# GCSE MARKING SCHEME

## SUMMER 2016

## SCIENCE - PHYSICS P2
## 4473/01/02

**INTRODUCTION**

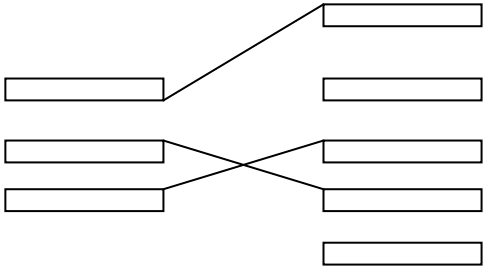
This marking scheme was used by WJEC for the 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was 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' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

**GCSE SCIENCE - PHYSICS P2**

**SUMMER 2016 MARK SCHEME**

| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| **1** | | (a) | | | 3 |  <br>All 3 correct - 3 marks<br>2 correct - 2 marks<br>1 correct - 1 mark<br>More than one line from a box on the left loses that mark | Accept non straight lines | | |
| | | (b) | (i) | | 1 | E | | | |
| | | | (ii) | | 1 | H | | | |
| | | Total | | | **5** | | | | |

| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| **2** | | (a) | (i) | | 2 | $a = \frac{8}{10}$ (1-subs) = 0.8 (1-ans) [m/s$^2$] | $a = \frac{(8-0)}{10}$ = 0.8<br>0.8 on its own for both marks | | $a = \frac{(0-8)}{10}$<br>Do not accept an answer of -0.8 |
| | | | (ii) | | 2 | Smaller acceleration [between B and C] (1) because the line is less steep / smaller velocity (speed) change [in the same time](1)<br>**Alternative:**<br>[Comparison of] accelerations of 0.8 [AB] with 0.2 [BC] / or using m/s$^2$ award 2 marks<br>Acceleration along BC is 0.6 m/s$^2$ less award 2 marks<br>**The 1st mark must be linked to the 2nd mark.** | Converse argument if clearly referring to A to B<br>Slower acceleration (1)<br>Slower rate (1)<br>Award 1 mark for answer of 0.2 | | Doesn't travel so far<br>The cyclist accelerates at a slower speed |
| | | | (iii) | | 2 | $d = s \times t$ = 10 × 20 (1-subs) = 200 [m] (1) | | | |
| | | (b) | | | 2 | Forward straight line down to the axis from D (1) terminating at coordinate (55,0) (1) no tolerance | Line drawn without a ruler if a good attempt has been made to make it straight. | | |
| | | Total | | | **8** | | | | |

| Question Number | | | | | | | | | |
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| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| **3** | | (a) | (i) | | 1 | (Making the gas) <u>very</u> hot / at a high temperature | Heats up a lot | | "Make the particles hot". OR "Make them hot" or Increase temperature or High pressure |
| | | | (ii) | | 1 | The container is in danger of melting / difficult to achieve such high temperatures / requires high energy | "The container melts" OR just "Containment" If pressure identified in (i) then accept leaking or bursting | Exploding | |
| | | (b) | (i) | | 1 | Hydrogen underlined | | | |
| | | | (ii) | | 1 | Protons underlined | | | |
| | | | (iii) | | 1 | Fusion underlined | | | |
| | | (c) | | | 2 | **Any 2 × (1) from:**<br>• Reactants are readily available from [water in] the oceans<br>• Fossil fuels are likely to run out / are finite / it is a sustainable source of energy<br>• [Producing electricity from it] does not <u>increase</u> global warming / add to acid rain<br>• Releases a large amount of energy<br>• Doesn't produce radioactive waste | Water / hydrogen / deuterium is readily available from the oceans | Reference to tritium | Other energy sources are running out / Cleaner energy supply / Reference to cost / reference to less pollution |
| | | Total | | | **7** | | | | |

| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
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| FT | HT | | | | | | | | |
| **4** | | (a) | (i) | I | 1 | 250 [cpm] ± 10 | | | |
| | | | | II | 1 | 12 000 [years] (no tolerance) | | | |
| | | | | III | 1 | 6 000 [years] (no tolerance) | | | |
| | | | (ii) | | 1 | **Answer must be the same as (a)(iii)** i.e. 6 000 [years] | | | |
| | | (b) | | | 3 | 14 - (1)<br>6 - (1)<br>8 - (1) | | | **ecfs** on 14 or 6 |
| | | Total | | | **7** | | | | |

| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| **5** | | (a) | (i) | | 2 | work = 50 × 44 (1-subs) = 2 200 [J] (1-ans) | | | |
| | | | (ii) | | 1 | 3 200 + 2 200 (**ecf** from (a)(i)) = 5 400 [J] (1-ans) | | | |
| | | | (iii) | | 1 | 3 200 – 2 200 (**ecf** from (a)(i)) = 1 000 [J] (1-ans) | | | Negative answer |
| | | (b) | (i) | | 2 | Momentum change = 80 × 4 (1 for change of velocity value even if not multiplied by 80) = 320 [kg m/s] (1-ans)<br>Answer of 320 [kg m/s] award 2 marks | Accept 80 × 5 = 400 or 80 × 1 = 80 for 1 mark<br>Accept (5-1) for 1 mark even if not multiplied by a mass. | | |
| | | | (ii) | | 2 | $\frac{320(\ \textbf{ecf}\ \text{from(b)i})}{2}$ (1-subs) = 160 [N] (1-ans) | | | |
| | | | (iii) | | 1 | **Answer must be the same as (b)(ii)** i.e. 160 [N] | | Negative answer | 800 N (weight of the boat) |
| | | Total | | | **9** | | | | |

| Question Number | | | | | Mark | Answer | Accept | Neutral answer | Do not accept |
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| FT | HT | Sub-section | | | | | | | |
| **6** | **1** | (a) | (i) | | 1 | 15 | | | |
| | | | (ii) | | 1 | 36 [m] | | | |
| | | | (iii) | | 2 | Increases [distance] (1)<br>because it travels further in the <u>same time</u> (1)<br>**The 1st mark must be linked to the 2nd mark.** | Thinking <u>time is the same</u> (1) so distance increases (1) / Thinking distance and overall stopping distance increase (1) | | Takes you longer to think / Thinking distance and braking distance increase |
| | | (b) | | | 2 | <u>Thinking</u> distance increases (1)<br><u>braking</u> distance unchanged (1) | Both distances increase / The data increases (1) | Stopping distance<br>References to time<br>Ignore any reasoning<br>References to overall stopping distance | |
| | | (c) | | | 3 | $2 \times 40 = 80$ (1)<br>$\frac{80\textbf{ecf}}{31}$ (1)<br>= 2.58 [s] or 2.6 [s] (1) | $\frac{40}{31} = 1.29$ (2)<br>$\frac{80}{70}$ (1) [=1.14]<br>Any number divided by 31 award 1 mark only<br>2.5 [s] on its own award 2 marks | | $\frac{40}{70} = 0.57$ |
| | | (d) | | | 2 | Overall stopping distance <u>is 96 m</u> (1)<br>which is <u>more than</u> 80 m / 16 m <u>more</u> / <u>more than</u> 2 gaps (1)<br>**The 1st mark must be linked to the 2nd mark.** | which is more than 40 m / more than a gap (1) | Reference to braking distance | |
| | | Total | | | **11** | | | | |

| Question Number | | | | | | | | | |
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| FT | HT | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
| **7** | **2** | (a) | | | 6 | **Indicative content:**<br>Voltmeter drawn in parallel with the lamp with correct symbol and ammeter drawn in series with lamp with correct symbol. The variable resistor is set [at highest / lowest resistance] and values of the current from the ammeter and voltage from the voltmeter are taken. The variable resistor is then altered and new readings taken. Repeating in this way, a series of values of current and voltage are recorded.<br><br>**5-6 marks**<br>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.<br><br>**3-4 marks**<br>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.<br><br>**1-2 marks**<br>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.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | | | |
| | | (b) | (i) | | 1 | 2 [A] no tolerance | | | |
| | | | (ii) | | 2 | $\frac{6}{2}$ (1) = 3 [$\Omega$] (1) **ecf (b)(i)** | | | |
| | | | (iii) | | 2 | $6 \times 2$ (1) = 12 [W] (1) **ecf (b)(i)** | Use of $P = I^2R$ **ecf** on $R$ | | |
| | | | (iv) | | 2 | Any line through (10, 2.25) (1)<br>Straight line from origin (1) no tolerance | | Ignore coordinate lines at (6,2) | More than one line e.g. a pair of coordinate lines |
| | | Total | | | **13** | | | | |

