UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2009 question paper for the guidance of teachers

9702 PHYSICS

9702/21 Paper 21 (AS Structured Questions), maximum raw mark 60

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1 (a) (i) car uses 210 / 14 = 15 litres of fuel C1
volume reading = 45 litres . ..... A1 [2]

(ii) from 'full' to '3/4' mark ..... B1 [1]

(b) (i) line/graph does not pass through ('empty, 0) / there is an intercept ..... B1 [1]
(*do not allow 'non-linear'*)

(ii) (meter shows zero fuel when there is some left in the tank so)
acts as a 'reserve' ..... B1 [1]

[Total: 5]

2 (a) (i) (air) resistance increases with speed M1
resultant / accelerating force decreases ..... A1 [2]

(ii) *either* (air) resistance is zero
or weight / gravitational force is only force ..... B1 [1]

(b) use of gradient of a tangent M1
acceleration = 1.9 ± 0.2 m s^{-2} ..... A2 [3]
(*for values* > ± *0.2 but* ≤ *0.4, allow 1 mark*)
(*answer 3.3 m s^{-2} scores no marks*)

(c) (i) **1** weight = $90 \times 9.8 = 880$ N ..... A1 [1]
(*use of g = 10 m s^{-2} then deduct mark but once only in the Paper*)
2 accelerating force = $90 \times 1.9 = 170$ N …(*allow ecf*) ..... A1 [1]

(ii) resistive force = 880 – 170 = 710 N ..... A1 [1]
(*allow ecf but only if resistive force remains positive*)

[Total: 9]

3 (a) (i) *either* sum / total momentum (of system of bodies) is constant
or <u>total</u> momentum before = <u>total</u> momentum after M1
for an isolated system / no (external) force acts on system ..... A1 [2]

(ii) zero momentum before / after decay M1
so α-particle and nucleus D must have <u>momenta</u> in opposite directions ..... A1 [2]

(b) (i) kinetic energy = $\frac{1}{2} mv^2$ C1
$1.0 \times 10^{-12} = \frac{1}{2} \times 4 \times \underline{1.66} \times 10^{-27} \times v^2$ M1
$v = 1.7 \times 10^7$ m s^{-1} ..... A0 [2]

(ii) $1.7 \times 10^7 \times 4u = 216u \times V$ C1
$V = 3.1 \times 10^5$ m s^{-1} ..... A1 [2]
(*accept 3.2* $\times$ *10^5 m s^{-1}, do not accept 220 rather than 216*)

(c) $(1.7 \times 10^{7})^2 = 2 \times$ *deceleration* $\times 4.5 \times 10^{-2}$ C1
deceleration / $a = 3.2 \times 10^{15}$ m s^{-2} ..... A1 [2]
(*accept calculation based on calculating* $F = 2.22 \times 10^{-11}$ *N and then use of* $F = ma$)

[Total: 10]

4 **(a)** **(i)** returns to original shape / size / length etc. B1
when load / distorting forces / weight / strain is removed ..... B1 [2]

(ii) **1** $R = \rho L / A$ ..... B1 [1]
2 $E = WL / Ae$ ..... B1 [1]

(b) $E = WR / e\rho$ C1
$= (34 \times 0.44) / (7.7 \times 10^{-4} \times 9.2 \times 10^{-8})$ C1
$= 2.1 \times 10^{11}$ Pa ..... A1 [3]

[Total: 7]

5 **(a)** transfer / propagation of energy M1
as a result of oscillations / vibrations ..... A1 [2]

(b) **(i)** displacement / velocity / acceleration (of particles in the wave) ..... B1 [1]

(ii) displacement etc. is normal to direction of energy transfer /
travel of wave / propagation of wave ……(*not 'wave motion'*) ..... B1 [1]

(iii) displacement etc. along / same direction of energy transfer /
travel of wave / propagation of wave ……(*not 'wave motion'*) ..... B1 [1]

(c) diffraction: suitable object, means of observation M1
either laser *or* lamp and aperture
or distant source M1
light region where darkness expected A1

interference: suitable object, means of observation and illumination B1
light and dark fringes observed B1
appropriate reference to a dimension for diffraction or
for interference ..... B1 [6]

[Total: 11]

6 **(a)** energy transferred from source / changed from some form to electrical M1
per unit charge (to drive charge round a complete circuit) ..... A1 [2]

(b) <u>and</u> power in R = I^2X M1
$E = I(X + r)$ M1
power in cell = EI <u>and</u> algebra clear leading to ratio = $X / (X + r)$ ..... A1 [3]

(c) (i) 1.4 W A1
0.40 Ω ……(*allow ±0.05* Ω) ..... A1 [2]

(ii) current in circuit = $\sqrt{1.4/0.4}$ = 1.87 A C1
1.5 = 1.87 (r + 0.40) C1
r = 0.40 Ω …..... A1 [3]

(d) *either* less power lost / energy wasted / lost
or greater efficiency (of energy transfer) ..... B1 [1]

[Total: 11]

7 (a) deviation shown correctly ..... B1 [1]

(b) smaller deviation (not zero deviation) M1
acceptable path wrt position of N ..... A1 [2]

(c) the nucleus is (very) small M1
in comparison to the atom ..... A1 [2]
(special *case: 'atom is mostly empty space' scores 1 mark*)

(d) deviation depends on charge on the nucleus / N / electrostatic repulsion B1
same charge so no change in deviation ..... B1 [2]

[Total: 7]