CCEA GCSE PHYSICS (2003 SPECIFICATION)

PHYSICS



EXAM QUESTION PACK

PAPER 2 HIGHER TIER G7605 PAPERS

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Rewarding Learning

Centre Number

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	

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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. _____

_____

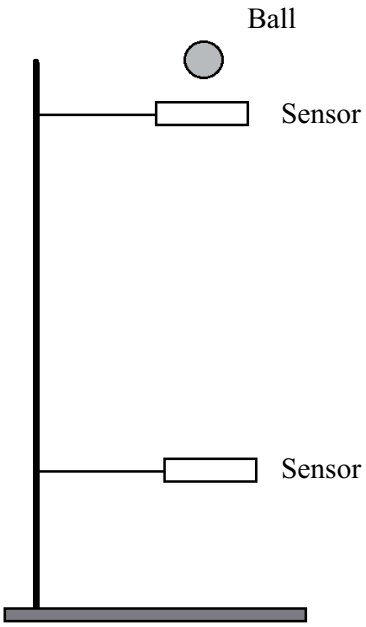
2. _____

_____

[2]

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(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]

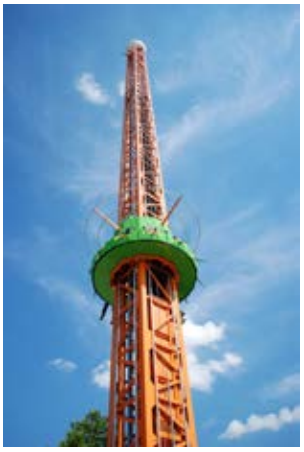
Examiner Only

Marks	Remark

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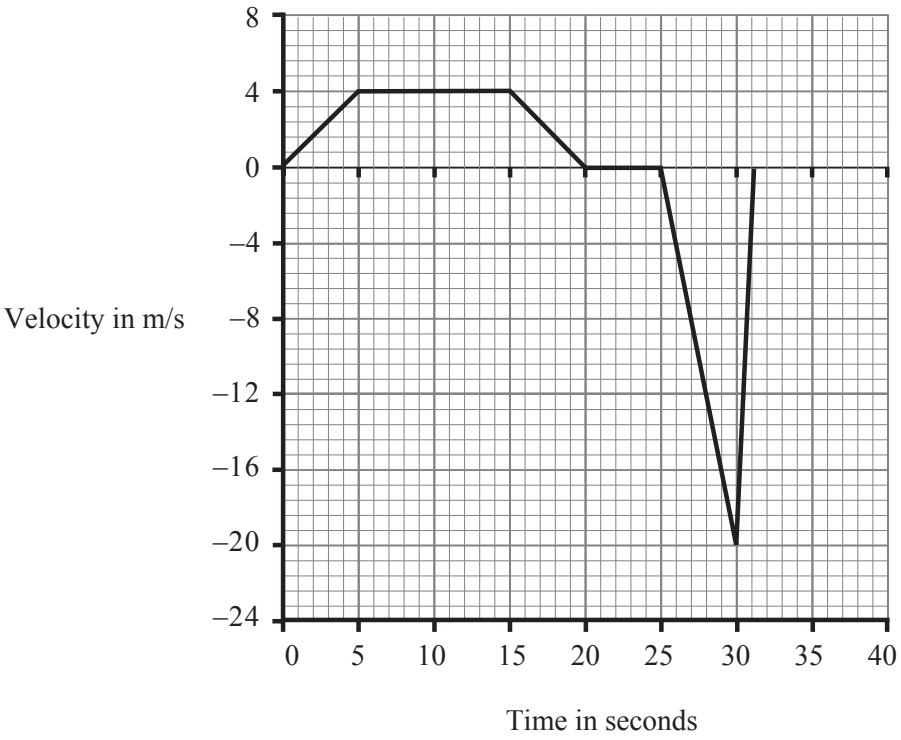
Examiner Only	
Marks	Remark

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



© *iStockphoto / Thinkstock*

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



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

_____

_____

_____

_____

_____

_____ [4]

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(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

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(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.

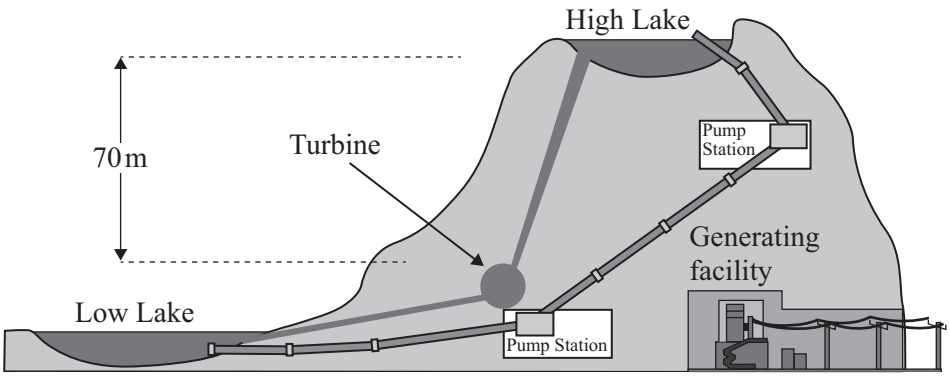
Maximum momentum = _____ kg m/s [4]

Examiner Only	
Marks	Remark

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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.



© V Ryan www.technologystudent.com

(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

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(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?

_____

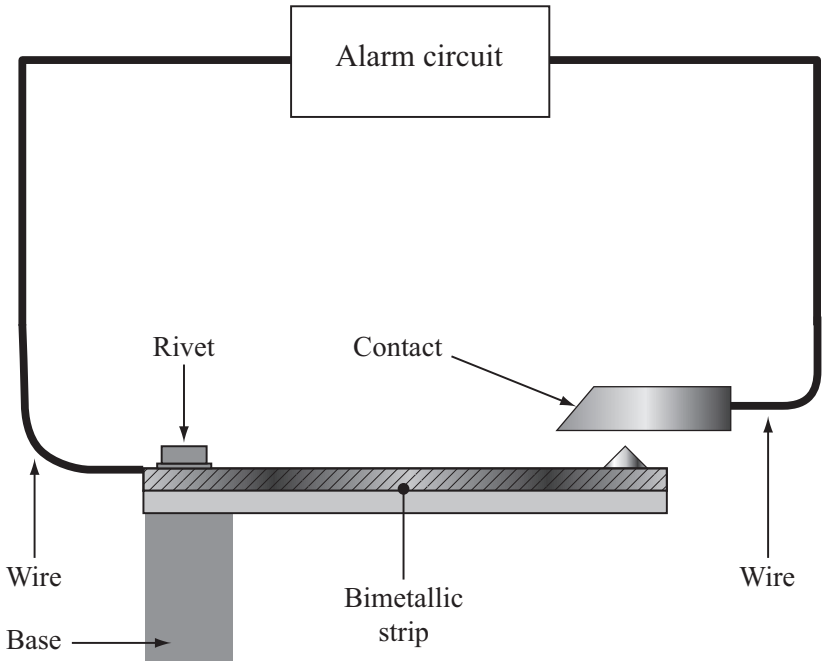
_____ [1]

Examiner Only	
Marks	Remark

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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]

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(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.



© iStockphoto / Thinkstock

(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.

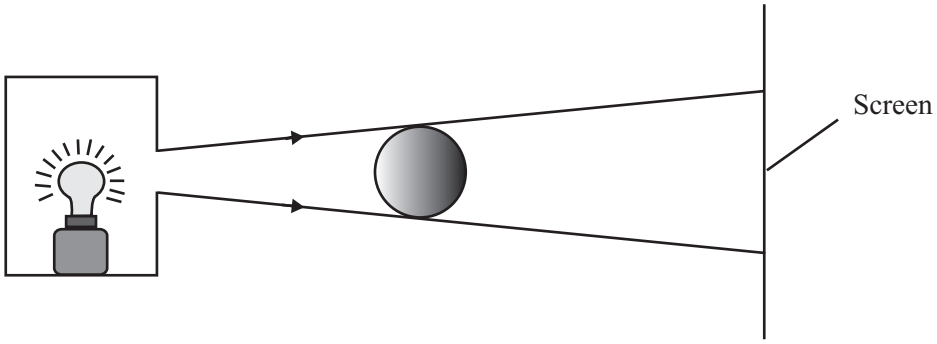
_____

_____

_____

_____ [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]

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(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.

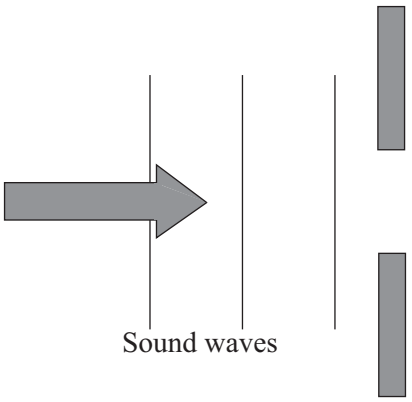
	Shadow's size decreases	**No change in size of shadow**	**Shadow's size increases**
Using a larger screen			
Moving the screen away from the ball			
Moving the light source away from the ball			

[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

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(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°.

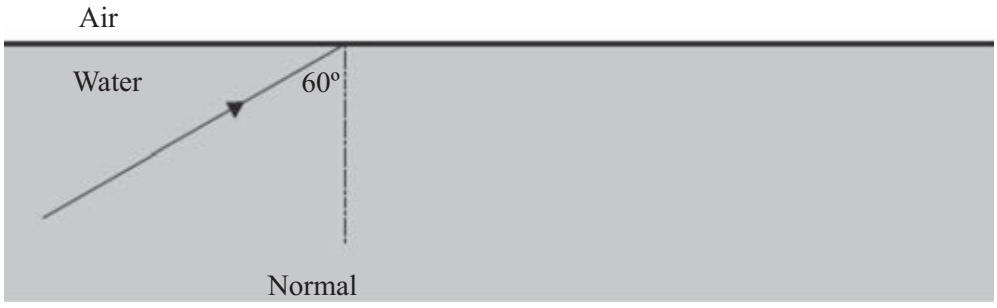
_____

_____ [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]



Examiner Only

Marks	Remark

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(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.

_____

_____

_____

_____

_____

_____

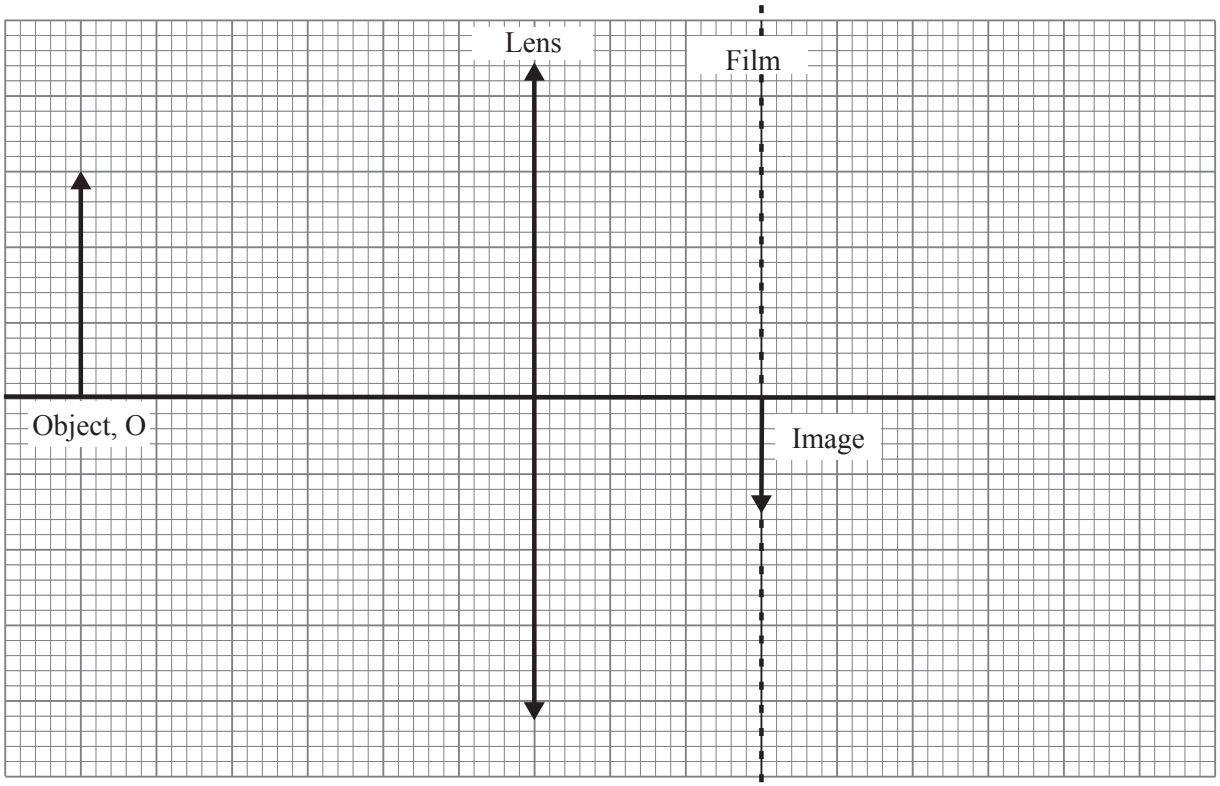
_____ [3]

