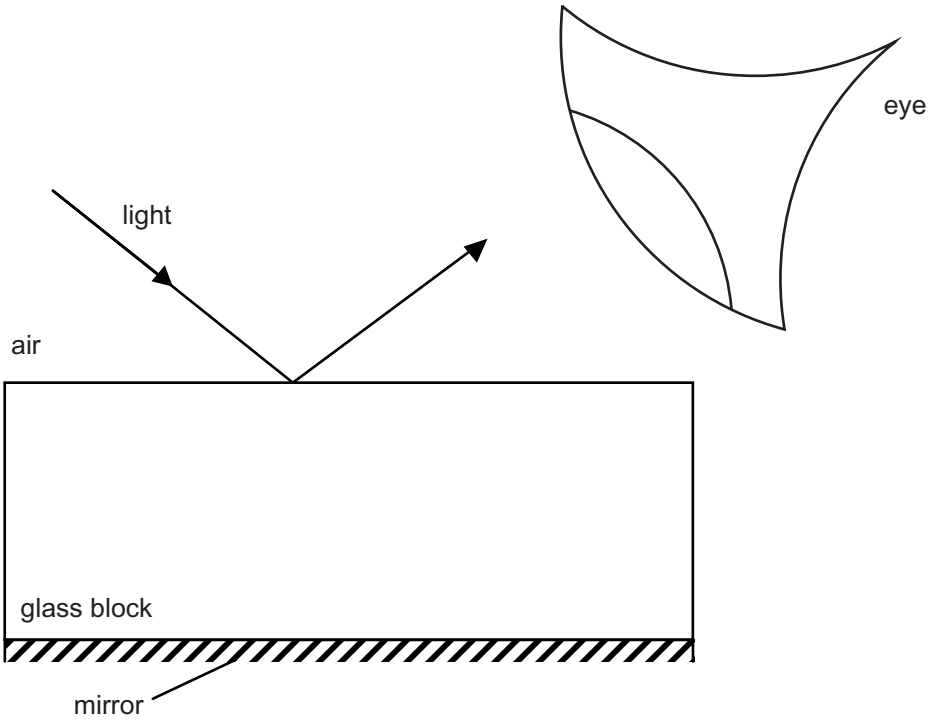
Examiner Only	
Marks	Remark
Total Question 1	

[Turn over

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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]

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(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.

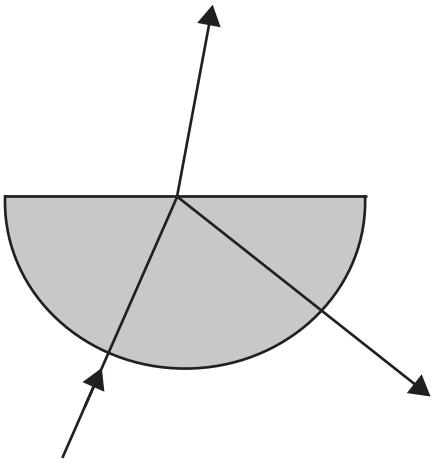


Diagram 1

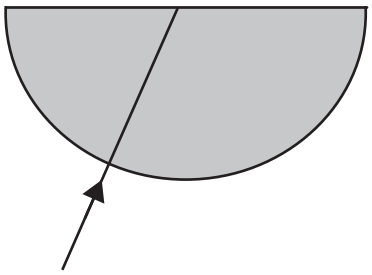


Diagram 2

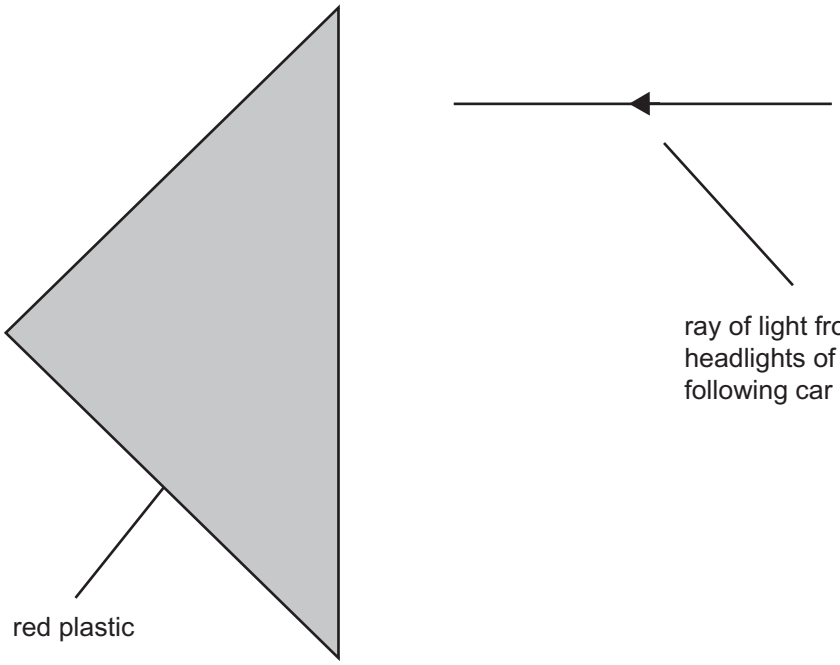
[2]

