

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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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2011	9702	21

- 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
 $= 4.86 \times 10^{-7} \Omega \text{ m}$ A0 [2]
- (ii) (uncertainty in R =) $[0.2 / 7.5] \times 100 = 2.7\%$
and (uncertainty in L =) $[3 / 1750] \times 100 = 0.17\%$ C1
(uncertainty in A =) $2 \times (0.01 / 0.38) \times 100 = 5.3 \%$ C1
total = 8.13% C1
- uncertainty = $0.395 \times 10^{-7} (\Omega \text{ m})$ A1 [4]
(*missing 2 factor in uncertainty in A, then allow max 3/4*)
- (c) resistivity = $(4.9 \times 10^{-7} \pm 0.4 \times 10^{-7}) \Omega \text{ m}$ A1 [1]
- 2 (a) work done is the force \times 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 = $850 \times 9.81 \times \sin 7.5^\circ$ C1
= 1090 N A1 [2]
(*use of incorrect trigonometric function, 0/2*)
- (c) (i) $\Sigma F = 4600 - 1090 = (3510)$ M1
deceleration = $3510 / 850$ A1
= 4.1 ms^{-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
= $0.5 \times 850 \times 25^2$
= $2.7 \times 10^5 \text{ J}$ A1 [2]
2. work done = 4600×75.7
= $3.5 \times 10^5 \text{ J}$ 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 may be considered to act M1 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) $W \times 0.2 = 80 \times 0.5 + 70 \times 1.3$
 $= 40 + 91$
 $W = 655 \text{ N}$
(allow 2/3 for one error in distance but 0/3 if two errors) C1 C1 A1 [3]
- (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) $E = [F / A] \div [e / l]$
 $e = (25 \times 1.7) / (5.74 \times 10^{-8} \times 1.6 \times 10^{11})$
 $e = 4.6 \times 10^{-3} \text{ m}$ C1 C1 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) $I = 12 / (6 + 12)$
minimum current = 0.67 A C1 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]

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
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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
means of freezing picture e.g. strobe
B1
B1 [2]
- (c) (i) two correct lines labelled X
B1 [1]
- (ii) correct line labelled N
B1 [1]