Cambridge International AS & A Level

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

**PHYSICS** **9702/22**

Paper 2 AS Level Structured Questions **March 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.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the March 2019 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.



© UCLES 2019

**PUBLISHED**

## 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.

© UCLES 2019

| |
|---|
| 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. |

© UCLES 2019

| Question | Answer | Marks |
|---|---|---|
| 1(a) | kilogram / kg | **B1** |
| | kelvin / K | **B1** |
| 1(b) | units for $v$: $m\,s^{-1}$ and units for $F$: $kg\,m\,s^{-2}$ | **C1** |
| | units for $e$: A s | **C1** |
| | units for $\mu$: $m\,s^{-1}\,A\,s / kg\,m\,s^{-2}$<br>$= A\,kg^{-1}\,s^{2}$ | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 2(a)(i) | distance in a specified direction (from a point) | **B1** |
| 2(a)(ii) | change in velocity / time (taken) | **B1** |
| 2(b)(i) | constant velocity so no resultant force | **B1** |
| | no resultant force so in equilibrium | **B1** |
| 2(b)(ii) | (difference in height =) $47 \times 2.8 \times 60 \times \sin 24° = 3200$ m | **A1** |

© UCLES 2019

| Question | Answer | Marks |
|---|---|---|
| 2(b)(iii) | 1 $(\Delta)E = mg(\Delta)h$<br>$= 85 \times 9.81 \times 3200$ | **C1** |
| | $= 2.7 \times 10^6$ J | **A1** |
| | 2 <u>In terms of energy</u>:<br>work done = $2.7 \times 10^6$ J<br>force $= 2.7 \times 10^6 / (47 \times 2.8 \times 60)$ | **C1** |
| | $= 340$ N | **A1** |
| | <u>In terms of forces</u>:<br>component of weight along path = force due to air resistance<br>force $= 85 \times 9.81 \times \sin 24°$ | **(C1)** |
| | $= 340$ N | **(A1)** |
| 2(b)(iv) | $(\Delta)p = \rho g(\Delta)h$<br>$(92 - 63) \times 10^3 = \rho \times 9.81 \times 3200$ | **C1** |
| | $\rho = 0.92$ kg m$^{-3}$ | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 3(a) | $(m \times 3.0)$ or $(2.5 \times 9.6 \times \cos 60°)$ | **C1** |
| | $(m \times 3.0) - (2.5 \times 9.6 \times \cos 60°) = 0$ so $m = 4.0$ (kg) | **A1** |

© UCLES 2019

| Question | Answer | Marks |
|---|---|---|
| 3(b) | $2.5 \times 9.6 \times \sin 60° = (4.0 + 2.5) \times V$ | **C1** |
| | $V = 3.2\ \text{m s}^{-1}$ | **A1** |
| | or<br>use of momentum vector triangle:<br>$(4.0 \times 3.0)^2 + [(4.0 + 2.5) \times V]^2 = (2.5 \times 9.6)^2$ | **(C1)** |
| | $V = 3.2\ \text{m s}^{-1}$ | **(A1)** |
| 3(c) | $E = ½mv^2$<br><br>difference in $E_K = ½ \times 2.5 \times (9.6)^2 – ½ \times 4.0 \times (3.0)^2$ | **C1** |
| | = 97 J | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 4(a) | force per unit positive charge | **B1** |
| 4(b)(i) | 1 $E = V / d$ or $E = \Delta V / \Delta d$<br>$d = 4.0 \times 10^3 / 5.0 \times 10^4$ | **C1** |
| | $= 8.0 \times 10^{-2}$ m | **A1** |
| | 2 plates are (in) horizontal (plane) (above and below the rod) | **B1** |
| | top (plate) negative and bottom (plate) positive | **B1** |
| 4(b)(ii) | magnitude $= 5.0 \times 10^4 \times 3 \times 1.6 \times 10^{-19}$<br>$= 2.4 \times 10^{-14}$ N | **A1** |
| | direction is (vertically) downwards / down | **B1** |

