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

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

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.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

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.

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

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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 (= ½mv^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 ± 20 Ω 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]**