Examiner Only	
Marks	Remark

[Turn over

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(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.

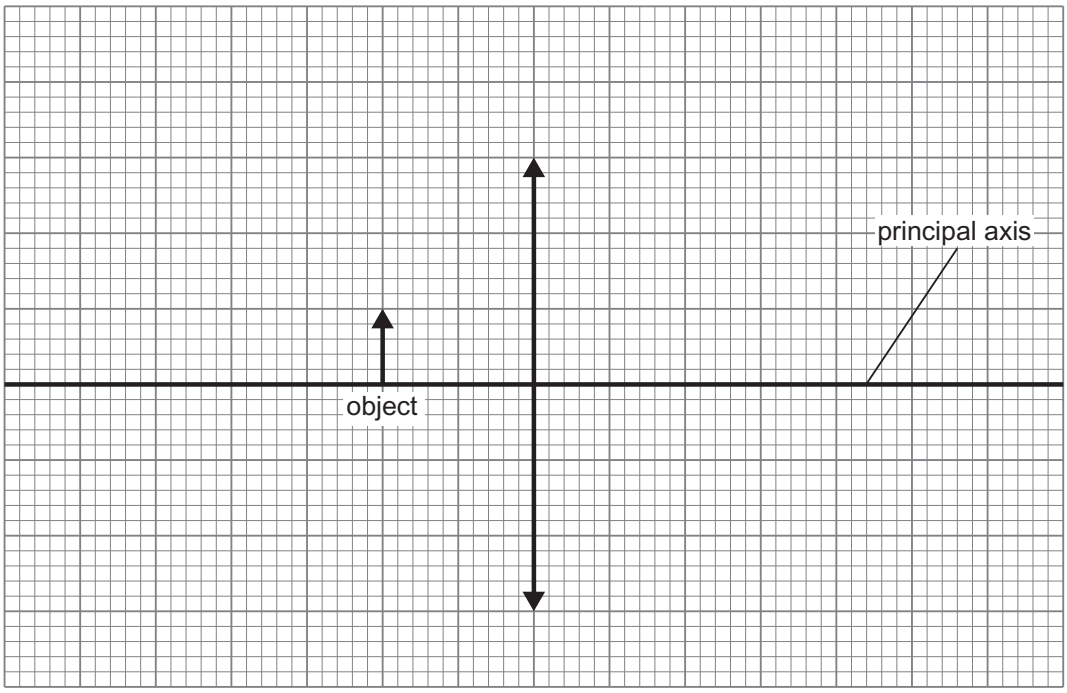


[2]

Examiner Only	
Marks	Remark

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



(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]

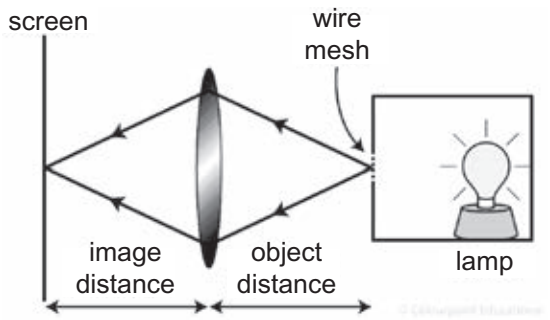
(v) Mark with the letter **E** the approximate position you should place your eye to view the image. [1]

Examiner Only	
Marks	Remark

[Turn over

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(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?

