UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2012 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) $\frac{V}{t} = \frac{\pi P r^4}{8 C l}$

$C = [\pi \times 2.5 \times 10^3 \times (0.75 \times 10^{-3})^4] / (8 \times 1.2 \times 10^{-6} \times 0.25)$ C1

$= 1.04 \times 10^{-3}$ N s m^{-2} A1 [2]

(b) $4 \times \%r$ C1

$\%C = \%P + 4 \times \%r + \%V/t + \%l$

$= 2\% + 5.3\% + 0.83\% + 0.4\%$ (= 8.6%) A1

$\Delta C = \pm 0.089 \times 10^{-3}$ N s m^{-2} A1 [3]

(c) $C = (1.04 \pm 0.09) \times 10^{-3}$ N s m^{-2} A1 [1]

2 (a) (i) $v^2 = u^2 + 2as$

$= (8.4)^2 + 2 \times 9.81 \times 5$ C1

$= 12.99$ m s^{-1} *(allow 13 to 2 s.f. but not 12.9)* A1 [2]

(ii) $t = (v - u) / a$ or $s = ut + ½at^2$

$= (12.99 - 8.4) / 9.81$ or $5 = 8.4t + ½ \times 9.81t^2$ M1

$t = 0.468$ s A0 [1]

(b) reasonable shape M1

suitable scale A1

correctly plotted 1st and last points at (0,8.4) and (0.88 – 0.96,0)

with non-vertical line at 0.47 s A1 [3]

(c) (i) 1. kinetic energy at end is zero so $\Delta KE = ½ mv^2$ or $\Delta KE = ½ mu^2 - ½ mv^2$ C1

$= ½ \times 0.05 \times (8.4)^2$

$= (-) 1.8$ J A1 [2]

2. final maximum height $= (4.2)^2 / (2 \times 9.8) = (0.9$ (m)) C1

change in PE $= mgh_2 - mgh_1$ C1

$= 0.05 \times 9.8 \times (0.9 - 5)$

$= (-) 2.0$ J A1 [3]

(ii) change is – 3.8 (J) B1

energy lost to ground (on impact) / energy of deformation of the ball / thermal energy in ball B1 [2]

3 (a) A body continues at rest or constant velocity unless acted on by a resultant (external) force B1 [1]

(b) (i) constant velocity/zero acceleration and therefore no resultant force M1

no resultant force (and no resultant torque) hence in equilibrium A1 [2]

(ii) component of weight $= 450 \times 9.81 \times \sin 12°$ (= *917.8*) C1

tension $= 650 + 450g \sin 12° = (650 + 917.8)$ C1

$= 1600$ (1570) N A1 [3]

(iii) work done against frictional force or friction between log and slope M1
output power greater than the gain in PE / s A1 [2]

4 (a) total resistance = 20 (kΩ) C1
current = 12 / 20 (mA) or potential divider formula C1
p.d. = [12 / 20] × 12 = 7.2 V A1 [3]

(b) parallel resistance = 3 (kΩ) C1
total resistance 8 + 3 = 11 (kΩ) C1
current = 12 / 11 × 10^3 = 1.09 × 10^{-3} or 1.1 × 10^{-3} A A1 [3]

(c) (i) LDR resistance decreases M1
total resistance (of circuit) is less hence current increases A1 [2]

(ii) resistance across XY is less M1
less proportion of 12 V across XY hence p.d. is less A1 [2]

5 (a) E = stress / strain B1 [1]

(b) (i) 1. diameter / cross sectional area / radius
2. original length B1 [1]

(ii) measure original length with a metre ruler / tape B1
measure the diameter with micrometer (screw gauge) B1 [2]
allow digital vernier calipers

(iii) energy = ½ Fe or area under graph or ½ kx^2 C1
= ½ × 0.25 × 10^{-3} × 3 = 3.8 × 10^{-4} J A1 [2]

(c) straight line through origin below original line M1
line through (0.25, 1.5) A1 [2]

6 (a) two waves travelling (along the same line) in opposite directions overlap/meet M1
same frequency / wavelength A1
resultant displacement is the sum of displacements of each wave /
produces nodes and antinodes B1 [3]

(b) apparatus: source of sound + detector + reflection system B1
adjustment to apparatus to set up standing waves – how recognised B1
measurements made to obtain wavelength B1 [3]

(c) (i) at least two nodes and two antinodes A1 [1]

(ii) node to node = λ / 2 = 34 cm (allow 33 to 35 cm) C1
$c = f\lambda$ C1
f = 340 / 0.68 = 500 (490 to 520) Hz A1 [3]

7 **(a)** W = 1 and X = 0 A1 [1]
Y = 2 A1 [1]
Z = 55 A1 [1]

(b) explanation in terms of mass – energy conservation B1
energy released as gamma or photons or kinetic energy of products or em radiation B1 [2]