



# **GCSE MARKING SCHEME**

**SCIENCE - PHYSICS (NEW)**

**JANUARY 2013**

## INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2013 examination in GCSE SCIENCE - PHYSICS (NEW). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

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**GCSE Science - Physics 1 Mark Scheme**

**January 2013**

**FOUNDATION TIER**

| Question |     |  | Marking details                                                                                                                                                                                                                                                                                                                                                             | Mark     |
|----------|-----|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 1.       |     |  | 1 <sup>st</sup> and 4 <sup>th</sup> boxes ticked.<br><br><b>Question total</b>                                                                                                                                                                                                                                                                                              | 2<br>[2] |
| 2.       |     |  |  Any 1 correct - 1 mark<br> Any 2 correct – 2 marks<br> Any 3 or all four correct – 3 marks<br><br><b>Question total</b> | 3<br>[3] |
| 3.       |     |  | Beta stopped at aluminium (1)<br>Gamma stopped at lead or passes through the lead (1)<br>Alpha stopped at thin paper (1)<br><br><b>Question total</b>                                                                                                                                                                                                                       | 3<br>[3] |
| 4.       | (a) |  | Earth, Sun, Solar system. Milky Way, Universe.<br>All in correct positions – 4 marks, 4 correct- 2 marks, 3 correct – 2 marks, 2 correct – 1 mark                                                                                                                                                                                                                           | 4        |
|          | (b) |  | Milky Way                                                                                                                                                                                                                                                                                                                                                                   | 1        |
|          | (c) |  | It is a <u>distance</u> (travelled by light in 1 year)                                                                                                                                                                                                                                                                                                                      | 1        |
|          |     |  | <b>Question total</b>                                                                                                                                                                                                                                                                                                                                                       | [6]      |
| 5.       | (a) |  | Radon                                                                                                                                                                                                                                                                                                                                                                       | 1        |
|          | (b) |  | 15 [cpm]                                                                                                                                                                                                                                                                                                                                                                    | 1        |
|          | (c) |  | Nuclear industry accounts for <u>only</u> 1% / a <u>very</u> small part                                                                                                                                                                                                                                                                                                     | 1        |
|          |     |  | <b>Question total</b>                                                                                                                                                                                                                                                                                                                                                       | [3]      |
| 6.       | (a) |  | 15 [cm]                                                                                                                                                                                                                                                                                                                                                                     | 1        |
|          | (b) |  | 20 [cm]                                                                                                                                                                                                                                                                                                                                                                     | 1        |
|          | (c) |  | $f = \frac{10}{5}$ (1) = 2 [Hz] (1)                                                                                                                                                                                                                                                                                                                                         | 2        |
|          | (d) |  | wave speed = 20 (ecf) x 2 (ecf) (1 – substitution) = 40(1) Unit cm/s (1)                                                                                                                                                                                                                                                                                                    | 3        |
|          | (e) |  | stay the same                                                                                                                                                                                                                                                                                                                                                               | 1        |
|          |     |  | <b>Question total</b>                                                                                                                                                                                                                                                                                                                                                       | [8]      |

