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

9702/22 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)** average velocity = 540 / 30 C1
= 18 m s^{-1} A1 [2]

(b) velocity zero at time t = 0 B1
positive value and horizontal line for time t = 5 s to 35 s B1
line / curve through v = 0 at t = 45 s to negative velocity B1
negative horizontal line from 53 s with magnitude less than positive value and horizontal line to time = 100 s B1 [4]

2 **(a)** **(i)** force is rate of change of momentum B1 [1]

(ii) work done is the product of the force and the distance moved in the direction of the force B1 [1]

(b) **(i)** $W = Fs$ **or** $W = mas$ **or** $W = m(v^2 - u^2) / 2$ **or** W = force × distance s A1 [1]

(ii) $as = (v^2 - u^2) / 2$ any subject M1
$W = mas$ hence $W = m(v^2 - u^2) / 2$ M1
RHS represents terms of energy **or** with u = 0 KE = ½mv^2 A1 [3]

(c) **(i)** work done = ½ × 1500 × [$(30)^2 - (15)^2$] (=506250) C1
distance = WD / F = 506250 / 3800 = 133 m A1 [2]
or $F = ma$ a = 2.533 (m s^{-2}) C1
$v^2 = u^2 + 2as$ s = 133 m A1

(ii) the change in kinetic energy is greater or the work done by the force has to be greater, hence distance is greater (for same force) A1 [1]

allow: same acceleration, same time, so greater average speed and greater distance

3 **(a)** **(i)** stress = force / (cross-sectional) area B1 [1]

(ii) strain = extension / original length **or** change in length / original length B1 [1]

(b) point beyond which material does not return to the original length / shape / size when the load / force is removed B1 [1]

(c) UTS is the maximum force / original cross-sectional area — M1
wire is able to support / before it breaks — A1 [2]

allow one: maximum stress the wire is able to support / before it breaks

(d) (i) straight line from (0,0) — M1
correct shape in plastic region — A1 [2]

(ii) only a straight line from (0,0) — B1 [1]

(e) (i) ductile: initially force proportional to extension then a large extension for small change in force — B1
brittle: force proportional to extension until it breaks — B1 [2]

(ii) **1.** does not return to its original length / permanent extension (as entered plastic region) — B1
2. returns to original length / no extension **(as no plastic region / still in elastic region)** — B1 [2]

4 (a) electric field strength = force / positive charge — B1 [1]

(b) (i) at least three equally spaced parallel vertical lines — B1
direction down — B1 [2]

(ii) $E = 1500 / 20 \times 10^{-3} = 75000\,\text{V m}^{-1}$ — A1 [1]

(iii) $F = qE$ — C1
($W = mg$ and) $qE = mg$ — C1
$q = mg / E = 5 \times 10^{-15} \times 9.81 / 75000$
$= 6.5 \times 10^{-19}\,\text{C}$ — A1
negative charge — A1 [4]

(iv) $F > mg$ or F now greater — B1
drop will move upwards — B1 [2]

5 (a) (i) $I_1 + I_3 = I_2$ — A1 [1]

(ii) $E_1 = I_2\frac{R_2}{2} + I_1\frac{R_2}{2} + I_1R_1 + I_1r_1$ — A1 [1]

(iii) $E_1 - E_2$ — B1
$= -I_3r_2 + I_1 (R_1 + r_1 + R_2 / 2)$ — B1 [2]

(b) p.d. across BJ of wire changes / resistance of BJ changes — B1
there is a difference in p.d across wire and p.d. across cell E_2 — B1 [2]

6 (a) waves overlap — B1
(resultant) displacement is the sum of the displacements of each of the waves — B1 [2]

(b) waves travelling in opposite directions overlap / incident and reflected waves overlap
(allow superpose or interfere for overlap here) B1
waves have the same speed and frequency B1 [2]

(c) **(i)** time period = 4 × 0.1 (ms) C1
$f = 1 / T = 1 / 4 \times 10^{-4} = 2500\,\text{Hz}$ A1 [2]

(ii) **1.** the microphone is at an antinode and goes to a node and then an antinode / maximum amplitude at antinode and minimum amplitude at node B1 [1]

2. $\lambda / 2 = 6.7\,(\text{cm})$ C1
$v = f\lambda$ C1
$v = 2500 \times 13.4 \times 10^{-2} = 335\,\text{m s}^{-1}$ A1 [3]

incorrect λ then can only score second mark

7 **(a)** **(i)** the half life / count rate / rate of decay / activity is the same no matter what external factors / environmental factors **or** two named factors such as temperature and pressure changes are applied B1 [1]

(ii) the observations of the count rate / count rate / rate of decay / activity / radioactivity during decay shows variations / fluctuations B1 [1]

(b)

property	α-particle	β-particle	γ-radiation
charge	**(+)2*e***	**–*e***	0
mass	4*u*	**9.11×10^{-31} kg**	0
speed	**0.01 to 0.1 *c***	up to 0.99 *c*	***c***

one mark for each correct line B3 [3]

(c) collision with molecules B1
causes ionisation (of the molecule) / electron is removed B1 [2]