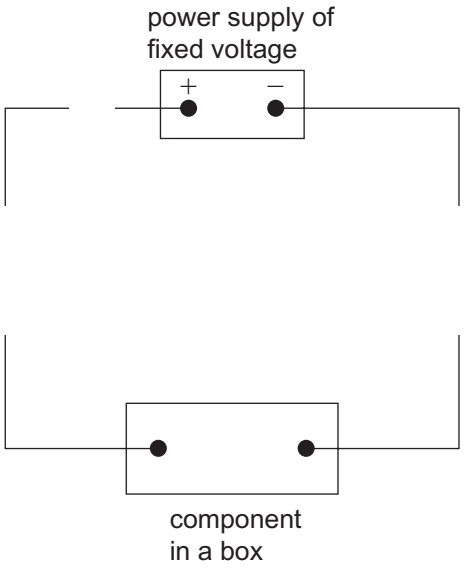
_____ [1]

Examiner Only	
Marks	Remark
Total Question 2	

Examiner Only	
Marks	Remark

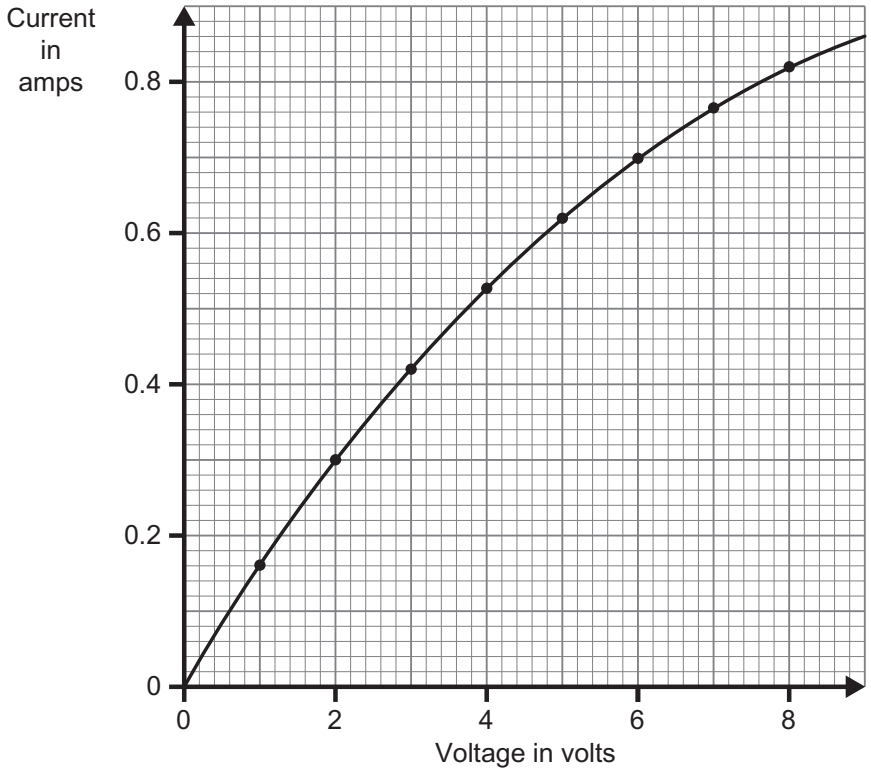
3 **(a)** Zoe was given a sealed box containing a component that conducts electricity.
Two terminals attached to the box allowed her to connect it to a circuit.
To find out what the component was she decided to investigate how the current passing through the component depended on the voltage across it.

(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]



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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]

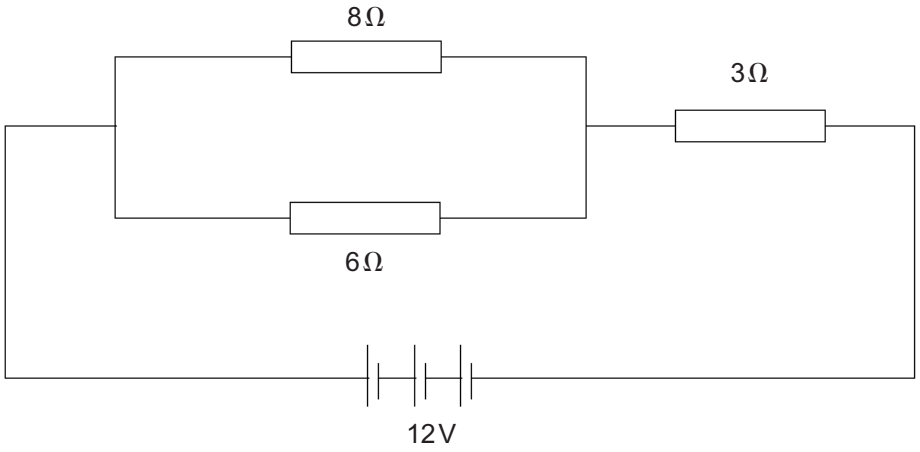
Examiner Only	
Marks	Remark

[Turn over

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(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]