| Question |     |       | Marking details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Mark            |
|----------|-----|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 7.       | (a) | (i)   | radiation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1               |
|          |     | (ii)  | conduction                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1               |
|          | (b) |       | Warm air is less dense than cold air (1) so it rises (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2               |
|          | (c) | (i)   | 20[%]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1               |
|          |     | (ii)  | The cost [of insulation] is the <u>least</u> of all (accept “ <u>just</u> £600”)(1) and the annual saving is the <u>greatest</u> (accept “ <u>shortest</u> payback time”) (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2               |
|          |     | (iii) | conducted through the ceiling (1) then convected through the attic space(1).<br><b>Question total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2<br><b>[9]</b> |
| 8.       | (a) | (i)   | best ability to conduct electricity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1               |
|          |     | (ii)  | Lead                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1               |
|          |     | (iii) | Steel provides the strength (up to 2 000 units) (1), aluminium is used for its low density (1) meaning the wires aren’t too heavy (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3               |
|          | (b) |       | mass = 2 700 x 0.12 (1 substitution) = 324 [kg] (1)<br><b>Question total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2<br><b>[7]</b> |
| 9.       | (a) | (i)   | 900 or 1 800 <u>MHz</u> (1) (value + unit for the mark)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1               |
|          |     | (ii)  | The bigger the frequency, the <u>smaller</u> the output power (1) whereas to be proportional, as one increases, the other would increase.(1) OR EQUIVALENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2               |
|          |     | (iii) | more research (1) by <u>other</u> scientists (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 2               |
|          | (b) |       | microwaves                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1               |
|          |     |       | <b>Question total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>[6]</b>      |
| 10.      | (a) |       | Indicative content:<br>Cost of generating electricity using nuclear energy is cheaper than wind. To generate the same power output requires 1 800 turbines for every nuclear power station which would cost £5 400 million compared with £4 000 million. Also during the lifetime of a nuclear power station, wind turbines would need to be replaced 3 times. There is no waste produced by wind but with nuclear power there is radioactive waste to dispose of which adds cost and has an impact on the environment due to radiation hazards. Onshore wind power would produce less of a greenhouse effect than nuclear but offshore wind would produce more. | 6               |

| Question |     |      | Marking details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Mark        |
|----------|-----|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
|          |     |      | <p><b>5 – 6 marks</b> The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p><b>3 – 4 marks</b> The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p><b>1 – 2 marks</b> The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p><b>0 marks</b> The candidate does not make any attempt or give a relevant answer worthy of credit.</p> |             |
|          | (b) | (i)  | plots (1) x2 smooth curve or best fit straight line (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 3           |
|          |     | (ii) | As rotor diameter increases so does the maximum power output (1) but the increase is non-uniform / at an increasing rate / non-linear / not proportional (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2           |
|          | (c) |      | Efficiency = $\frac{3}{5} \times 100$ (1 substitution) = 60[%] (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2           |
|          |     |      | <b>Question total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>[13]</b> |
|          |     |      | <b>Foundation paper total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>[60]</b> |

## HIGHER TIER

| Question       |     |       | Marking details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Mark |
|----------------|-----|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 1.             | (a) | (i)   | best ability to conduct electricity                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1    |
|                |     | (ii)  | Lead                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1    |
|                |     | (iii) | Steel provides the strength (up to 2 000 units) (1), aluminium is used for its low density (1) meaning the wires aren't too heavy (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3    |
|                | (b) |       | mass = 2 700 x 0.12 (1 substitution) = 324 [kg] (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 2    |
| Question total |     |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | [7]  |
| 2.             | (a) | (i)   | 900 or 1 800 <u>MHz</u> (1) (value + unit for the mark)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1    |
|                |     | (ii)  | The bigger the frequency, the <u>smaller</u> the output power (1) whereas to be proportional, as one increases, the other would increase.(1) OR EQUIVALENT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2    |
|                |     | (iii) | more research (1) by <u>other</u> scientists (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 2    |
|                | (b) |       | microwaves                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1    |
| Question total |     |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | [6]  |
| 3.             | (a) |       | A network (1) of power stations/substations/power lines (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2    |
|                | (b) | (i)   | To reduce voltage (1) to safe levels (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2    |
|                |     | (ii)  | Convert 0.46 MW to 460 000 W (1), subs, (1),                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 3    |
|                |     |       | rearrange $\frac{460000}{230} = 2\,000\text{ [A]}$ (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |      |
| Question total |     |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | [7]  |
| 4.             | (a) |       | Indicative content:<br>Cost of generating electricity using nuclear energy is cheaper than wind. To generate the same power output requires 1 800 turbines for every nuclear power station which would cost £5 400 million compared with £4 000 million. Also during the lifetime of a nuclear power station, wind turbines would need to be replaced 3 times. There is no waste produced by wind but with nuclear power there is radioactive waste to dispose of which adds cost and has an impact on the environment due to radiation hazards. Onshore wind power would produce less of a greenhouse effect than nuclear but offshore wind would produce more. | 6    |