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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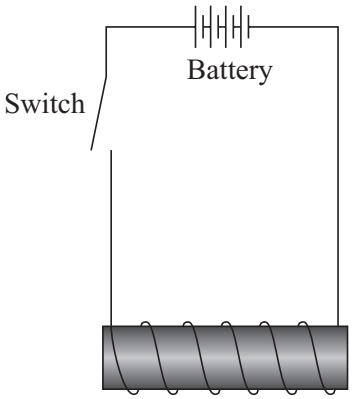
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(Questions continue overleaf)

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Examiner Only	
Marks	Remark

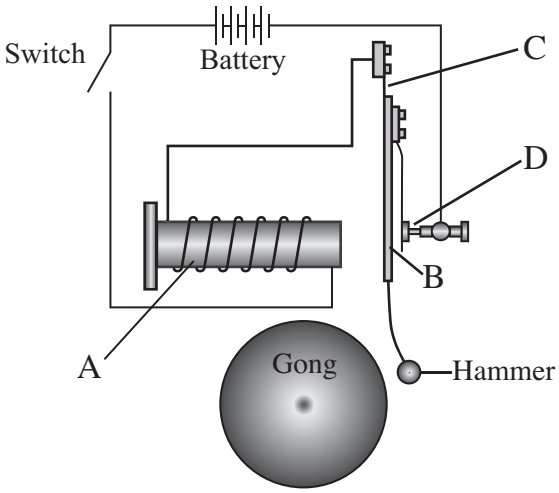
4 **(a)** The diagram below shows the electromagnet used in a doorbell.



(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.



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(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 _____

_____

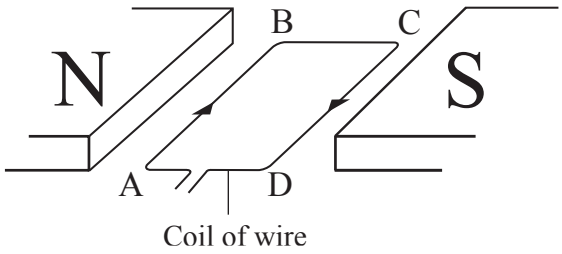
C _____

_____

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]

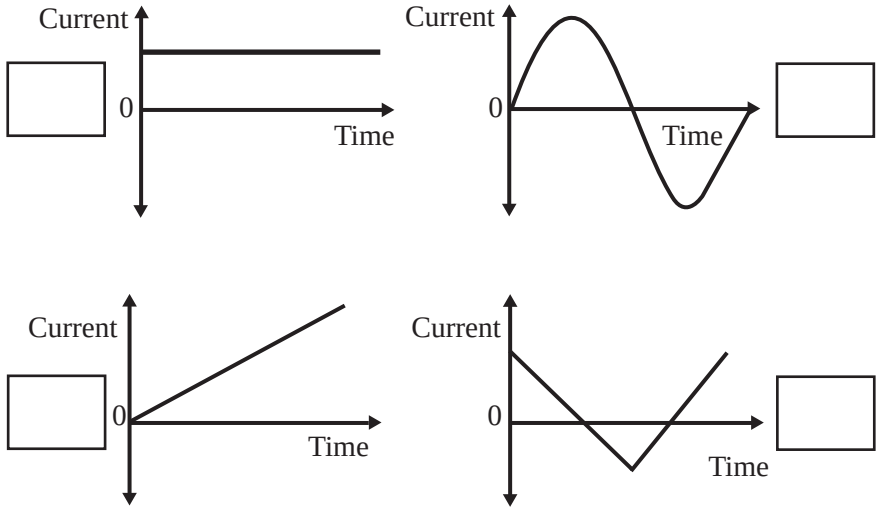
Examiner Only

Marks	Remark

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(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]

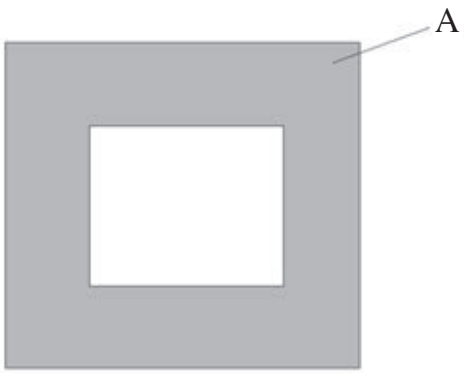
Examiner Only

Marks	Remark

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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

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?

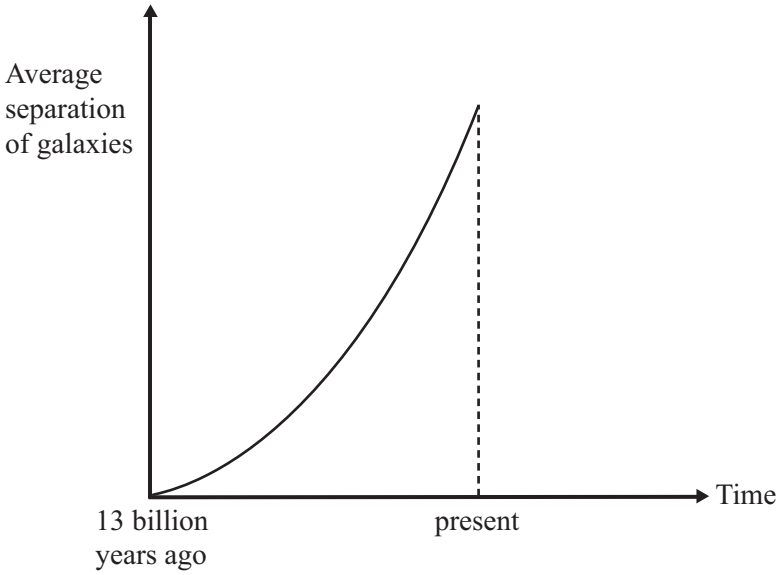
_____ [1]

(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]

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(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.

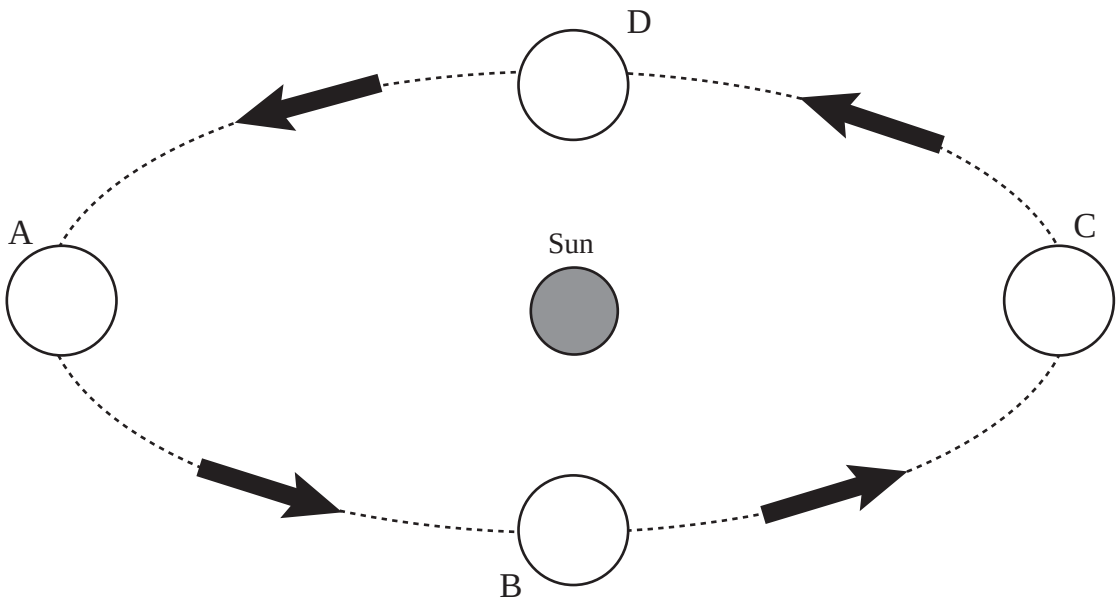
(d) (i) Explain carefully why this is so.

_____

_____

_____ [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?

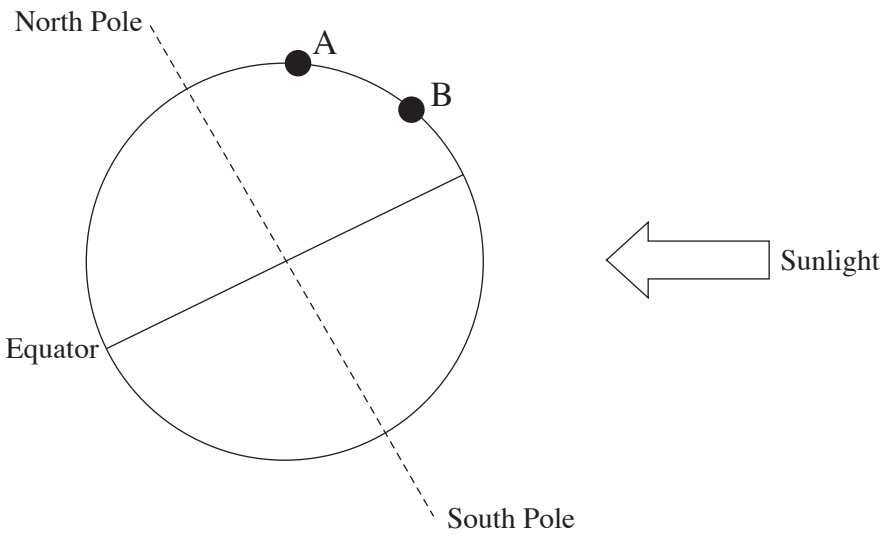
_____ months [1]

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Marks	Remark

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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?

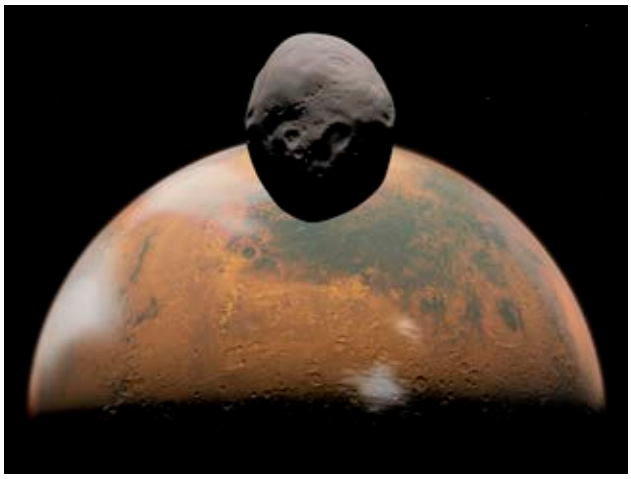
_____ [1]

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Marks	Remark

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(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]

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Marks	Remark

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Rewarding Learning

General Certificate of Secondary Education
2012

Science: Physics

Paper 2
Higher Tier

[G7605]

MONDAY 25 JUNE, AFTERNOON

MARK SCHEME

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Subject-specific instructions

1 In numerical problems, the marks for intermediate steps shown in the mark scheme are for the benefit of candidates who do not obtain the correct final answer. A correct answer and unit, if obtained from a valid starting-point, gets full credit, even if all the intermediate steps are not shown. It is not necessary to quote units for intermediate numerical quantities.

Note that this "correct answer" rule does not apply to formal proofs and derivations, which must be valid in all the stages shown in the mark scheme to obtain full credit.

2 Do not reward wrong physics. No credit is given for substitution of numerical data, or subsequent arithmetic, in a physically incorrect equation.

