Cambridge International AS & A Level

**Cambridge Assessment International Education**
Cambridge International Advanced Subsidiary and Advanced Level

**PHYSICS** **9702/23**

Paper 2 AS Level Structured Questions **May/June 2018**

MARK SCHEME

Maximum Mark: 60

**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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## Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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| GENERIC MARKING PRINCIPLE 5:<br><br>Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen). |
| GENERIC MARKING PRINCIPLE 6:<br><br>Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind. |

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| Question | Answer | Mark |
|---|---|---|
| 1(a)(i) | zero error **or** wrongly calibrated scale | **B1** |
| 1(a)(ii) | reading scale from different angles **or** wrongly interpolating between scale readings/divisions | **B1** |
| 1(b)(i) | $P = V^2/R$ **or** $P = VI$ and $V = IR$ | **C1** |
| | $P = 5.0^2/125$ **or** $5.0 \times 0.04$ **or** $(0.04)^2 \times 125$<br>$= 0.20\,\text{W}$ | **A1** |
| 1(b)(ii) | $\%V = 2\%$ **or** $\Delta V/V = 0.02$ | **C1** |
| | $\%P = (2 \times 2\%) + 3\%$ **or** $\%P = (2 \times 0.02 + 0.03) \times 100$<br>$= 7\%$ | **A1** |
| 1(b)(iii) | absolute uncertainty in $P = (7/100) \times 0.20$<br>$= 0.014$ | **C1** |
| | power $= 0.20 \pm 0.01\,\text{W}$ **or** $(2.0 \pm 0.1) \times 10^{-1}\,\text{W}$ | **A1** |

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| Question | Answer | Mark |
|---|---|---|
| 2(a)(i) | (work =) force × distance moved in the direction of the force | **B1** |
| 2(b)(i) | $\rho = m/V$ | **C1** |
| | $= (20/9.81)/(4/3 \times \pi \times 0.16^3)$<br>$= 120\,\text{kg m}^{-3}$ | **A1** |
| 2(b)(ii) | the pressure on the lower surface (of sphere) is greater than the pressure on the upper surface (of sphere) | **B1** |
| 2(b)(iii) | $a = (170 - 20)/(20/9.81)$ | **C1** |
| | $= 74\,\text{m s}^{-2}$ | **A1** |
| 2(b)(iv) | $D = 170 - 20\ (= 150)$ | **C1** |
| | $810 \times (0.16^2) \times v^2 = 150$ | **C1** |
| | $v = 2.7\,\text{m s}^{-1}$ | **A1** |
| 2(b)(v) | $4870 = (4850 \times v)/(v - 6.30)$ | **C1** |
| | $v = 1530\,\text{m s}^{-1}$ | **A1** |

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| Question | Answer | Mark |
|---|---|---|
| 3(a) | $v = u + at$<br><br>$v = 9.6 - (9.81 \times 0.37) = 6.0\,\text{m s}^{-1}$ | **A1** |
| 3(b) | $s = \frac{1}{2} \times (9.6 + 6.0) \times 0.37$<br>**or**<br>$6.0^2 = 9.6^2 - (2 \times 9.81 \times s)$<br>**or**<br>$s = (9.6 \times 0.37) - (\frac{1}{2} \times 9.81 \times 0.37^2)$<br>**or**<br>$s = (6.0 \times 0.37) + (\frac{1}{2} \times 9.81 \times 0.37^2)$ | **C1** |
| | $s = 2.9\,\text{m}$ | **A1** |
| 3(c)(i) | $(\Delta)E = mg(\Delta)h$ | **C1** |
| | $\Delta E = 0.056 \times 9.81 \times 2.9$<br><br>$= 1.6\,\text{J}$ | **A1** |
| 3(c)(ii) | $E = \frac{1}{2}mv^2$ | **C1** |
| | $\Delta E = \frac{1}{2} \times 0.056 \times (6.0^2 - 3.8^2)$<br><br>$= 0.60\,\text{J}$ | **A1** |
| 3(d) | force on ball (by ceiling) <u>equal</u> to force on ceiling (by ball) | **M1** |
| | and opposite (in direction) | **A1** |
| 3(e) | $(p =)\ mv$ **or** $0.056 \times 6.0$ **or** $0.056 \times 3.8$ | **C1** |
| | change in momentum $= 0.056 \times (6.0 + 3.8)$<br><br>$= 0.55\,\text{N s}$ | **A1** |

