UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2006 question paper

9702 PHYSICS

9702/04 Paper 4 (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 instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began.

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 grade thresholds for various grades are published in the report on the examination for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses.

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1	(a)		*either* ratio of work done to mass/charge *or* work done moving unit mass/charge from infinity *or* both have zero potential at infinity	B1	[1]
	(b)		gravitational forces are (always attractive)	B1	
			electric forces can be attractive or repulsive	B1	
			for gravitational, work got out as masses come together /mass moves from infinity	B1	
			for electric, work done on charges if same sign, work got out if opposite sign as charges come together	B1	[4]
2	(a)	(i)	idea of heat lost (by oil) = heat gained (by thermometer)	C1	
			$32 \times 1.4 \times (54 - t) = 12 \times 0.18 \times (t - 19)$	C1	
			$t = 52.4°C$	A1	[3]
		(ii)	*either* ratio (= 1.6/54) = 0.030 *or* (=1.6/327) = 0.0049	A1	[1]
	(b)		thermistor thermometer (allow 'resistance thermometer')	B1	
			because small mass/thermal capacity	B1	[2]
	(c)		boiling point temperature is constant	M1	
			further comment e.g. heating of bulb would affect only rate of boiling	A1	[2]
3	(a)		use of $a = -\omega^2 x$ clear	C1	
			either $\omega = \sqrt{(2k/m)}$ *or* $\omega^2 = (2k/m)$	B1	
			$\omega = 2\pi f$	C1	
			$f = (1/2\pi)\sqrt{(2 \times 300)/0.240)}$	B1	
			$= 7.96 \approx 8$ Hz	A0	[4]
	(b)	(i)	resonance	B1	[1]
		(ii)	8 Hz	B1	[1]
	(c)		(increase amount of) damping	B1	
			without altering (k or) m …(some indirect reference is acceptable)	B1	
			sensible suggestion	B1	[3]
4	(a)	(i)	$GMm \{(R + h_1)^{-1} - (R + h_2)^{-1}\}$	B1	
			$½m \{v_1^2 - v_2^2\}$	B1	[2]
	(b)		$2M \times 6.67 \times 10^{-11} \{(26.28 \times 10^6)^{-1} - (29.08 \times 10^6)^{-1}\} = 5370^2 - 5090^2$	B1	
			$M \times 4.888 \times 10^{-19} = 2.929 \times 10^6$	C1	
			$M = 6.00 \times 10^{24}$ kg	A1	[3]
			(If equation in **(a)** *is dimensionally unsound, then 0/3 marks in* **(b)***, if dimensionally sound but incorrect, treat as e.c.f.)*		
5	(a)	(i)	(induced) e.m.f proportional/equal to rate of change of flux (linkage) *(allow 'induced voltage, induced p.d.)*	B1	
			flux is cust as the disc moves	M1	
			hence inducing an e.m.f	A0	[2]
		(ii)	field in disc is not uniform/rate of cutting not same/speed of disc not same (over whole disc)	B1	
			so different e.m.f.'s in different parts of disc	M1	
			lead to eddy currents	A0	[2]
	(b)		eddy currents dissipate thermal energy in disc	B1	
			energy derived from oscillation of disc	B1	
			energy of disc depends on amplitude of oscillations	B1	[3]

6	**(a)**	**(i)**	peak voltage = $6\sqrt{2}$	C1	
			peak voltage = 8.48 V	A1	[2]
		(ii)	zero because *either* no current in circuit (and $V = IR$)		
			or all p.d. across diode	B1	[1]
	(b)		waveform: half-wave rectification	B1	
			peak height at about 4.25 cm	B1	
			half-period spacing of 2.0 cm	B1	[3]
			(allow ±¼ square for height and half-period)		
	(c)	**(i)**	*capacitor shown in parallel with resistor*	B1	[1]
		(ii)	*either* energy = $\frac{1}{2}CV^2$ or = $\frac{1}{2}QV$ <u>and</u> $Q = CV$	C1	
			$= \frac{1}{2} \times 180 \times 10^{-6} \times (6\sqrt{2})^2$	C1	
			$= 6.48 \times 10^{-3}$ J	A1	[3]
		(iii)	*either* fraction = 0.43^2 or final energy = 1.2 mJ	C1	
			fraction = 0.18	A1	[2]
7	**(a)**	**(i)**	quantum/packet/discrete amount of energy	M1	
			electromagnetic mentioned	A1	[2]
		(ii)	max. k.e. corresponds to electron emitted from surface	B1	
			energy is required to bring electron to surface	B1	[2]
	(b)		at higher frequency, fewer photons (per second) for same intensity	M1	
			so rate of emission decreases	A1	[2]
			(allow argument based on photoelectric efficiency)		
8	**(a)**	**(i)**	*either* number = $6.02 \times 10^{23} \times (\{2.65 \times 10^{-6}\}/234)$		
			or number = $(2.65 \times 10^{-9})/(234 \times 1.66 \times 10^{-27})$	C1	
			$= 6.82 \times 10^{15}$	A1	[2]
		(ii)	$A = \lambda N$	C1	
			$604 = \lambda \times 6.82 \times 10^{15}$		
			$\lambda = 8.86 \times 10^{-14}$ s^{-1}	A1	[2]
		(iii)	$T_{½} = \ln 2/\lambda$		
			$= 7.82 \times 10^{12}$ s	C1	
			$= 2.48 \times 10^{5}$ years	A1	[2]
	(b)		half-life is (very) long (compared with time of counting)	B1	[1]
	(c)		there would be appreciable decay of source during the taking of measurements	B1	[1]