UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

MARK SCHEME for the November 2005 question paper

9702 PHYSICS

9702/04 Core 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.

CIE is publishing the mark schemes for the November 2005 question papers for most IGCSE and GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

1	**(a)**	$GM / R^2 = R\omega^2$	C1	
		$\omega = 2\pi / (24 \times 3600)$	C1	
		$6.67 \times 10^{-11} \times 6.0 \times 10^{24} = R^3 \times \omega^2$		
		$R^3 = 7.57 \times 10^{22}$	M1	
		$R = 4.23 \times 10^7$ m	A0	
	(b)(i)	$\Delta\Phi = GM/R_e - GM/R_o$	C1	
		$= (6.67 \times 10^{-11} \times 6.0 \times 10^{24})\ (1 / 6.4 \times 10^6 - 1 / 4.2 \times 10^7)$		
		$= 5.31 \times 10^7$ J kg^{-1}	C1	
		$\Delta E_P = 5.31 \times 10^7 \times 650$	C1	
		$= 3.45 \times 10^{10}$ J	A1	**[4]**
	(c)	e.g. satellite will already have some speed in the correct direction	B1	**[1]**
2	**(a)**	obeys the law pV = constant $\times T$	M1	
		at all values of p, V and T	A1	**[2]**
	(b)	$n = (2.9 \times 10^5 \times 3.1 \times 10^{-2}) / (8.31 \times 290)$	C1	
		$= 3.73$ mol	A1	**[2]**
	(c)	at new pressure, $n_n = 3.73 \times \frac{3.4}{2.9} \times \frac{290}{300}$		
		$= 4.23$ mol	C1	
		change = 0.50 mol	C1	
		number of strokes = 0.50 / 0.012 = 42 (must round up for mark)	A1	**[3]**
3	**(a)**	correct statement, words or symbols	B1	**[1]**
	(b)(i)	$w = p\Delta V$	C1	
		$= 1.03 \times 10^5 \times (2.96 \times 10^{-2} - 1.87 \times 10^{-5})$		
		= (–) 3050 J	A1	**[2]**
	(ii)	$q = 4.05 \times 10^4$ J	B1	**[1]**
	(iii)	$\Delta U = 4.05 \times 10^4 - 3050 = 37500$ J …no e.c.f. from **(a)**	A1	**[1]**
		penalise 2 sig.fig. once only		
	(c)	number of molecules = N_A	C1	
		energy $= 37500 / (6.02 \times 10^{23})$		
		$= 6.2 \times 10^{-20}$ J (accept 1 sig.fig.)	A1	**[2]**
4	**(a)(i)**	$\omega = 2\pi f$	C1	
		$= 2\pi \times 1400$		
		= 8800 rad s^{-1}	A1	**[2]**
	(ii)	$a_0 = (-)\omega^2 x_0$	C1	
		$= (8800)^2 \times 0.080 \times 10^{-3}$		
		= 6200 m s^{-2}	A1	**[2]**
	(b)	straight line through origin with negative gradient	M1	
		end points of line correctly labelled	A1	**[2]**
	(c)(i)	zero displacement	B1	**[1]**
	(ii)	$v = \omega x_0$	C1	
		$= 8800 \times 0.080 \times 10^{-3}$		
		= 0.70 m s^{-1}	A1	**[2]**

5	(a)	$\frac{1}{2}mv^2 = qV$ ……(or some verbal explanation) ……………………	B1	
		$\frac{1}{2} \times 9.11 \times 10^{-31} \times v^2 = 1.6 \times 10^{-19} \times 1.2 \times 10^4$ ………………………	B1	
		$v = 6.49 \times 10^7$ m s^{-1} ………………………………………………	A0	
	(b)(i)	*within field:* circular arc …………………………………………	B1	
		in 'downward' direction ………………………………	B1	
		beyond field: straight, with no 'kink' on leaving field …………………	B1	[3]
	(ii)1.	v is smaller ………………………………………………………	M1	
		deflection is larger ………………………………………………	A1	[2]
	2.	(magnetic) force is larger ………………………………………	M1	
		deflection is larger ………………………………………………	A1	[2]
6	(a)	(numerically equal to) force per unit length ………………………	M1	
		on straight conductor carrying unit current ………………………	A1	
		normal to the field ………………………………………………	A1	[3]
	(b)	flux through coil = $BA\sin\theta$ ………………………………………	B1	
		flux linkage = $BAN\sin\theta$ …………………………………………	B1	[2]
	(c)(i)	(induced) e.m.f. proportional to ………………………………………	M1	
		rate of change of flux (linkage) ………………………………………	A1	[2]
	(ii)	graph: two square sections in correct positions, zero elsewhere …..	B1	
		pulses in opposite directions ……………………………	B1	
		amplitude of second about twice amplitude of first …………..	B1	[3]
7	(a)(i)	energy required to separate the nucleons in a nucleus ………………	M1	
		nucleons separated to infinity / completely ………………………	A1	[2]
	(ii)	S shown at peak ………………………………………………	B1	[1]
	(b)(i)	4 ………………………………………………………………	A1	[1]
	(ii)1.	idea of energy as product of A and energy per nucleon ……………	C1	
		energy $= (8.37 \times 142 + 8.72 \times 90) - 235 \times 7.59$		
		$= 1189 + 785 - 178$		
		= 190 MeV ………(–1 for each a.e.) …………………………	A2	[3]
	2.	energy $= mc^2$ ……………………………………………………	C1	
		1 MeV $= 1.6 \times 10^{-13}$ J …………………………………………	C1	
		energy $= (190 \times 1.6 \times 10^{-13}) / (3.0 \times 10^8)^2$		
		$= 3.4 \times 10^{-28}$ kg ………………………………………………	A1	[3]