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 B2
two correct scores 1 only [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 B1
resultant force = 0 B1 [2]

(b) shape and orientation correct and forces labelled and arrows correct M1
angles correct / labelled A1 [2]

(c) **(i)** $T\cos 18° = W$ Scale diagram: C1
$T = 520 / \cos 18° = 547$ N ± 20 N A1 [2]

(ii) $R = T\sin 18°$
$= 169$ N ± 20 N A1 [1]

(d) θ is larger hence $\cos\theta$ is smaller, $T = W / \cos\theta$ M1
hence T is larger A0 [1]

3 **(a)** weight = $m \times g$
$= 130.5 \times 9.81 = 1280$ N A1 [1]

(b) **(i)** $F = ma$
$T - 1280 = 130.5 \times 0.57$ C1
$T = 1280 + 74.4 = 1350$ N A1 [2]

(ii) 1280 N A1 [1]

(c) $1240 - 1280 = 130.5 \times a$ C1
$a = (-)\ 0.31\,\text{m s}^{-2}$ A1 [2]

(d) **(i)** **1.** 3.5 s A1 [1]

2. 6.5 s A1 [1]

(ii) basic shape M1
correct points 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 N m^{-1} A1 [1]

(ii) $W = \frac{1}{2} k x^2$ or W = ½ final force × 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 J A0 [2]

(c) **(i)** $0.81 = \frac{1}{2} mv^2$ C1
v = 8.0 (8.0498) m s^{-1} A1 [2]

(ii) 4 × KE / 4 × WD or 3.24 J C1
hence twice the compression = 72 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 Ω A1 [3]

6 **(a)** **(i)** amplitude = 7.6 mm allow 7.5 mm A1 [1]

(ii) 180° / π <u>rad</u> A1 [1]

(iii) $v = f \times \lambda$
$= 15 \times 0.8$ C1
= 12 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]

(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 <u>much</u> less as spacing in gases much greater B1 [3]

(b) density = mass / volume C1
mass = 1.67×10^{-27} kg and volume = $4/3\ \pi\ r^3$ C1
density = $(1.67 \times 10^{-27}) / 4/3 \times \pi \times (1.0 \times 10^{-15})^3$
$= 3.99 \times 10^{17}$ kg m^{-3} 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]