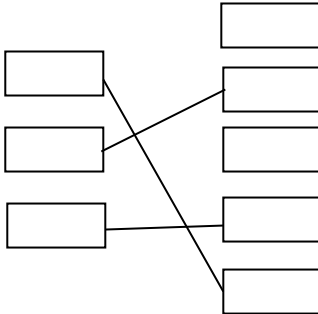
| Question       |     |      | Marking details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Mark |
|----------------|-----|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
|                |     |      | <p><b>5 – 6 marks</b> The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p><b>3 – 4 marks</b> The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p><b>1 – 2 marks</b> The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p><b>0 marks</b> The candidate does not make any attempt or give a relevant answer worthy of credit.</p> |      |
|                | (b) | (i)  | plots (1) x2 smooth curve or best fit straight line (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 3    |
|                |     | (ii) | As rotor diameter increases so does the maximum power output (1) but the increase is non-uniform / at an increasing rate / non-linear / not proportional (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2    |
|                | (c) |      | use of 3 MW (1), subs into equation (1),<br><br>rearrange to give $\frac{3}{0.6}$ ans = 5 [MW] (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3    |
| Question total |     |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | [14] |
| 5.             | (a) |      | Helium Y, Iron N, Hydrogen Y, Sodium Y,<br><br>(all correct 2 marks / 2 or 3 correct 1 mark / 0 or 1 correct 0 marks)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2    |
|                | (b) | (i)  | Conversion of 410 nm to $410 \times 10^{-9}$ (1) subs (1),<br><br>rearrange $\frac{3 \times 10^8}{410 \times 10^{-9}} = 7.3 \times 10^{14}$ [Hz] (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 3    |
|                |     | (ii) | Convert light year to m – $3 \times 10^8 \times 3.2 \times 10^7$ (1) = $9.6 \times 10^{15}$ [m] (1),<br><br>$\times 8.6 = 8.26 \times 10^{16}$ [m] (1) (accept $8.3 \times 10^{16}$ but not $8.2 \times 10^{16}$ )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 3    |
| Question total |     |      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | [8]  |



**GCSE Science - Physics 2 Mark Scheme**

**January 2013**

**FOUNDATION TIER**

| <b>Question</b> |     |      | <b>Answer / Explanatory Notes</b>                                                                                                                                                                                                                                                                                                                                                                         | <b>Marks Available</b> |
|-----------------|-----|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| 1.              | (a) |      | <p>Correct lines <math>3 \times (1) - (-1)</math> for additional lines</p>                                                                                                                                                                                                                                              | 3                      |
|                 | (b) |      | <p>Acceleration = <math>\frac{30}{6}(1 - \text{substitution}) = 5 \text{ [m/s}^2\text{]} (1)</math></p> <p>For <math>\frac{30}{6} = 0.2</math> award 1 mark (the substitution mark)</p>                                                                                                                                                                                                                   | 2                      |
|                 | (c) |      | <p><u>Slows down</u> (accept falls slower) (1) ....because <u>air</u> resistance increases/becomes more than weight (1) Don't accept slow increase in air resistance.</p> <p>Forces mark (1) e.g. <u>increased</u> surface area against <u>air</u> [particles]</p> <p>Motion mark (1)</p> <p>e.g. air resistance increases (1) parachute goes up (0) – <b><u>N.B. independent marking points.</u></b></p> | 2                      |
|                 |     |      | <b>Question total</b>                                                                                                                                                                                                                                                                                                                                                                                     | <b>[7]</b>             |
| 2.              | (a) |      | <p>Plots <math>\pm \frac{1}{2}</math> square (2) [–1 per error]</p> <p>Joined point to point (1) <b>ecf</b> for incorrect plots</p> <p>If line is correct assume points are correct even if they can't be seen.</p> <p>Ignore thickness of line but do not accept disjointed / wispy / double / curves</p>                                                                                                | 3                      |
|                 | (b) | (i)  | <p>Use of 200 m from graph (1)</p> <p>Speed = <math>\frac{200}{40}(1 - \text{subst}) = 5 \text{ [m/s]} (1)</math></p> <p>Correct working of gradient (matching points) = 3 marks e.g. <math>\frac{100}{20} = 5</math></p>                                                                                                                                                                                 | 3                      |
|                 |     | (ii) | 60 [s] <b>ecf</b> from graph                                                                                                                                                                                                                                                                                                                                                                              | 1                      |
|                 | (c) | (i)  | Faster speed in the <u>last 40</u> seconds <b>or</b> 5 m/s compared with 10 m/s                                                                                                                                                                                                                                                                                                                           | 1                      |
|                 |     | (ii) | Steeper line / has a larger gradient / same time [interval] but travelled further <b>or</b> 5 m/s compared with 10 m/s                                                                                                                                                                                                                                                                                    | 1                      |
|                 |     |      | <b>Question total</b>                                                                                                                                                                                                                                                                                                                                                                                     | <b>[9]</b>             |