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(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

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(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

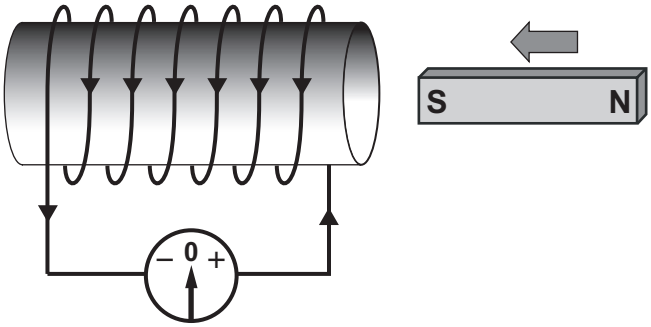
Explain, in detail, how the comb acquires a negative charge and how it is able to pick up small pieces of paper. Remember the pieces of paper are **not** electrically charged.

[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.

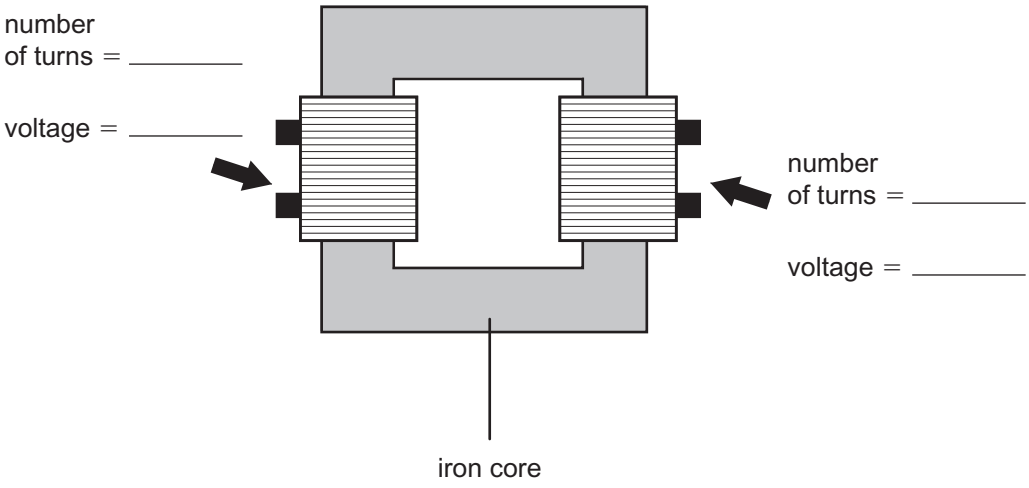
[6]

[Turn over

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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.

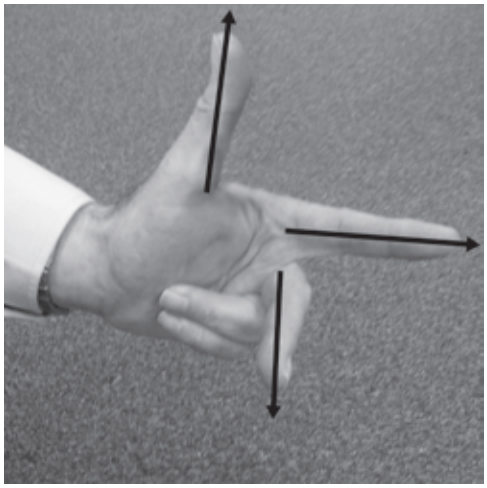
_____

_____ [2]

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(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]

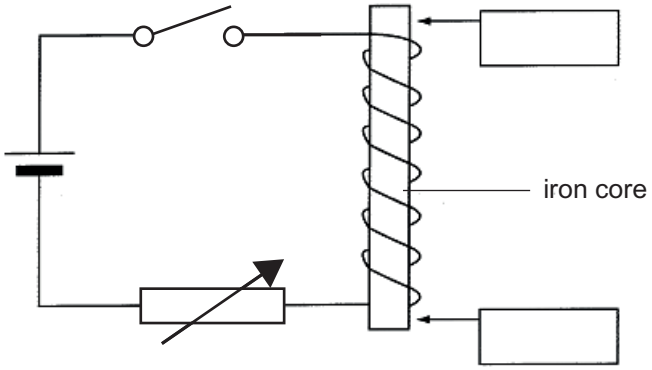
(iii) Describe how the force would change, if the current used was alternating (a.c.).

