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

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1 **(a)** scalar has magnitude/size, vector has magnitude/size and direction B1 [1]

(b) acceleration, momentum, weight B2 [2]
(–1 for each addition or omission but stop at zero)

(c) **(i)** horizontally: $7.5\cos 40° / 7.5\sin 50° = 5.7(45) / 5.75$ not 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) A1 [4]
(allow ± 0.2 N for scale diagram)

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 $(18 \times 0.65) = 11.7$ (m)
stage 2: distance $= (9 \times [3.5 – 0.65]) = 25.7$ (m)
total distance = 37.(4) m A1 [2]
(–1 for misreading graph)
{for stage 2, allow calculation of acceleration ($6.32\,m\,s^{-2}$)
and then $s = (18 \times 2.85) + ½ \times 6.32\,(2.85)^2 = 25.7$ m}

(ii) *either* $F = ma$ *or* $E_K = ½mv^2$ C1
$a = (18 – 0)/(3.5 – 0.65)$ $E_K = ½ \times 1250 \times (18)^2$ C1

$F = 1250 \times 6.3 = 7900$ N *or* $F = ½ \times 1250 \times (18)^2 / 25.7 = 7900$ N A1 [3]
or initial momentum $= 1250 \times 18$ (C1)
F = change in momentum / time taken (C1)
$F = (1250 \times 18) / 2.85 = 7900$ (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]

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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]

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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 [2*e* × 1 / 2000 u] / [*e* × 4u] — C1

ratio = 1 /4000 *or* 2.5×10^{-4} *or* 2.7×10^{-4} — A1 [3]

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