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

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.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the October/November 2009 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

UNIVERSITY of CAMBRIDGE
International Examinations

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 × $F \times x$
or work is area under F/x graph which is ½Fx B1
$F = kx$ B1
so work / energy = ½kx^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]