Rewarding Learning

71	

Candidate Number

General Certificate of Secondary Education
2012

Science: Physics

Paper 2
Higher Tier

[G7605]

G7605

MONDAY 25 JUNE, AFTERNOON

TIME

1 hour 45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all five** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 125.
Quality of written communication will be assessed in Question **2(c)(i)** and Question **3(d)(iv)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Details of calculations should be shown.
Units must be stated with numerical answers where appropriate.

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	

Total Marks	

Examiner Only	
Marks	Remark

1 **(a)** **(i)** Two forces, one of 10 N and the other of 6 N, can act on a toy car at the same time. Calculate the largest and the smallest resultant of these two forces. Complete the diagram below by drawing the directions of the forces that give the largest and the smallest resultant force.

Largest resultant force = _____ N

Smallest resultant force = _____ N

[4]

(ii) State two effects that an unbalanced force can have on an object.

1. _____

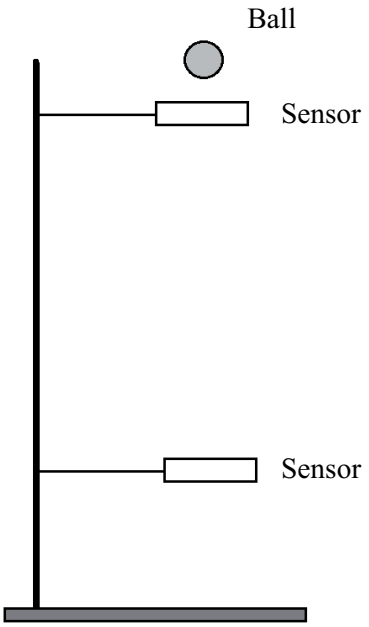
_____

2. _____

_____

[2]

(b) In an experiment to measure the acceleration of free fall (acceleration due to gravity) a ball is dropped between two sensors. The sensors are connected to a computer.
This arrangement allows the **velocity** of the ball to be measured as it passes each sensor.



(i) What other piece of data is required to calculate the **acceleration**?

_____

_____ [1]

(ii) State the equation that would allow you to find the acceleration of free fall using the data provided by the computer and the additional piece of data stated in **(i)**.

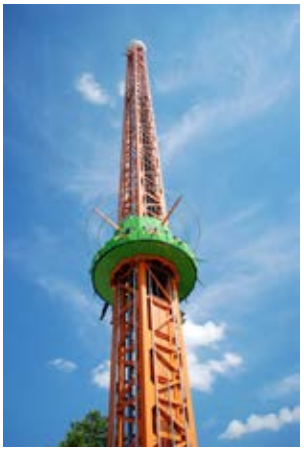
[2]

Examiner Only

Marks	Remark

(c) A theme park ride is shown in the picture opposite. The passengers are lifted to a height and then dropped.

The graph below shows how the velocity of the passengers changes during the ride.



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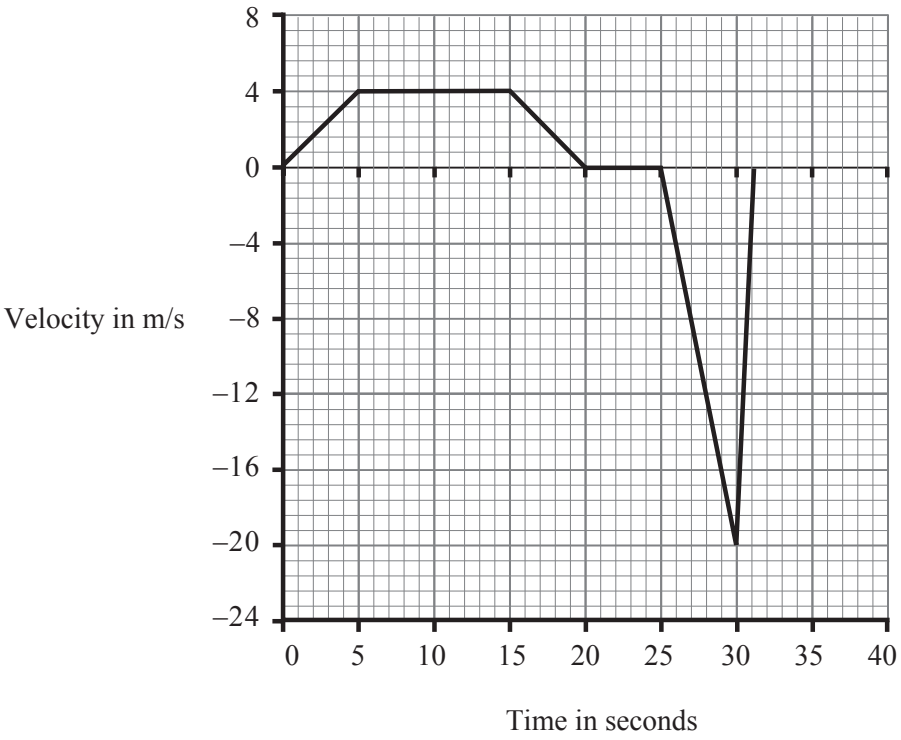