However, answers to later parts of questions that are consistent with an earlier incorrect numerical answer, and are based on a physically correct equation, must gain full credit. Annotate this by writing **ECF** (Error Carried Forward) by your text marks.

3 The normal penalty for an arithmetical and/or unit error is to lose the mark(s) for the answer/unit line. Substitution errors lose both the substitution and answer mark, but 10^n errors (e.g. writing 550 nm as 550×10^{-6} m) count only as arithmetical slips and lose the answer/unit mark.

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				AVAILABLE MARKS
1	(a)	(i)	Largest = 16 N [1] both arrows in same direction [1] Smallest force = 4 N [1] Ignore signs. Insist on 2 arrows arrows in opposite direction [1] [4]	
		(ii)	Object accelerating or decelerating or change in speed/velocity or moves [1] change of direction/topples change of shape [1] Any **two** [2]	
	(b)	(i)	Time (to fall) **or** distance (between the gates) [1] Time to reach ground [0], time to pass through gates [0]	
		(ii)	The answer here **must be consistent** with the answer to **(b)(i)** If time then $v = u + at$ } Give [1] if answer to **(b)(i)** wrong If distance then $v^2 = u^2 + 2as$ } $\frac{v - u}{t}$ [1] $\frac{\text{change in velocity}}{\text{time}}$ [1] [2]	
	(c)	(i)	(Uniform) acceleration for 5 secs [1] or velocity increases **Constant** speed (velocity) for next 10 secs [1] (Uniform) deceleration for next 5 secs [1] or decelerates At rest for 5 secs **or** speed/vel = 0 [1] constant speed [0] [4] Deduct [$\frac{1}{2}$] for each missing time, round **down**	
		(ii)	Height = area between graph and time axis (or shaded) [1] $\frac{1}{2} \times 5 \times 4 + 10 \times 4 + \frac{1}{2} \times 5 \times 4$ [3] [1] [1] [1] = 60 (m) [1] [5] **or** $\frac{1}{2}(20 + 10) \times 4 = 60$ (m) [3] [1]	
		(iii)	Average velocity = 60/20 [1] allow **ecf** for distance = 3 (m/s) no ecf for time $\frac{\textbf{total displacement}}{\text{time}}$ [1] if no further working shown [2]	
		(iv)	Positive – $\overset{\text{up}}{\text{ascending}}$ Negative – $\overset{\text{down}}{\text{descending}}$ **or** travelling in opposite directions **or** change of direction velocity is a vector **or** is now moving down [1]	
		(v)	Deceleration = velocity change/time taken [1] = 20/1 [2] = 20 [1] m/s^2 [1] Ignore **minus** sign [5]	
		(vi)	Momentum = mass × velocity [1] mass × speed [0] [1] [1] = 2500 × 20 [2] = 50 000 (kg m/s) [1] [4]	30

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AVAILABLE MARKS

2 **(a)** **(i)** Unlimited supply/suitable alternative/never runs out/replaced in a lifetime [1]
but **exclude** can be used over again **accept** sustainable

(ii) It uses electricity [1]
which is not a renewable energy resource [1] [2]
or reference to use of fossil/non-renewable [2]

(iii) PE = mgh [1]
= 1 × 10 × 70 [2] [2] or [0] Formula mark only given
= 700 (J) [1] if second line is correct [4]

(iv) Converted to heat or sound – or non-useful forms [1]
Changed other forms

(v) KE= 595 **or** $\frac{1}{2}mv^2 = 595$ [1] **or** $\frac{85}{100} \times 700$
$\frac{1}{2}1\ v^2 = 595$ [2] or $= \frac{85}{100} \times 700$
$v^2 = 1190$ [1] 100% v = 37.4 ← [3] if 100% of energy used
v = 34.5 (m/s) [1] v = 31.8 ← [3] if 85% of v taken
allow **ecf for PE** from **(iii)** CREDIT [5]

(vi) Efficiency = (useful) energy output/(total) energy input [1]
$\frac{\text{output}}{\text{input}} = [0]$ $\frac{\text{out}}{\text{in}} = [0]$ $\frac{E_{OUT}}{E_{IN}}$ [1]
= 500/700 [1]
= 0.71 (71%) [1] **Accept** 0.7 – 0.71
Allow e.c.f. from **(iii)** provided the answer does not give an efficiency >1 max. [1] (eqn) [3]

(vii) The demand for extra electricity can be met very quickly [1]
It is faster than fossil **or** fossil slower

(b) **(i)** It should **bend** upward/towards contact [1]
move up [0]

(ii) The metal with greater (rate of) expansion should be further from the contacts or on the bottom [1]
outside [0] inside [0]

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AVAILABLE MARKS

(c) **(i)** Heat is conducted (from the processor) by the metal [1]
Air is heated by **convection** [1]
Heat is also **radiated** (from the structure) [1] [3]

Quality of written communication [2]

Response	Mark
Candidates describe in detail using good spelling, punctuation and grammar the main points shown above. The form and style is of a high standard and specialist terms are used appropriately at all times.	[2]
Candidates make some reference to 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]
Response not worthy of credit.	[0]

2 out of 3 gets [2] for QWC
conduction, convection, radiation [1]
and award [1] for QWC

(ii) Black is the best emitter of (radiant) heat [1]
absorber and emitter give [1]

25

3 **(a)** Luminous give out their own light [1]
Non-luminous reflect light, do not emit light or are seen by reflected light [1] [2]

(b) **(i)** Extended/large [1]

(ii) Circular/round/same as object/ball [1]

(iii) Ray from top of source glancing bottom of ball [1] } must be extended towards screen
Ray from bottom of source glancing top of ball [1] } [2]
poorly drawn rays penalty [–1]

(iv) Region of partial shadow identified – correct rays needed before credit here [1]

(v) Using larger screen – no change [1] more than 1 tick per row [0]
Moving screen away from ball – size increases [1]
Moving light source away from ball – size decreases [1] [3]

(c) **(i)** Waves circular curved (in correct sense) [1]
Wavelength unchanged (judge by eye) [1] or stated [2]



(ii) Diffraction/or difraction **only** [1]

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AVAILABLE MARKS

(d) **(i)** When angle of incidence (in water) is 49° **or** at this angle of incidence angle of refraction (in the air) is 90° **or** light emerges along boundary **or** perpendicular to boundary

or

When the angle of incidence (in water) is **greater** than 49° total internal reflection occurs [1]

(ii) Refracted ray on correct side of normal, along boundary [1] and weak reflected ray [1] judge by eye [2]

(iii) Total internal reflection at the boundary [1]
Angle of incidence = angle of reflection (judge by eye) [1]
Any ray in the air give [0] [2]

(iv) Endoscope or **keyhole** surgery/looking directly/any-oscopy into the body [1]
Takes light in and brings image out [1]
Fibre transmits light by total internal reflection [1] or TIR
Flexible/small/thin/bendy
Any **three** statements [3]

Quality of written communication [1]

Response	Mark
Candidates describe in detail using good spelling, punctuation and grammar the main points shown above. The form and style is of a high standard and specialist terms are used appropriately at all times.	1
Response not worthy of credit.	0

(e) **(i)** Ray from top of object parallel to Pr axis refracted to top of image **or** ray reverse from image [1]
Pr focus marked where ray cuts Pr axis with an F [1] [2]

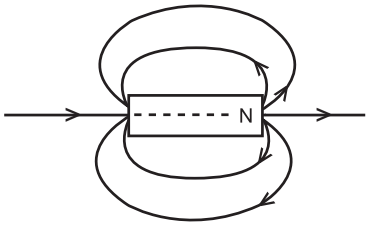
(ii) Focal length = 2.0 ± 0.2 (cm) **or** consistent with their ray diagram [1] 25

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AVAILABLE MARKS

4 **(a)** **(i)** N pole at the right end [1]

(ii) One straight line through core [1]
Two loops, one above one below from one end to the other [1]
Direction from the right end to the left end [1] one arrow [3]
Conflicting arrows no credit for direction
Any three lines
Consistent with their N pole
Crossing line, [–1]



(iii) A (Core) (electromagnet) magnetised / energised (when current flows/switch) closed [1] strengthens the magnet/becomes an electromagnet/ attracts B
B (Armature) attracted to electromagnet [1] moves towards electromagnet/causes hammer to strike gong
C (Spring flexible conductor) to return armature to starting position [1] allows armature to move to and fro
D Contact opens or closes **or** to make or break the circuit [1] [4]

(b) **(i)** BC – No None or blank [1]
CD – Yes Up [1] [2]
both needed

(ii) (Electric) motor/generator/moving coil meter/dynamo [1]

(c) Top left DC [1] Top right AC [1]
Bottom left DC [1] Bottom right AC [1] [4]

(d) **(i)** Two coils around the core [1] coils must have 2 ends
One with more turns than the other [1]
Input connected to fewer turns [1]
Output connected to greater turns [1] [4]
Battery connected [–1]
Two coils joined give [0]

(ii) Iron [1]
To increase the strength of the magnetic field [1] [2]
– temporary magnetism
To transfer the magnetic field
easily magnetised and demagnetised
or magnetically soft
soft iron [–1]

(iii) **Changing** current/magnetic field (in one coil) [1]
induces/produces/makes a current or voltage in the other coil [1] [2]

(iv) Step up at the power station end [1]
Step down at the consumer end [1] [2]

25

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					AVAILABLE MARKS
5	**(a)**	**(i)**	Gravity	[1]	
		(ii)	Milky Way	[1]	
		(iii)	The **distance** from Earth to centre of galaxy **or** distance travelled by light in 27 000 years	[1]	
		(iv)	Universe/Space is expanding **or** galaxies are moving apart Universe had a definite start	[1]	
		(v)	(Light from these galaxies is) red shifted Doppler [0]	[1]	
	(b)	**(i)**	Heliocentric – planets orbit the sun/Sun at the centre (of the solar system) [1] universe [0] Geocentric – Earth at the centre (of the solar system) [1]	[2]	
		(ii)	The **retrograde motion** of the planets – looping of the planets Strange motion [0]	[1]	
		(iii)	The Church/The Pope/Religion/Christian	[1]	
	(c)		Correct order 3 6 2 3 in the correct order give [2] 1 in the correct position give [1]	[2]	
	(d)	**(i)**	In the summer more energy per square metre falls on the Earth **or** the reverse in the winter [1] **or** longer time in sky **or** high in the sky [1] { N. Hemisphere tilt towards the sun [1] so longer time in sky [1] **or** more energy/m^2 [1] } [2] higher in the sky [1]		
		(ii)	Axis tilted to NE to SW 	[1]	
		(iii)	B Spring D Autumn } both needed	[1]	
		(iv)	9 months/270 days/$\frac{3}{4}$ year	[1]	
		(v)	 left hand half shaded accept curved terminator 	[1]	
		(vi)	B	[1]	
	(e)		Increasing gravitational force [1] Gravitational force increases as distance decreases [1]	[2]	20
				Total	**125**

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2011

Science: Physics

Paper 2
Higher Tier

G7605

[G7605]

WEDNESDAY 15 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.
Answer **all five** questions.