| Question |     |       | Answer / Explanatory Notes                                                                                                                                                                                                                                                                                                                                                | Marks Available |
|----------|-----|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 3.       | (a) |       | Momentum = $800 \times 12$ (1 – subst)<br>= 9 600 [kg m/s] (1)                                                                                                                                                                                                                                                                                                            | 2               |
|          | (b) | (i)   | 0 (ignore units)                                                                                                                                                                                                                                                                                                                                                          | 1               |
|          |     | (ii)  | 9 600 <b>ecf</b> for subtract (a) – (b)(i)                                                                                                                                                                                                                                                                                                                                | 1               |
|          |     | (iii) | $\frac{9600(1)(\text{ecf from (b)(ii)})}{3(1)}$ [=3 200 N]                                                                                                                                                                                                                                                                                                                | 2               |
|          | (c) |       | Any 1 from:<br><ul style="list-style-type: none"> <li>• <u>worse</u> weather conditions or implied</li> <li>• <u>worn</u> tyres / incorrect tyre pressure</li> <li>• <u>poor</u> brakes</li> <li>• <u>worse</u> road conditions</li> <li>• <u>high</u> speed / momentum / mass bigger</li> </ul> NOT drink driving / tiredness<br>References to reaction time are neutral | 1               |
|          |     |       | <b>Question total</b>                                                                                                                                                                                                                                                                                                                                                     | <b>[7]</b>      |

