

# GCSE (9–1) Physics B (Twenty First Century Science)

# H

## J259/04 Depth in physics (Higher Tier)

### Sample Question Paper

## Date – Morning/Afternoon

Time allowed: 1 hour 45 minutes



**You must have:**

- the Data Sheet

**You may use:**

- a scientific or graphical calculator



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<b>First name</b>											
<b>Last name</b>											
<b>Centre number</b>							<b>Candidate number</b>				

### INSTRUCTIONS

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

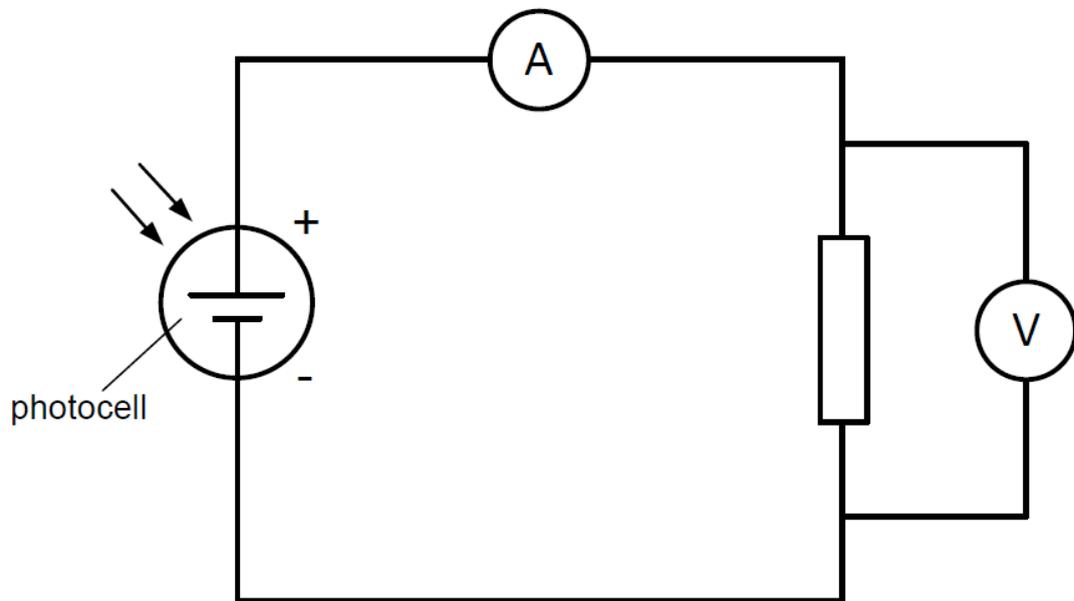
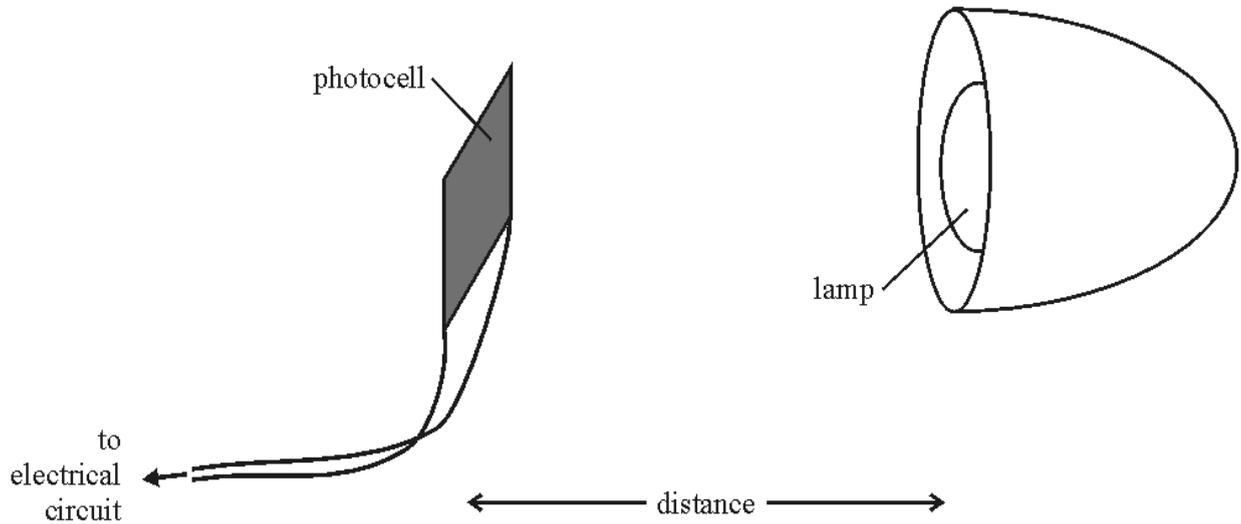
### INFORMATION

- The total mark for this paper is **90**.
- The marks for each question are shown in brackets [ ].
- Quality of extended responses will be assessed in questions marked with an asterisk (\*).
- This document consists of **20** pages.



- 2 Sam is doing an experiment to investigate the output of a solar panel. She is using a small photocell to model the panel.

She is measuring the power output of the photocell when it is different distances from a lamp, as shown below.