INFORMATION FOR CANDIDATES

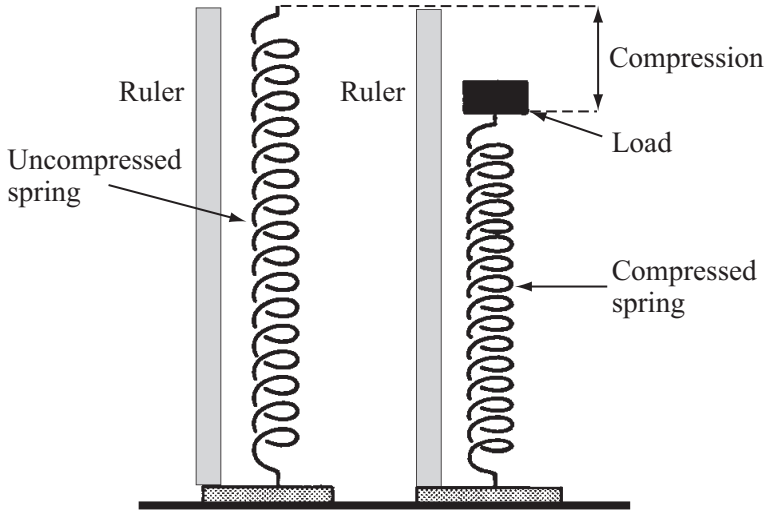
The total mark for this paper is 125.
Quality of written communication will be assessed in Question **3(c)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Details of calculations should be shown.
Units must be stated with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

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

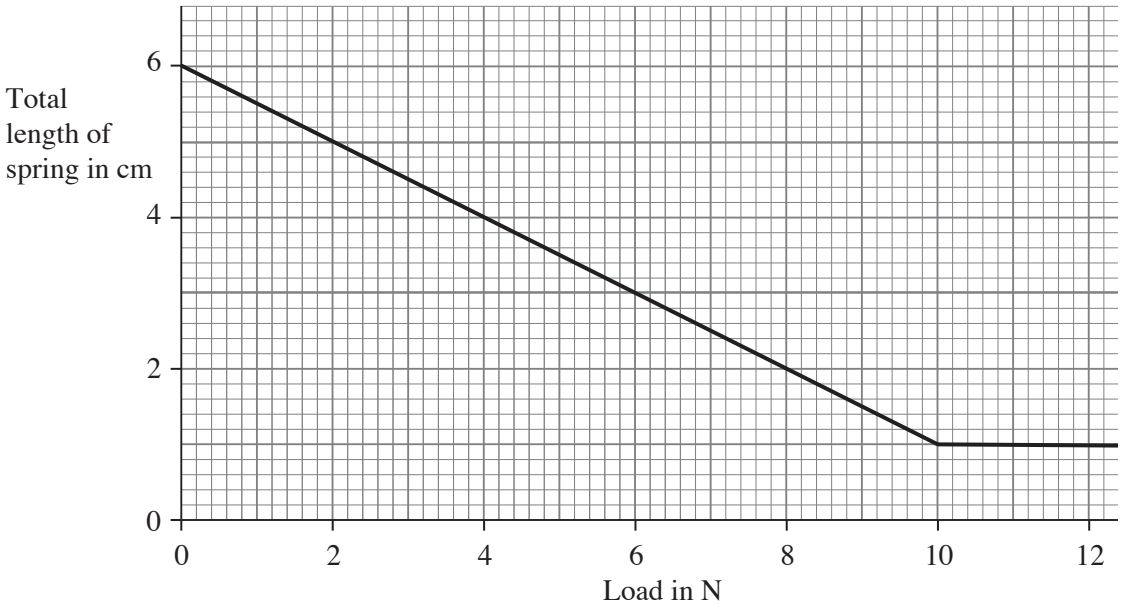
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Examiner Only	
Marks	Remark

1 **(a)** Albert carries out an experiment using the apparatus shown in the diagram below, to see how the compression of a spring depends on the load applied. He measures the total length of the spring when different loads are applied.



A graph of his results is shown below.



(i) Explain why the total length of the spring remains constant when the applied load is 10 N or more.

_____

_____ [1]

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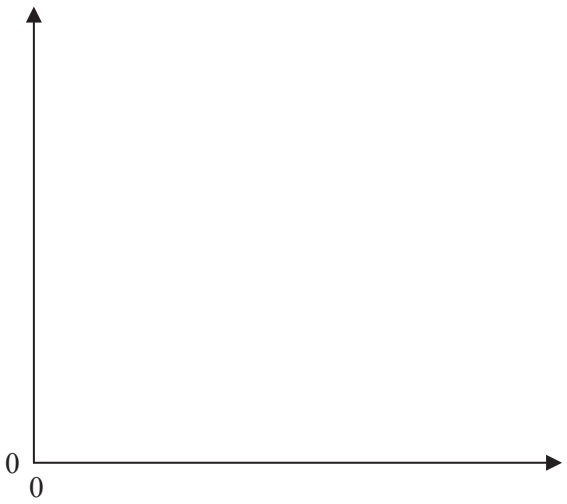
(ii) For a given load placed on the spring the compression is defined as;

Compression of spring	=	*Length of spring with no load*	– *Length of spring with a load*

The compression of the spring is directly proportional to the load placed on the spring.
To show that this is true data must be taken from the graph.
Complete the table below using data **derived** from the graph opposite.
Add column headings with the correct units.
Insert 6 pairs of values in the table.

[7]

(iii) On the axes below sketch the graph that John would plot to show that the compression and the load added to the spring are directly proportional.
Label each axis with the quantity plotted.



[3]

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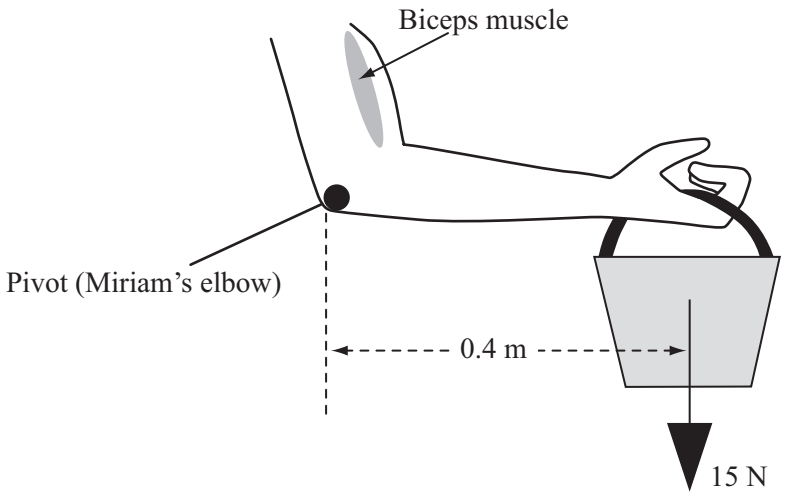
Marks	Remark

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Examiner Only	
Marks	Remark

(b) The diagram below shows Miriam holding a bucket. Miriam's forearm is stationary and horizontal.

(i) Calculate the moment of the 15 N force about the pivot and state its direction.
Remember to include the correct unit for moment.
You are advised to show clearly how you get your answer.



Moment = _____

Direction = _____ [4]

(ii) The biceps muscle exerts a force. This force creates an anticlockwise moment about the pivot, which is Miriam's elbow. On the diagram mark the position and direction of this force. [1]

(iii) Miriam's forearm acts like a lever. In the diagram above it is horizontal and stationary. What does this tell you about the clockwise and anticlockwise moments of the forces acting on her forearm?

_____ [1]

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Examiner Only	
Marks	Remark

(c) When an object moves in a circle, a force called a centripetal force, must act on it.

(i) In what direction does the centripetal force always act?

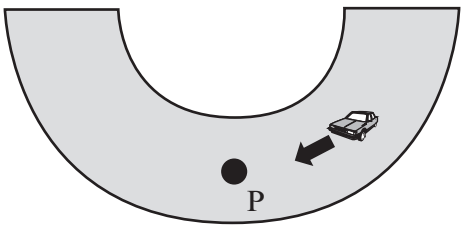
_____ [1]

(ii) For each of the examples given below, state what provides the centripetal force. One has already been completed.

Example	**What provides the centripetal force**
An artificial satellite orbits the earth	*Gravitational force between the satellite and the earth*
A chestnut whirled in a horizontal circle at the end of a length of string	
An electron orbits a nucleus	
A racing car travelling around a circular track	

[6]

(iii) The diagram below represents a racing car, moving in a clockwise direction around a circular track. At the point P there is oil on the track which causes the centripetal force to disappear very suddenly. Mark, carefully, on the diagram the direction the racing car at P will now move.

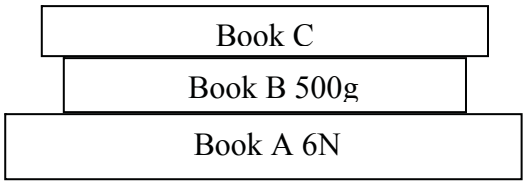


[1]

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(d) A pile of books has a total weight of 14 N.

Examiner Only	
Marks	Remark



(i) Use the information in the diagram to calculate the weight of book C.
You are advised to show clearly how you get your answer.

Weight of book C = _____ N [2]

(ii) The area of book A in contact with the table is 700 cm^2.
Calculate the total pressure that the books exert on the table.
You are advised to show clearly how you get your answer.

Pressure = _____ N/cm^2 [3]

Examiner Only	
Marks	Remark

2 **(a)** Most fuels used today are fossil fuels. One such fuel is coal.

(i) Explain how the energy stored in coal was dependent on the Sun's energy.

_____

_____

_____ [3]

Many people today are concerned about global warming.

(ii) Describe how energy from the Sun is trapped in the Earth's atmosphere.

_____

_____

_____

_____

_____

_____

_____ [3]

(b) Recently the UK government gave approval for the construction of more nuclear power stations. This has been met with approval from some people and disapproval from others.

(i) State one **environmental** reason why building nuclear power stations may be a **good** idea.

_____

_____

_____ [1]

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Examiner Only	
Marks	Remark

(ii) State one **environmental** reason why building nuclear power stations may be a **bad** idea.

_____

_____

_____ [1]

(iii) Name the fuel used in nuclear power stations and state if it is a renewable or a non-renewable source of energy.

_____

_____ [2]

At the end of their useful lives all power stations are de-commissioned.

(iv) Explain fully why it is more expensive to de-commission a nuclear power station than one that used fossil fuels.

_____

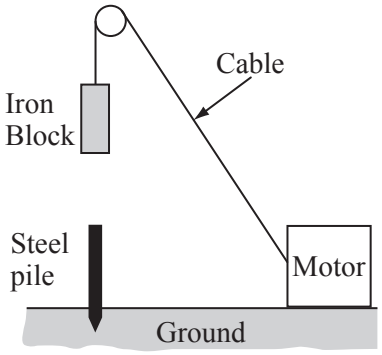
_____

_____

_____

_____ [2]

(c) On building sites, a steel pile is driven into the ground by allowing a heavy iron block to fall vertically onto the pile. The diagram below shows the main parts of this arrangement.



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(i) State the Principle of Conservation of Energy.

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Marks	Remark

_____

_____ [2]

The motor does 30 kJ of **useful** work in raising the iron block.
The electrical energy required to do this is 40 kJ.

(ii) How much of the input energy is converted into **unwanted** forms?

_____ [1]

(iii) Calculate the efficiency of the motor.
You are advised to show clearly how you get your answer.

Efficiency = _____ [3]

(iv) The motor takes 12 seconds to raise the iron block.
Calculate the output power of the motor.
Remember to include the correct unit for power in your answer.
You are advised to show clearly how you get your answer.

Output power of the motor = _____ [3]

When the steel pile is struck, it penetrates 0.03 m into the ground against an average friction force. In doing so the steel pile does 15kJ of useful work.

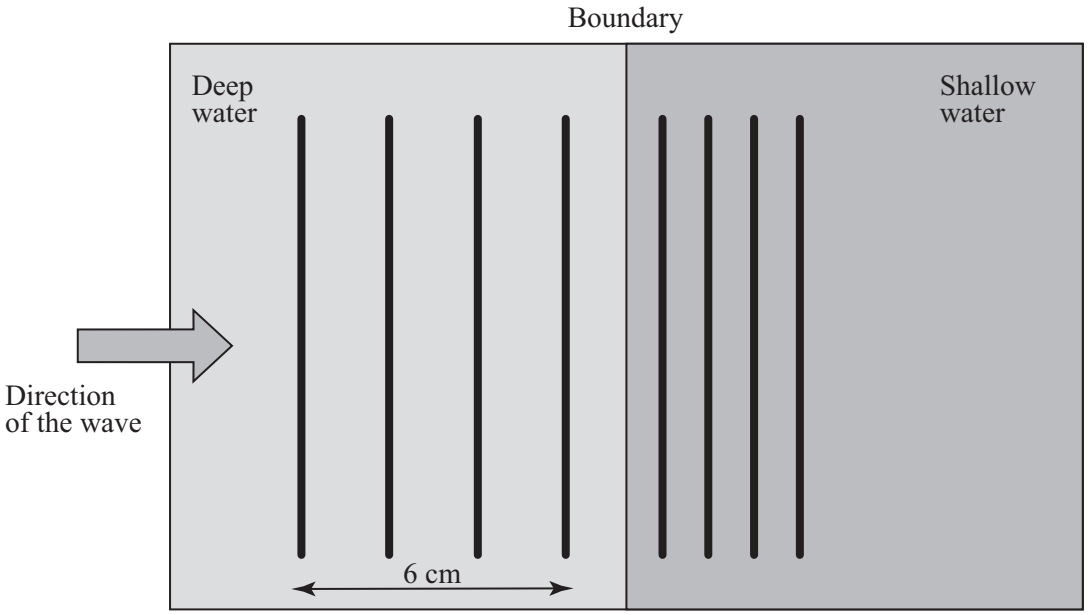
(v) Calculate the size of the friction force between the steel pile and the ground.
You are advised to show clearly how you get your answer.

