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)
vector quantity has magnitude and direction B1

(ii) **1.** temperature: scalar B1
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)
$T = 14.3\,\text{N}$ (A1)
or $T = 25 \sin 35°$ (C2)
$T = 14.3\,\text{N}$ (A1)
or *R* and *T* resolved vertically and horizontally (C2)
leading to $T = 14.3\,\text{N}$ (A1)

2 **(a)** **(i)** $V_H = 12.4 \cos 36°$ $(= 10.0\ \text{m s}^{-1})$ C1
distance = 10.0 × 0.17
= 1.7 m A1 [2]

(ii) $V_V = 12.4 \sin 36°$ $(= 7.29\ \text{m s}^{-1})$ C1
$h = 7.29 \times 0.17 - ½ \times 9.81 \times 0.17^2$ 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]

4 **(a)** energy = average force × extension
= ½ × F × x B1
(Hooke's law) extension proportional to (applied) force B1
hence $F = kx$ B1
so $E = ½kx^2$ 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) λ = 4.0 cm B1 [1]

(iii) *either* $v = \lambda/T$ *or* $v = f\lambda$ and $f = 1/T$ 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
non-linear
(*any two sensible suggestions, 1 each, max 2*) B2

7 **(a)** **(i)** most α-particles were deviated through small angles B2 [2]
(*allow 1 mark for 'straight through' / undeviated*)

(ii) small fraction of α-particles deviated through large angles M1
greater than 90° (allow rebound back) A1 [2]

(b) e.g. β-particles have a range of energies
β-particles deviated by (orbital) electrons
β-particle has (very) small mass
(*any two sensible suggestions, 1 each, max 2*) B2 [2]

Do not allow β-particles have negative charge or β-particles have high speed