

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 $g = \pm 0.41 / \pm 0.42$ to any number of s.f. C1
 $g = (9.8 \pm 0.4) \text{ m s}^{-2}$ 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 = $(\frac{48}{4.5}) = 10.7 \text{ cm}^3$ A1 [1]
- (ii) 1 volume = $10.7 / (6.0 \times 10^{23})$
= $1.8 \times 10^{-23} \text{ cm}^3$ A1 [1]
2 separation = $\sqrt[3]{(1.8 \times 10^{-23})}$
= $2.6 \times 10^{-8} \text{ cm}$ A1 [1]

[Total: 8]

- 3 (a) (i) speed = 4.0 m s^{-1} ...(allow 1 s.f.) A1 [1]
- (ii) $v^2 = 2gh$
= $2 \times 9.8 \times 1.96$ M1
 $v = 6.2 \text{ m s}^{-1}$ A0 [1]
(*use of $g = 10 \text{ m s}^{-2}$ loses the mark*)
- (b) correct basic shape with correct directions for vectors M1
speed = $(7.4 \pm 0.2) \text{ m s}^{-1}$ A1
at $(33 \pm 2)^\circ$ to the vertical A1 [3]
(*for credit to be awarded, speed and angle must be correct on the diagram – not calculated*)

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(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 $t = 0.447 \text{ s}$, then $v = 4.4 \text{ m s}^{-1}$)

(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 \times distance moved (in direction of the force) B1
 either work = $\frac{1}{2} \times F \times x$
 or work is area under F/x graph which is $\frac{1}{2}Fx$ B1
 $F = kx$ B1
 so work / energy = $\frac{1}{2}kx^2$ 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 $\Delta E_S = \frac{1}{2} \times 1.8 \times 10^{-2} (0.036^2 - 0.021^2)$ 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 interfereM1
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 = $\frac{1}{2}R$ M1
ratio is $2R / \frac{1}{2}R = 4$ (allow mark if clear numbers in the ratio) A0 [1]
- (b) at 1.5 V, current is 0.10 A C1
resistance = $V/I = \frac{1.5}{0.1}$
= 15Ω 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]

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- 7 (a) *either* forms of same element
or atoms / nuclei with same number of protonsM1
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]

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