UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2011 question paper

for the guidance of teachers

9702 PHYSICS

9702/21 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) metre rule / tape (*not 'rule'*) B1 [1]

(ii) micrometer (screw gauge) / digital caliper B1 [1]

(iii) ammeter and voltmeter / ohmmeter / multimeter on 'ohm' setting B1 [1]

(b) (i) resistivity = RA / L C1
= $[7.5 \times \pi \times (0.38 \times 10^{-3})^2 / 4] / 1.75$ M1
= $4.86 \times 10^{-7}\ \Omega$ m A0 [2]

(ii) (uncertainty in R =) [0.2 / 7.5] × 100 = 2.7%
and (uncertainty in L =) [3 / 1750] × 100 = 0.17% C1
(uncertainty in A =) 2 × (0.01 / 0.38) × 100 = 5.3 % C1
total = 8.13% C1

uncertainty = 0.395×10^{-7} (Ω m) A1 [4]
(*missing 2 factor in uncertainty in A, then allow max 3/4*)

(c) resistivity = $(4.9 \times 10^{-7} \pm 0.4 \times 10^{-7})\ \Omega$ m A1 [1]

2 (a) work done is the force × the distance moved / displacement in the direction of the force
or
work is done when a force moves in the direction of the force B1 [1]

(b) component of weight = 850 × 9.81 × sin 7.5° C1
= 1090 N A1 [2]
(*use of incorrect trigonometric function, 0/2*)

(c) (i) ΣF = 4600 – 1090 = (3510) M1
deceleration = 3510 / 850 A1
= 4.1 m s^{-2} A0 [2]

(ii) $v^2 = u^2 + 2as$
$0 = 25^2 + 2 \times -4.1 \times s$ C1
s = 625 / 8.2
= 76 m A1 [2]
(*allow full credit for calculation of time (6.05 s) & then s*)

(iii) 1. kinetic energy = $\frac{1}{2} mv^2$ C1
= $0.5 \times 850 \times 25^2$
= 2.7×10^5 J A1 [2]

2. work done = 4600 × 75.7
= 3.5×10^5 J A1 [1]

(iv) difference is the loss in potential energy (*owtte*) B1 [1]

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3 **(a)** point where the weight of an object / gravitational force — M1
may be considered to act — A1 [2]

(b) product of the force and the perpendicular distance (to the pivot) — B1 [1]

(c) **(i)** 1. sum / net / resultant force is zero — B1

2. net / resultant moment is zero
sum of clockwise moments = sum of anticlockwise moments — B1 [2]

(ii) $W \times 0.2 = 80 \times 0.5 + 70 \times 1.3$ — C1
$= 40 + 91$ — C1
$W = 655$ N — A1 [3]
(*allow 2/3 for one error in distance but 0/3 if two errors*)

(iii) move pivot to left — (M1)
gives greater clockwise moment / smaller anticlockwise moment — (A1)
or
move W to right — (M1)
gives smaller anticlockwise moment — (A1) [2]

4 **(a)** **(i)** *stress* is force / area — B1 [1]

(ii) *strain* is extension / original length — B1 [1]

(b) **(i)** $E = [F / A] \div [e / l]$ — C1
$e = (25 \times 1.7) / (5.74 \times 10^{-8} \times 1.6 \times 10^{11})$ — C1
$e = 4.6 \times 10^{-3}$ m — A1 [3]

(ii) A becomes $A/2$ or stress is doubled — B1
$e \propto l / A$ or substitution into full formula — B1
total extension increase is $4e$ — A1 [3]

5 **(a)** **(i)** $I = 12 / (6 + 12)$ — C1
minimum current = 0.67 A — A1 [2]

(ii) correct start and finish points — M1
correct shape for curve with decreasing gradient — A1 [2]

(b) maximum current = 2.0 A — A1
minimum current = 0 — A1 [2]

(c) **(i)** smooth curve starting at (0,0) with decreasing gradient — M1
end section not horizontal — A1 [2]

(ii) full range of current / p.d. possible
or currents / p.d. down to zero
or brightness ranging from off to full brightness — B1 [1]

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6 **(a)** any two of:
large number of molecules / atoms / particles
molecules in random motion
no intermolecular forces
elastic collisions
time of collisions much less than time between collisions
volume of molecules much less than volume of containing vessel B1 + B1 [2]

(b) molecules collide with the walls
change in momentum of molecules implies force (on molecules)
molecules exert equal and opposite force on wall
pressure is averaging effect of many collisions
(*any three statements, 1 each*) B3 [3]

7 **(a)** when waves overlap / meet, (resultant) displacement is the sum of the individual displacements B1 [1]

(b) **(i)** two (ball-type) dippers (M1)
connected to the same vibrating source /motor (A1)
or
one wave source described (M1)
with two slits (A1) [2]

(ii) lamp with viewing screen on opposite side of tank B1
means of freezing picture e.g. strobe B1 [2]

(c) **(i)** two correct lines labelled X B1 [1]

(ii) correct line labelled N B1 [1]

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