(i) Describe the motion of the passengers for the first 25 seconds.

_____

_____

_____

_____

_____

_____ [4]

Examiner Only	
Marks	Remark

(ii) Using the graph calculate the height the passengers are taken to.
You are advised to show clearly how you get your answer.

Height = _____ m [5]

(iii) Calculate the **average** velocity of the passengers as they travel upwards.
You are advised to show clearly how you get your answer.

Average velocity = _____ m/s [2]

(iv) Why is the velocity positive between 0 and 20 seconds and negative from 25 to 31 seconds?

_____

_____ [1]

(v) Calculate the deceleration of the passengers between 30 and 31 seconds.
Remember to include the unit for deceleration in your answer.
You are advised to show clearly how you get your answer.

Deceleration = _____ [5]

Examiner Only	
Marks	Remark

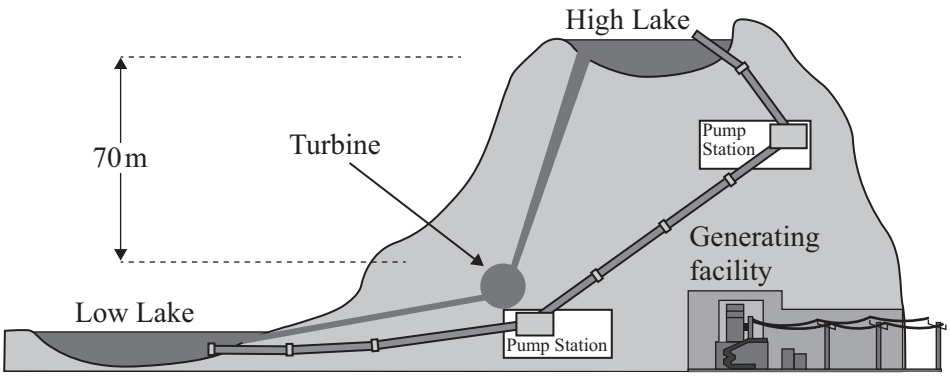
(vi) Calculate the **maximum** momentum of the passengers and carriage during the ride. The passengers and car have a total mass of 2500 kg.
You are advised to show clearly how you get your answer.

Maximum momentum = _____ kg m/s [4]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

2 **(a)** The Dinorwig power station in Wales is described as a pumped storage scheme. Electricity is used to pump water into a high level lake as shown in the diagram below. This is done during the night when the demand for electricity is much lower than during the day.



(i) A hydroelectric power station uses a renewable source of energy to generate electricity. What is a renewable energy source?

_____

_____ [1]

(ii) Unlike a hydroelectric power station, the Dinorwig scheme **cannot** be described as a renewable energy source. Explain why.

_____

_____

_____ [2]

(iii) The water falls 70 m from the high lake to the turbine.
Calculate the potential energy of 1 kg of water 70 m above the turbine.
You are advised to show clearly how you get your answer.

Potential energy = _____ J [4]

Only 85% of this potential energy is converted to kinetic energy when the water falls from the high lake to the turbine.

(iv) What has happened to the other 15% of the potential energy?

_____

_____ [1]

(v) Knowing that 85% of the potential energy is converted to kinetic energy, calculate the average speed of each 1 kg of water as it reaches the turbines.
You are advised to show clearly how you get your answer.

Average speed = _____ m/s [5]

Examiner Only	
Marks	Remark

(vi) For every 1 kg of water that reaches the turbines 500 J of electricity are generated. Using your answer to part **(iii)** calculate the overall efficiency of the Dinorwig power scheme.
You are advised to show clearly how you get your answer.

Efficiency = _____ [3]

(vii) The generators at Dinorwig can reach maximum electrical power output in 5 seconds. What advantage is this over fossil fuel or nuclear power stations?

