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OCR
Oxford Cambridge and RSA

# Foundation

## GCSE

## Physics B Twenty First Century Science

### J259/01: Breadth in physics (Foundation Tier)

General Certificate of Secondary Education

## Mark Scheme for June 2024

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OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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# MARKING INSTRUCTIONS

## PREPARATION FOR MARKING

### RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM 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 available in RM Assessor.
3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **required number** of standardisation responses.

## 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 RM Assessor 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 RM Assessor messaging system.
5. **Crossed Out Responses**
   Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

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**Rubric Error Responses – Optional Questions**

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

**Multiple Choice Question Responses**

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).

*When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.*

**Contradictory Responses**

When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

**Short Answer Questions (requiring only a list by way of a response, usually worth only one mark per response)**

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

**Short Answer Questions (requiring a more developed response, worth two or more marks)**

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

**Longer Answer Questions (requiring a developed response)**

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

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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. Award No Response (NR) if:
   - there is nothing written in the answer space

   Award Zero '0' if:
   - anything is written in the answer space and is not worthy of credit (this includes text and symbols).

   Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The RM Assessor **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 RM Assessor 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.

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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.**

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11. Annotations available in RM Assessor

| Annotation | Meaning |
|---|---|
| | Correct response |
| | Incorrect response |
| | Omission mark |
| BOD | Benefit of doubt given |
| CON | Contradiction |
| RE | Rounding error |
| SF | Error in number of significant figures |
| ECF | Error carried forward |
| L1 | Level 1 |
| L2 | Level 2 |
| L3 | Level 3 |
| NBOD | Benefit of doubt not given |
| SEEN | Noted but no credit given |
| I | Ignore |

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12. Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

| Annotation | Meaning |
|---|---|
| / | alternative and acceptable answers for the same marking point |
| ✓ | Separates marking points |
| **DO NOT ALLOW** | Answers which are not worthy of credit |
| **IGNORE** | Statements which are irrelevant |
| **ALLOW** | Answers that can be accepted |
| **( )** | Words which are not essential to gain credit |
| **__** | Underlined words must be present in answer to score a mark |
| **ECF** | Error carried forward |
| **AW** | Alternative wording |
| **ORA** | Or reverse argument |

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13. **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.

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The breakdown of Assessment Objectives for GCSE (9-1) in Physics B:

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

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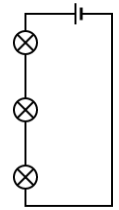
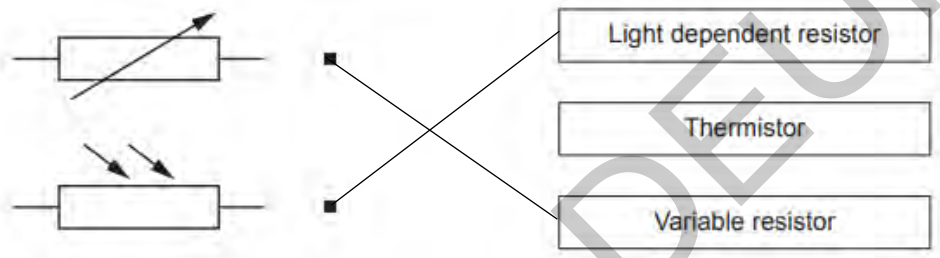
| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 1 | (a) | (i) | It has branches. ✓ | 1 | 1.2 | Middle box indicated |
| | | (ii) | Lamps stay the same brightness ✓ | 1 | 3.1a | Bottom box indicated |
| | (b) | |  ✓ | 1 | 1.2 | Third box indicated |
| | (c) | |  <br>Line from first diagram to Variable resistor ✓<br>Line from second diagram to Light dependent resistor ✓ | 2 | 1.1 | |
| | | | | 5 | | |