| Question |     |       | Answer / Explanatory Notes                                                                                                                                                      | Marks Available       |            |
|----------|-----|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|------------|
| 4.       | (a) | (i)   | graphite / moderator                                                                                                                                                            | 1                     |            |
|          |     | (ii)  | to cause [fission / chain] reactions / if too quick, reaction won't work                                                                                                        | 1                     |            |
|          | (b) | (i)   | boron / control rods                                                                                                                                                            | 1                     |            |
|          |     | (ii)  | to prevent an <u>uncontrolled</u> chain reaction / <u>control</u> the chain reaction / prevent overheating or meltdown / Don't accept "to stop fission" only must be qualified. | 1                     |            |
|          | (c) | (i)   | 235                                                                                                                                                                             | 1                     |            |
|          |     | (ii)  | 36                                                                                                                                                                              | 1                     |            |
|          |     | (iii) | [91 – 36] = 55 (No ecf for 91 – (ii))                                                                                                                                           | 1                     |            |
|          | (d) |       | $^{136}_{56}\text{Ba}$ circled                                                                                                                                                  | 1                     |            |
|          | (e) |       | 37 (1)<br>0 (1)                                                                                                                                                                 | 2                     |            |
|          |     |       |                                                                                                                                                                                 |                       |            |
|          |     |       | <b>Question total</b>                                                                                                                                                           | <b>[10]</b>           |            |
| 5.       | (a) | (i)   | 2 [A]                                                                                                                                                                           | 1                     |            |
|          |     | (ii)  | $R = \frac{6}{2}$ (1 –substitution) = 3 [ $\Omega$ ] (1) <b>ecf</b> from (i)<br><br>(If found for wire in (i) $R = 4.8 \Omega$ )                                                | 2                     |            |
|          |     | (iii) | $6 \times 2$ (1 – subst) = 12 [W] (1) <b>ecf</b> from (i)<br>(If found for wire in (i) $P = 7.5 \text{ W}$ )                                                                    | 2                     |            |
|          |     | (iv)  | 11 [V]                                                                                                                                                                          | 1                     |            |
|          |     | (v)   | 3.25 [A]                                                                                                                                                                        | 1                     |            |
|          | (b) | (i)   | <b>Lamp</b> has bigger resistance or converse argument or values given $W = 4.8 \Omega$ and $L = 5.2 \Omega$                                                                    | 1                     |            |
|          |     | (ii)  | Smaller current through it or converse argument <b>or</b> calculations shown (allow temperature increase)                                                                       | 1                     |            |
|          |     |       |                                                                                                                                                                                 |                       |            |
|          |     |       |                                                                                                                                                                                 | <b>Question total</b> | <b>[9]</b> |

| Question |     |                                                                                                                           | Answer / Explanatory Notes                                                                                                                                                                                                                                                                                                                              | Marks Available |      |
|----------|-----|---------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------|
| 6.       | (a) | (i)                                                                                                                       | Helium <u>nucleus/nuclei</u> / 2 protons and 2 neutrons (accept 2p and 2n)                                                                                                                                                                                                                                                                              | 1               |      |
|          |     | (ii)                                                                                                                      | Gamma more penetrating [than alpha] / so would not be blocked by smoke / wouldn't change the current / weakly ionising. <b><u>Any 2 x (1) due to all points being interlinked.</u></b>                                                                                                                                                                  | 2               |      |
|          |     | (iii)                                                                                                                     | Or gamma is more weakly ionising (1) so doesn't cause an electric current (1) (Don't accept gamma is not ionising.)<br>Distance between detector / ceiling and the human body (1) so / hence alpha is easily absorbed by the air / case (1)<br>(Answer must be relevant to this context so <b>don't accept alpha will be blocked by skin / paper.</b> ) | 2               |      |
|          | (b) | (i)                                                                                                                       | <u>Longer 1/2-life</u> (1) (don't accept longer to decay)<br>so detector stays active / works longer or doesn't need replacing [as often] (1)                                                                                                                                                                                                           | 2               |      |
|          |     | (ii)                                                                                                                      | I. becquerel [accept [Becquerel!] / Bq / bq                                                                                                                                                                                                                                                                                                             | 1               |      |
|          |     |                                                                                                                           | II. 26 000 is half of 52 000 (1 – method)<br>so time is one 1/2-life = <u>432</u> [years] (1)                                                                                                                                                                                                                                                           | 2               |      |
|          |     |                                                                                                                           | (Accept $\frac{52000}{2}$ as recognition of half-life – don't allow any other value divided by 2).                                                                                                                                                                                                                                                      |                 |      |
|          |     | III. $\frac{864}{432} = 2$ or 864 years is 2 1/2-lives or implied (1)<br>so 1/4 of the mass remains = <u>0.1</u> [µg] (1) | 2                                                                                                                                                                                                                                                                                                                                                       |                 |      |
|          |     | Question total                                                                                                            |                                                                                                                                                                                                                                                                                                                                                         |                 | [12] |

