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 **October/November 2019**

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 | Marks |
|---|---|---|
| 1(a) | base units: $kg\,m\,s^{-2} \times m$<br><br>$= kg\,m^2\,s^{-2}$ | **A1** |
| 1(b)(i) | distance of COG from P (= GP)<br>$= 17 \cos 45° - 4.0$ **or** $(144.5)^{½} - 4.0$ (= 8.0 cm) | **C1** |
| | moment = $0.15 \times 8.0 \times 10^{-2}$<br><br>$= 1.2 \times 10^{-2}$ N m | **A1** |
| 1(b)(ii) | (line of action of) weight acts through pivot/P<br>**or**<br>distance between (line of action of) weight and pivot/P is zero | **B1** |
| | (so) weight does not have a moment about pivot/P | **B1** |

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| Question | Answer | Marks |
|---|---|---|
| 2(a) | (work done =) force × distance <u>moved</u> in direction of force | **B1** |
| 2(b)(i) | **1.** acceleration = gradient **or** $a = (v - u) / t$ **or** $a = \Delta v / t$ | **C1** |
| | e.g. $a = 2.4 / 3.0$<br>$= 0.80\ \text{m s}^{-2}$ | **A1** |
| | **2.** tension in cable = $(13.0 + 2.0) \times 10^3$ | **C1** |
| | work done $= 15 \times 10^3 \times (3.0 \times 2.4)$<br>$= 1.1 \times 10^5\ \text{J}$ | **A1** |
| 2(b)(ii) | power = $Fv$ | **C1** |
| | $v = 2.0\ (\text{m s}^{-1})$ | **C1** |
| | input power $= (1.6 \times 10^4 \times 2.0) / 0.67$<br>$= 4.8 \times 10^4\ \text{W}$ | **A1** |
| 2(b)(iii) | work is done against friction so (increase in) GPE is less (than work done by motor)<br>**or**<br>energy is lost or transferred or converted to heat/thermal energy due to friction or resistance force<br>**or**<br>work is done lifting the cable so GPE is less | **A1** |

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| Question | Answer | Marks |
|---|---|---|
| 3(a)(i) | mass | **B1** |
| 3(a)(ii) | charge | **B1** |
| 3(b)(i) | $E = V/d$ **or** $E = F/q$ | **C1** |
| | $F = (1.2 \times 10^3 \times 4.2 \times 10^{-9}) / 3.6 \times 10^{-2}$ | **C1** |
| | $= 1.4 \times 10^{-4}$ N | **A1** |
| 3(b)(ii) | $W = mg$ | **C1** |
| | $= 5.9 \times 10^{-6} \times 9.81$<br>resultant force = $1.4 \times 10^{-4} - (5.9 \times 10^{-6} \times 9.81)$ | **C1** |
| | $a = F/m$ | **C1** |
| | $a = [1.4 \times 10^{-4} - (5.9 \times 10^{-6} \times 9.81)] / [5.9 \times 10^{-6}] = 14\ \text{m s}^{-2}$ | **A1** |
| 3(b)(iii) | **1.** $s = ut + ½at^2$<br>$1.8 \times 10^{-2} = ½ \times 14 \times t^2$ | **C1** |
| | $t = 0.051$ s | **A1** |
| | **2.** $p = 0.75 \times 0.051$<br>$= 0.038$ m | **A1** |