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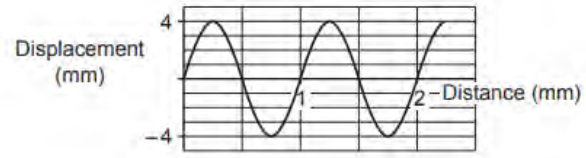
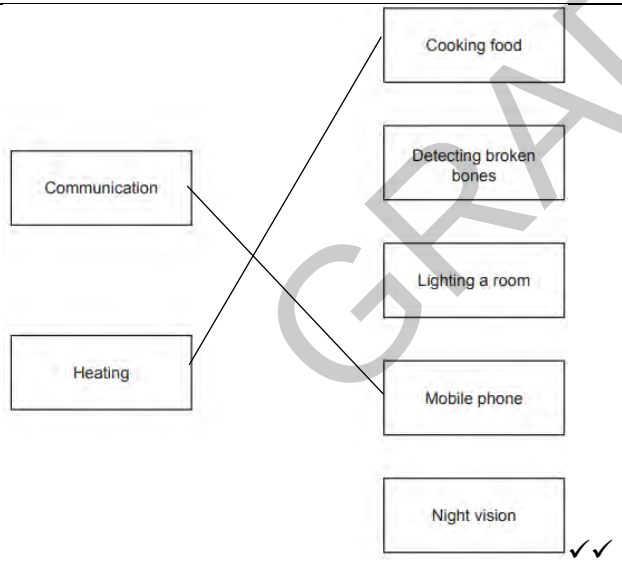
| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 2 | (a) | | B ✓ | 1 | 1.2 | |
| | (b) | |  ✓ | 1 | 1.1 | Bottom box indicated |
| | (c) | | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 3.5 award 2 marks.**<br>**The third mark is for the correct unit: Hz.**<br>Strategy of understanding frequency is number of waves per unit time eg 7 ÷ 2 ✓<br><br>3.5 ✓<br>Hz ✓ | 3<br><br>**2 × 2.1**<br><br>**1.1** | | **ALLOW** 7 ÷ time if candidate attempts to convert time to hours or minutes<br><br>**ALLOW** Hertz |
| | (d) | |  ✓✓ | 2 | 1.1 | **ALLOW** 1 line correct for 1 mark<br><br>If there are 2 or more lines from the Communication box, treat as **CON.**<br><br>If there are 2 or more lines from the Heating box, treat as **CON.** |

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| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| | **(e)** | | light ✓<br>transverse ✓<br>speed ✓ | **3** | **3 × 1.1** | Must be in this order |
| | **(f)** | **(i)** | (plane) mirror / reflecting surface ✓ | **1** | **1.2** | **ALLOW** reflective surface / reflection surface<br>**DO NOT ALLOW** reflecting line |
| | | **(ii)** | "***i***" between the normal and the incident ray with or without an arc. ✓ | **1** | **1.2** | **ALLOW** upper case "**I**". |
| | | | | **12** | | |

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| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 3 | (a) | | Chemical store ✓ | 1 | 1.1 | Top box indicated |
| | (b) | (i) | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 70 award 2 marks**<br>Any mass value ÷12 ✓<br>840 ÷ 12 = 70 (kg) ✓ | 2 | 2 × 2.1 | **ALLOW** any mass for MP1. This could be another mass mentioned in the question or a clearly calculated sum of masses. |
| | | (ii) | 2340 - 840 = 1500 (kg) ✓ | 1 | 2.1 | |
| | (c) | | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 1404000 award 2 marks**<br>Substitution into equation: mass × 10 × 60 ✓<br>= 2340 × 10 × 60 = 1404000 (J) ✓ | 2 | 2 × 2.1 | **ALLOW** any mass for substitution mark. This could be another mass mentioned in the question, their masses from b(i) or b(ii) or a clearly calculated sum of masses.<br>**ALLOW** final answer to be given to 2 sf ie 1400000 |
| | (d) | | The rate of energy transfer ✓ | 1 | 1.1 | Bottom box indicated |
| | (e) | | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 10 000 award 4 marks**<br>Conversion of 20 kJ to 20000 J ✓<br>Select and apply equation: Power = energy transferred / time ✓<br>Power = 20000 ÷ 2 ✓<br>10 000 (W) ✓ | 4 | 1.2<br>1.1<br>2 × 2.1 | **ALLOW** no or incorrect conversion of kJ to J for method and evaluation marks [Max 3 marks]. |
| | | | | 11 | | |