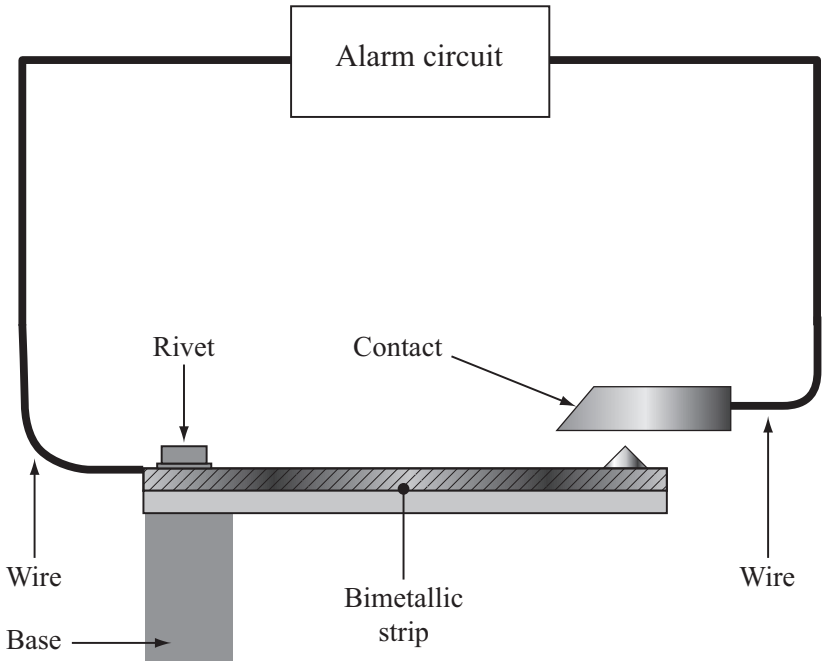
_____

_____ [1]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(b) A bimetallic strip consists of two different metals. For the same increase in temperature one metal expands more than the other. The diagram below shows a bimetallic strip being used to operate an alarm should the temperature in a storeroom become too high.
When the circuit is completed the alarm will sound.



© *How Stuff Works*

(i) Describe how the bimetallic strip should behave to set the alarm off.

_____ [1]

(ii) Describe how the metals should be arranged on this bimetallic strip so that the alarm will work correctly.
Remember one metal expands more than the other.

_____

_____

_____ [1]

(c) The processor in a computer generates a lot of heat. This heat must be removed otherwise the processor may fail to work properly.
The processor is placed in contact with a metal structure similar to the one shown below.

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(i) Describe how the three processes of heat transfer remove heat from the processor.

_____

_____

_____

_____ [3]

Quality of written communication [2]

(ii) Explain why painting the metal structure black makes it more efficient at removing heat from the processor.

_____

_____ [1]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

3 **(a)** Explain the difference between a luminous and a non-luminous object.

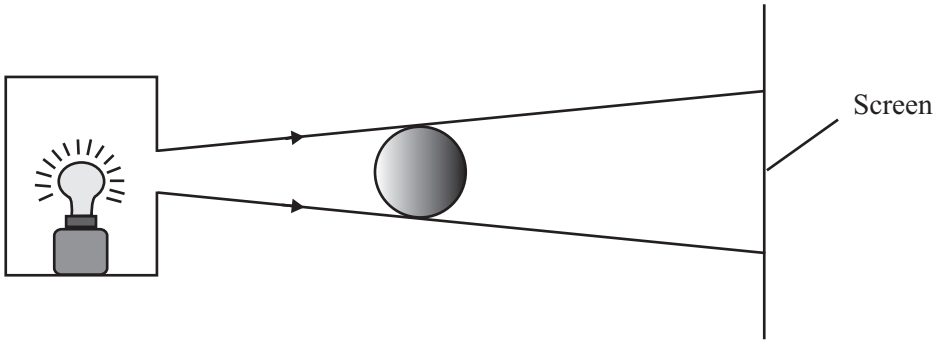
_____

_____

_____

_____ [2]

(b) A light source produces a shadow of a ball on a screen as shown. Two rays are shown to indicate the region of total shadow on the screen.



(i) What name is given to this type of light source?

_____ [1]

(ii) What is the shape of the shadow on the screen?

_____ [1]

(iii) Using a ruler, draw two further rays on the diagram above which will allow you to indicate the regions of partial shadow (penumbra). [2]

(iv) Label a region of partial shadow on your diagram with the letter P. [1]

(v) What is the effect, if any, of the following changes on the size of the complete shadow on the screen? Indicate your response by ticking (✓) the appropriate box.

