**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Advanced Subsidiary Level and GCE Advanced Level**

# MARK SCHEME for the October/November 2010 question paper

# for the guidance of teachers

## 9702 PHYSICS

**9702/22** Paper 2 (AS Structured Questions), maximum raw mark 60

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.

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| | | | | | |
|---|---|---|---|---|---|
| **1** | **(a)** | **(i)** | scalar quantity has magnitude (allow size) | B1 | |
| | | | vector quantity has magnitude and direction | B1 | [2] |
| | | **(ii)** | **1.** temperature: scalar | B1 | [1] |
| | | | **2.** acceleration: vector | B1 | [1] |
| | | | **3.** resistance: scalar | B1 | [1] |
| | **(b)** | *either* | triangle / parallelogram with correct shape | C1 | |
| | | | tension = 14 .3 N (*allow ± 0.5 N*) | A2 | [3] |
| | | | (*if > ±0.5 N but ≤ ±1 N, allow 1 mark*) | | |
| | | *or* | $R$ = 25 cos 35° | (C1) | |
| | | | $T$ = $R$ tan 35° | (C1) | |
| | | | $T$ = 14.3 N | (A1) | |
| | | *or* | $T$ = 25 sin 35° | (C2) | |
| | | | $T$ = 14.3 N | (A1) | |
| | | *or* | $R$ and $T$ resolved vertically and horizontally | (C2) | |
| | | | leading to $T$ = 14.3 N | (A1) | |
| **2** | **(a)** | **(i)** | $V_H$ = 12.4 cos 36° (= 10.0 m s$^{-1}$) | C1 | |
| | | | distance = 10.0 × 0.17 | | |
| | | | = 1.7 m | A1 | [2] |
| | | **(ii)** | $V_V$ = 12.4 sin 36° (= 7.29 m s$^{-1}$) | C1 | |
| | | | $h$ = 7.29 × 0.17 – ½ × 9.81 × 0.17$^2$ | C1 | |
| | | | = 1.1 m | A1 | [3] |
| | **(b)** | | smooth curve with ball hitting wall below original | B1 | |
| | | | smooth curve showing rebound to ground with correct reflection at wall | B1 | [2] |
| **3** | **(a)** | | point at which (whole) weight (of body) (allow mass for weight) | M1 | |
| | | | appears / seems to act ... (for mass need 'appears to be concentrated') | A1 | [2] |
| | **(b)** | **(i)** | point C shown at centre of rectangle ± 5 mm | B1 | [1] |
| | | **(ii)** | arrow vertically downwards, from C with arrow starting from the same margin of error as in **(b)(i)** | B1 | [1] |
| | **(c)** | **(i)** | reaction / upwards / supporting / normal reaction force | M1 | |
| | | | friction | M1 | |
| | | | force(s) at the rod | A1 | [3] |
| | | **(ii)** | comes to rest with (line of action of) weight acting through rod | | |
| | | | allow C vertically below the rod | B1 | |
| | | | so that weight does not have a moment about the pivot / rod | B1 | [2] |

| | | | | | |
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| **4** | **(a)** | | energy = average force × extension | B1 | |
| | | | = ½ × *F* × *x* | B1 | |
| | | | (Hooke's law) extension proportional to (applied) force | B1 | |
| | | | hence *F* = *kx* | B1 | |
| | | | so $E = \frac{1}{2}kx^2$ | A0 | [4] |
| | **(b)** | **(i)** | correct area shaded | B1 | [1] |
| | | **(ii)** | 1.0 $cm^2$ represents 1.0 mJ or correct units used in calculation | C1 | |
| | | | $E_S$ = 6.4 ± 0.2 mJ | A2 | [3] |
| | | | (*for answer > ±0.2 mJ but ≤ ±0.4 mJ, then allow 2/3 marks*) | | |
| | | **(iii)** | arrangement of atoms / molecules is changed | B1 | [1] |
| **5** | **(a)** | **(i)** | distance (of point on wave) from rest / equilibrium position | B1 | [1] |
| | | **(ii)** | distance moved by wave energy / wavefront during one cycle of the source **or** minimum distance between two points with the same phase **or** between adjacent crests or troughs | B1 | [1] |
| | **(b)** | **(i)** | *T* = 0.60 s | B1 | [1] |
| | | **(ii)** | $\lambda$ = 4.0 cm | B1 | [1] |
| | | **(iii)** | *either* $v = \lambda/T$ *or* $v = f\lambda$ <u>and</u> $f = 1/T$ | C1 | |
| | | | $v = 6.7\ cm\ s^{-1}$ | A1 | [2] |
| | **(c)** | **(i)** | amplitude is decreasing | M1 | |
| | | | so, it is losing power | A1 | [2] |
| | | **(ii)** | *intensity* ~ (*amplitude*)$^2$ | C1 | |
| | | | ratio = $2.0^2 / 1.1^2$ | C1 | |
| | | | = 3.3 | A1 | [3] |
| **6** | **(a)** | **(i)** | at 22.5 °C, $R_T$ = 1600 Ω or 1.6 kΩ | C1 | |
| | | | total resistance = 800 Ω | A1 | [2] |
| | | **(ii)** | *either* use of potential divider formula *or* current = 9 / 2000 (4.5 mA) | C1 | |
| | | | V = (0.8/2.0) × 9    V = (9/2000) × 800 | | |
| | | | = 3.6 V    = 3.6 V | A1 | [2] |
| | **(b)** | **(i)** | total resistance = 4/5 × 1200 | C1 | |
| | | | = 960 Ω | A1 | [2] |
| | | **(ii)** | for parallel combination, 1/960 = 1/1600 + 1/$R_T$ | | |
| | | | $R_T$ = 2400 Ω / 2.4 kΩ | C1 | |
| | | | temperature = 11 °C | A1 | [2] |

| | | | | | |
|---|---|---|---|---|---|
| | **(c)** | | e.g. only small part of scale used / small sensitivity | B1 | |
| | | | non-linear | B1 | [2] |
| | | | (*any two sensible suggestions, 1 each, max 2*) | | |
| **7** | **(a)** | **(i)** | <u>most</u> $\alpha$-particles were deviated through small angles | B2 | [2] |
| | | | (*allow 1 mark for 'straight through' / undeviated*) | | |
| | | **(ii)** | small fraction of $\alpha$-particles deviated through large angles | M1 | |
| | | | greater than 90° (allow rebound back) | A1 | [2] |
| | **(b)** | | e.g. $\beta$-particles have a range of energies | | |
| | | | $\beta$-particles deviated by (orbital) electrons | | |
| | | | $\beta$-particle has (very) small mass | | |
| | | | (*any two sensible suggestions, 1 each, max 2*) | B2 | [2] |

Do not allow $\beta$-particles have negative charge or $\beta$-particles have high speed