| Question |  |  | Answer / Explanatory Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Marks Available |
|----------|--|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 7.       |  |  | <p><b>Indicative content:</b><br/> The advantage is that the time taken for the given journey is reduced from 4 h to 3.5 h with the increase in speed.<br/> The disadvantage is that in the event of an emergency stop being necessary, the total stopping distance is increased from 96 m to 121.5 m, increasing risk of serious injury or death. Relevant factors clearly explained, e.g. tiredness, related to time or speed / separation from vehicle in front. Increased momentum at higher speed related to increased force on vehicle and occupants in the event of a collision.</p> <p>5 – 6 marks The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p>3 – 4 marks The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p>1 – 2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p>0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.</p> | 6               |
|          |  |  | <b>Question total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>[6]</b>      |
|          |  |  | <b>Total for foundation tier paper</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>[60]</b>     |

## HIGHER TIER

| Question |     |                       | Answer / Explanatory Notes                                                                                                                                                                                                                                                                                         | Marks Available |
|----------|-----|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 1.       | (a) | (i)                   | 2 [A]                                                                                                                                                                                                                                                                                                              | 1               |
|          |     | (ii)                  | $R = \frac{6}{2}$ (1 –substitution) = 3 [Ω] (1) <b>ecf</b> from (i)<br>(If found for wire in (i) $R = 4.8 \Omega$ )                                                                                                                                                                                                | 2               |
|          |     | (iii)                 | 3.25 [A]                                                                                                                                                                                                                                                                                                           | 1               |
|          | (b) | (i)                   | <b>Lamp</b> has bigger resistance or converse argument or values given $W = 4.8 \Omega$ and $L = 5.2 \Omega$                                                                                                                                                                                                       | 1               |
|          |     | (ii)                  | Smaller current through it <b>or</b> converse argument or calculations shown (allow temperature increase)                                                                                                                                                                                                          | 1               |
|          | (c) |                       | Beyond about 11 V, W has the bigger current (1) hence W has the bigger power (1)<br><b>Or</b> <u>power calculations</u> at 12 V (1) this is because the current in W is now bigger than in L (1)<br><b>Or</b> at 11 V the powers are equal (1) because the currents are equal (1)                                  | 2               |
|          |     |                       |                                                                                                                                                                                                                                                                                                                    |                 |
|          |     | <b>Question total</b> | <b>[8]</b>                                                                                                                                                                                                                                                                                                         |                 |
| 2.       | (a) | (i)                   | Helium <u>nucleus/nuclei</u> / 2 protons and 2 neutrons (accept 2p and 2n)                                                                                                                                                                                                                                         | 1               |
|          |     | (ii)                  | Gamma more penetrating than alpha / so would not be blocked by smoke / wouldn't change the current / weakly ionising. <b><u>Any 2 x (1) due to all points being interlinked.</u></b><br><b>Or</b> gamma is more weakly ionising (1) so doesn't cause an electric current (1) (Don't accept gamma is not ionising.) | 2               |
|          |     | (iii)                 | Distance between detector / ceiling and the human body (1) so / hence alpha is easily absorbed by the air / case (1)<br>(Answer must be relevant to this context so <b>don't accept alpha will be blocked by skin.</b> )                                                                                           | 2               |
|          | (b) | (i)                   | <u>Longer ½-life</u> (1) (don't accept longer to decay)<br>so detector stays active / works longer or doesn't need replacing [as often] (1)                                                                                                                                                                        | 2               |
|          |     | (ii)                  | I. becquerel [accept [Becquerel!]] / Bq / bq                                                                                                                                                                                                                                                                       | 1               |
|          |     |                       | II. 26 000 is half of 52 000 (1 – method)<br>so time is one ½-life = <u>432</u> [years] (1)                                                                                                                                                                                                                        | 2               |
|          |     |                       | (Accept $\frac{52000}{2}$ as recognition of half-life – don't allow any other value divided by 2).<br>III. $\frac{864}{432} = 2$ or 864 years is 2 ½-lives (1)<br>so ¼ of the mass remains = <u>0.1</u> [μg] (1)                                                                                                   | 2               |
|          |     | <b>Question total</b> | <b>[12]</b>                                                                                                                                                                                                                                                                                                        |                 |