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| Question | Answer | Mark |
|---|---|---|
| 3(f) | resultant force = 0.55 / 0.085 (= 6.47 N) | **C1** |
| | force by ceiling = 6.47 – (0.056 × 9.81)<br>= 5.9 N | **A1** |

| Question | Answer | Mark |
|---|---|---|
| 4(a) | (Young modulus =) stress / strain | **B1** |
| 4(b)(i) | $k = F / \Delta L$ **or** 1 / gradient | **C1** |
| | $= 90 \times 10^{3} / (2 \times 10^{-3})$ (*or other point on line*)<br>$= 4.5 \times 10^{7}\ \text{N m}^{-1}$ | **A1** |
| 4(b)(ii) | $E = \frac{1}{2} F \Delta L$ **or** $E = \frac{1}{2} k (\Delta L)^2$ | **C1** |
| | $= \frac{1}{2} \times 90 \times 10^{3} \times 2 \times 10^{-3}$ **or** $\frac{1}{2} \times 4.5 \times 10^{7} \times (2 \times 10^{-3})^2$ | **C1** |
| | = 90 J | **A1** |
| 4(c) | straight line starting from (0, 150) and below original line | **M1** |
| | line ends at (90, 147) | **A1** |

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| Question | Answer | Marks |
|---|---|---|
| 5(a) | intensity $\propto$ (amplitude)$^2$ | **B1** |
| 5(b)(i) | $v = f\lambda$ **or** $c = f\lambda$ | **C1** |
| | $f = 3.00 \times 10^8 / 0.060$<br>$= 5.0 \times 10^9$ Hz | **A1** |
| 5(b)(ii) | (at X path) difference $= 3\lambda$ | **M1** |
| | (at X phase) difference $= 0$ or $1080°$ | **M1** |
| | so intensity is at a maximum/it is an intensity maximum | **A1** |
| 5(b)(iii) | **1.** decrease in the distance between (adjacent intensity) maxima/minima | **B1** |
| | **2.** (intensity) maxima and minima exchange places | **B1** |

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| Question | Answer | Mark |
|---|---|---|
| 6(a) | $R = \rho L / A$ | **C1** |
| | $3.0 = \rho / [\pi \times (0.48 \times 10^{-3} / 2)^2]$ | **C1** |
| | $\rho = 5.4 \times 10^{-7}\,\Omega\text{m}$ | **A1** |
| 6(b)(i) | p.d. $= 5.0 - (2.0 \times 1.6)$<br>$= 1.8\,\text{V}$ | **A1** |
| 6(b)(ii)1. | current in resistor $= 1.8 / 4.5\ (= 0.40\,\text{A})$ | **C1** |
| | current in wire $= 1.6 - 0.40\ (= 1.2\,\text{A})$ | **C1** |
| | $R_X = 1.8 / 1.2$<br>$= 1.5\,\Omega$ | **A1** |
| | **or** | |
| | $R_T = 1.8 / 1.6$ **or** $(5.0 / 1.6) - 2.0\ (= 1.125\,\Omega)$ | **(C1)** |
| | $(1 / 1.125) = (1 / 4.5) + (1 / R_X)$ | **(C1)** |
| | $R_X = 1.5\,\Omega$ | **(A1)** |
| 6(b)(ii)2. | length $= 1.5 / 3.0$ **or** $1.5 \times 1.8 \times 10^{-7} / (5.4 \times 10^{-7})$<br>$= 0.50\,\text{m}$ | **A1** |

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| Question | Answer | Mark |
|---|---|---|
| 7(a)(i) | Q plotted at (82, 210) | **A1** |
| 7(a)(ii) | R plotted at (83, 210) | **A1** |
| 7(b) | lepton(s) | **B1** |
| 7(c) | up down down changes to up up down **or** udd → uud<br>**or**<br>down changes to up **or** d → u | **B1** |

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