

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 = $1.9 \pm 0.2 \text{ m s}^{-2}$ 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 = $90 \times 9.8 = 880 \text{ N}$ A1 [1]
(use of $g = 10 \text{ m s}^{-2}$ then deduct mark but once only in the Paper)
2 accelerating force = $90 \times 1.9 = 170 \text{ N}$... (allow ecf) A1 [1]
- (ii) resistive force = $880 - 170 = 710 \text{ N}$ 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
 $1.0 \times 10^{-12} = \frac{1}{2} \times 4 \times \underline{1.66} \times 10^{-27} \times v^2$ M1
 $v = 1.7 \times 10^7 \text{ m s}^{-1}$ A0 [2]
- (ii) $1.7 \times 10^7 \times 4u = 216u \times V$ C1
 $V = 3.1 \times 10^5 \text{ m s}^{-1}$ A1 [2]
(accept $3.2 \times 10^5 \text{ m s}^{-1}$, do not accept 220 rather than 216)

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- (c) $(1.7 \times 10^7)^2 = 2 \times \text{deceleration} \times 4.5 \times 10^{-2}$ C1
deceleration / $a = 3.2 \times 10^{15} \text{ m s}^{-2}$ A1 [2]
 (accept calculation based on calculating $F = 2.22 \times 10^{11} \text{ N}$
 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
 $= 2.1 \times 10^{11} \text{ Pa}$ 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) and power in R = $I^2 X$ M1
 $E = I(X + r)$ M1
 power in cell = EI and algebra clear leading to ratio = $X / (X + r)$ A1 [3]

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(c) (i) 1.4 W A1
0.40 Ω (allow $\pm 0.05 \Omega$) A1 [2]

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

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

[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]