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| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 4 | (a) | | The clamp stand might fall over ✓<br>Clamp the (retort) stand to the bench / heavy weight as counterbalance AW / move the (retort) stand to the middle of the bench ✓<br><br>**OR**<br><br>Masses could fall (and cause injury). ✓<br>Keep feet away / stand back / move the (retort) stand to the middle of the bench. ✓<br><br>**OR**<br><br>The spring could break / snap / flick into eye / face / body AW. ✓<br>Wear safety goggles /use a (protective) screen / stand well back. ✓ | **2** | **2 × 2.2** | Please bear in mind that other responses may be equally valid and should be credited.<br><br>**IGNORE** ruler might fall over as a hazard and **IGNORE** clamp ruler as a way to minimise the risk.<br><br>The way to minimise the risk must relate to the hazard identified, but if no hazard identified then **ALLOW** a mark for any way to minimise as per the MS. |
| | (b) | | Correct order (A) **E C D F B** ✓✓✓ | **3** | **3 × 1.2** | If not, then:<br>**C** before **D** before **B** ✓<br>**E** anywhere before **C** ✓<br>**F** between **D** and **B** ✓<br><br>A – Hang a hooked mass on the spring.<br>E – Wait for the mass to stop bouncing.<br>C – Measure and record the extension.<br>D – Remove the mass from the spring.<br>F – Check the spring has returned to its original length.<br>B – Repeat for a larger mass. |

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|---|---|---|---|---|---|---|
| | **(c)** | | **Any one from**<br>Add a pointer or marker to the spring (pointing at the ruler) ✓<br>Adjust so the end of the ruler is at the end of the spring ✓<br>Align with zero or a whole number on the ruler AW ✓ | **1** | **3.3b** | **ALLOW** put the spring at the end of the ruler. |
| | **(d)** | |  ✓ | **1** | **1.2** | Third box indicated |
| | **(e)** | | Non-linear ✓ | **1** | **2.2** | |
| | | | | **8** | | |

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| Question | | | Answer | Marks | AO | Guidance |
|---|---|---|---|---|---|---|
| 5 | (a) | | kinetic ✓<br>thermal ✓ | 2 | 2 × 1.1 | Must be in this order |
| | (b) | | 4 (s) ✓ | 1 | 3.1a | |
| | (c) | | 125 (– 20) ✓<br>= 105 (°C) ✓ | 2 | 2 × 3.1a | **ALLOW** MP1 for sight of 125 |
| | (d) | | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 10500 award 3 marks**<br>Convert g to kg (200 g → 0.2 kg) ✓<br>Substitute into equation: Change in internal energy = 0.2 x 500 x 105 ✓<br>Evaluation = 10 500 (J) ✓ | 3<br><br>1.2<br><br>2.1<br>2.1 | | **ALLOW ECF** of temperature change from part (c)<br>**ALLOW** no or incorrect conversion of mass for substitution and evaluation marks [Max 2 marks] |
| | (e) | | energy ✓<br>temperature ✓<br>kilogram ✓ | 3 | 3 × 1.1 | Must be in this order |
| | (f) | | 20 °C ✓ | 1 | 3.2a | **ALLOW ECF** from the lower temperature used in part (c) if it is between 15° and 30°C. For example, if 25° was read from the graph then allow 25° here with **ECF** annotation |
| | | | | 12 | | |