| Question |     |  | Answer / Explanatory Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Marks Available |
|----------|-----|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 3.       |     |  | <p><b>Indicative content:</b><br/> The advantage is that the time taken for the given journey is reduced from 4 h to 3.5 h with the increase in speed.<br/> The disadvantage is that in the event of an emergency stop being necessary, the total stopping distance is increased from 96 m to 121.5 m, increasing risk of serious injury or death. Relevant factors clearly explained, e.g. tiredness, related to time or speed / separation from vehicle in front. Increased momentum at higher speed related to increased force on vehicle and occupants in the event of a collision.</p> <p>5 - 6 marks The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p>3 – 4 marks The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p>1 – 2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p>0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.</p> | 6               |
|          |     |  | <b>Question total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>[6]</b>      |
| 4.       | (a) |  | Initial K.E. = $0.5 \times 1500 \times 15^2 = 168\,750$ [J] (1)<br>Final K.E. = $0.5 \times 1500 \times 5^2 = 18\,750$ [J] (1)<br>Loss = $150\,000$ [J] (1) (award 1 mark for doing any subtraction but award no marks for use of $(15-5)^2$ .)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 3               |
|          | (b) |  | $F = \frac{150000(ecf)}{7.5} = 20\,000$ [N] (1) manip, (1) subst, (1) ans<br>For candidates who present a momentum argument:<br>$\frac{x}{t} = \frac{(u+v)}{2}$ to find time = 0.75 [s](1)<br>momentum change = $15\,000$ [kg m/s](1)<br>$F = \frac{15000(ecf)}{0.75(ecf)} = 20\,000$ [N] (1)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 3               |
|          | (c) |  | $F = 20\,000$ [N] ecf from (b)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1               |
|          |     |  | <b>Question total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>[7]</b>      |

| Question |     |       | Answer / Explanatory Notes                                                                                                                                                                                                                                                                       | Marks Available |
|----------|-----|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 5.       | (a) |       | General description of 3 parts (1)<br>Reference to all 3 times (1)<br>Reference to 25 m/s value / value of acceleration (0.125) / deceleration (0.25) (1)                                                                                                                                        | 3               |
|          | (b) | (i)   | Either:<br>$a = 0.125$ (1) and<br>$F = ma = 80\,000$ (1) x 0.125 (ecf) = 10 000 [N](1)<br><br>or $F = 80\,000(1) \times \left\{ \frac{(25 - 0)}{200} \right\}(1) = 10\,000$ [N](1)                                                                                                               | 3               |
|          |     | (ii)  | Force is bigger (1 mark only) but force is twice as big (2 marks only) because time is smaller / half as long / gradient is bigger or twice as big (1) (Calculated value for force of 20 000 N gets 2 marks but a statement the force is bigger because the time is halved (1) is still needed.) | 3               |
|          | (c) | (i)   | $(300 + 600)(1) \times (0.5$ (1) x 25)(1) = [11 250 m] N.B. no mark for answer<br>OR Area = $(0.5 \times 200 \times 25)(1) + (300 \times 25)(1) + (0.5 \times 100 \times 25)(1)$<br>= 2 500 + 7 500 + 1 250 = [11 250 m] N.B. no mark for answer                                                 | 3               |
|          |     | (ii)  | mean speed = $\frac{11250(ecf)}{600} = 18.75$ [m/s] [1 for subs, 1 for answer]                                                                                                                                                                                                                   | 2               |
|          |     | (iii) | Area P + area R = area Q [1] accept P + R = Q                                                                                                                                                                                                                                                    | 1               |
|          |     |       | <b>Question total</b>                                                                                                                                                                                                                                                                            | <b>[15]</b>     |

[illegible]



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