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

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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the October/November 2009 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

UNIVERSITY of CAMBRIDGE
International Examinations

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* $> \pm 0.2$ *but* ≤ 0.4, *allow 1 mark*)
(*answer 3.3 m s*$^{-2}$ *scores no marks*)

(c) **(i)** **1** weight = 90×9.8 = 880 N .... A1 [1]
(*use of g = 10 m s*$^{-2}$ *then deduct mark but once only in the Paper*)
2 accelerating force = 90×1.9 = 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 total momentum before = total 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 momenta in opposite directions .... A1 [2]

(b) **(i)** kinetic energy = $\frac{1}{2}mv^2$ C1
$1.0 \times 10^{-12} = \frac{1}{2} \times 4 \times 1.66 \times 10^{-27} \times v^2$ 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* 3.2×10^{5} *m s*$^{-1}$, *do not accept 220 rather than 216*)

(c) $(1.7 \times 10^7)^2 = 2 \times \textit{deceleration} \times 4.5 \times 10^{-2}$ 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]