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

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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]