_____

_____ [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?

_____

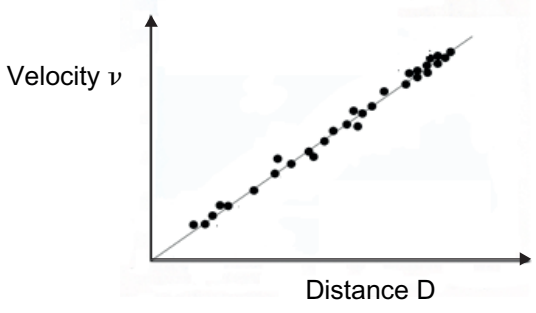
_____ [1]

(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.

_____

_____ [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.

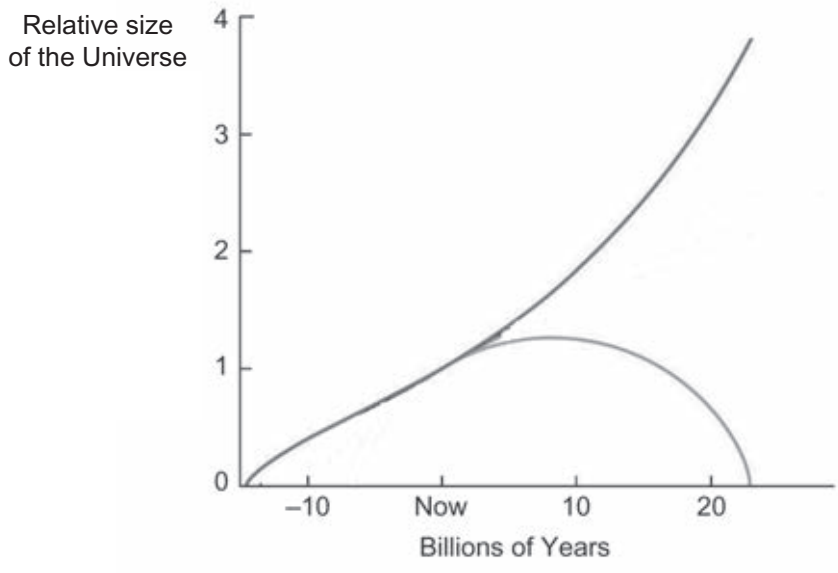
(iii) The Hercules galaxy is 670 million light years from the Milky Way. Calculate the velocity at which this galaxy is moving away from us.

Velocity = _____ km/s [2]

Examiner Only	
Marks	Remark

[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?

_____

_____

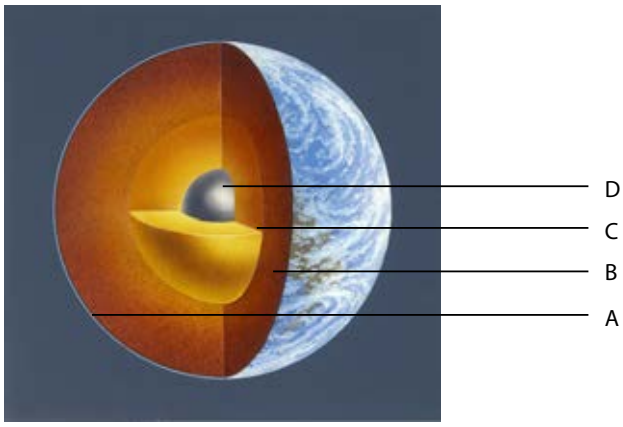
_____ [2]

Examiner Only	
Marks	Remark
Total Question 5	

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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.