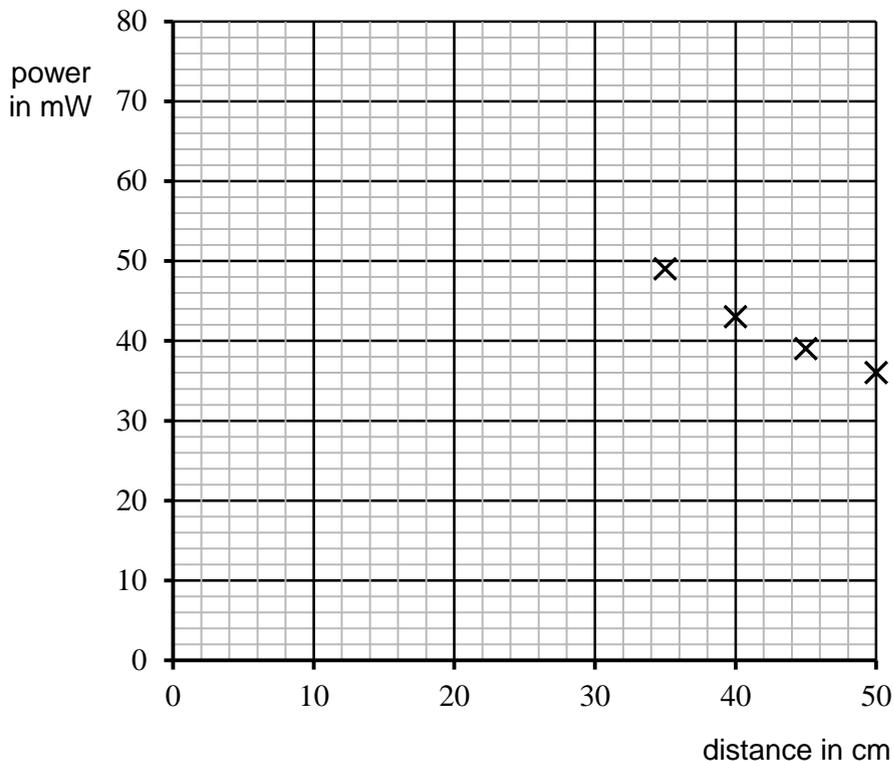


(a) Sam obtained a range of values of power at different distances, as shown in the table below:

<b>distance (cm)</b>	25	30	35	40	45	50
<b>power (mW)</b>	72	57	49	43	39	36

Four data points have been plotted on the graph axes below.

(i) Plot the remaining two data points and add a best-fit curve. [2]



(ii) What does the graph show?  
 .....  
 ..... [1]

(iii) At a distance of 25 cm the power was 72mW. The voltage across the photocell was recorded as 12 V. Using the equation: power = potential difference x current, calculate the current through the photocell.  
 .....A [4]

(iv) Calculate the resistance in Ohms of the photocell using the equation: potential difference = current x resistance.  
 .....Ω [3]

(b) Describe how this experiment should be completed to get a good, reliable set of data.

.....  
.....  
.....  
..... [4]

(c) Tom has done an identical experiment to Sam's in a **different part** of the same lab.

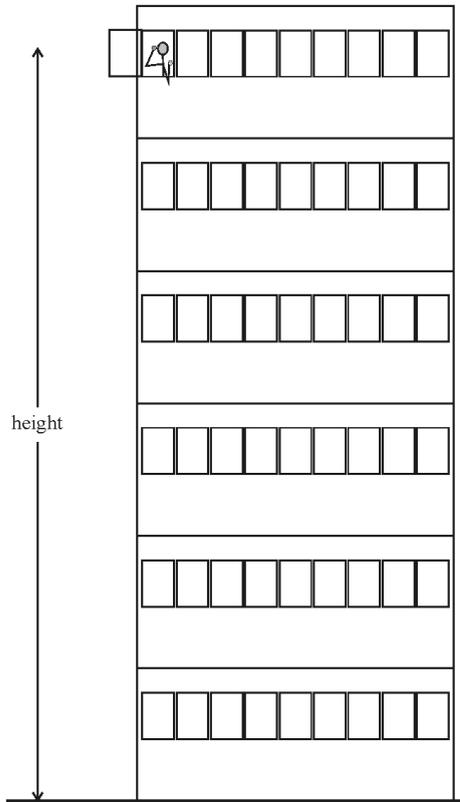
He used an identical lamp, photocell and resistor, but his values of power were much lower than Sam's for the same distances.

He thinks that his part of the lab must have been different from Sam's.

Suggest and explain a reason for the difference in their results.

.....  
.....  
.....  
..... [2]

- 3 Tom is trying to measure the acceleration due to gravity ( $g$ ) by dropping six tennis balls from a top floor window in a tall building. He starts a stopwatch as he lets go of each ball and stops it when he hears the ball hit the ground.



- (a) Tom says that he knows that the height through which the ball is falling is 13.5 m.

Suggest and describe one way which Tom may have used to measure this height.

.....

.....

.....

[2]

**(b)** Tom finds that it takes an average of 1.8 seconds for the ball to fall. Use this time to calculate the average speed of a falling ball and use this value to find the acceleration due to gravity,  $g$ .

.....m/s<sup>2</sup> [5]

**(c)** Toms' method gives a value for  $g$  which is too low.

Suggest and explain one experimental error which could account for this.

