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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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]**

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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]**

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