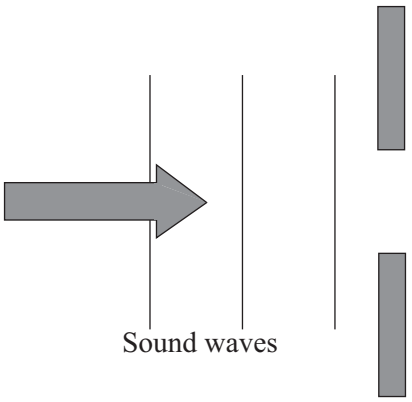
	Shadow's size decreases	**No change in size of shadow**	**Shadow's size increases**
Using a larger screen			
Moving the screen away from the ball			
Moving the light source away from the ball			

[3]

(c) The diagram below shows sound waves approaching an open doorway.

(i) On the diagram below carefully draw three waves to show the shape of the sound waves, after they pass through the doorway. [2]

You need not draw the diagram to scale, but it should be clear whether the wavelengths of the waves on the right of the doorway are bigger than, smaller than or equal to the wavelengths on the left hand side.



(ii) What is this process called?

_____ [1]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

(d) The diagram below shows a ray of light passing through water towards the air above it. The critical angle for water is 49°.

(i) Explain carefully what is meant by the statement that the critical angle for water is 49°.

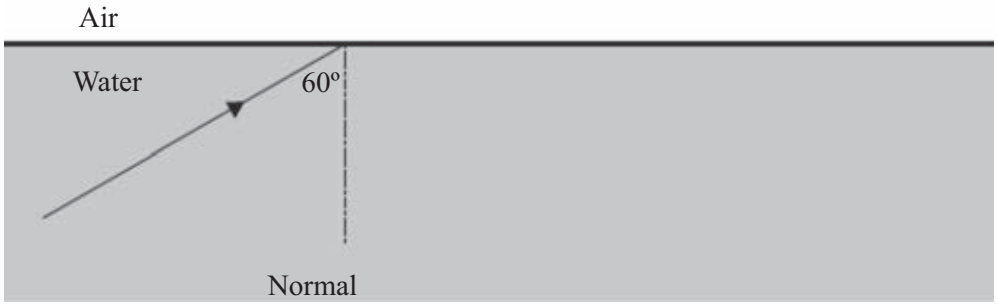
_____

_____ [1]

(ii) On the diagram above, continue the ray of light to show how it behaves at the surface of the water. [2]

The diagram below shows a second ray of light approaching the water surface at a different angle.

(iii) Continue this ray to show how it behaves at the surface of the water.
Remember the critical angle of the water is 49°. [2]



(iv) Describe **one** use of optical fibres in medicine, making clear the **special properties of the fibre** that make it suitable for the use described.