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<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO element</th><th>Guidance</th></tr>
<tr><td>6</td><td>(a)</td><td></td><td>219 top ✓<br>86 bottom✓</td><td>2</td><td>1.1</td><td>ALLOW one mark for the correct numbers transposed.</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>The time taken for the activity to fall to half ✓</td><td>1</td><td>1.1</td><td>Bottom box indicated</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>11 days ✓</td><td>1</td><td>2.2</td><td>Third box indicated</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>(Alpha) radiation cannot penetrate the syringe/plastic/glass ✓</td><td>1</td><td>2.1</td><td>ALLOW alpha radiation has a low penetration power OR alpha cannot pass through paper or other similar materials.<br>IGNORE reference to lead being poisonous.</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Alpha radiation is more ionising ✓</td><td>1</td><td>1.1</td><td>Second box indicated</td></tr>
<tr><td></td><td>(d)</td><td></td><td>Technetium (or Tc) ✓<br><br>Any one from<br>Suitable length of time to allow the procedure ✓<br>Several half-lives in 24 hours ✓<br>The hospital visit is about the length of 1 half-life ✓<br>Patient will not remain radioactive for long ✓<br>Low(er) risk to the patient ✓<br>Low(er) risk to close family✓</td><td>2</td><td>2 × 3.2b</td><td>ALLOW 6 hours for first marking point.<br><br>ALLOW any valid comment about half life or risk.<br><br>Please bear in mind that other content may be equally valid and should be credited.</td></tr>
<tr><td></td><td>(e)</td><td></td><td><table><tr><th></th><th>Contamination</th><th>Irradiation</th></tr><tr><td>A radioactive substance …</td><td>✓</td><td></td></tr><tr><td>An image of the bones …</td><td></td><td>✓</td></tr><tr><td>People close to the patient …</td><td></td><td>✓</td></tr></table>✓✓</td><td>2</td><td>2.1</td><td>ALLOW 1 mark for one row correct</td></tr>
<tr><td></td><td></td><td></td><td></td><td>10</td><td></td><td></td></tr>
</table>

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| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 7 | (a) | (i) | Step-up transformer ✓ | 1 | 1.1 | Bottom box indicated |
| | | (ii) | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 1100 (A) award 3 marks.**<br>**If answer = 1125 (A) award 2 marks.**<br><br>Substitution into equation:<br>$I_s$ = 25 000 × 18 000 ÷ 400 000 ✓<br>Evaluation: $I_s$ = 1125 (A) ✓<br>Final value to 2sf = 1100 (A) ✓ | 3 | <br><br><br>2.1<br><br>2.1<br>1.2 | <br><br><br><br><br>**ALLOW** final mark for clear evidence of an incorrectly calculated final answer correctly rounded to 2 significant figures e.g., 723 changed to 720. |
| | (b) | | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 40% award 3 marks.**<br><br>Evidence of 2 readings from the graph.<br>(Value$_{gas}$=) 215 **AND** (Value$_{hrs}$= )130✓<br><br>**EITHER:**<br>Calculation of percentage change:<br>$\frac{\text{value}_{gas}-\text{value}_{hrs}}{\text{value}_{gas}}$ ✓<br>A $\frac{215-130}{215} \times 100 = 40\%$ (accept 39.5%). ✓<br>**OR**<br>Calculation of ratio; $\frac{\text{value}_{\text{hrs}}}{\text{value}_{\text{gas}}}$ OR $\frac{\text{value}_{gas}}{\text{value}_{hrs}}$ ✓<br>Percentage change = $100 - \left(\frac{\text{value}_{\text{hrs}}}{\text{value}_{\text{gas}}} \times 100\right) = 40\%$ ✓ | 3 | <br><br><br>3.2a<br><br>2 × 2.1 | <br>**ALLOW** final value to more than 2SF.<br><br>**ALLOW** values in range:<br>Value$_{gas}$: 210 to 220.<br>Value$_{hrs}$: 125 to 130<br><br>**ALLOW**<br>$\frac{\text{value}_{gas}-\text{value}_{hrs}}{\text{value}_{hrs}}$ OR $\frac{\text{value}_{gas}-\text{value}_{hrs}}{\text{value}_{mean}}$<br>Second mark point, only allow correct denominator and $\times 100$. |
| | | | | 7 | | |