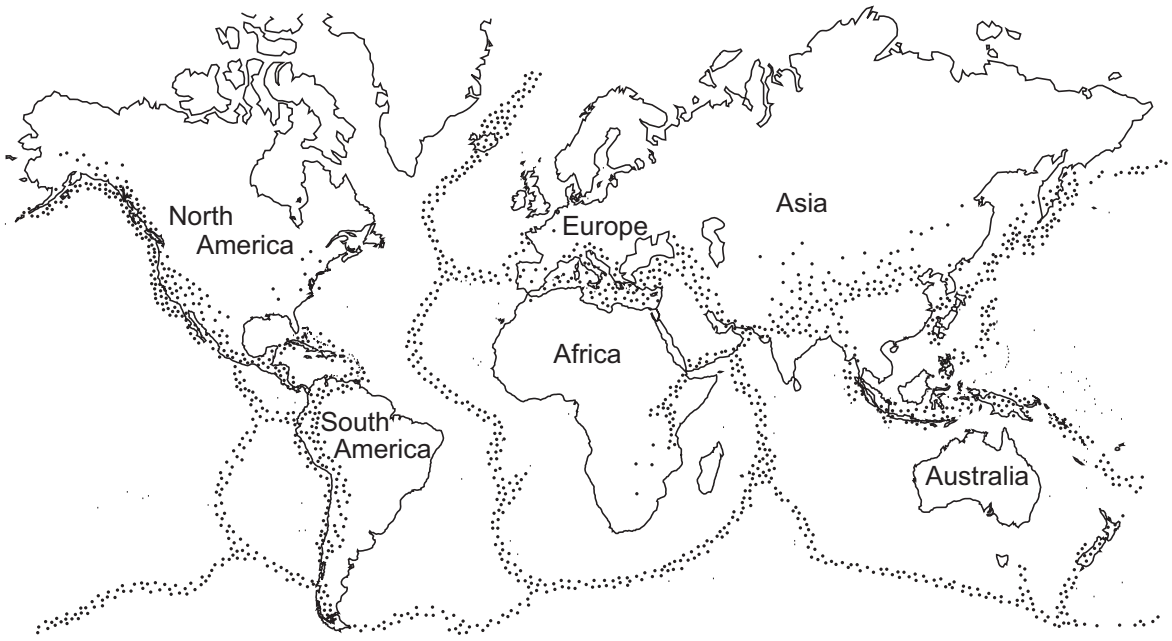
	Name of layer	Solid or Liquid	Composition
A			
B			
C	Outer core	Liquid	Nickel and Iron
D	Inner core		

[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



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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]

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(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.

© Dorling Kindersley RF / Thinkstock

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	
6	
Total Marks	

Examiner Number

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Rewarding Learning

General Certificate of Secondary Education
2013

Physics

Unit 2

Higher Tier

[GPH22]

MONDAY 24 JUNE, MORNING

MARK SCHEME

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General Marking Instructions and Mark Grids

Introduction
Mark schemes are intended to ensure that the GCSE examination is marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses likely to be worthy of credit. They also set out the criteria that they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these marking instructions.

Quality of candidates' responses
In marking the examination papers, examiners should be looking for a quality response reflecting the level of maturity which may reasonably be expected of a 16-year-old which is the age at which the majority of candidates sit their GCSE examinations.

Flexibility in marking
Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, the examiners should seek the guidance of the Supervising Examiner.

Positive marking
Examiners must be positive in their marking, giving appropriate credit for description, explanation and analysis, using knowledge and understanding and for the appropriate use of evidence and reasoned argument to express and evaluate personal responses, informed insights and differing viewpoints. Examiners should make use of the whole of the available mark range of any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected of a 16-year-old GCSE candidate.

Awarding zero marks
Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Types of mark scheme
Mark Schemes for questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

						AVAILABLE MARKS
1	(a)	(i)	Frequency = 15/60 = 0.25	[1]		
			Hz (no alternative)	[1]	[2]	
		(ii)	v = f λ (or equivalent) or v = 0.25 × 8	[1]		
			= 2 (m/s)	[1]	[2]	
			Allow e.c.f. from **(i)** for frequency			
			Use of speed = distance/time give [0]			
	(b)	(i)	Dotted line from barrier with i = r along diagonal	[1]		
			Must be to **right** of barrier			
			3 (or more) reflected waves crossing this dotted line	[1]		
			all normal to dotted line (along diagonal)	[1]		
			Reflected and incident wavelengths equal	[1]	[4]	
		(ii)	Wavelength marked		[1]	
		(iii)	Frequency Unchanged	[1]		
			Speed Unchanged	[1]		
			Wavelength Unchanged	[1]	[3]	
	(c)	(i)	Values 0.6, 1.3, 1.7, 2.4, 3.0 (ms) At least 4 correct		[1]	
		(ii)	Any suitable values, e.g. 1.0/0.003	[1]		
			= 333 (m/s)	[1]		
			Convert ms → s	[1]	[3]	
		(iii)	Points plotted, using their values (+/–1 division)	[2]		
			If maximum of two points incorrect give [1]			
			Best fit **straight** line/curve – ignore not passing 0,0	[1]	[3]	
		(iv)	0.48 to 0.52 (m) No e.c.f. from graph in **(iii)**		[1]	20