Friction Force = _____ N [4]

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Examiner Only	
Marks	Remark

3 **(a)** The diagram below shows what happens when a water wave moves from deep water to shallow water. The diagram is not full scale.



(i) What is the wavelength of the water wave in the deep water?

Wavelength in deep water = _____ cm [1]

The water wave is made by a long bar vibrating in the water.

(ii) The long bar makes 20 vibrations in 5 seconds
Calculate the frequency of the water wave produced.
You are advised to show clearly how you get your answer.
Include the appropriate unit in your answer.

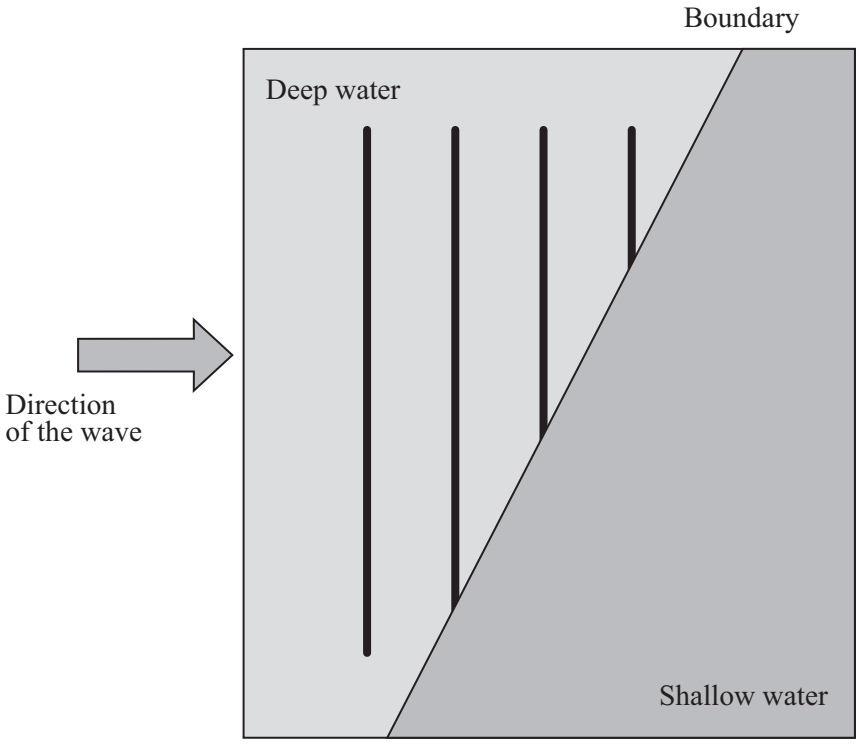
Frequency = _____ [3]

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(iii) Using your answers to parts **(i)** and **(ii)** calculate the speed of the water wave in the deep water.
You are advised to show clearly how you get your answer.

Speed in deep water = _____ cm/s [3]

The direction of the boundary is now changed so that the water wave enters the shallow water at an angle as shown in the diagram below.



(iv) Complete the diagram to show what happens to the water wave in the shallow water. [4]

(v) State what causes this change of direction.

_____

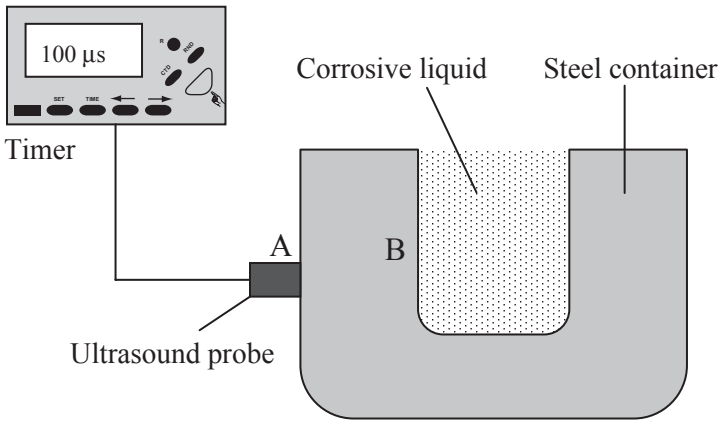
_____ [2]

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Marks | Remark

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Examiner Only	
Marks	Remark

(b) A corrosive liquid is stored in a steel container. The thickness of the wall of the container is measured using ultrasound.
The diagram below illustrates the method used.



The ultrasound probe is placed in contact with the outside of the steel container at the point A. It then emits a pulse of ultrasound and 100 microseconds later detects the reflection of this ultrasound from the inner wall of the container at B.

(i) What is ultrasound?

_____

_____

_____ [2]

In a particular measurement, the following data was obtained.

Time elapsed = 100 µs (0.0001 s).
Speed of ultrasound in steel = 5000 m/s.

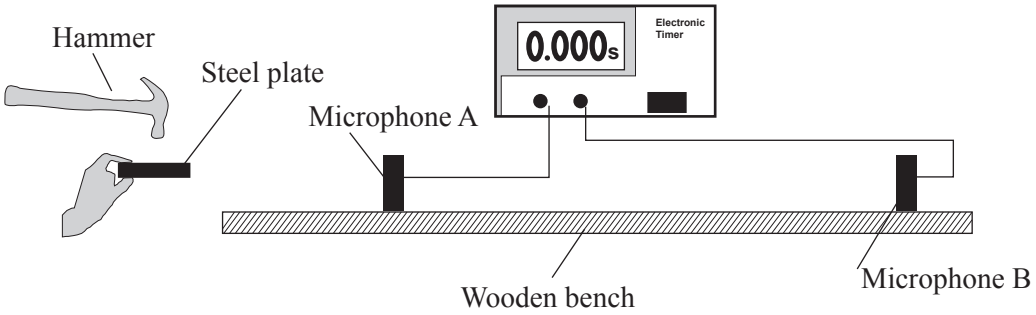
(ii) Using this data, calculate the thickness of the wall of the container.
Remember to include the correct unit for the thickness.
You are advised to show clearly how you get your answer.

Thickness = _____ [4]

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Marks	Remark

(c) Roy set up the apparatus shown below. Each microphone is connected to an electronic timer. The timer starts when a sound reaches one of the microphones and stops when it reaches the other microphone.
Roy also has a hammer and steel plate as part of the apparatus.



Describe how Roy could use the above apparatus to show that sound travels faster in wood than in air. State clearly what measurement would show that this is true.

_____

_____

_____

_____

_____

_____

_____

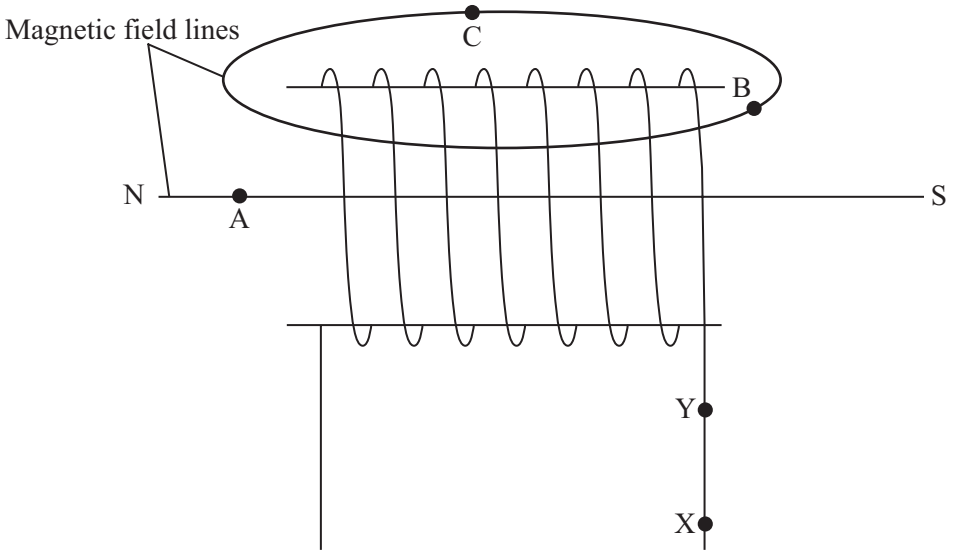
_____ [4]

Quality of written communication [2]

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Marks	Remark

4 **(a)** The diagram below shows a coil of wire wrapped around a cardboard cylinder. When an electric current is passed through the coil a magnetic field is created around the coil. The ends are marked N (north pole) and S (south pole). Two magnetic field lines are also shown.



(i) On the diagram mark the direction of the current between the points X and Y that will produce the magnetic poles shown in the diagram. [1]

(ii) On the diagram mark the directions of the magnetic field lines at the points A, B and C. [3]

(iii) The arrangement above is described as an electromagnet. What does this mean?

_____

_____ [1]

(iv) What material, placed inside the cardboard cylinder, will increase the strength of the magnet?

_____ [1]

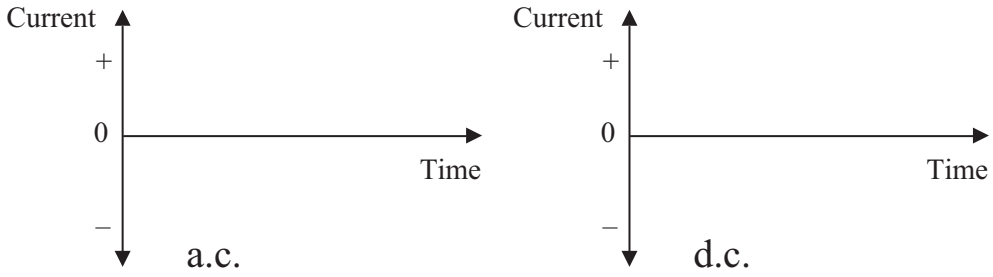
(v) Apart from increasing the current in the coil, or adding a different core, what could be done to the coil shown above to increase the strength of the magnetic field at the centre of the coil?

_____ [1]

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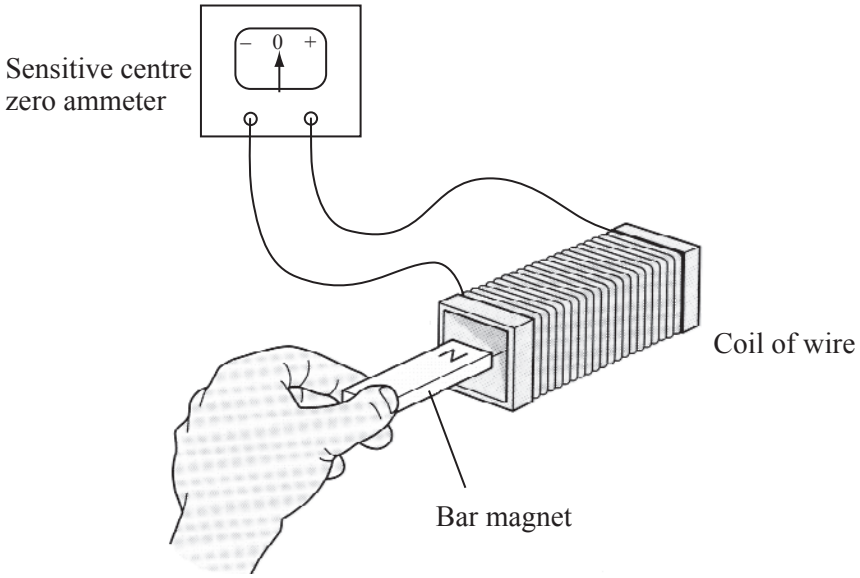
Examiner Only	
Marks	Remark

(b) (i) On the axes below show how an alternating current (a.c.) and a direct current (d.c.) might vary, if at all, with time.



[2]

The diagram below shows a magnet and a coil of wire.



(ii) Describe how an alternating current can be induced in the coil using the magnet.

_____

_____

_____

_____ [2]

(iii) Describe how a brief direct current can be induced in the coil using the magnet.