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| Question | Answer | Marks |
|---|---|---|
| 4(a)(i) | $p = mv$ | **C1** |
| | $= 0.2(00) \times 6.(00) \times \sin 60(.0)°$ **or** $0.2(00) \times 6.(00) \times \cos 30(.0)°$<br>$= 1.04\ \text{kg m s}^{-1}$ | **A1** |
| 4(a)(ii) | $0.300 \times v_x \times \sin 60.0° = 1.04$<br>$v_x = 4.00\ \text{m s}^{-1}$ | **A1** |
| 4(a)(iii) | $0.30 \times 4.0 \times \cos 60°$ **or** $0.20 \times 6.0 \times \cos 60°$ **or** $(0.30 + 0.20)v$ **or** $0.50v$ | **C1** |
| | $0.30 \times 4.0 \times \cos 60° + 0.20 \times 6.0 \times \cos 60° = (0.30 + 0.20)v$ **or** $0.50v$<br>so $v = 2.4\ \text{m s}^{-1}$ | **A1** |
| 4(b)(i) | $E = ½mv^2$ | **C1** |
| | $½ \times 0.50 \times 2.4^2 = ½ \times 72 \times x^2$ | **C1** |
| | $x = 0.20\ \text{m}$ | **A1** |
| 4(b)(ii) | **1.** straight line from the origin sloping upwards | **B1** |
| | **2.** line drawn from a positive value of $E_k$ at $x = 0$ to a positive value of $x$ at $E_k = 0$ | **M1** |
| | line has an increasing downwards slope | **A1** |

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| Question | Answer | Marks |
|---|---|---|
| 5(a)(i) | (coherence means) constant phase difference (between waves) | **B1** |
| 5(a)(ii) | (interference is) the sum/addition/combination of the displacements of overlapping/meeting waves | **B1** |
| 5(b)(i) | $n\lambda = d \sin\theta$ | **C1** |
| | $\lambda$ = sin 51° / (2 × 6.7 × $10^5$)<br>= 5.8 × $10^{-7}$ m | **A1** |
| 5(b)(ii) | smaller angle (corresponding to second order maxima and so) shorter distance (between second order maxima spots) | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 6(a)(i) | $R = V / I$ | **C1** |
| | resistance = (12 / 0.20) / 2 **or** 6 / 0.20<br>= 30 Ω | **A1** |
| 6(a)(ii) | $I$ = 0.50 – 0.20 (= 0.30 A) | **C1** |
| | $R$ + 28 = 12 / 0.30 (= 40 Ω)<br>$R$ = 12 Ω | **A1** |

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| Question | Answer | Marks |
|---|---|---|
| 6(b) | p.d. across lamp = $0.20 \times 30$ (= 6.0 V) | **C1** |
| | p.d. across $R = 0.30 \times 12$ (= 3.6 V) | **C1** |
| | $V_{XY} = 6.0 - 3.6$<br>$= 2.4\,\text{V}$ | **A1** |
| | **or** | |
| | p.d. across lamp = $0.20 \times 30$ (= 6.0 V) | **(C1)** |
| | p.d. across $28\,\Omega$ resistor = $0.30 \times 28$ (= 8.4 V) | **(C1)** |
| | $V_{XY} = 8.4 - 6.0$<br>$= 2.4\,\text{V}$ | **(A1)** |
| 6(c) | $P = VI$ **or** $P = EI$ **or** $P = I^2R$ **or** $P = V^2/R$ | **C1** |
| | ratio = $(6.0 \times 0.20) \times 2 / (12 \times 0.50)$ **or** $0.20 / 0.50$<br>$= 0.40$ | **A1** |
| 6(d) | no change to $V$ across lamps, so power in lamps unchanged<br>**or**<br>current in battery/total current increases (and e.m.f. the same) so power produced by battery increases | **B1** |
| | both the above statements and so the ratio decreases | **B1** |

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| Question | Answer | Marks |
|---|---|---|
| 7(a) | number of protons = 95 | **A1** |
| | number of neutrons = 146 | **A1** |
| 7(b) | Np/neptunium (nucleus) has <u>kinetic</u> energy<br>**or**<br>gamma/$\gamma$-radiation produced | **B1** |
| 7(c)(i) | $I = NQ / t$ | **C1** |
| | $I = (6.9 \times 10^{11} \times 2 \times 1.60 \times 10^{-19}) / 30$<br>$= 7.4 \times 10^{-9}$ A | **A1** |
| 7(c)(ii) | $P = (6.9 \times 10^{11} \times 5.5 \times 10^{6} \times 1.60 \times 10^{-19}) / 30$ | **C1** |
| | $= 0.020$ W | **A1** |

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