_____

_____

_____

_____

_____

_____

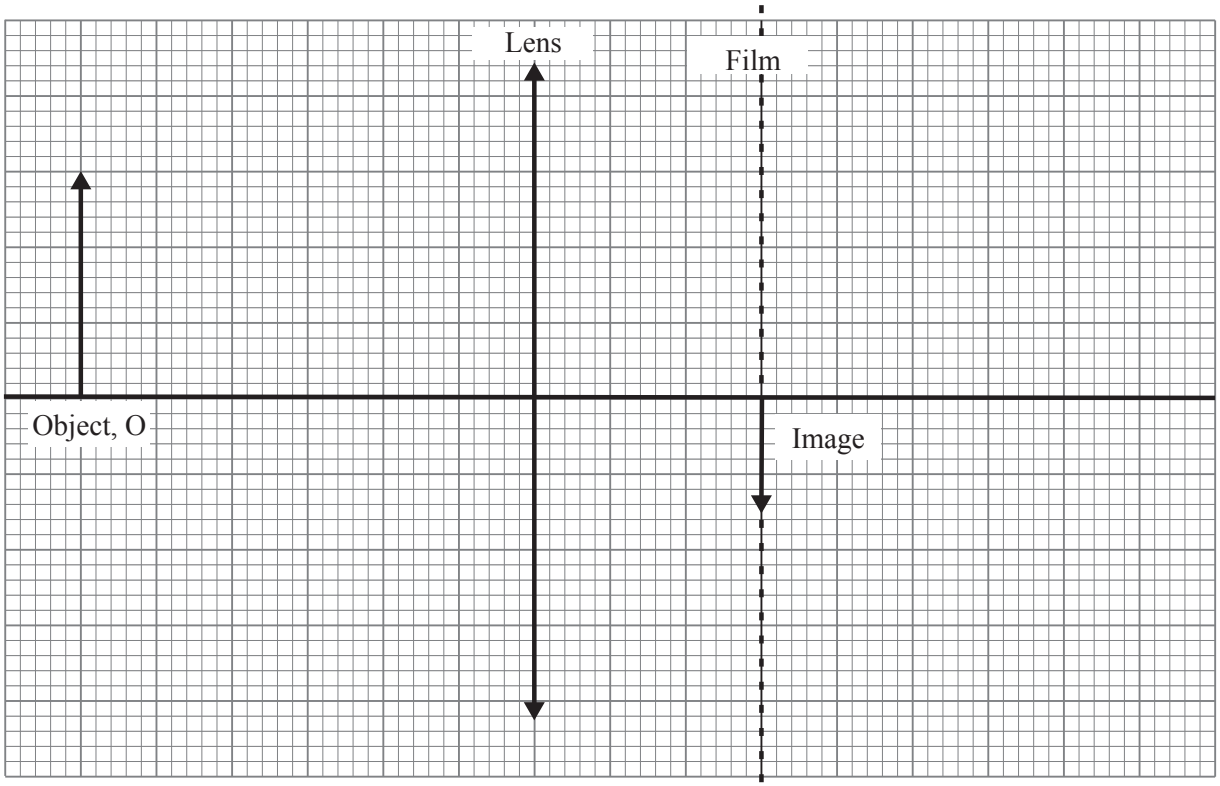
_____ [3]

Quality of written communication [1]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(e) A camera is used to photograph an object, O, which is 3.0 cm high and placed 6.0 cm from the camera lens as shown in the diagram below. The distance between the film and the lens is 3.0 cm as shown in the **full-scale** diagram below.



(i) Using a ruler, draw a ray on the grid above to enable you to find the position of the principal focus (focal point) of the lens. Label this point "F". [2]

(ii) Using your answer to part **(i)**, find the focal length of the lens.

Focal length = _____ cm [1]

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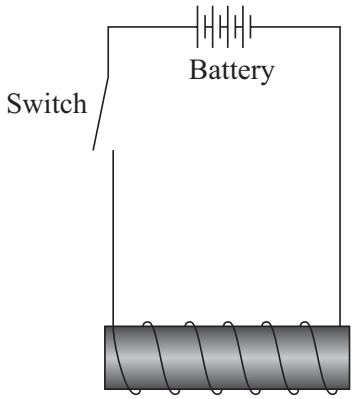
(Questions continue overleaf)

Examiner Only	
Marks	Remark

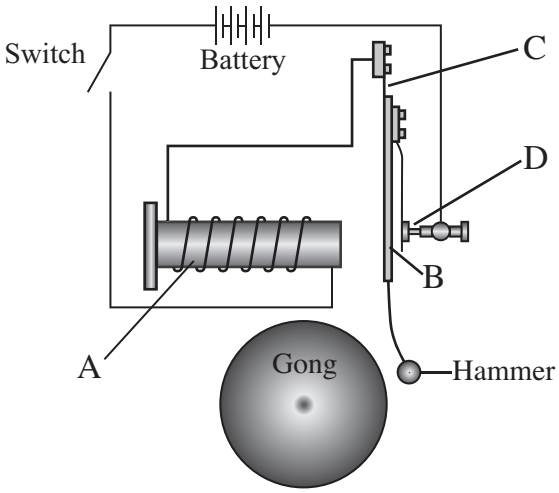
4 **(a)** The diagram below shows the electromagnet used in a doorbell.



(i) On the diagram above mark the **north pole** of the electromagnet when the switch is closed. [1]

(ii) On the diagram above draw three magnetic field lines around the electromagnet.
On the magnetic field lines mark their direction. [3]

The diagram below shows an electric bell and its circuit.



(iii) When the switch is closed the bell rings. Describe the role the parts marked by letters play in the working of the bell.

A _____

_____

B _____

_____

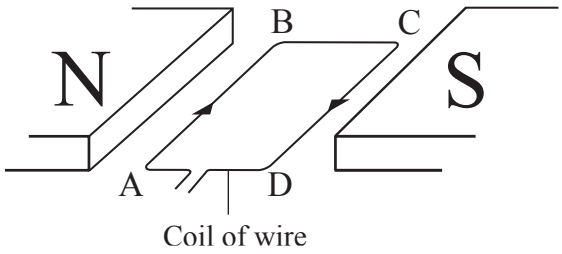
C _____

_____

D _____

_____ [4]

(b) The diagram below shows a loop of wire placed between the north (N) and south (S) poles of a magnet. The direction of the magnetic field is from north to south.
An electric current flows in the loop in the direction shown.
As a result of this some parts of the loop will experience a force.