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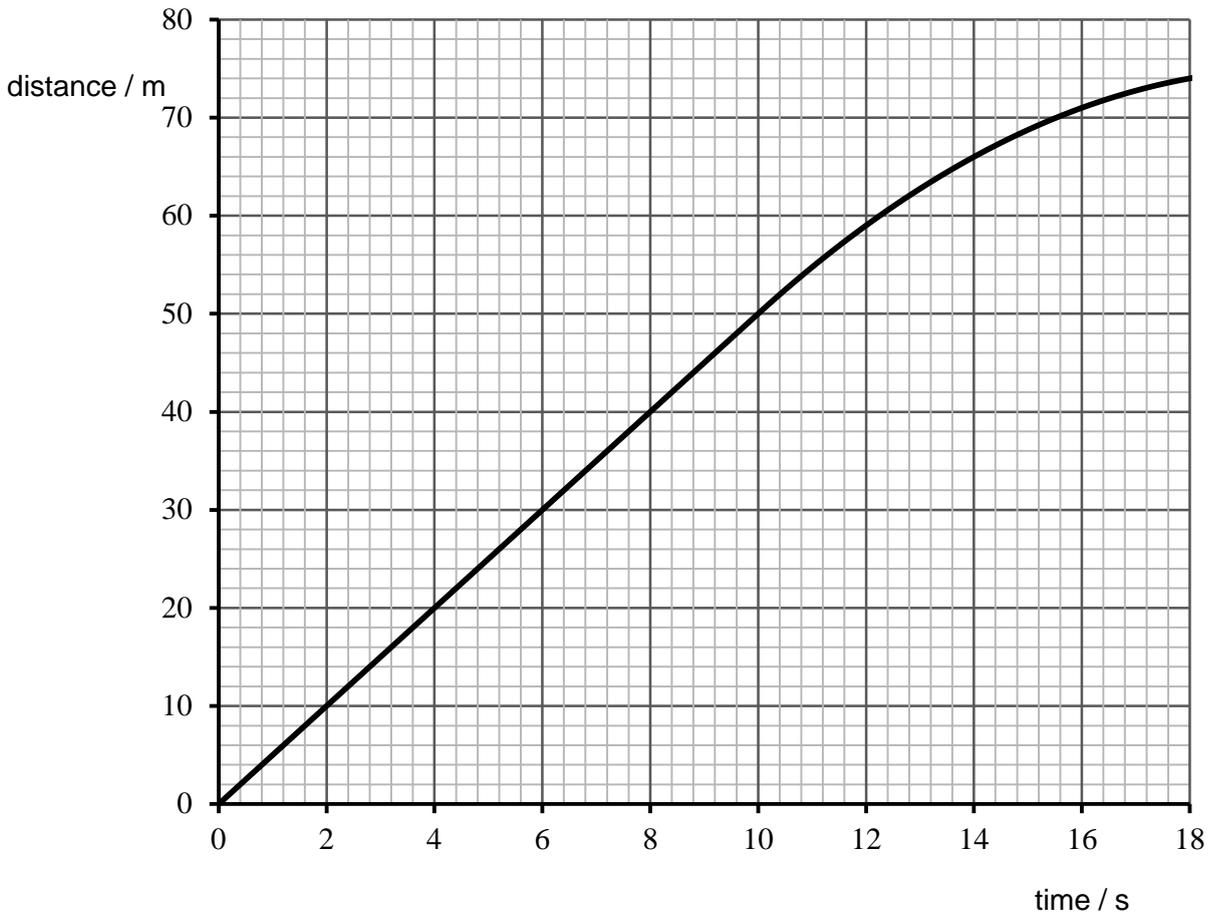
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[2]

4 Below is a distance-time graph for a short car journey along a straight road.



(a) Explain how the graph shows that that the car begins to decelerate at a time of 10 s.

.....

.....

.....

.....

**[2]**

(b) Use the graph to calculate the mean deceleration between 10 and 16 seconds.

Show your working clearly.

.....m/s<sup>2</sup> **[4]**

(c) A second car starts from the same starting point as the first car at the same time. It has an initial velocity of 1.0 m/s and accelerates at a uniform rate.

(i) When the second car has travelled a distance of 66 m, its velocity is 7.0 m/s. Calculate the acceleration of this second car.

.....m/s<sup>2</sup> [3]

(ii) Calculate the time taken to reach the velocity of 7.0 m/s and use this to **sketch a line** on the graph opposite showing the journey of the second car.

.....s [3]

5 (a) The table below gives information about three planets in the solar system.

planet	percentage of carbon dioxide in the atmosphere	density of the atmosphere at the planet's surface (kg/m <sup>3</sup> )	distance from the Sun (millions of km)	mean surface temperature (°C)
Venus	96 %	120	1.1	470
Earth	0.04 %	1.3	1.5	20
Mars	95 %	0.02	2.3	-60

One astronomer has described the temperatures of these three planets as follows:



**Professor Rubin**

The mean temperatures of the Earth, Venus and Mars all correlate with their distances from the Sun, but the temperature differences are not due to the difference in the distances.

Explain what Professor Rubin means and decide whether the data in the table supports her statement.

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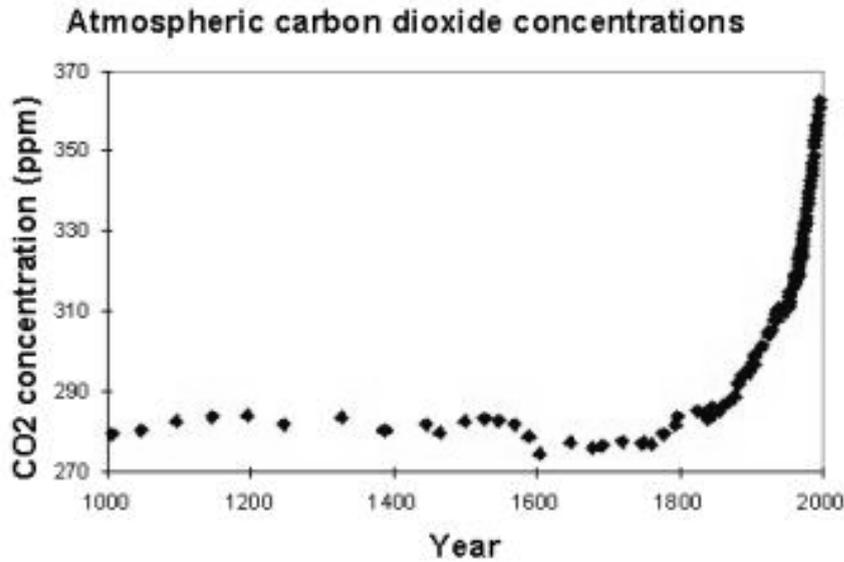
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**[4]**

- (b) Increased levels of carbon dioxide in the atmosphere have been linked to the greenhouse effect. The graph below shows the amount of carbon dioxide in the atmosphere over a 1000 year period.



Many scientists think this is evidence that human activity has had an effect on the amount of carbon dioxide in the atmosphere.