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						AVAILABLE MARKS
2	(a)	(i)	Ray entering glass bent towards normal	[1]		
			Reflected ray at mirror so that i = r	[1]		
			Ray entering air bent away from normal and parallel to reflected ray. Judge by eye.	[1]	[3]	
		(ii)	Light from glass (water) to air/more dense into a less dense **or** from low speed material to higher speed material	[1]		
			Angle of incidence greater than **critical** angle	[1]	[2]	
		(iii)	Refracted ray bent away from normal (even along boundary)	[1]		
			But only 1 ray must be refracted			
			Reflected ray i = r with no refraction	[1]	[2]	
		(iv)	TIR at the sloped sides × 2, both required at right angles	[1]		
			Reflected ray back to headlamp and parallel to incident	[1]	[2]	
	(b)	(i)	F marked on RHS 3 cm from lens		[1]	
		(ii)	Ray from top of O undeviated through centre of lens	[1]		
			Ray from top of O parallel to Pr axis passes through F then	[1]		
			rays extrapolated back until they meet, intersection marked I/image	[1]	[3]	
			Not meeting [0]			
		(iii)	Arrows left to right (both needed)		[1]	
			Conflicting arrows [0] incl. extrapolated rays			
		(iv)	Virtual	[1]		
			Light only appears to pass through it/cannot be formed on a screen/light rays only appear to meet	[1]	[2]	
		(v)	E to the right of lens or 		[1]	
	(c)	(i)	Magnification = $\frac{\text{image distance}}{\text{object distance}} = \frac{\text{distance I from lens}}{\text{distance O from lens}}$			
			Calculations such as $\frac{100}{25} = 4$ and $\frac{60}{30} = 2$	[1]	[2]	
			At least two calculations required			
			also accept any mathematical form that is correct – squaring or inverse	[1]		
		(ii)	Becomes diminished/smaller		[1]	20
			Magnification < 1 give [0]			

						AVAILABLE MARKS
3	(a)	(i)	Switch in series	[1]		
			Ammeter in series	[1]		
			Voltmeter in parallel with box	[1]		
			Variable resistor in series with power supply	[1]	[4]	
			Correct symbols required for full marks			
			If not all correct symbols give maximum [2]/[4]			
		(ii)	Value of current read from graph = 0.62 A			
			Look for evidence on graph if that is only work shown	[1]		
			R = 5/0.62 = 8.1 (Ω) Accept 8.0, 8.06 or 8.1	[1]	[2]	
		(iii)	Not proportional	[1]		
			Graph is not a straight line (passing through 0,0)			
			or I does not double when V doubles			
			or graph is a curve/not increasing at same rate	[1]	[2]	
		(iv)	No	[1]		
			Gradient changes **or** at least two values of resistance calculated	[1]	[2]	
			Resistance increases give [0] unless supported with calculations			
		(v)	(Filament) bulb/lamp		[1]	
	(b)	(i)	Parallel resistors 1/R = 1/8 + 1/6 = 7/24 [1] **or** $\frac{8 \times 6}{8 + 6}$	[1]		
			R = 3.4 (Ω)	[1]		
			Total R = 3.4 + 3 = 6.4 (Ω)	[1]	[3]	
			No e.c.f. within a part			
			$\frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{R}$ [0] – must be substitutions			
		(ii)	I = V/R = 12/6.4 = 1.88 (1.9) (A) Allow e.c.f. for R from **(i)**		[2]	
	(c)		**Electrons** are transferred from jacket to comb			
			Negative charge on comb repels electrons in the paper			
			Paper nearer the comb is now positive			
			Opposite/unlike charges then attract		[4]	20

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AVAILABLE MARKS

4 (a) Indicative content

1. A momentary deflection when magnet moved in
2. No deflection when magnet stationary
3. A momentary deflection when magnet moved out
4. When moved out deflection is larger
5. Direction is opposite