(i) Complete the table below to show which of the sections of the wire loop experience a force. Some information is already shown in the table.

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

[2]

(ii) What electrical device is based on the arrangement of the coil and magnet shown above?

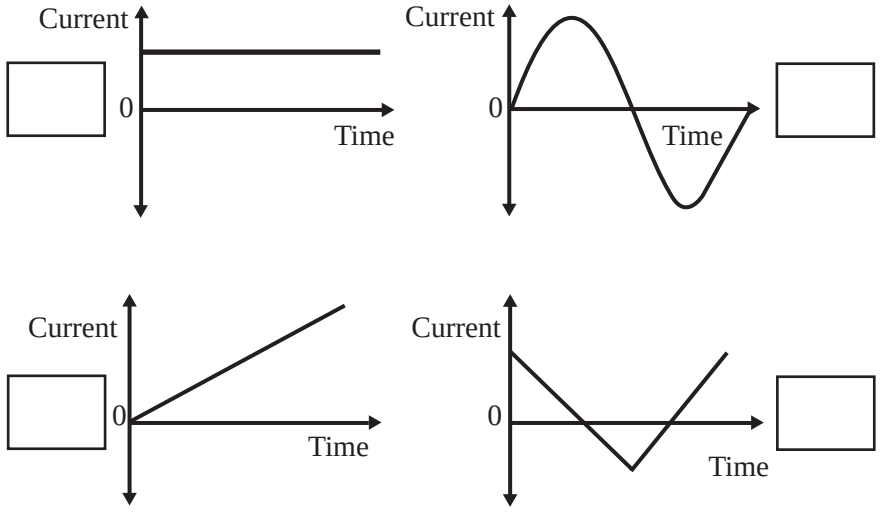
_____ [1]

Examiner Only

Marks	Remark

(c) The graphs below show how different electric currents vary with time. The currents are either alternating (a.c.) or direct current (d.c.).

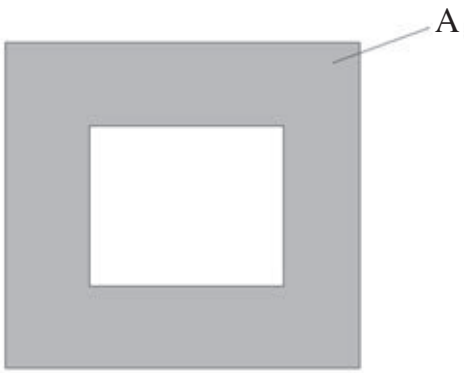
Identify the current shown in each case by writing a.c. or d.c. in the boxes provided.



[4]

Examiner Only	
Marks	Remark

(d) (i) Complete the diagram below to show the structure of a **step-up** transformer. Label each part and clearly indicate where the input and output voltages are connected.



[4]

(ii) Name the material used for part A of the transformer. Why is it used?

_____

_____

_____ [2]

(iii) The transformer may be described as a device that transfers electrical energy from one circuit to another. Describe how it does this.

_____

_____

_____

_____

_____ [2]

(iv) State where step-up and step-down transformers are used in the transmission of electricity to consumers.

_____

_____

_____ [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

5 **(a)** **(i)** A galaxy is a collection of many millions of star systems.
What force holds these star systems together in a galaxy?

_____ [1]

(ii) In which galaxy is our solar system found?