_____

_____

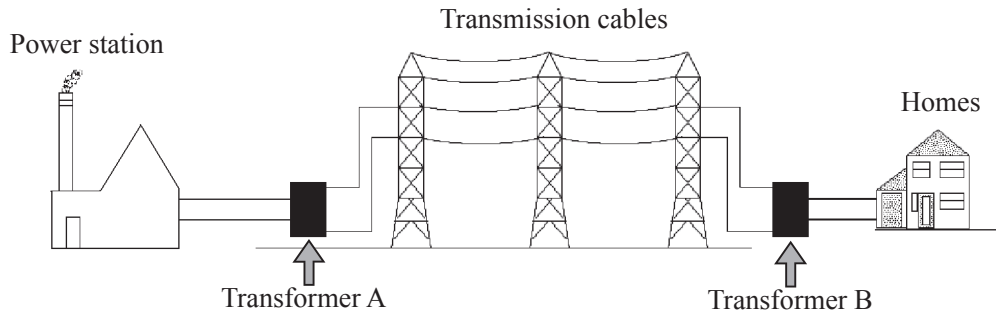
_____

_____ [2]

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Examiner Only	
Marks	Remark

(c) The diagram below shows some of the stages in the generation of electricity and its transmission to homes using cables.



(i) Name the types of transformer marked A and B. In each case describe the feature of the construction of the transformer that allows it to change the voltage in the required way.

A _____

Feature _____

_____

_____

B _____

Feature _____

_____

_____ [4]

(ii) Explain how the system shown above improves the efficiency of the transmission of electricity.

_____

_____

_____ [1]

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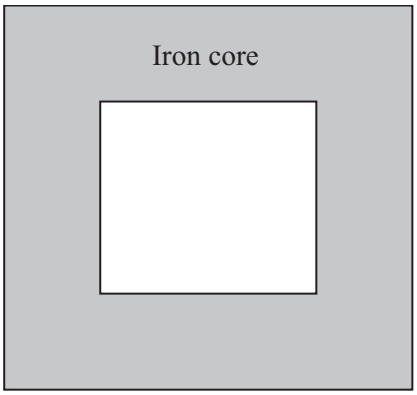
Examiner Only	
Marks	Remark

(d) Many of the circuits in a computer require a low voltage of 12 V to operate. The computer is fitted with a transformer which provides an output voltage of 12 V when an input voltage of 240 V is applied to it. The primary coil of this transformer has 300 turns.

(i) Calculate the number of turns on the secondary coil of this transformer.
You are advised to show clearly how you get your answer.

Secondary coil turns = _____ [3]

(ii) Complete the diagram below to show the primary and secondary coils. Indicate where the 240 V is applied and where the 12 V supply to the computer is obtained.



[3]

(iii) State whether the input voltage is a.c. or d.c. and similarly state whether the output voltage is a.c. or d.c.

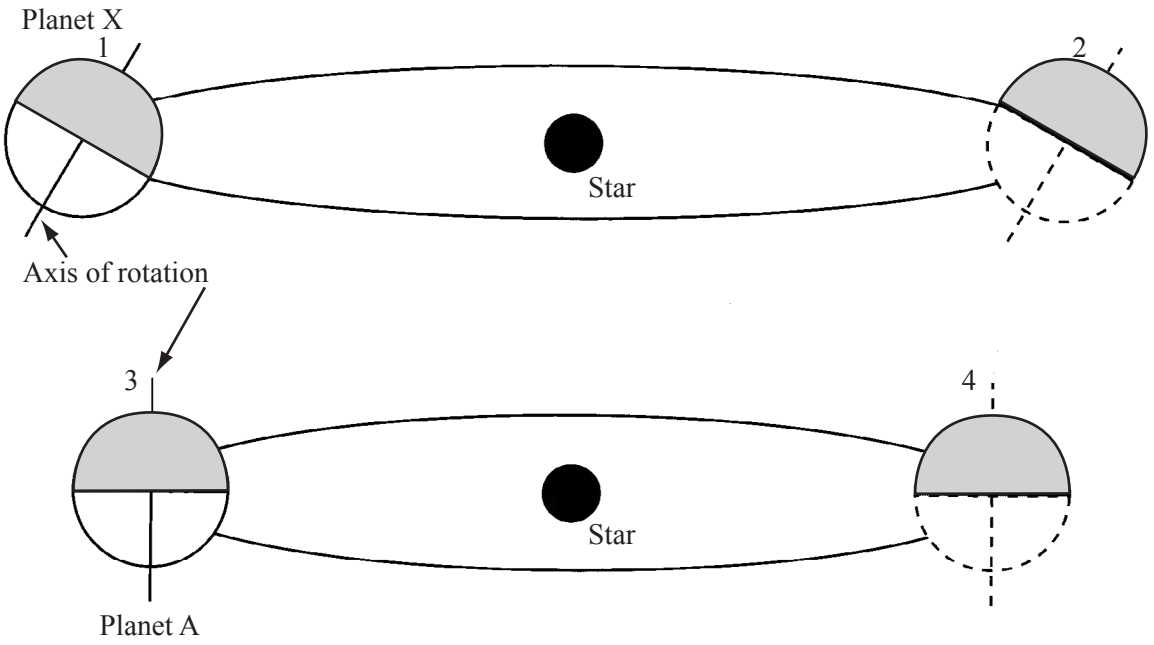
The input voltage is _____

The output voltage is _____ [1]

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Examiner Only	
Marks	Remark

5 **(a)** The diagram below shows two planets X and A.
The northern hemisphere of each planet is shaded.
The axes of rotation are shown.



What can you conclude from the diagrams about the lengths of day and night in the **northern hemisphere** of each planet?

Record your answers by placing ticks (✓) in the correct boxes in the table below.

	Day longer than night	Day same length as night	Day shorter than night
Planet X at 1			
Planet X at 2			
Planet A at 3			
Planet A at 4			

[4]

(b) What is a light year?

_____

_____

_____ [2]

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(c) Nebulae are clouds of gas in space. They are places where stars are formed.

Examiner Only	
Marks	Remark

(i) Describe and explain what happens in nebulae in the first stage of a star's formation.

Description _____

Explanation _____ [2]

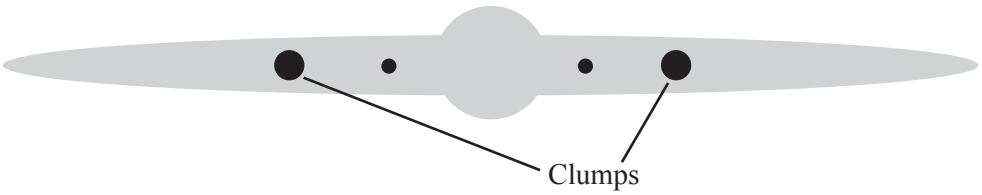
In the later stages of star formation the nebula flattens as it spins with a bulge in the centre as shown below. This bulge eventually becomes a star.

(ii) What has to happen to the gas in this bulge at this stage before nuclear fusion begins?

_____

_____ [1]

Sometimes the material in the nebula forms clumps as shown in the diagram below.



(iii) What do these clumps of material eventually become?

_____ [1]

(iv) State one feature of the motion of the planets in our solar system that suggests that they were all formed from the same nebula.

_____ [1]

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Examiner Only	
Marks	Remark

(d) Our present model of the solar system is described as heliocentric. Models of the solar system proposed hundreds of years ago are described as geocentric.

(i) For each model state what is at the centre of the solar system.

_____

_____

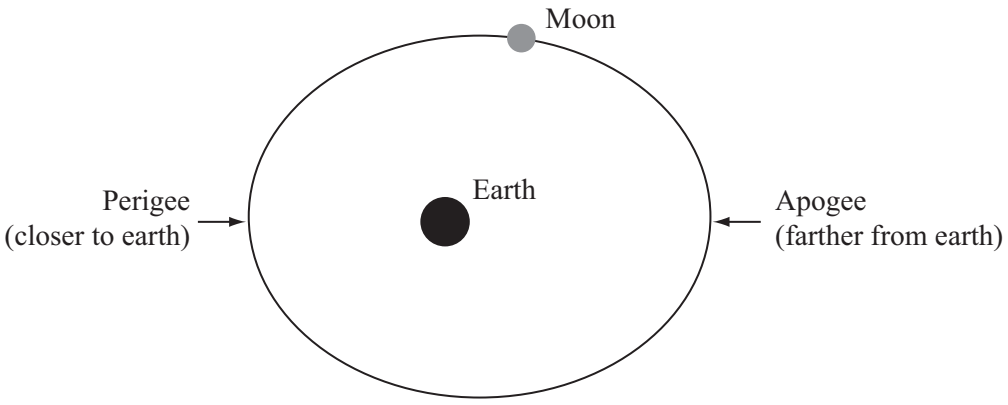
_____

_____

_____

_____ [2]

The Moon's orbit around the Earth is not circular. It is oval as shown in the diagram below.



© NASA http://science.nasa.gov/headlines/y2008/images/fullmoon/diagram.gif

(ii) What can you say about the size of the gravitational force that the Earth exerts on the Moon as the Moon orbits the Earth?

_____

_____

_____ [2]

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(e) (i) What is the Big Bang theory?

Examiner Only	
Marks	Remark

_____

_____ [2]

(ii) One piece of evidence that supports this theory is known as the "Red Shift". Explain what is meant by this and what conclusion can be drawn to support the Big Bang theory.

_____

_____

_____

_____

_____

_____ [3]

THIS IS THE END OF THE QUESTION PAPER

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111064

Rewarding Learning

General Certificate of Secondary Education
2011

Science: Physics

Paper 2
Higher Tier

[G7605]

WEDNESDAY 15 JUNE, MORNING

MARK SCHEME

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				AVAILABLE MARKS
1	**(a)**	**(i)**	The coils touch/cannot be compressed any more [1] REACHED ITS LIMIT [0]	
		(ii)	Column headings – Load(Force)[1] in N [1] } ind. [2] Compression [1] in cm [1] } marks [2] Values Load 0 2 4 6 8 10 } GIVE CREDIT FOR VALUES Comp 0 1 2 3 4 5 } IF NO HEADINGS [3] ½ for each pair round down WRONG HEADING TO VALUES GIVE [0] VALUES >10N – NO CREDIT	
		(iii)	X axis – Load Y-axis Compression – OR VICE VERSA [1] Straight [1] line through 0,0 [1] give marks if no label [2] curved at end [0] wrong labels – 0	
	(b)	**(i)**	Moment = force × distance = 15 × 0.4 [1] = 6 or 600 [1] N m N cm [1] Clockwise [1]	
		(ii)	Upward at the biceps – upward arrow between elbow (pivot) and inner crook of upper arm. [1]	
		(iii)	Equal/balanced [1] FORCES BALANCED give [0] unless equal/balanced given	
	(c)	**(i)**	Towards the centre (of the circle) [1]	
		(ii)	Tension [1] in the string [1] [2] Electrical attraction [1] between electron and nucleus [1] [2] Friction [1] between tyres and road [1] [2] underlined essential before 2nd mark can be given	
		(iii)	Arrow at a tangent judge by eye to circle at P or passing through P to the left [1]	
	(d)	**(i)**	Weight of C = 3 (N) [2] If Weight of B = 5N give 1 mark	
		(ii)	Pressure = Force/Area [1] = 14/700 NO ECF – IF WRONG WEIGHT [1] = 0.02 (N/cm^2) [1] or 200 (Pa) $\frac{3}{700}$ or $\frac{6}{700}$ or $\frac{5}{700}$ – SUBSUMED 1 mark only	30

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AVAILABLE MARKS

2 **(a)** **(i)** Not animals
Plants/vegetation absorb sunlight/photosynthesis [1]
Plants (die) and are buried/over a long time (>1 million years) [1]
High temperature/pressure convert them to coal [1]

(ii) Solar radiation heats up the surface/short λ radiation passes through [1]
Heat re-radiated from surface [1]
Is absorbed by atmosphere [1]
REFLECTED – give 0. OZONE – MARK UP TO YOU SEE IT THEN STOP.

(b) **(i)** Gases such as carbon dioxide/sulphur dioxide not released [1]
LESS BURNING OF FOSSIL FUELS/LESS ACID RAIN.
LESS ATMOSPHERIC POLLUTION.

(ii) Radioactive waste products/NUCLEAR WASTE [1]
TOXIC [0] DANGEROUS [0] POSSIBILITY OF A NUCLEAR ACCIDENT [1]

(iii) Uranium/plutonium [1]
Non-renewable ← AWARD IF NAME OF FUEL NOT GIVEN [1]

(iv) Specialist personnel/Equipment/storage/storage time. [1]
Due (to the dangers of) radioactivity ← essential for 2nd mark. [1]
Loss of land use – 1st mark.