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| Question | | | Answer | Marks | AO element | Guidance |
|---|---|---|---|---|---|---|
| 8 | (a) | (i) | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 2 ($m/s^2$) award 2 marks.**<br>Substitution into equation: 22 ÷ 11 ✓<br>Evaluation: 2 ($m/s^2$) ✓ | **2** | **2 × 2.1** | |
| | | **(ii)** | 1500 ✓ | **1** | **3.2a** | Second box indicated |
| | | **(iii)** | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 3000 (N) award 3 marks.**<br>Select and apply: F = ma ✓<br>Substitute values: F = 1500 x 2 ✓<br>Evaluation: F = 3000 (N) ✓ | **3**<br><br>**1.1**<br>**2 × 2.1** | | **ALLOW** Force = change in momentum/time<br>**ALLOW ECF** from part (i) and (ii) for full marks.<br>e.g. if mass = 250 kg, F = 500 N if a = 2<br>if mass = 5000 kg, F = 10000 N if a = 2<br>if mass = 5000 kg, F = 2500 N if a = 0.5s |
| | **(b)** | | **Any one from**<br><br>Driver could lose control of the vehicle ✓<br>Large (resultant) force ✓<br>harm/injure driver/passengers ✓<br>passengers continue moving forward when car stops ✓<br>Brakes/tyres might overheat ✓ | **1** | **1.1** | **ALLOW** any other correct suggestion<br><br>**ALLOW** whiplash.<br><br>**ALLOW** collision caused by vehicle behind but not just collision. |
| | | | | **7** | | |

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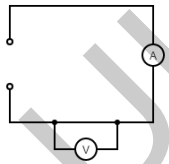
| Question | | | Answer | Marks | AO | Guidance |
|---|---|---|---|---|---|---|
| 9 | (a) | | Use of correct symbols for ammeter and voltmeter ✓ | 3 | 1 × 1.1 | **ALLOW** lines through meters   |
| | | | Wire and power supply and ammeter in series ✓ | | 2 × 1.2 | **ALLOW** a resistor symbol for wire / a cell symbol for power supply<br>**IGNORE** additional components / short circuits |
| | | | Voltmeter in parallel around the wire ✓ | | | **ALLOW** voltmeter in parallel across the power supply if there are no other components in the circuit other than the ammeter, the power supply and the wire. |

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| | | | | | | |
|---|---|---|---|---|---|---|
| | **(b)** | **(i)** | Both Plotted to within ½ small square ✓<br>(0.65, 3.2) and (0.98, 4.8) | **1** | **1.2** | Use overlay |
| | | **(ii)** | Straight LOBF ✓ | **1** | **2.2** | All points within 1 small square of the line vertically.<br>**ALLOW** one anomalous point identified **or** clearly anomalous<br>**IGNORE** minor errors e.g. feathering / tramlines<br>**DO NOT ALLOW** line thickness > 1 small square<br>**ALLOW ECF** from incorrectly plotted points and judge the line on the balance of points above and below |
| | | **(iii)** | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 5 award 2 marks.**<br>Find the gradient of the line from two sets of coordinates taken from the line.<br>e.g. $\frac{6-0}{1.2-0}$✓<br>= 5 ✓ | **2** | **2 × 2.2** | **ALLOW** e.g. Δy ÷ Δx **or** rise over run<br>**ALLOW** any gradient value that rounds to 5 at 1 s.f.<br>**ALLOW ECF** for 2 marks using their two sets of x and y coordinates (from their line) |
| | | **(iv)** | 5 (Ω) ✓ | **1** | **3.2a** | **ALLOW ECF** from part (iii), their gradient rounded to 1 s.f. or better<br>**ALLOW** any value that rounds to 5 at 1 s.f.<br><br>If answer out of range: **ALLOW** correct evaluation of y ÷ x values from **their** line of best fit. Working must be seen. |
| | **(c)** | | The resistance will increase ✓<br><br>Double length will double resistance / a statement about resistance being proportional to length ✓ | **2** | **2 × 3.2b** | **ALLOW** resistance doubles = 2 marks<br>**ALLOW** for 2 marks e.g. it will be 10 Ω (instead of 5) or check for use of 2x their value in (b)(iv) |
| | | | Total | **10** | | |