Response	Marks
Candidates describe in detail using good spelling, punctuation and grammar **all the main points** shown above and the precaution is clearly stated. The form and style is of a high standard and specialist terms are used appropriately at all times.	[5]–[6]
Candidates describe in detail using good spelling, punctuation and grammar **3 points** shown above. The form and style is of a high standard and specialist terms are used appropriately at all times.	[3]–[4]
Candidates make some reference to **one or two of the main points** shown above using satisfactory spelling, punctuation and grammar. The form and style is of a satisfactory standard and they have made some reference to specialist terms.	[1]–[2]
Response is not worthy of credit.	[0]

[6]

(b) (i) 6 (V) input to 100 turn coil [1]
24 (V) output from the 400 turn coil [1] [2]

(ii) Both a.c. ticked [1] each [2]

(iii) Current is reduced [1]
– resistance reduced give [0]
so there is reduced energy losses (in the cables) [1] [2]

(c) (i) Thumb = motion/force [1]
First finger = magnetic **field** direction or **N** → **S** [1]
Second finger = current [1] [3]

(ii) Up [1]

(iii) It would reverse direction repeatedly
or increase and decrease in magnitude repeatedly
or vibrate up and down repeatedly
or vibrate [1]
Change give [0]

(d) (i) Adjust the variable resistor/change the resistance of variable resistor [1]
change R [0]

(ii) Top is North and bottom is South [1]
go → 0 give [0]
linking not a conductor with weakened magnetic field [0]

(iii) It would reduce [1]
It goes to zero give [0]
Linking wood with insulator or is not a conductor give [0]

20

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						AVAILABLE MARKS
5	**(a)**	**(i)**	Hydrogen and helium *both needed*		[1]	
		(ii)	(Nuclear) fusion – *exact spelling*		[1]	
		(iii)	Gravity and gas or radiation pressure *both needed* outward pressure/radiation [0]		[1]	
	(b)		1. Gas and dust cloud shrinks 2. This is due to gravity 3. It heats up or fusion occurs 4. Eventually hot enough for a star to shine 5. Small clumps form the planets	any 3 of 5 for [3]		
			Evidence – all planets lie in same plane **or** orbit the Sun in the same direction **or** rocky planets close and gas planets further away		[4]	
	(c)	**(i)**	(Cosmic) **Microwave background or** CMBR **or** 3 cm background		[1]	
		(ii)	Afterglow/echo/ remnant/residual/leftover energy from Big Bang Big Bang without qualification [0]		[1]	
	(d)	**(i)**	The light from the galaxy is shifted to longer wavelengths **or** is red shifted		[1]	
		(ii)	The **more distant** the galaxy the **greater the velocity** Velocity proportional to distance give [1] Their velocity is increasing give [0]		[2]	
		(iii)	Velocity = 25 × 670	[1]		
			= 16 750 (km/s)	[1]	[2]	
	(e)	**(i)**	Big Freeze – upward curve	[1]		
			Big Crunch – closed loop	[1]	[2]	
		(ii)	The galaxies continue to move apart (forever) **or** Universe/Space continues to expand	[1]		
			Temperature of the Universe falls Any mention of planets moving apart give [0]	[1]	[2]	
		(iii)	Gravity	[1]		
			pulls the galaxies back/stops Space/Universe expanding Universe collapses on itself, collapses to singularity Planets getting closer [0]	[1]	[2]	20

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AVAILABLE MARKS

6 **(a)** **(i)**

A	Crust [1]	Solid [1]	
B	Mantle [1]	Any one of: Solid (can flow) Liquid Semi-solid Semi-liquid Solid/liquid [1]	
C			
D		Solid [1]	Nickel/iron [1]

[6]

(ii) The (**crust** of the) Earth is made up of **plates** [1]

(iii) The plates are moving (slowly) [1]
Some parts of the plates stick [1]
then move suddenly essential [1] [3]

(iv) **Friction** between moving plates [1]
produces heat [1]
melts rock – makes magma [1] [3]

Alternative answer:
plates move apart [1]
magma/lava fills the gaps [1]
this comes from deep in Earth [1]
or as a result of friction heating/melting rocks

(b) Continents are on plates **or** Earth made up of plates [1]
These plates have moved [1] [2]
Continental Drift without more detail give [1]

Alternative answer:
Convection currents in the mantle [1]
cause plates to move [1]

15

Total **115**