© UCLES 2019

| Question | Answer | Marks |
|---|---|---|
| 4(b)(iii) | $6.2 \times 10^{-16} = 2.4 \times 10^{-14} \times 72 \times 10^{-3} \times \cos\theta$ | **C1** |
| | $\theta = 69°$ | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 5(a)(i) | (two) waves meet/overlap (at a point) | **B1** |
| | (resultant) displacement is sum of the displacement of each wave | **B1** |
| 5(a)(ii) | constant phase difference (between the waves) | **B1** |
| 5(b) | $I \propto A^2$<br>$3I / I = (A + 1.5)^2 / 1.5^2$ | **C1** |
| | $A = 1.1$ cm | **A1** |
| 5(c)(i) | $\lambda = ax / D$ | **C1** |
| | e.g. $a = 680 \times 10^{-9} \times 2.0 / 4.0 \times 10^{-3}$ | **C1** |
| | $a = 3.4 \times 10^{-4}$ m | **A1** |
| 5(c)(ii) | straight line from positive value on $x$-axis and always below 'old' line | **B1** |
| | straight line with a smaller positive gradient than 'old' line | **B1** |

| Question | Answer | Marks |
|---|---|---|
| 6(a) | e.m.f.: energy transferred from chemical to electrical (per unit charge) | **B1** |
| | p.d.: energy transferred from electrical to thermal (per unit charge) | **B1** |

© UCLES 2019

| Question | Answer | Marks |
|---|---|---|
| 6(b)(i) | 1 $I$ = 4.8 / 32<br>= 0.15 A | **A1** |
| | 2 $P = EI$ or $P = VI$ or $P = I^2R$ or $P = V^2 / R$<br>= 6.0 × 0.15 or $0.15^2 \times 40$ or $6.0^2 / 40$ | **C1** |
| | = 0.90 W | **A1** |
| | 3 number = $It / e$<br>= [0.15 × 25] / $1.6 \times 10^{-19}$ | **C1** |
| | = $2.3 \times 10^{19}$ | **A1** |
| | or<br>$Q$ = 0.15 × 25 (= 3.75)<br>number = 3.75 / $1.6 \times 10^{-19}$ | **(C1)** |
| | = $2.3 \times 10^{19}$ | **(A1)** |
| | 4 4.8 / 6.0 = 32 / ($R_{XY}$ + 32) or 1.2 / 6.0 = $R_{XY}$ / ($R_{XY}$ + 32)<br>or 4.8 / 1.2 = 32 / $R_{XY}$ | **C1** |
| | $R_{XY}$ = 8.0 Ω | **A1** |
| | Alternative methods: | |
| | $R_{XY}$ = (6.0 – 4.8) / 0.15 or | **(C1)** |
| | = 8.0 Ω | **(A1)** |
| | or<br>6.0 = 0.15 (32 + $R_{XY}$) | **(C1)** |
| | $R_{XY}$ = 40 – 32<br>= 8.0 Ω | **(A1)** |

© UCLES 2019

| Question | Answer | Marks |
|---|---|---|
| 6(b)(i) | 5 $1 / 8.0 = 1 / R_X + 1 / 24$ | **C1** |
| | $R$x = 12 Ω | **A1** |
| | Alternative method: | |
| | $I_Z = 4.8 / 32 = 0.15$ and $I_Y = 1.2 / 24 = 0.05$<br>$I_X = 0.15 – 0.05$ (= 0.10) | **(C1)** |
| | $R_X = 1.2 / 0.10 = 12\ \Omega$ | **(A1)** |
| 6(b)(ii) | total resistance decreases | **M1** |
| | (so voltmeter) reading increases | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 7(a)(i) | alpha, neutron and proton | **B1** |
| 7(a)(ii) | neutron | **B1** |
| 7(a)(iii) | beta plus or $\beta^+$ | **B1** |
| 7(b) | $\bar{d}$ has charge (+)⅓ $e$ | **C1** |
| | (so) other quark has charge = $e$ – ⅓ $e$<br>= (+)⅔ $e$ | **M1** |
| | other quark is an up / u | **A1** |

© UCLES 2019