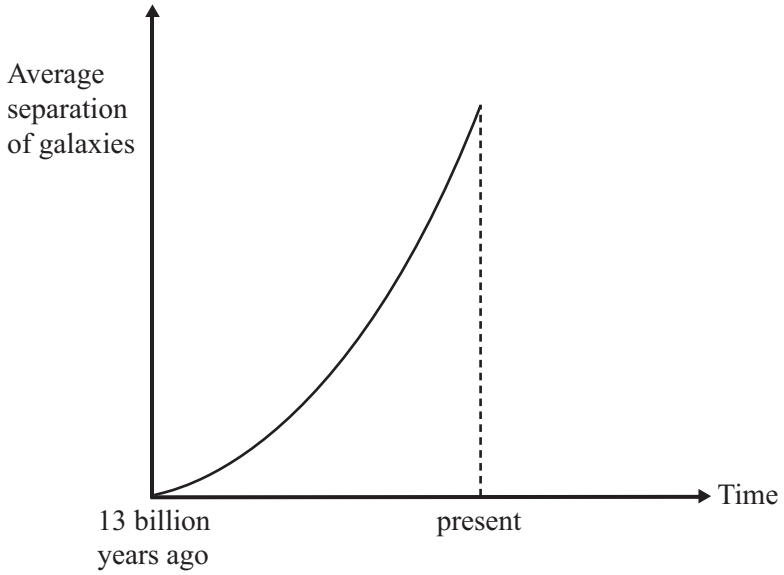
_____ [1]

(iii) The Earth is 27 000 light years from the centre of our galaxy.
What is 27 000 light years?

_____

_____ [1]

The graph below shows how the average separation of the galaxies has changed over time.



(iv) In what way does this graph support the Big Bang theory?

_____

_____ [1]

(v) What observation provided the data for the graph shown above?

_____ [1]

(b) The modern model of our solar system is called the Heliocentric Model. The model in use about 500 years ago was called the Geocentric Model.

(i) Complete the two sentences below to describe the **major** difference between these two models.

In the Heliocentric Model, _____

_____

_____

In the Geocentric Model, _____

_____

_____ [2]

(ii) Give one scientific observation which can be explained well by the Heliocentric Model and cannot be satisfactorily explained by the Geocentric Model.

_____

_____ [1]

(iii) When the Heliocentric Model was first proposed it experienced considerable opposition. Where did most of this opposition come from?

_____

_____ [1]

Examiner Only

Marks	Remark

(c) The Nebular Model is normally given as the method responsible for the formation of our solar system. The various stages are listed below, each one is given a number.

Arrange the stages in the **correct time order** by writing the appropriate number in the boxes provided. Some have been done for you.

1. Collisions between the various particles in the nebula caused the gas and dust to flatten into a disc.

2. The gas in the outer parts of the nebula also began to form clumps and the gas planets such as Jupiter and Saturn began to form. These gas planets then attracted to them the remaining gas.

3. The gas cloud began to shrink and the gas molecules moved closer together.

4. The newly formed Sun then drew the heavier material closer and the rocky planets such as Earth began to form.

5. Many billions of years ago a large star exploded leaving behind a large, slowly rotating interstellar gas cloud (nebula), consisting mostly of hydrogen and helium.

6. The gas cloud heated up as it shrank. The hottest part of the nebula was at the centre. Eventually the temperature became hot enough to allow nuclear fusion to take place and the Sun began to shine.

1st stage	5
	1
6th stage	4

[2]

Examiner Only	
Marks	Remark

In the Northern Hemisphere it is generally warmer in summer than it is in winter.

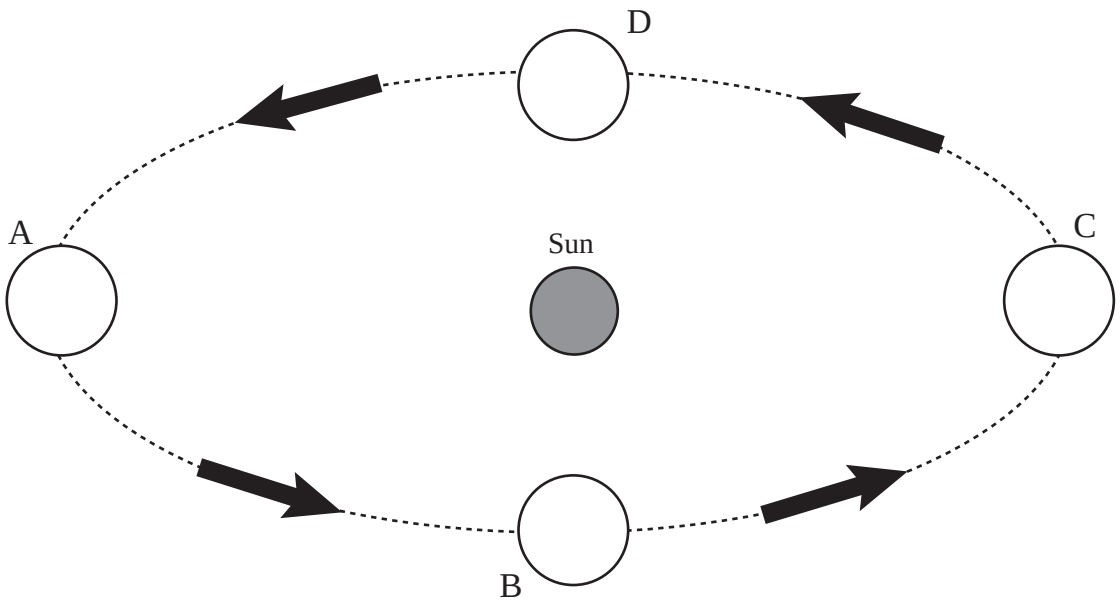
(d) (i) Explain carefully why this is so.