| Question Number | | Sub-section | | | Mark | Answer | Accept | Neutral answer | Do not accept |
|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| | **3** | (a) | | | 2 | beta - high energy/fast moving electron (1)<br>gamma - electromagnetic wave (1) | em wave<br>One is a fast moving electron and one is an em wave – award 1 mark only<br>Beta is an electron and gamma is a wave – award 1 mark only | Properties of beta and gamma | Beta is a particle and gamma is a wave |
| | | (b) | | | 2 | The activity/mass/number of [unstable] nuclei (1)<br>halves [in this time / in 59.4 days] (1) | Count rate | | Atoms<br>Molecules<br>Radiation<br>Radioactivity |
| | | (c) | (i) | | 2 | It has a suitable half-life / not too long a half-life / not too short a half-life (1)<br>so it doesn't decay [too] quickly / so it doesn't decay [too] slowly (1)<br>**OR**<br>Emits beta (1)<br>which is absorbed in tumour (1)<br>**The 1st mark must be linked to the 2nd mark.** | Relatively short<br>Relatively long | Half-life is 8.4 days | Gamma and beta<br>Can't penetrate the tumour or ionises the tumour<br>Kills cancer cells |
| | | | (ii) | | 3 | 12 weeks = 84 days (1)<br>No. of half-lives = 10 (1) [award for method of calculating no. of half-lives]<br>$\frac{1}{1024}$ or 0·09765% (1) | $1/2^{10}$ award 2 marks<br>If no workings shown 10 on the answer line award 2 marks / $\frac{1}{10}$ award 1 mark<br>Halving 131 ten times (0.1279) award 2 marks | | |
| | | Total | | | **9** | | | | |

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|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| | **4** | | (i) | | 4 | Moderator slows down neutrons (1)<br>so absorbed / captured by uranium nuclei / atoms (1)<br>More than one neutron emitted [at fission] (1)<br>but some absorbed /all but 1 neutron absorbed by control rods (1)<br>**The 1st mark must be linked to the 2nd mark and the 3rd mark must be linked to the 4th mark.** | | Collide with<br>Causes fission<br>Neutrons are introduced<br>Raising or lowering the control rods | |
| | | | (ii) | | 2 | Fusion requires high temperature **and** pressure (1)<br>which is difficult to contain (1)<br>**The 1st mark must be linked to the 2nd mark.** | | References to stars | |
| | | Total | | | **6** | | | | |

| Question Number | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
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| | **5** | | (i) | | 2 | $1\,200 \times 10 \times 5$ (1)<br>= 60 000 [J] (1) | | | |
| | | | (ii) | | 2 | $1\,000 \times 40$ (1)<br>= 40 000 [J] (1) | | | |
| | | | (iii) | | 3 | Total work done = 40 000 **ecf** + 60 000 **ecf**<br>= 100 000 [J] (1)<br>100 000 **ecf** = $F \times 40$ (1)<br>$F$ **=** $\frac{100\,000}{40}$ = 2 500 [N] (1) | $\frac{40\,000\textbf{ecf}}{40}$ award 1 mark only<br>$\frac{60\,000\textbf{ecf}}{40}$ award 1 mark only<br>100 000 anywhere award 1 mark<br>60 000 – 40 000 = 20 000, $\frac{20\,000}{40}$ = 500 award 2 marks | | Substitution into force = change in momentum ÷ time |
| | | Total | | | **7** | | | | |

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|---|---|---|---|---|---|---|---|---|---|
| FT | HT | | | | | | | | |
| | **6** | (a) | (i) | | 2 | $\frac{(10-8)}{10}$ (1 – substitution)<br>= 0.2 [m/s$^2$] (1 – answer) | | | |
| | | | (ii) | | 2 | (0.5 × 2 × 10) + (10 × 8) (1)<br>= 90 [m] (1) | 0.5(8 +10) × 10 (1)<br>= 90 [m] (1) | | |
| | | | (iii) | | 4 | Horizontal line at 10 m/s to 35 s ± 1 small square tolerance (1)<br>Time: $\frac{10}{0.5}$ (1)<br>= 20 [s] (1)<br>Straight line on graph to correct point (55,0) **ecf** from 20 s and horizontal line (1) no tolerance<br>N.B. if diagonal line is not drawn scroll to bottom of page to look for the time calculation | Straight line on graph to correct point (55,0) award 3 marks<br><u>If no calculation shown</u> accept any forward diagonal line to $x$-axis - award 1 mark<br>A diagonal line that ends at 55 s (**ecf**) but not on the $x$-axis award 2 marks | | |

| Question Number | | | | | | | | |
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| | | (b) | | | 6 | **Indicative content:**<br>Between A and B, when the skydiver first jumps, the only force acting is the weight force. As the skydiver speeds up air resistance increases, the resultant force decreases so the acceleration decreases, eventually reaching a terminal speed when both forces balance. At B the parachute opens, air resistance is now much larger than weight giving deceleration from B to C. As the skydiver slows down, the air resistance decreases, the resultant force decreases, and deceleration decreases. At C the skydiver has slowed down to a [lower] constant speed as the forces have balanced again.<br><br>**5-6 marks**<br>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.<br><br>**3-4 marks**<br>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.<br><br>**1-2 marks**<br>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.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | | | |
| | | Total | | | **14** | | | | |