

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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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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  
 $= 4.86 \times 10^{-7} \Omega \text{ m}$  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  
 $= 1090 \text{ N}$  A1 [2]  
(*use of incorrect trigonometric function, 0/2*)
- (c) (i)  $\Sigma F = 4600 - 1090 = (3510)$  M1  
deceleration =  $3510 / 850$  A1  
 $= 4.1 \text{ ms}^{-2}$  A0 [2]
- (ii)  $v^2 = u^2 + 2as$   
 $0 = 25^2 + 2 \times -4.1 \times s$  C1  
 $s = 625 / 8.2$   
 $= 76 \text{ m}$  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 =  $4600 \times 75.7$   
 $= 3.5 \times 10^5 \text{ J}$  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)  $W \times 0.2 = 80 \times 0.5 + 70 \times 1.3$  C1  
 $= 40 + 91$  C1  
 $W = 655 \text{ N}$  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  
 $e = 4.6 \times 10^{-3} \text{ m}$  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]