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<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>AO</th><th>Guidance</th></tr>
<tr><td>10</td><td>(a)</td><td></td><td>star / comet / (artificial) satellite / asteroid / meteor ✓</td><td>1</td><td>1.1</td><td>IGNORE other named planets, the Sun / moons / dust / rocks / gases</td></tr>
<tr><td></td><td>(b)</td><td></td><td>Any one calculation ✓<br><br>and corresponding comparison ✓</td><td>2</td><td>3.2a</td><td>ALLOW for max 1 mark rough estimate e.g. 3480 is about a third/quarter of Earth’s diameter or e.g. moon is much less than diameter of Earth<br>ALLOW ≠ or is not as AW for < or ><br>ALLOW any correct MP2 also gains MP1<br>ALLOW for 2 marks the student is correct for Charon:Pluto with correct corresponding calculation
<table>
<tr><td>Moon and Earth</td><td>Pluto and Charon</td></tr>
<tr><td>3480 ÷ 12700 or 0.274…</td><td>1210 ÷ 2370 or 0.51</td></tr>
<tr><td>0.274 < 0.5</td><td>0.51 ≈ or > 0.5</td></tr>
<tr><td>OR</td><td></td></tr>
<tr><td>12700 ÷ 3480 or 3.6</td><td>2370 ÷ 1210 or 1.96</td></tr>
<tr><td>3.6 > 2 or 3.6 is ≈ a third</td><td>1.96 ≈ or < 2</td></tr>
<tr><td>OR</td><td></td></tr>
<tr><td>12700 ÷ 2 or 6350</td><td>2370 ÷ 2 or 1185</td></tr>
<tr><td>6350 > 3480</td><td>1185 ≈ or <1210</td></tr>
<tr><td>OR</td><td></td></tr>
<tr><td>2 x 3480 or 6960</td><td>2 x 1210 or 2420</td></tr>
<tr><td>6960 < 12700</td><td>2420 ≈ or > 2370</td></tr>
</table></td></tr>
</table>

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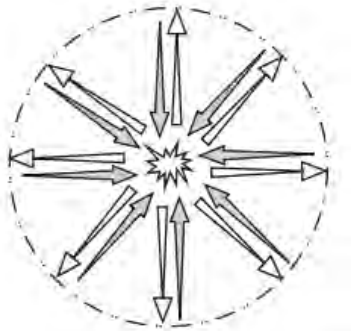
| Question | | | Answer | Marks | AO | Guidance |
|---|---|---|---|---|---|---|
| | (c) | | Pluto has longer orbital time / moves more slowly (than Earth) ORA ✓<br><br>**Any one from**<br>as it is further from the Sun AW ORA ✓<br>force between Sun and Pluto is less that that between Sun and Earth ORA ✓<br>Pluto has further to travel / circumference of orbit longer ORA ✓ | **2** | **2 × 2.1** | Must be a comparison. |
| | (d) | | gravity ✓<br>fusion ✓ | **2** | **1.1** | Must be in this order |
| | (e) | |  ✓ | **1** | **2.1** | Top left box indicated |
| | | | TOTAL | **8** | | |

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