UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2009 question paper for the guidance of teachers

9702 PHYSICS

9702/22 Paper 22 (AS Structured Questions), maximum raw mark 60

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1 **(a)** **(i)** *either* 1.55% *or* 1.6% …(not 1.5 or 2) ..... A1 [1]

(ii) *either* 1.09% *or* 1.1% …(not 1.0 or 1) ..... A1 [1]

(b) answer of {**(ii)** + 2 × **(i)**} to any number of sig. fig.
either 4.2% *or* 4.3% ..... A1 [1]

(c) **(i)** *either* the value has more significant figures than the data
or uncertainty of ±0.4 renders more than 2 s.f. meaningless) ..... B1 [1]

(ii) uncertainty in g = ±0.41 / ±0.42 to any number of s.f. C1
g = (9.8 ± 0.4) m s^{-2} ..... A1 [2]

[Total: 6]

2 **(a)** **(i)** e.g. (phase) change from liquid to gas / vapour
thermal energy required to maintain constant temperature ..... B1 [1]
(*do not allow 'convert water to steam'*)

(ii) e.g. evaporation takes place at surface B1
boiling takes place in body of the liquid B1
e.g. evaporation occurs at all temperatures B1
boiling occurs at one temperature ..... B1 [4]

(b) **(i)** volume = $\left(\frac{48}{4.5}=\right)$ 10.7 cm^3 ..... A1 [1]

(ii) **1** volume = 10.7 / (6.0 × 10^{23})
= 1.8 × 10^{-23} cm^3 ..... A1 [1]
2 separation = $\sqrt[3]{(1.8 \times 10^{-23})}$
= 2.6 × 10^{-8} cm ..... A1 [1]

[Total: 8]

3 **(a)** **(i)** speed = 4.0 m s^{-1} …(*allow 1 s.f.*) ..... A1 [1]

(ii) $v^2 = 2gh$
= 2 × 9.8 × 1.96 ..... M1
v = 6.2 m s^{-1} ..... A0 [1]
(*use of g = 10 m s^{-2} loses the mark*)

(b) correct basic shape with correct directions for vectors M1
speed = (7.4 ± 0.2) m s^{-1} A1
at (33 ± 2)° to the vertical ..... A1 [3]
(*for credit to be awarded, speed and angle must be correct on the diagram – not calculated*)

(c) (i) *either* $v^2 = 2 \times 9.8 \times 0.98$ *or* $v = 6.2 / \sqrt{2}$ C1
speed = 4.4 m s^{-1} ..... A1 [2]
(*allow calculation of t = 0.447 s, then v = 4.4 m s^{-1})*

(ii) **1** momentum = *mv* C1
change in momentum = 0.034 (6.2 + 4.4) C1
= 0.36 kg m s^{-1} ..... A1 [3]
(*use of 0.034 (6.2 - 4.4) loses last two marks*)
2 force = $\Delta p / \Delta t$ …….(however expressed) C1

$$= \frac{0.36}{0.12}$$

= 3.0 N ……(*allow 1 s.f.*) ..... A1 [2]

[Total: 12]

4 (a) ability to do work B1
as a result of a change of shape of an object/stretched etc ..... B1 [2]

(b) work = average force ×distance moved (in direction of the force) B1
either work = ½ × *F* × *x*
or work is area under *F/x* graph which is ½*Fx* B1
F = *kx* B1
so work / energy = ½*kx*^{2} ..... A0 [3]

(c) (i) spring constant $= \frac{3.8}{2.1}$ M1
= 1.8 N cm^{-1} ..... A0 [1]

(ii) **1** $\Delta E_P = mg\Delta h$ *or* $W\Delta h$ C1
$= 3.8 \times 1.5 \times 10^{-2}$
= 0.057 J ..... A1 [2]
2 $\Delta E_S = ½ \times 1.8 \times 10^2 (0.036^2 - 0.021^2)$ M1
= 0.077 J ..... A0 [1]
3 work done = 0.077 – 0.057
= 0.020 J ..... A1 [1]
(*allow e.c.f. if* $\Delta E_S > \Delta E_P$)

[Total: 10]

5 **(a)** **(i)** frequency f ..... B1 [1]

(ii) amplitude A ..... B1 [1]

(b) π rad or 180° ……(unit necessary) ..... B1 [1]

(c) **(i)** speed = $f \times L$ ..... B1 [1]

(ii) wave is reflected at end / at P B1
either incident and reflected waves interfere
or two waves travelling in opposite directions interfere M1
speed is the speed of incident or reflected wave / one of these waves ..... A1 [3]

[Total: 7]

6 **(a)** total resistance in series = 2R
total resistance in parallel = ½R M1
ratio is 2R / ½R = 4 .....(*allow mark if clear numbers in the ratio*) ..... A0 [1]

(b) at 1.5 V, current is 0.10 A C1
resistance = $V/I = \frac{1.5}{0.1}$
= 15 Ω ..... A1 [2]
(*use of tangent or any other current scores no marks*)

(c)

	p.d. across each lamp / V	resistance of each lamp / Ω	combined resistance / Ω
series	1.5	15	30
parallel	3.0	20	10

column 1 ..... A1
columns 2 and 3: max 3 marks with -1 mark for each error or omission ..... A3 [4]

(d) **(i)** ratio is 3 .....(allow e.c.f.) ..... A1 [1]

(ii) resistance increases as potential difference increases B1
increasing p.d. increases current B1
current increases non-linearly so resistance increases ..... B1 [3]

[Total: 11]

7 **(a)** *either* forms of same element
or atoms / nuclei with same number of protons M1
atoms / nuclei contain different numbers of neutrons ..... A1 [2]
(*use of 'element' rather than atoms / nuclei scores max 1 mark*)

(b) **(i)** decay is not affected by environmental factors ..... B1 [1]
(*allow two named factors*)

(ii) *either* time of decay (of a nucleus) cannot be predicted
or nucleus has constant probability in a given time ..... B1 [1]

(c) $^{185}_{75}\text{Re}$ B1
either $^{0}_{-1}\text{e}$ *or* $^{0}_{-1}\beta$ ..... B1 [2]

[Total: 6]