Explain how the graph supports this idea.

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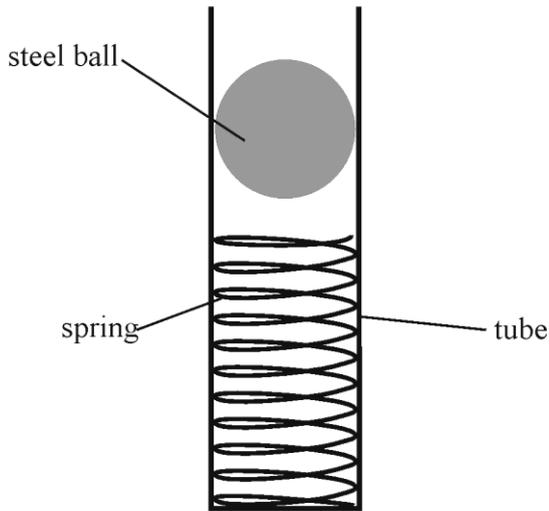
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[4]

- 6 This question is about using a spring to fire a small steel ball from a 'cannon'. The spring fits inside a tube, as shown below.



The spring is compressed, and the energy stored in the spring is used to fire the ball.

- (a) The spring used has a spring constant of  $32 \text{ N/m}$ , and the steel ball has a weight of  $0.14 \text{ N}$ .

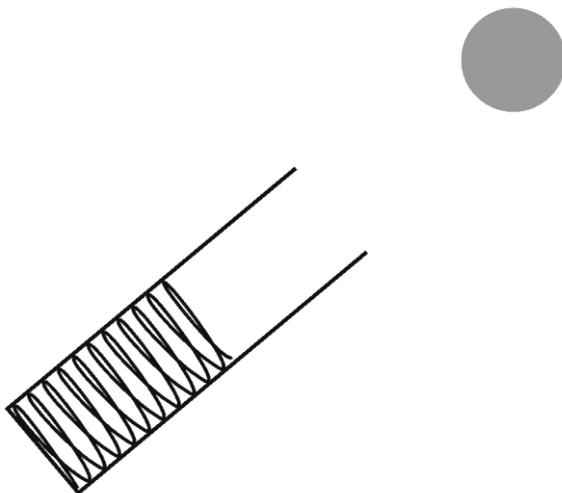
The ball is placed on top of the spring. Show that the weight of the ball compresses the spring by about  $4 \text{ mm}$ .

.....

.....

..... [3]

- (b) Alex is going to use this apparatus to investigate the range of a projectile fired at an angle. The diagram below shows the steel ball just after it has left the tube.

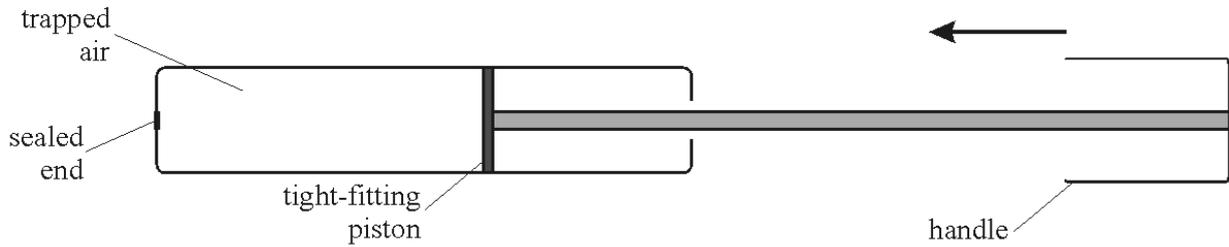


**On the diagram**, draw an arrow on the steel ball to show the direction of the resultant force acting on it. You should ignore any effects due to the presence of air.

[1]



7 This question is about compressing a gas inside a cylinder. The cylinder is the pump used for inflating a bicycle tyre. In this case, it is sealed at the end so no air can escape.



(a) The trapped air has a volume of  $120 \text{ cm}^3$  and a pressure of  $100 \text{ kPa}$ .

(i) The handle is slowly pushed in until the volume of trapped air is  $50 \text{ cm}^3$ .

Calculate the new pressure of the air on the walls of the pump.

Show your working clearly.

(ii) Explain the pressure change in terms of the behaviour of the particles of trapped air. .....kPa [3]

.....

.....

.....

..... [3]

(iii) In doing the calculation, you have to assume that no gas leaked out when the handle was moved.

State one other assumption which must be made for the calculation, and explain why this assumption would be correct if the volume change were slow but incorrect if the volume change were rapid.

