UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level and GCE Advanced Subsidiary Level

MARK SCHEME for the May/June 2006 question paper

9702 PHYSICS

9702/04 Paper 4

Maximum raw mark 60

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All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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The minimum marks in these components needed for various grades were previously published with these mark schemes, but are now instead included in the Report on the Examination for this session.

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1 **(a)** centripetal force is provided by gravitational force B1
$mv^2 / r = GMm / r^2$ B1
hence $v = \sqrt{(GM / r)}$ A0 **[2]**

(b) **(i)** $E_K (= \frac{1}{2}mv^2) = GMm / 2r$ B1 **[1]**

(ii) $E_P = - GMm / r$ B1 **[1]**

(iii) $E_T = - GMm / r + GMm / 2r$ C1
$= - GMm / 2r$. A1 **[2]**

(c) **(i)** if E_T decreases then $- GMm / 2r$ becomes more negative
or $GMm / 2r$ becomes larger M1
so r decreases A1 **[2]**

(ii) $E_K = GMm / 2r$ and r decreases M1
so (E_K and) v increases A1 **[2]**

2 **(a)** e.g. fixed mass/ amount of gas
ideal gas
(*any two, 1 each)* B2 **[2]**

(b) **(i)** $n = pV / RT$ C1
$= (2.5 \times 10^7 \times 4.00 \times 10^4 \text{ x } 10^{-6}) / (8.31 \times 290)$ C1
$= 415$ mol A1 **[3]**

(ii) volume of gas at 1.85×10^5 Pa $= (2.5 \times 10^7 \times 4.00 \times 10^4) / (1.85 \times 10^5)$
$= 5.41 \times 10^6$ cm^3 C1
so, $5.41 \times 10^6 = 4.00 \times 10^4 + 7.24 \times 10^3 N$ C1
$N = 741$ A1 **[3]**
(answer 740 or fails to allow for gas in cylinder, max 2/3)

3 **(a)** gradient of graph is (a measure of) the sensitivity M1
the gradient varies with temperature A1 **[2]**

(b) $2040 \pm 20\ \Omega$ corresponds to 15.0 ± 0.2 °C C1
T / K = T / °C + 273.15 (allow 273.2) C1
temperature is 288.2 K A1 **[3]**

4 **(a)** **(i)** 1.0 B1 **[1]**

(ii) 40 Hz B1 **[1]**

(b) **(i)** speed $= 2\pi fa$ C1
$= 2\pi \times 40 \times 42 \times 10^{-3}$
$= 10.6$ m s^{-1} A1 **[2]**

(ii) acceleration $= 4\pi^2 f^2 a$ C1
$= (80\pi)^2 \times 42 \times 10^{-3}$
$= 2650$ m s^{-2} A1 **[2]**

(c) **(i)** S marked correctly (on 'horizontal line through centre of wheel) B1

(ii) A marked correctly (on 'vertical line' through centre of wheel) B1 **[2]**

5 **(a)** **(i)** force per unit positive charge (ratio idea essential) B1 **[1]**

(ii) $E = Q / 4\pi\varepsilon_0 r^2$ M1
ε_0 being the permittivity of free space A1 **[2]**

(b) **(i)** $2.0 \times 10^6 = Q / (4\pi \times 8.85 \times 10^{-12} \times 0.35^2)$ C1
$Q = 2.7 \times 10^{-5}$ C A1 **[2]**

(ii) $V = (2.7 \times 10^{-5}) / (4\pi \times 8.85 \times 10^{-12} \times 0.35)$ C1
$= 7.0 \times 10^5$ V A1 **[2]**

(c) electrons are stripped off the atoms B1
electrons and positive ions move in opposite directions,
(giving rise to a current) B1 **[2]**

6 **(a)** **(i)** arrow B in correct direction (down the page) B1

(ii) arrow F in correct direction (towards Y) B1 **[2]**

(b) **(i)** When two bodies interact, force on one body is equal but opposite in direction to force on the other body. B1 **[1]**

(ii) direction opposite to that in **(a)(ii)** B1 **[1]**

(c) suggested reasonable values of I and d B1
mention of expression $F = BIL$ B1
force between wires is small M1
compared to weight of wire A1 **[4]**

7 **(a)** 'uniform' distribution B1 **[1]**

(b) concentric rings B1 **[1]**

(c) higher speed, more momentum M1
$\lambda = h / p$ M1
so λ decreases and ring diameter decreases A1 **[3]**

8 **(a)** arrow labelled E pointing down the page B1 **[1]**

(b) **(i)** $Bqv = qE$ M1
forces are independent of mass and charge 'cancels' M1
so no deviation A1 **[3]**

(ii) magnetic force > electric force M1
so deflects M1
'downwards' A1 **[3]**