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 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]

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

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