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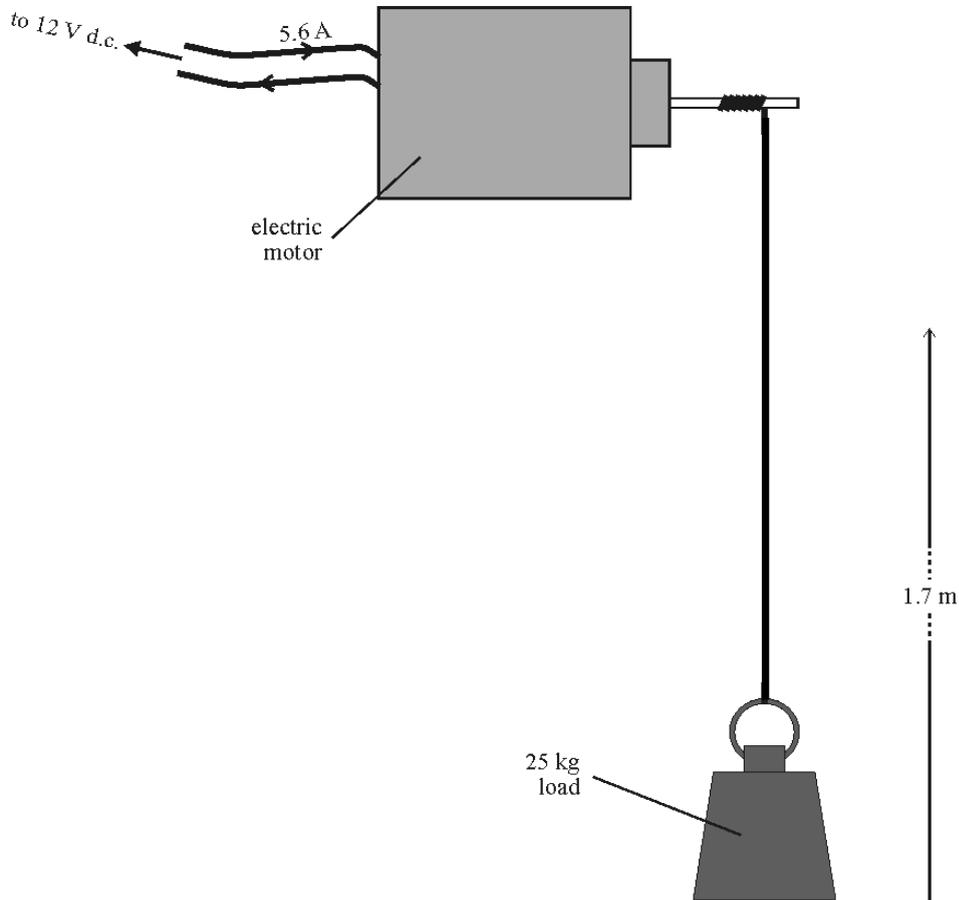
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..... [4]



8 This question is about an electric motor.

- (a) An electric motor, attached to a 12 V d.c. source, draws a current of 5.6 A while lifting a load of 25 kg. It takes the motor 45 seconds to lift the load through a height of 1.7 m.



- (i) Assuming that all energy losses occur in the motor, and that the motor is well-insulated, calculate the increase in the internal energy of the motor.

.....J [6]

- (ii) A force of 250 N is needed to lift the load a distance of 1.7 m. Calculate the work done.

.....J [3]

- (b) When an electric motor is switched on, it has a very large current through it, but this rapidly drops to a much smaller value.

Which **two** of the following statements can explain this observation?  
Put ticks (✓) in the boxes after the **two** correct statements.

The turning motor acts as a generator which produces a p.d. opposing the battery p.d.

As the motor speeds up, the friction in the turning parts becomes smaller.

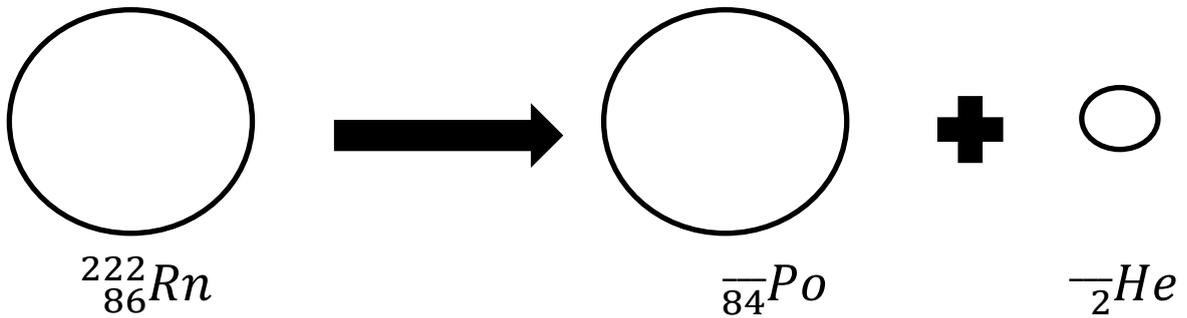
Friction in the motor dissipates energy resulting in more energy taken from the supply.

Current heats the coils in the motor which makes their resistance increase.

As the motor turns faster, the force needed to turn it decreases

[2]

- 9 Radon-222 is a dense radioactive gas. The diagram below shows the alpha decay of Radon-222.



- (a) Complete the above equation by adding the **two missing numbers** to the products produced. [1]
- (b) Radon is found in many minerals. People working in deep mines where these minerals are extracted have long been known to have a high rate of lung cancer.

Explain this in terms of the properties of radon and alpha radiation.

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.....

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..... [2]

**END OF QUESTION PAPER**

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## Specimen Assessment Material

GCSE (9–1) in Physics B (Twenty First Century Science)

J259/04 Depth in physics (Higher Tier)

**SAMPLE MARK SCHEME**

**Duration:** 1 hour 45 minutes

**MAXIMUM MARK    90**

**This document consists of 20 pages**

**MARKING INSTRUCTIONS****PREPARATION FOR MARKING****SCORIS**

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *scoris assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>
3. Log-in to scoris and mark the **required number** of practice responses (“scripts”) and the **required number** of standardisation responses.

YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

**MARKING**

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 50% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone, email or via the scoris messaging system.

5. Work crossed out:
  - a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
  - b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.
6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.
7. There is a NR (No Response) option. Award NR (No Response)
  - if there is nothing written at all in the answer space
  - OR if there is a comment which does not in any way relate to the question (e.g. 'can't do', 'don't know')
  - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the question.Note: Award 0 marks – for an attempt that earns no credit (including copying out the question).
8. The scoris **comments box** is used by your Team Leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.** If you have any questions or comments for your Team Leader, use the phone, the scoris messaging system, or email.
9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

10. For answers marked by levels of response:

Read through the whole answer from start to finish, using the Level descriptors to help you decide whether it is a strong or weak answer. The indicative scientific content in the Guidance column indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the skills and science content evidenced within the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.

Once the level is located, award the higher or lower mark:

**The higher mark** should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met.

**The lower mark** should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing.

**In summary:**

**The skills and science content determines the level.**

**The communication statement determines the mark within a level.**

Level of response questions in this paper are **1** and **7(b)**.