_____

_____

_____ [2]

In the diagram below, the dotted line shows the orbit of the Earth around the Sun.



Four different positions along this path are marked A, B, C and D. The arrows show the direction of the Earth's motion around the Sun. Northern Ireland has summer when the Earth is in position A.

(ii) On the diagram above draw the axis of rotation of the Earth in position C. [1]

(iii) What are the seasons in the **southern hemisphere** when the Earth is in positions B and D?

B: _____ D: _____ [1]

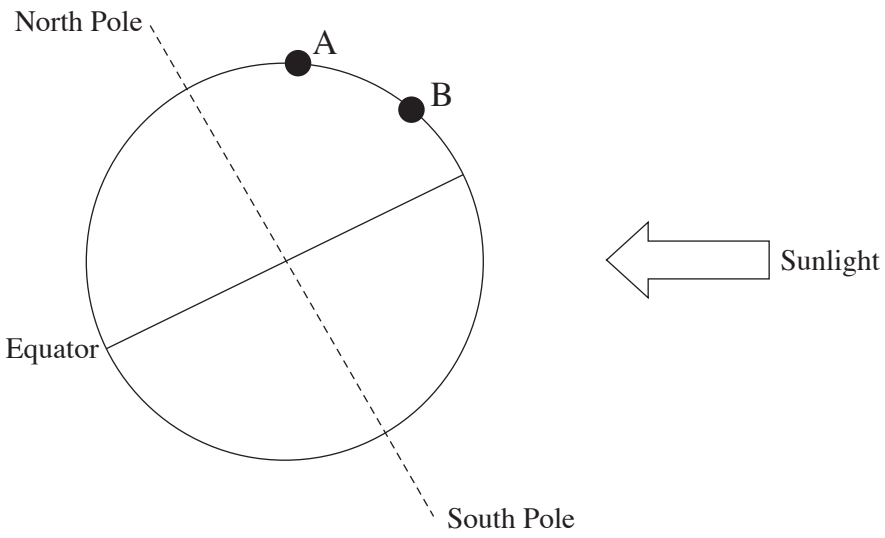
(iv) How long does it take the Earth to move from A to D?

_____ months [1]

Examiner Only

Marks	Remark

The diagram below shows the Earth illuminated by sunlight.



(v) Shade the part of the Earth that is in night. [1]

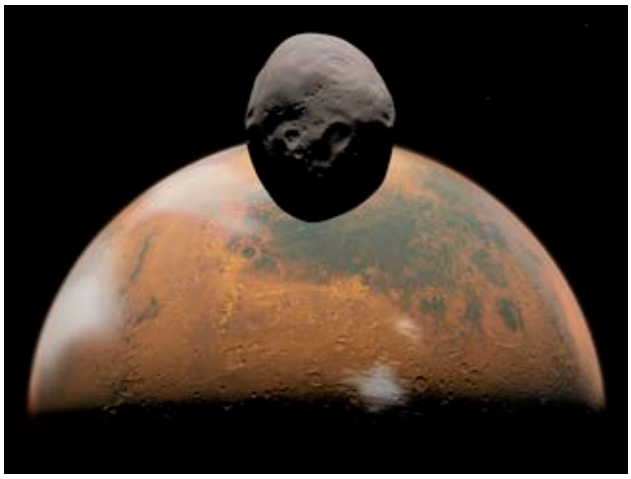
(vi) A and B are two cities. Which has the greater number of hours of daylight?

_____ [1]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(e) The planet Mars has a moon called Phobos. The masses of Phobos and Mars are constant. Phobos gets closer to Mars each time it completes an orbit of Mars.



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Is the gravitational force between Phobos and Mars increasing, decreasing or remaining constant as Phobos orbits Mars? Give a reason for your answer.

_____

Reason: _____

_____

_____ [2]

THIS IS THE END OF THE QUESTION PAPER