(c) **(i)** Energy cannot be created or destroyed = energy in = energy out [1]
It can only change its form/converted. [1]

(ii) 40 − 30 = 10 kJ or 25%. 10 [0] [1]

(iii) Efficiency = useful output energy/total input energy [1]
= 30/40 [1]
= 0.75 or 75% 0.75% NO ANSWER MARK. [1]

(iv) Power = work done/time taken [1]
= 30/12 [1]
= 2.5 kW needed. 2.5 – [2] [1]

(v) Work done = force × distance [1] [1]
15000 = F × 0.03 [1] or F = 15000/0.03 [1] [2]
F = 500 000 (N) [1]
500 kN

25

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				AVAILABLE MARKS
3	**(a)**	**(i)** 2 cm	[1]	
		(ii) 20/5 = 4	[1]	
		Hz	[1]	
			[1]	
		(iii) v = fλ	[1]	
		= 4 × 2	[1]	
		= 8 allow ecf for frequency and wavelength	[1]	
		(iv) Wavefronts refracted towards the boundary	[1]	
		Straight and parallel	[1]	
		Shorter wavelength only if refraction correct	[1]	
		Refracted wavefront continuous with incident one AND NO MORE	[1]	
		(v) Wave slows down [2] change of speed only give 1 increase of speed [0]	[2]	
	(b)	**(i)** US is sound of frequency greater than 20 kHz (sound) above our range of hearing [1]	[2]	
		(ii) DISTANCE = (speed × time) [1]		
		= (5000 × 0.0001) [1] NOT DIVIDING by 2 max. 2 marks	[2]	
		= 0.25 or 25^2	[1]	
		m cm	[1]	
	(c)	Arrangement – Firstly sound made in air	[1]	
		– Secondly sound made in material	[1]	
		– Second sound produces a shorter time/SHORTER TIME GIVES FASTER SPEED	[1]	
		REPEAT and AVERAGE RECORD TIME	[1]	
		QWC	[2]	25

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4	**(a)**	**(i)**	$X \rightarrow Y$	[1]
		(ii)	A to the left	[1]
			B into coil (to the left)	[1]
			C to the right	[1]
		(iii)	Only magnetised when a current is flowing/electricity on electrically charged [0]	[1]
		(iv)	Iron/steel/nickel/cobalt	[1]
		(v)	Add more turns/loops/coils/coils closer	[1]
	(b)	**(i)**	a.c. (sinusoidal) waveform	[1]
			d.c. any line/curve that does not cross the time axis.	[1]
		(ii)	Move the magnet Towards and away from coil/side to side rotate	[2] or [0]
		(iii)	Move the magnet in one direction } BOTH NEEDED [2] OR [0]	[1] [1]
	(c)	**(i)**	A Step – up	[1]
			More turns on <u>secondary</u> (than the <u>primary</u>)	[1]
			B Step – down	[1]
			Fewer turns on the <u>secondary</u> (than the <u>primary</u>)	[1]
		(ii)	Current is reduced/less energy/heat loss less resistance [0]	[1]
	(d)	**(i)**	$N_p/N_s = V_p/V_s$ STEP UP RATIO 20 [1]	[1]
			$300/N_s = 240/12$	[1]
			$N_s = 15$	[1]
		(ii)	Two coils shown wrapped on the iron core – coils in series [0]	[1]
			NO FURTHER CREDIT	
			one coil (connected) to 240 and other coil to 12 V	[1]
			Primary turns greater than secondary turn	[1]
		(iii)	input is a.c. output is a.c. – both needed	[1]

AVAILABLE MARKS

25

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			AVAILABLE MARKS
5	**(a)**	Planet X at 1 – day longer Planet X at 2 – day shorter Planet A at 3 – same length Planet A at 4 – same length [4]	
	(b)	The distance [1] light travels in 1 year ← only give credit if distance mark given [1]	
	(c) **(i)**	(Gas) particles are drawn closer together/condense compress/ density increases [1] Due to gravity [1]	
	(ii)	Temperature has to increase/heats up [1]	
	(iii)	Planets [1]	
	(iv)	All orbit (the Sun) in same plane/same direction [1]	
	(d) **(i)**	Geocentric – Earth at centre [1] Heliocentric – Sun at centre (of the universe – 0) [1]	
	(ii)	The closer Perigee [1] to the Earth the force gets greater [1] changes gets [1] [2]	
	(e) **(i)**	The creation of the Universe [1] in a large explosion ← dependant on 1st line [1]	
	(ii)	Light from (distant) galaxies – NOT STARS [1] is shifted to longer wavelength/red end of spectrum [1] showing that they (galaxies) are moving away/universe is expanding [1]	20
		Total	**125**

GCSE

Science: Physics

Summer 2010

Mark Schemes

Issued: October 2010

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Rewarding Learning

General Certificate of Secondary Education
2010

Science: Physics

Paper 2
Higher Tier

[G7605]

WEDNESDAY 16 JUNE, MORNING

MARK SCHEME

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Subject-specific instructions

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3 The normal penalty for an arithmetical and/or unit error is to lose the mark(s) for the answer/unit line. Substitution errors lose both the substitution and answer mark, but 10^n errors (e.g. writing 550 nm as 550×10^{-6} m) count only as arithmetical slips and lose the answer/unit mark.

					AVAILABLE MARKS
1	(a)	(i)	Mass is an unchanging property/amount of particles/ amount of matter/substance/material [1] Weight is the **force** due to **gravity** [1]	[2]	
		(ii)	D = M/V **or** = 270/(125 – 25) [1] [1] = 2.7 [1] Aluminium [1]	[3]	
	(b)	(i)	P = F/A incorrect physics give [0] [1] = 20 000/8 [1] = 2500 method not required for full marks [1] Pa or N/m^2 [1]	[4]	
		(ii)	Pivot P marked as RH end	[1]	
		(iii)	Weight at centre of beam on or in the beam area	[1]	
		(iv)	CM = ACM [2] [2] F × 4 = 20 000 × 2.5 method not required for full marks [2] [1] [1] no ecf for the marking of the pivot F = 12 500 (N) [1] Equal sign not required in 2nd line [1]	[5]	
	(c)	(i)	Time = distance/(average) velocity – or equivalent [1] = 1.2/0.7 [2] = 1.7 (s) [1]	[4]	
		(ii)	Average velocity = $\frac{1}{2}$ (initial + final) [1] 0.7 = $\frac{1}{2}$ (0 + final) method not required for full marks [1] Final velocity = 1.4 (m/s) [1] Alternative: $s = \frac{1}{2}(u + v)\,t$ 1.2 = $\frac{1}{2}$ (0 + 0.7) 1.7 or 1.2 = $\frac{1}{2}$ (0 + v) 1.7 v = 1.4	[3]	
		(iii)	Acceleration = velocity change/time [1] = (1.4 – 0)/1.7 **ecf from (i) – time – and (ii) – final velocity** [1] = 0.8 (m/s^2) [1] Alternative: $s = ut + \frac{1}{2}at^2$ [1] $v^2 = u^2 + 2as$ [1] $1.2 = 0 + \frac{1}{2}a \times (1.7)^2$ [1] $1.4^2 = 0 + 2 \times a \times 1.2$ [1] $a = 0 + \frac{1.2 \times 2}{1.7^2} = 0.8$ [1] $a = 0.8$ [1]	[3]	
	(d)	(i)	Thinking distance SAME [1] Braking distance GREATER [1]	[2]	
		(ii)	Thinking distance – **CONSTANT speed**/ same speed as before [1] Braking distance – Deceleration [1] **or** slowing down velocity decreasing	[2]	30

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AVAILABLE MARKS

2 **(a)** **(i)** 200 × 100 [1]
= 20 000 (J) [1] [2]

(ii) 200 (J) [1]

(iii) Work (done) = force × distance (moved)
ecf from **(ii)** for work method not required for full marks [1]
200 = F × 8 [2]
F = 200/8 = 25 (N) [1] [4]
Alternative:
20 000 = F × 800 [1] for [1] F × 8 or F × 800
F = 25 (N) no credit for 200 alone

(iv) KE = $\frac{1}{2}mv^2$ method not required for full marks [1]
= $\frac{1}{2} \times 85 \times 8^2$ [1]
= 2720 (J) [1] [3]

(v) PE = mgh [1]
85 × 10 × h = 1700 ecf from **(iv)** for KE [2]
[1] [1]
h = 2.0 (m) [1] [4]
method not required for full marks
PE = 2720 [0]

(b) **(i)** Any **five** from:
Known weight or known mass or use of newtonmeter or balance to find it
Two points a measured distance apart/length of string
Switch on motor
Time to move between points/measured with stopclock
Repeat or take average
Power = $\frac{\text{work done}}{\text{time taken}}$ essential for full marks [5]

Alternative is Power = weight × average speed

Quality of written communication [1]

(ii) Input (electrical energy) or power or energy wasted
Energy used by motor = input energy [1]

(c) **(i)** Upward curve or line starting at same [1]
Copper rising more quickly – larger rise in temperature in same time [1] [2]

(ii) Collisions [1]
(iii) Vibrations [1]
insist on these terms **only**

25

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						AVAILABLE MARKS
3	(a)	(i)	Transverse	[1]		
			Longitudinal	[1]	[2]	
		(ii)	Energy, KE or PE or mechanical energy		[1]	
		(iii)	Vibrates/oscillates	[1]		
			Perpendicular to the direction of energy transfer/motion of wave	[1]	[2]	
			moves up or down [1]			
			moves up **and** down [2]			
		(iv)	0.3 (m)		[1]	
		(v)	0.8 (m)		[1]	
		(vi)	f = no. of vibrations/time taken (or f = 24/8 or equivalent)	[1]		
			f = 3 (Hz)	[1]	[2]	
			$f = \frac{I}{T}$ give [1]			
		(vii)	$v = f\lambda$	[1]		
			$v = 3 \times 0.8$ ecf from **(v)** for wavelength and **(vi)** for frequency	[1]		
			v = 2.4 (m/s)	[1]	[3]	
	(b)	(i)	1. Hammer seen striking gong or bell still working	[1]		
			2. No sound heard from bell or fainter sound	[1]	[2]	
		(ii)	Sound cannot travel in a vacuum **or** sound needs particles for propagation **or** equivalent **or** light can travel through a vacuum		[1]	
		(iii)	Ultrasound/ultrasonic		[1]	
	(c)	(i)	One wave shown over the four grid squares	[1]		
			of **greater the amplitude** as before	[1]	[2]	
		(ii)	**Two waves shown** over the four grid squares	[1]		
			Same amplitude	[1]	[2]	
	(d)	(i)	(1st echo is) from the bottom of the ice	[1]		
			(2nd echo is) from the top of the ice	[1]	[2]	
		(ii)	Distance to the ice = 0.26 × 1500/2	[2]		
			= 195	[1]	[3]	25

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					AVAILABLE MARKS
4	**(a)**	Two (complete) loops one above and one below coil	[1]		
		One straight line through centre/or continuation of loop	[1]		
		Direction out of RIGHT hand end or in at left hand conflicting arrows – [0]	[1]	[3]	
	(b) **(i)**	Variable resistor/variable power supply/rheostat/potential divider		[1]	
	(ii)	4 points plotted $\pm \frac{1}{2}$ smallest square	[1]		
		Best fit line	[1]		
		Through 0, 0 $\pm$ 1 square	[1]	[3]	
	(iii)	10 clips 1.2 A intersects line at approximately 10 clips		[1]	
	(c) **(i)**	Battery, switch	[1]		
		in series with coil – complete circuit Ignore ammeters/voltmeter	[1]		
		Coil wound around soft iron core – look for this point before any further credit Additional components, e.g. motor [1]	[1]	[3]	
	(ii)	Iron Is attracted when electromagnet switched on	[1]		
		Is an electromagnet/temporary magnetism/magnetic	[1]	[2]	
	(iii)	X and Y **both** correct		[1]	
	(iv)	An insulator (may be a named insulator)	[1]		
		Otherwise device at XY always ON/contacts or X, Y short circuit	[1]	[2]	
	(d) **(i)**	$V_s/V_p = N_s/N_p$ [1] $V_s = 6 \times 240/1800$ [2] $= 0.8$ [1]		[4]	
	(ii)	Changing current/magnetic field in primary coil is changing Causes changing current/voltage to be induced in secondary		[1]	
	(iii)	step up – increases the voltage	[1]		
		Reduces current/energy losses (in cable)	[1]		
		step down – reduces the voltage	[1]		
		Safer voltage (for domestic appliances) useable/suitable for domestic appliances reduces resistance – [0]	[1]	[4]	25