## 11. Annotations

<b>Annotation</b>	<b>Meaning</b>
<b>DO NOT ALLOW</b>	Answers which are not worthy of credit
<b>IGNORE</b>	Statements which are irrelevant
<b>ALLOW</b>	Answers that can be accepted
( )	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
<b>ECF</b>	Error carried forward
<b>AW</b>	Alternative wording
<b>ORA</b>	Or reverse argument

## 12. Subject-specific Marking Instructions

### INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

The breakdown of Assessment Objectives for GCSE (9–1) in Physics B (Twenty First Century Science):

	<b>Assessment Objective</b>
<b>AO1</b>	<b>Demonstrate knowledge and understanding of scientific ideas and scientific techniques and procedures.</b>
<b>AO1.1</b>	Demonstrate knowledge and understanding of scientific ideas.
<b>AO1.2</b>	Demonstrate knowledge and understanding of scientific techniques and procedures.
<b>AO2</b>	<b>Apply knowledge and understanding of scientific ideas and scientific enquiry, techniques and procedures.</b>
<b>AO2.1</b>	Apply knowledge and understanding of scientific ideas.
<b>AO2.2</b>	Apply knowledge and understanding of scientific enquiry, techniques and procedures.
<b>AO3</b>	<b>Analyse information and ideas to interpret and evaluate, make judgements and draw conclusions and develop and improve experimental procedures.</b>
<b>AO3.1</b>	Analyse information and ideas to interpret and evaluate.
<b>AO3.1a</b>	Analyse information and ideas to interpret.
<b>AO3.1b</b>	Analyse information and ideas to evaluate.
<b>AO3.2</b>	Analyse information and ideas to make judgements and draw conclusions.
<b>AO3.2a</b>	Analyse information and ideas to make judgements.
<b>AO3.2b</b>	Analyse information and ideas to draw conclusions.
<b>AO3.3</b>	Analyse information and ideas to develop and improve experimental procedures.
<b>AO3.3a</b>	Analyse information and ideas to develop experimental procedures.
<b>AO3.3b</b>	Analyse information and ideas to improve experimental procedures.

Question	Answer	Marks	AO element	Guidance
1*	<p><i>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</i></p> <p><b>Level 3 (5–6 marks)</b></p> <p>Balanced explanation of both points of view linked to the risks / benefits.  <b>AND</b>  Judgement made as to the better argument.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated</i></p> <p><b>Level 2 (3–4 marks)</b></p> <p>Explains at least one point in favour of nuclear power and one against.  <b>AND</b>  Makes a reasoned choice of Pam or Suraiya as being right.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b></p> <p>States differences between renewable and non-renewable energy sources.  <b>AND</b>  Considers only one side of the argument.</p> <p><i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be</i></p>	6	1.1 x3 2.2 x1 3.1b x1 3.2b x1	<p><b>AO1.1 Renewable vs. Non-renewable energy resources</b></p> <p>For example:</p> <ul style="list-style-type: none"> <li>• Coal and oil are non – renewable so will run out</li> <li>• Nuclear is also non renewable</li> <li>• A renewable energy resource will not run out e.g. wind, wave, solar etc.</li> </ul> <p><b>AO1.1 Nuclear energy hazards</b></p> <p><b>For example</b></p> <p>Ionising radiation can have hazardous effects, notably on many varied types of living organisms and plants</p> <p><b>AO2.2</b> Compare the ways in which the main energy resources are used to generate electricity</p> <p><b>AO 3.1b Risk/benefit</b></p> <ul style="list-style-type: none"> <li>• CO<sub>2</sub> contributes to global warming</li> <li>• nuclear waste could leak / enter the biosphere</li> <li>• risk small, but consequence serious</li> <li>• possibility of employment in new power station</li> <li>• which may bring money into the area</li> <li>• nuclear power stations don't produce CO<sub>2</sub> (once built)</li> <li>• coal / gas produce CO<sub>2</sub></li> <li>• solar / wind / hydroelectric / tidal don't produce CO<sub>2</sub> at the point of electricity generation</li> <li>• radioactive waste produced in nuclear power stations</li> </ul> <p><b>AO3.2b</b></p> <p>Judgement made as to the better argument</p>

Question			Answer	Marks	AO element	Guidance
			<p><i>clear.</i></p> <p><b>0 marks</b> No response or no response worthy of credit.</p>			
2	(a)	(i)	<p>Both points correctly plotted ✓</p> <p>Smooth curve drawn ✓</p>	2	1.2	
		(ii)	Power goes down with distance (non-uniformly) ✓	1	3.1a	<b>ALLOW</b> negative correlation correctly described
		(iii)	<p><b>FIRST CHECK ANSWER ON ANSWER LINE.</b> <b>If answer = <math>6 \times 10^{-3}</math> (A) award 4 marks.</b></p> <p>Rearrange equation to give:</p> <p>Current = Power ÷ Potential difference ✓</p> <p>Converts mW to W = 0.072 W ✓</p> <p>= 0.072 (w) ÷ 12 (V) ✓</p> <p>= <math>6 \times 10^{-3}</math> A ✓</p> <p>Or 6 mA</p>	4	1.2 2.1 2.1 2.1	
		(iv)	<p><b>FIRST CHECK ANSWER ON ANSWER LINE.</b> <b>If answer = 2000 (Ω) award 3 marks.</b></p> <p>Rearrange equation to give resistance</p> <p>Resistance = Potential difference ÷ current ✓</p> <p>= 12 (v) ÷ <math>6 \times 10^{-3}</math> (A) ✓</p> <p>= 2000 (Ω) ✓</p>	3	1.2 2.1 2.1	

