UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 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.

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1 **(a)**	scalar has magnitude/size, vector has magnitude/size and direction	B1	[1]
(b)	acceleration, momentum, weight *(–1 for each addition or omission but stop at zero)*	B2	[2]
(c) **(i)**	horizontally: 7.5 cos 40° / 7.5 sin 50° = 5.7(45) / 5.75 <u>not</u> 5.8 N	A1	[1]
(ii)	vertically: 7.5 sin 40° / 7.5 cos 50° = 4.8(2) N	A1	[1]
(d)	*either* correct shaped triangle	M1	
	correct labelling of two forces, three arrows and two angles	A1	
	or correct resolving: $T_2 \cos 40° = T_1 \cos 50°$	(B1)	
	$T_1 \sin 50° + T_2 \sin 40° = 7.5$	(B1)	
	T_1 = 5.7(45) (N)	A1	
	T_2 = 4.8 (N) *(allow ± 0.2 N for scale diagram)*	A1	[4]
2 **(a)** **1.**	constant velocity / speed	B1	[1]
2.	*either* constant / uniform decrease (in velocity/speed) *or* constant rate of decrease (in velocity/speed)	B1	[1]
(b) **(i)**	distance is area under graph for both stages	C1	
	stage 1: distance (18 × 0.65) = 11.7 (m) stage 2: distance = (9 × [3.5 – 0.65]) = 25.7 (m)		
	total distance = 37.(4) m *(–1 for misreading graph)* {for stage 2, allow calculation of acceleration (6.32 m s^{-2}) and then s = (18 × 2.85) + ½ × 6.32 (2.85)^2 = 25.7 m}	A1	[2]
(ii)	*either* $F = ma$ *or* $E_K = ½mv^2$	C1	
	a = (18 – 0)/(3.5 – 0.65) E_K = ½ × 1250 × (18)^2	C1	
	F = 1250 × 6.3 =7900 N *or* F = ½ × 1250 × (18)^2 / 25.7 = 7900 N	A1	[3]
	or initial momentum = 1250 × 18	(C1)	
	F = change in momentum / time taken	(C1)	
	F = (1250 × 18) / 2.85 = 7900	(A1)	
(c) **(i)**	stage 1: *either* half / less distance as speed is half / less *or* half distance as the time is the same *or* sensible discussion of reaction time	B1	[1]
(ii)	stage 2: *either* same acceleration and $s = v^2 / 2a$ *or* v^2 is ¼	B1	
	¼ of the distance	B1	[2]

3 (a) (i) power = work done per unit time / energy transferred per unit time / rate of work done — B1 [1]

(ii) Young modulus = stress / strain — B1 [1]

(b) (i) 1. $E = T / (A \times \text{strain})$ *(allow strain = ε)* — C1
$T = E \times A \times \text{strain} = 2.4 \times 10^{11} \times 1.3 \times 10^{-4} \times 0.001$ — M1
$= 3.12 \times 10^{4}\,\text{N}$ — A0 [2]

2. $T - W = ma$ — C1
$[3.12 \times 10^{4} - 1800 \times 9.81] = 1800a$ — C1
$a = 7.52\,\text{m s}^{-2}$ — A1 [3]

(ii) 1. $T = 1800 \times 9.81 = 1.8 \times 10^{4}\,\text{N}$ — A1 [1]

2. potential energy gain $= mgh$ — C1
$= 1800 \times 9.81 \times 15$
$= 2.7 \times 10^{5}\,\text{J}$ — A1 [2]

(iii) $P = Fv$ — C1
$= 1800 \times 9.81 \times 0.55$ — C1
input power = $9712 \times (100/30) = 32.4 \times 10^{3}\,\text{W}$ — A1 [3]

4 (a) p.d. = $\dfrac{\text{energy transformed from electrical to other forms}}{\text{unit charge}}$ — B1

e.m.f. = $\dfrac{\text{energy transformed from other forms to electrical}}{\text{unit charge}}$ — B1 [2]

(b) (i) sum of e.m.f.s (in a closed circuit) = sum of potential differences — B1 [1]

(ii) $4.4 - 2.1 = I \times (1.8 + 5.5 + 2.3)$ — M1
$I = 0.24\,\text{A}$ — A1 [2]

(iii) arrow (labelled) I shown anticlockwise — A1 [1]

(iv) 1. $V = I \times R = 0.24 \times 5.5 = 1.3(2)\,\text{V}$ — A1 [1]

2. $V_A = 4.4 - (I \times 2.3) = 3.8(5)\,\text{V}$ — A1 [1]

3. *either* $V_B = 2.1 + (I \times 1.8)$ *or* $V_B = 3.8 - 1.3$ — C1
$= 2.5(3)\,\text{V}$ — A1 [2]

5	**(a)** transverse waves have vibrations that are perpendicular / normal to the direction of energy travel	B1	
	longitudinal waves have vibrations that are parallel to the direction of energy travel	B1	[2]
	(b) vibrations are in a single direction	M1	
	either applies to transverse waves *or* normal to direction of wave energy travel *or* normal to direction of wave propagation	A1	[2]
	(c) (i) 1. amplitude = 2.8 cm	B1	[1]
	2. phase difference = 135° *or* 0.75π rad *or* ¾π rad *or* 2.36 radians (three sf needed)		
	numerical value	M1	
	unit	A1	[2]
	(ii) amplitude = 3.96 cm (4.0 cm)	A1	[1]
6	**(a) (i)** greater deflection	M0	
	greater electric field / force on α-particle	A1	[1]
	(ii) greater deflection	M0	
	greater electric field / force on α-particle	A1	[1]
	(b) (i) *either* deflections in opposite directions	M1	
	because oppositely charged	A1	
	or β less deflection	(M1)	
	β has smaller charge	(A1)	[2]
	(ii) α smaller deflection	M1	
	because larger mass	A1	[2]
	(iii) β less deflection because higher speed	B1	[1]
	(c) *either* $F = ma$ and $F = Eq$ *or* $a = Eq / m$	C1	
	ratio = *either* $\dfrac{(2 \times 1.6 \times 10^{-19}) \times (9.11 \times 10^{-31})}{(1.6 \times 10^{-19}) \times 4 \times (1.67 \times 10^{-27})}$ *or* $[2e \times 1 / 2000\ \text{u}] / [e \times 4\text{u}]$	C1	
	ratio = 1 /4000 *or* 2.5×10^{-4} *or* 2.7×10^{-4}	A1	[3]