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						AVAILABLE MARKS
5	**(a)**	**(i)**	365 **or** $365\frac{1}{4}$ days		[1]	
		(ii)	A: summer	[1]		
			C: winter	[1]	[2]	
		(iii)	Line through the earth's centre inclined to the vertical, **consistent with answer to (ii)**		[1]	
		(iv)	Area to **left of vertical terminator** shaded		[1]	
	(b)	**(i)**	Hydrogen **only**		[1]	
		(ii)	Gas/hydrogen moves towards centre Due to **gravitational forces *** ***** both needed before full marks awarded Gas cloud spins/pressure increases And heats up *** (Nuclear) fusion** begins when temperature very high Any 4 of the 5 points above nebula contracts [1] or density increases [1] – or gas hydrogen moves toward centre heating associated with fusion – [0]		[4]	
		(iii)	Planets orbit Sun in **same sense/direction** orbit in same way [0]	[1]		
			Planets orbit in same plane	[1]	[2]	
	(c)	**(i)**	(Force) increases		[1]	
		(ii)	Force **decreases** (with decreasing mass) Look for alternative, i.e. increase with increasing mass		[1]	
	(d)	**(i)**	Light year is the distance travelled by light in a year		[1]	
		(ii)	$3 \times 10^5 \times (4 \times 3.15 \times 10^7) = 3.78\ (3.8) \times 10^{13}$ (km) [1] [1] [1]		[3]	
		(iii)	$3.78 \times 10^{13}/25 =$ **1.512×10^{12}** [1] (seconds) ecf from **(ii)**	[1]		
			$= 1.512 \times 10^{12}/3.15 \times 10^7 = 48\,000$ years light 12 000 faster than craft [1] time is 12 000 × 4 years = 48 000 [1]	[1]	[2]	20
					Total	**125**

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GCSE

Science: Physics

Summer 2009

Mark Schemes

Issued: October 2009

Rewarding Learning

General Certificate of Secondary Education
2009

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Paper 2
Higher Tier

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FRIDAY 19 JUNE, MORNING

MARK SCHEME

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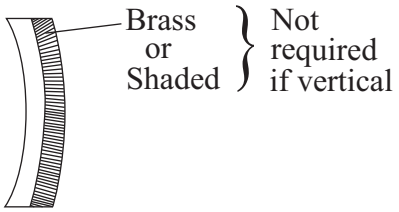
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				AVAILABLE MARKS
1	(a)	(i)	**Pivot** – centre of the wheel [1] **Effort** – at the handle, [1] must touch or pass through handle [1] **Direction** – upwards, [1] only if line of action when extended passes through handle [1] [3]	
		(ii)	The effort is further from the pivot [1] So smaller force can produce same moment as the weight [1]/or larger moment (Moment is essential in the answer) [2] Also accept increases moment of (effort) Force multiplier [0] unless further explanation. Moving effort [0] Larger effort [0] Turning force [0]	
	(b)	(i)	ACM = CM [1] [1] [1] F× 3 = 5000 × 5 [2] e.g. F × 3 = 500 × 5 give [2] F = 8333 N [1] accept 8300 [4]	
		(ii)	Pressure = Force/Area [1] **or** equivalent = 30 000/120 [1] = 250 [1] 0.025 N/cm^2 Pa or N/m^2 [1] **or** N/cm^2 [1] if no working present If working present, unit mark only given for Pa or N/m^2 [4]	
		(iii)	$v = u + at$ **or** $v = 0 + 10 \times 1.75$ [1] If 9.81ms^{-2}→ 17.1→17.2 v = 17.5 m/s [1] [2]	
		(iv)	Height = $\frac{1}{2}(u + v)t$ [1] = $\frac{1}{2}(0 + 17.5) \times 1.75$ [1] Also accept = 15.3 m [1] e.c.f. for v from **(iii)** mgh = $\frac{1}{2}$ mv^2 [3] s = $\frac{1}{2}$gt^2 [1] v^2 = 2as [1] s = ave. speed × time [1] = $\frac{1}{2} \times 10 \times 1.75^2$ [1] $17.5^2 = 2 \times 10$ [1] e.c.f. for v from **(iii)**	
	(c)	(i)	**Tension** (in the string) Must be tension [1]	
		(ii)	Decrease Increase No change Increase [$\frac{1}{2}$] each round down [2]	
	(d)		Momentum before = momentum after [1] [1] [1] 0.5 × 3 = (0.5 + 0.75) × V [2] [1] per side (0.5 × 3 + 0.75 × 0) gets [1] V = 1.2 m/s [1] [4]	25

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				AVAILABLE MARKS
2	**(a)**	**(i)**	Sketch showing: Bending [1] With brass on outside [1]  [2]	
		(ii)	As the temperature increases [1] gets hot/warms up/ strip bends away (from the knob) or to the left [1] away from contact strip bends and breaks contacts [2] opening the contacts/breaking circuit [1] [3] Quality of written communication [1]	
		(iii)	To set the temperature (at which thermostat switches (off)) or on control/change/raise or lower temperature [1] Adjust the distance strip has to bend [1] Reset heater [0] Sensitivity [0]	
		(iv)	Substance: Insulator or named insulator (e.g. polythene) [1] wood Reason: Otherwise heater permanently on **or** Otherwise thermostat is short circuited [1] [2] does not conduct **electricity** does not conduct heat [0]	
	(b)		Pin breaks (or bends) [1] Force on pin due to contracting flat iron bar [1] [2] It contracts [1] Increasing force/pressure on pin Pin contracts [0] shrinks [1] shortens [1]	
	(c)	**(i)**	GPE = mgh [1] $= 0.02 \times 10 \times 1.8$ [2] $20 \times 10 \times 1.8$ [1] $= 0.36$ (J) [1] 360 [2] [4]	
		(ii)	0.36 (J) (**e.c.f. from (i)**) Mark to benefit of candidate [1]	
		(iii)	KE = $\frac{1}{2}mv^2$ [1] $360 = \frac{1}{2} \times 20 \times v^2$ [2] or $360 = \frac{1}{2} \times 2 \times v^2$ [2] $0.36 = \frac{1}{2} \times 0.02 \times v^2$ [2] $v^2 = 36$ [1] $v^2 = u^2 + 2as$ wrong physics [0] $v = 6$ (m/s) [1] All e.c.f. from **(i)** [5]	
		(iv)	Speed: remains as before [1] KE: remains as before [1] [2]	
		(v)	Speed: remains as before [1] KE: increases [1] [2]	25

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				AVAILABLE MARKS
3	**(a)**	**(i)**	Passing energy from particles to particle Sound moves by **vibrations** of particles/molecules Needs particle to pass through/propagation [1] Sound produced by vibrations [0] needs moving particles [0]	
		(ii)	Electric bell in a chamber (bell jar) Hammer seen striking gong Sound of the bell is audible Chamber/bell jar connected to vacuum pump Pump switched on/air removed from chamber/bell jar Loudness of sound decreases Sound becomes inaudible Even though the hammer is seen still striking gong Any **six** [6]	
	(b)		$V = \frac{d}{t}$ [1] $340 = \frac{100}{t}$ [2] $340 = \frac{50}{t}$ [1] $t = 0.29$ [1] (0.294) 0.145 ← [0] unless work shown [4]	
	(c)		Speed = frequency × wavelength **or** $v = f\lambda$ [1] = 200 000 × 1500 or 200 000 × 1.5 [1] **or** 200 × 1.5 [0] – formula mark [1] = 300 000 000 (3×10^8) **or** 300 000 (3×10^5) [1] m/s [1] km/s [1] [4]	
	(d)	**(i)**	The wavelength should not have changed [1] **or** distance between waves The direction is wrong [1] **or** indicated by diagram [2]	
		(ii)	Straight wavefronts, unchanged wavelength (by eye) [1] not behind barrier Reflected so that $i = r$ (by eye) [1] Minimum is 2 wavefronts [2]	
	(e)	**(i)**	Observation . . . amplitude decreases [1] height – eventually str. line Explanation . . . sound gets quieter [1] lower/softer/loss of energy [2]	
		(ii)	Number of peaks or distance between peaks (doesn't change) [1] wavelength does not change [0] Frequency or pitch does not change [1] Tone [0] [2]	
		(iii)	It is louder or greater amplitude [1] It has the same pitch or frequency [1] [2]	25

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AVAILABLE MARKS

4 **(a)** **(i)** Energised/electromagnet switched on/magnetic
Core coil becomes magnetised [1]
Pulls/attracts armature/hammer [1] [2]

(ii) Conducts current/acts as part of the circuit [1]
Pulls armature back to (complete the circuit) [1]
Allows armature/hammer to move [1]
} Allows armature to be attracted [0] flexible [2]

(iii) The magnetic field would be too weak [2]
Not able to pull the armature over/break the circuit [2]
Weaker magnetic field give [1]/insufficient force [1] [2]

(iv) Use weaker spring/adjust contact to press less strongly/move tighter coil closer to armature/Increase number of turns/Increase the current (more cells)
More magnetic [1]
Any **three** [3]
Thicker wire without explanation [0]

(b) **(i)** N Pole on the left or S on the right [1]

(ii) Join ends of lines with straight parallel lines in coil [1]
Arrows **inside** coil from S to N (e.c.f. from **(i)**) [1] [2]
outside N to S
Drawing lines to straight lines on diagram [0] but mark for direction

(iii) Complete loop or straight line down centre [1]

(c) It experiences a force/is pushed or/pulled [1] or movement
Up/down page/perpendicular to field and current [1] [2]

(d) **(i)** d.c. flows in a same/constant direction [1] constant value [0]
constant polarity [1]
a.c. changes direction + to – (**repeatedly**) [1] [2]

(ii) Electromagnetic induction [1]

(iii) D.C. **or** direct current **or** constant current [1]

(iv) A complete iron core [1] which has a label [1]
Two coils of (insulated) wire [2] [4]

(v) At output of power station (any proper use) [1]
Any practical situation

(vi) To reduce energy loss in the grid or as appropriate depending on example given [1]

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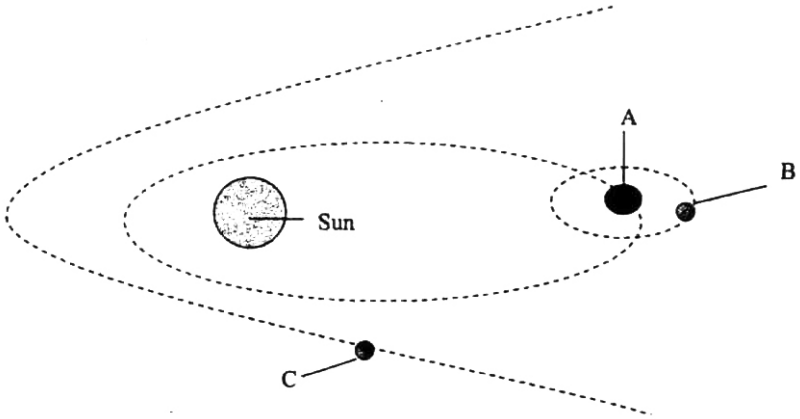
(e) **(i)** Clockwise from the live terminal
Fuse [1]
Switch [1]
Heater [1] [3]

(ii) If switch on neutral/wrong side:
Appliance can be live/at a high voltage/dangerous to touch [1]
Even when switch is off [1] [2]
Live side – Switch/fuse reversed – Then switch is dangerous to touch **or** switch is live if fuse blows

AVAILABLE MARKS

30

5 **(a)**



(i) A = planet orbit [1]

(ii) B = Moon orbit [1]

(iii) C = Comet path or an elliptical/circular path [1]

(b) **(i)** **24 hours** or **same time** as the Earth takes to make one rotation [1]
Same speed/rate [0]

(ii) Take photographs of large areas/spying/weather/sat nav/ any suitable use [1]

(c) **(i)** Stars/Suns – not **the** sun [1]

(ii) Gravity [1]

(iii) **Galaxies** are moving away from each other
Universe is expanding [1] but **not** expanding galaxies [1]

(iv) They are moving apart faster [1]

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				AVAILABLE MARKS
(d)	**(i)**	Time = distance/speed [1] or t = *s*/*v* = 8.6/0.00004 [1] = 215 000 years [1]	[3]	
	(ii)	Spacecraft too slow **or** takes longer than a human lifetime **or** distance too great/too much fuel/takes too long resources for life [1] Any **two** expense [0]	[2]	
	(iii)	2 × 8.6 = 17.2 [1] years [1] **5.4 × 10^8 s**	[2]	
(e)	**(i)**	Hydrogen	[1]	
	(ii)	Fusion	[1]	
	(iii)	**(**Two) hydrogen [1]/helium **nuclei** join [1] fusing [1]	[2]	20
			Total	**125**

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