Question		Answer	Marks	AO element	Guidance
	(b)	Lamp at fixed distance from photocell and read $I$ and $V$ ✓ Repeat reading at each distance ✓ Repeat for any outliers ✓ Take mean $I$ and $V$ for each distance ✓	4	3.3a 3.3b 3.3b 3.3a	
	(c)	Recognises that Tom's photocell is getting less light ✓ Suggested reason ✓	2	3.2a 3.2b	e.g. Sam was near a window (so more light) while Tom was in a dark corner; allow systematic mismeasurement of distance by one or the other if correctly justified e.g. the end of Sam's ruler wasn't near the actual lamp but some distance from it, so all her distances are too small  <b>ALLOW</b> any situation where Tom would receive less light than Sam

Question		Answer	Marks	AO element	Guidance
3	(a)	Measure angle to window from ground a measured distance away ✓ And use trigonometry ✓ <b>Or</b> Measure the height of ground floor 'repeat' ✓ And multiply by 5 and add height to window from floor ✓	2	3.3a  2.2	Suggestion How to implement ALLOW any other sensible suggestion
	(b)	<b>FIRST CHECK ANSWER ON ANSWER LINE.</b> <b>If answer = 8.3 (m/s<sup>2</sup>) award 5 marks</b> Recall speed = distance ÷ time ✓ speed = 13.5 m ÷ 1.8 s = 7.5 m/s ✓ $(0 + v) \div 2 = 7.5 \text{ m/s} \Rightarrow v = 15 \text{ m/s}$ ✓ Recall acceleration = change in speed ÷ time ✓ $a = (15 \text{ m/s} - 0) \div 1.8 \text{ s} = 8.3 \text{ (m/s}^2)$ ✓	5	1.1 2.1 2.1 1.1 2.1	
	(c)	suggested factor e.g. $h$ measured too small ✓ explain why it gives $g$ too low e.g. $t$ too long due to not stopping watch soon enough ✓	2	3.1a	

Question		Answer	Marks	AO element	Guidance
4	(a)	Graph is linear up to 10 s (i.e. constant speed)/no longer straight line after 10 s ✓  Gradient then (continually) decreases, i.e. decelerating ✓	2	1.2	
	(b)	Initial velocity = $50 \text{ m} \div 10 \text{ s} = 5 \text{ m/s}$ ✓  Tangent drawn at 16 s ✓  Gradient of tangent found = final velocity $\approx 2.0 \text{ m/s}$ ✓  $a = (v-u)/t = 3 \text{ m/s} \div 6 \text{ s} = 0.5 \text{ (m/s}^2\text{)}$ ✓	4	2.2	Maximum of 2 marks can be awarded if there is no tangent drawn  <b>ALLOW</b> 1.4 m/s to 2.6 m/s  <b>ECF</b> own values
	(c) (i)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE.</b> <b>If answer = <math>0.36 \text{ (m/s}^2\text{)}</math> award 3 marks</b>  <i>Select:</i> $v^2 - u^2 = 2as$  $\Rightarrow (7.0 \text{ m/s})^2 - (1.0 \text{ m/s})^2 = 2a \times 66 \text{ m}$ ✓  $a = (48 \text{ m}^2/\text{s}^2) \div 132 \text{ m}$ ✓  $= 0.36 \text{ (m/s}^2\text{)}$ ✓	3	2.1	
	(ii)	Average speed = $(1 \text{ m/s} + 7 \text{ m/s}) \div 2 = \text{distance/time}$ $4 \text{ m/s} = 66 \text{ m/time} \Rightarrow \text{time} = 66\text{m} \div 4 \text{ m/s} = 16.5 \text{ (s)}$ ✓  Curve starts at (0,4) and passes through/ends at (66, 16.5) ✓  Smooth concave curve ✓	3	2.2	<b>ECF</b> own time

Question		Answer	Marks	AO element	Guidance
5	(a)	<p>The professor can see a correlation between distance and temperature but doesn't think distance is the cause. ✓</p> <p><b>Any three from</b></p> <p>Combining density and % CO<sub>2</sub> data ✓</p> <p>Venus has much more CO<sub>2</sub> than Earth ✓</p> <p>Earth is warmed by greenhouse effect; Mars hardly if at all; Venus has larger/greater greenhouse effect ✓</p> <p>Sun's radiation gets weaker as you get further from Sun ✓</p> <p>So would expect Venus to be hottest and Mars coolest ✓</p>	4	3.1b	1 <sup>st</sup> mark for an explanation of the professor's statement
	(b)	<p>Graph shows (rapid) increase in CO<sub>2</sub> ✓</p> <p>Human activity increased (around this time) / industrial revolution/more factories / population increase ✓</p> <p>Hence correlation ✓</p> <p>Use of fossil fuels / deforestation (produces CO<sub>2</sub>) ✓</p>	4	<p>3.2b</p> <p>1.1</p> <p>3.2b</p> <p>1.1</p>	<p><b>DO NOT ALLOW</b> increase before 1750</p> <p><b>IGNORE</b> named examples of human / industrial activity e.g. more cars / more technology</p> <p>Must have described graph AND history of human activity for this mark</p> <p><b>IGNORE</b> breathing out CO<sub>2</sub></p>

Question		Answer	Marks	AO element	Guidance
6	(a)	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE.</b>  <b>If answer = 0.0044 m <math>\approx</math> 4 mm award 3 marks</b></p> <p>Recall and rearrange <math>F=kx \Rightarrow x=F \div k</math> ✓</p> <p>= 0.14 m <math>\div</math> 32 N/m ✓</p> <p>= 0.0044 m <math>\approx</math> 4 mm ✓</p>	3	2.1	1 <sup>st</sup> mark can be for algebraic rearrangement or for direct substitution and arithmetical rearrangement <b>DO NOT ALLOW</b> 4 mm without evaluation shown to more precision
	(b)	Arrow vertically downwards ✓	1	1.1	
	(c)	<p>Need to combine both ideas</p> <p>Steeper angle means sideways velocity smaller ✓</p> <p>So does not go far sideways before hits ground ✓</p> <p>Shallower angle means travelling closer to ground ✓</p> <p>So hits ground sooner than it would with a flight angled upwards ✓</p> <p>Therefore an intermediate angle of 45 degrees provides the greatest range ✓</p>	5	<p>2.1</p> <p>3.1b</p> <p>2.1</p> <p>3.1b</p> <p>3.2b</p>	<p>Do not expect vocabulary of component, but needs to recognise it has a lot of 'up' but not much 'sideways'</p> <p>Again do not expect 'component' but needs to recognise it has a lot of 'sideways' but not much 'up'</p>

