

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**

**9702/23**

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) 2nd row random, 3rd row neither, 4th row systematic all correct  
two correct scores 1 only B2 [2]
- (b) (i) 1. systematic error: the average / peak is not the true value / the readings are not centred around the true value B1 [1]
2. random error: readings have positive and negative values around the peak value / values are scattered / wide range B1 [1]
- (ii) 1. accurate: peak / average value moves towards the true value B1 [1]
2. precise: lines are closer together / sharper peak B1 [1]
- 2 (a) resultant moment = zero / sum of clockwise moments = sum of anticlockwise moments  
resultant force = 0 B1  
B1 [2]
- (b) shape and orientation correct and forces labelled and arrows correct  
angles correct / labelled M1  
A1 [2]
- (c) (i)  $T \cos 18^\circ = W$  Scale diagram: C1  
 $T = 520 / \cos 18^\circ = 547 \text{ N}$   $\pm 20 \text{ N}$  A1 [2]
- (ii)  $R = T \sin 18^\circ$   
 $= 169 \text{ N}$   $\pm 20 \text{ N}$  A1 [1]
- (d)  $\theta$  is larger hence  $\cos \theta$  is smaller,  $T = W / \cos \theta$   
hence  $T$  is larger M1  
A0 [1]
- 3 (a) weight =  $m \times g$   
 $= 130.5 \times 9.81 = 1280 \text{ N}$  A1 [1]
- (b) (i)  $F = ma$   
 $T - 1280 = 130.5 \times 0.57$  C1  
 $T = 1280 + 74.4 = 1350 \text{ N}$  A1 [2]
- (ii) 1280 N A1 [1]
- (c)  $1240 - 1280 = 130.5 \times a$  C1  
 $a = (-) 0.31 \text{ ms}^{-2}$  A1 [2]
- (d) (i) 1. 3.5 s A1 [1]
2. 6.5 s A1 [1]

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- (ii) basic shape  
correct points M1  
A1 [2]
- 4 (a) force is proportional to extension B1 [1]
- (b) (i) gradient of graph determined (e.g.  $50 / 40 \times 10^{-3}$ ) =  $1250 \text{ N m}^{-1}$  A1 [1]
- (ii)  $W = \frac{1}{2} k x^2$  or  $W = \frac{1}{2}$  final force  $\times$  extension M1  
 $= 0.5 \times 1250 \times (36 \times 10^{-3})^2$  or  $0.5 \times 45 \times 36 \times 10^{-3}$  M1  
 $= 0.81 \text{ J}$  A0 [2]
- (c) (i)  $0.81 = \frac{1}{2} m v^2$  C1  
 $v = 8.0 (8.0498) \text{ m s}^{-1}$  A1 [2]
- (ii)  $4 \times \text{KE} / 4 \times \text{WD}$  or  $3.24 \text{ J}$  C1  
hence twice the compression =  $72 \text{ mm}$  A1 [2]
- (iii) Max height is when all KE or WD  
or elastic PE is converted to GPE C1  
ratio =  $1/4$  or  $0.25$  A1 [2]
- 5 (a) (i) Start from (0,0) and smooth curve in correct direction B1  
Curve correct for end section never horizontal B1 [2]
- (ii)  $R = V / I$  hence take co-ords of  $V$  and  $I$  from graph and calculate  $V / I$  B1 [1]
- (b) (i) each lamp in parallel has a greater p.d. / greater current M1  
lamp hotter M1  
resistance of lamps in parallel greater A1 [3]
- (ii)  $P = V^2 / R$  or  $P = VI$  and  $V = IR$  C1  
 $R = 144 / 50 = 2.88$  for each lamp C1  
total  $R = 1.44 \Omega$  A1 [3]
- 6 (a) (i) amplitude =  $7.6 \text{ mm}$  allow  $7.5 \text{ mm}$  A1 [1]
- (ii)  $180^\circ / \pi \text{ rad}$  A1 [1]
- (iii)  $v = f \times \lambda$   
 $= 15 \times 0.8$  C1  
 $= 12 \text{ m s}^{-1}$  A1 [2]
- (b) correct sketch with peak moved to the right B1  
curve moved by the correct phase angle / time period of  $0.25 T$  B1 [2]
- (c) (i) zero (rad) A1 [1]
- (ii) antinode maximum amplitude,  
node zero amplitude / displacement A1 [1]

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- (iii) 3 A1 [1]
- (iv) horizontal line through central section of wave B1 [1]
- 7 (a) density in solids and liquids similar M1  
spacing in solids and liquids about the same A1  
density in gases much less as spacing in gases much greater B1 [3]
- (b) density = mass / volume C1  
mass =  $1.67 \times 10^{-27}$  kg and volume =  $\frac{4}{3} \pi r^3$  C1  
density =  $(1.67 \times 10^{-27}) / \frac{4}{3} \times \pi \times (1.0 \times 10^{-15})^3$   
=  $3.99 \times 10^{17}$  kg m<sup>-3</sup> A1 [3]
- (c) atoms / molecules composed of large amount of empty space / nucleus has very small volume compared to volume of atom / space between atoms in a gas is very large B1 [1]