Question			Answer	Marks	AO element	Guidance
7	(a)	(i)	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE.</b>  <b>If answer = 240 (kPa) award 3 marks</b></p> <p>Select: <math>P_1V_1=P_2V_2</math> ✓</p> <p><math>P \times 50 \text{ cm}^3 = 100 \text{ kPa} \times 120 \text{ cm}^3</math> ✓</p> <p><math>P = 100 \text{ kPa} \times 120 \text{ cm}^3 \div 50 \text{ cm}^3 = 240 \text{ (kPa)}</math> ✓</p>	3	1.1 2.2 2.2	
		(ii)	<p>particles have less space, so hit the walls more often ✓</p> <p>more momentum change per second (per unit area) ✓</p> <p>⇒ greater force ⇒ greater pressure ✓</p>	3	1.1	
		(iii)	<p>No temperature change ✓</p> <p>Work is done in pushing the piston in ✓</p> <p>Increase internal energy of gas, so temperature rises ✓</p> <p>Slow change allows gas to cool back as energy is transferred to environment ✓</p>	4	1.2	<b>ALLOW</b> idea of 'heat leaking out'

Question	Answer	Marks	AO element	Guidance
(b*)	<p><i>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</i></p> <p><b>Level 3 (5–6 marks)</b> Describes the current solar system with minor omissions (e.g. all planets orbit in same direction) and clearly explains gravity’s role in creating both the Sun and the planets. Changes in the early Sun resulting in nuclear fusion clearly described.</p> <p><i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Level 2 (3–4 marks)</b> Describes the current solar system with minor omissions (e.g. all planets orbit in same direction) and clearly explains gravity’s role in creating the Sun. Pressure/volume changes in the early Sun resulting described but nuclear fusion not explained in terms of nuclei.</p> <p><i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b> Describes major features of the current solar system (Sun, planets and moons). The role of gravity not clearly explained. Nuclear fusion may be named as creating energy, but not described in terms of nuclei joining together.</p> <p><i>The information is basic and communicated in an unstructured way. The information is supported by limited</i></p>	6	1.1 x2 2.1 x4	<p><b>AO2.1 Description of current solar system</b> For example</p> <ul style="list-style-type: none"> <li>• Sun is a star</li> <li>• at centre of solar system</li> <li>• planets orbit Sun</li> <li>• in same direction</li> <li>• moons orbit many planets</li> <li>• minor planets/asteroids comets also orbit Sun</li> </ul> <p><b>AO1.1 Role of gravity</b> For example</p> <ul style="list-style-type: none"> <li>• gas/dust cloud is swirling around</li> <li>• all parts of gas /dust cloud attract all other parts</li> <li>• most of gas /dust cloud collapses inwards</li> <li>• some parts of gas/dust cloud collapse further out to form planets</li> <li>• planets continue to orbit the Sun</li> <li>• held in place by Sun’s gravity</li> </ul> <p><b>AO2.1 Role of interactions in early Sun</b> For example</p> <ul style="list-style-type: none"> <li>• gas/dust collapses into smaller and smaller volume</li> <li>• pressure and temperature increase</li> <li>• atoms are close enough and hot enough for nuclei to join in fusion</li> <li>• fusion reaction releases energy</li> </ul>

		<p><i>evidence and the relationship to the evidence may not be clear.</i></p> <p><b>0 marks</b> No response or no response worthy of credit.</p>			
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Question			Answer	Marks	AO element	Guidance
8	(a)	(i)	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE.</b>  <b>If answer = 2599 (J) award 3 marks</b></p> <p>Recall equations: PE gained = <math>mgh</math>  electrical power = <math>IV</math>  electrical working = <math>Pt</math> ✓</p> <p>PE = <math>25 \text{ kg} \times 10 \text{ N/kg} \times 1.7 \text{ m} = 425 \text{ J}</math> ✓  Electrical power = <math>5.6 \text{ A} \times 12 \text{ V} = 67.2 \text{ W}</math> ✓  electrical working = <math>67.2 \text{ W} \times 45 \text{ s} = 3024 \text{ J}</math> ✓</p> <p>Increase in internal energy of motor = <math>3024 \text{ J} - 425 \text{ J}</math> ✓  = <math>2599 \text{ J} = 2600 \text{ (J)}</math> ✓</p>	6	1.1 2.1 2.1 2.1 1.1 1.1	Award 1 marks for correctly recalling 3 equations.
		(ii)	<p><b>FIRST CHECK THE ANSWER ON ANSWER LINE.</b>  <b>If answer = 425 (J) award 2 marks.</b></p> <p>Recall Work done = force x distance ✓  = <math>250 \text{ (N)} \times 1.7 \text{ (m)}</math> ✓  = <math>425 \text{ (J)}</math> ✓</p>	3	1.1 2.1 2.1	
	(b)		<p>The turning motor acts .....✓  Current heats the coils .....✓</p>	2	1.1 2.2	

Question		Answer	Marks	AO element	Guidance
9	(a)	${}_{84}^{218}\text{Po} \checkmark$ ${}_{2}^{4}\text{He} \checkmark$	2	2.2	
	(b)	Radon (dense so) trapped in mines/lungs $\checkmark$ Contamination by alpha emitter results in more tissue damage as alpha more ionising $\checkmark$	2	2.2	

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