UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2010 question paper

for the guidance of teachers

9702 PHYSICS

9702/23 Paper 2 (AS Structured Questions), maximum raw mark 60

This mark scheme is published as an aid to teachers and candidates, 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, which would have considered the acceptability of alternative answers.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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1	**(a)**	**(i)** 1% of ±2.05 is ±0.02	A1	[1]
		(ii) max. value is 2.08 V	A1	[1]
	(b)	there may be a zero error/calibration error/systematic error	M1	
		which makes all readings either higher or lower than true value	A1	[2]
2	**(a)**	no resultant force/sum of forces zero	B1	
		no resultant moment/torque/sum of moments/torques zero	B1	[2]
	(b)	**(i)** each force is represented by the side of a triangle/by an arrow	M1	
		in magnitude and direction	A1	
		arrows joined, head to tail	B1	[3]
		(*could be shown on a sketch diagram*)		
		(ii) if the triangle is 'closed' (then the forces are in equilibrium)	B1	[1]
	(c)	triangle drawn with correct shape (incorrect arrows loses this mark)	B1	
		T_1 = 5.4 ± 0.2 N	B1	
		T_2 = 4.0 ± 0.2 N	B1	[3]
	(d)	forces in strings would be horizontal	B1	
		(so) no vertical force to support the weight	B1	[2]
3	**(a)**	evidence of use of area below the line	B1	
		distance = 39 m (*allow ±0.5 m*)	A2	[3]
		(*if > ±0.5 m but ≤ 1.0 m, then allow 1 mark*)		
	(b)	**(i)** **1** $E_K = ½mv^2$	C1	
		$\Delta E_K = ½ \times 92 \times (6^2 - 3^2)$		
		= 1240 J	A1	[2]
		2 $E_P = mgh$	C1	
		$\Delta E_P = 92 \times 9.8 \times 1.3$		
		= 1170 J	A1	[2]
		(ii) $E = Pt$	C1	
		$E = 75 \times 8$		
		= 600 J	A1	[2]
	(c)	**(i)** energy = (1240 + 600) – 1170	M1	
		= 670 J	A0	[1]
		(ii) force = 670/39 = 17 N	A1	[1]
	(d)	frictional forces include air resistance	B1	
		air resistance decreases with decrease of speed	B1	[2]

4	**(a)**	**(i)**	solid has fixed volume and fixed shape/incompressible	B1	[1]
		(ii)	gas fills any space into which it is put	B1	[1]
	(b)		atoms/molecules have (elastic) collisions with the walls (of the vessel)	B1	
			momentum of atom/molecule changes	B1	
			<u>so</u> impulse (on wall)/force on wall	B1	
			random motion/many collisions (per unit time) gives rise to (constant) force/pressure	B1	[4]
	(c)		spacing (much) greater in gases than in liquids/about ten times	C1	
			either spacing depends on $1/\sqrt[3]{\rho}$		
			or ratio of spacings is about 8.8	A1	[2]
5	**(a)**	**(i)**	**1** number of oscillations per unit time (not per second)	B1	[1]
			2 $n\lambda$	A1	[1]
		(ii)	v = distance / time = $n\lambda/t$	M1	
			$n/t = f$ hence $v = f\lambda$	A1	
			or f oscillations per unit time so $f\lambda$ is distance per unit time	M1	
			distance per unit time is v so $v = f\lambda$	A1	[2]
	(b)	**(i)**	1.0 period is 3 × 2 = 6.0 ms	C1	
			frequency = $1/(6 \times 10^{-3})$ = 170 Hz	A1	[2]
		(ii)	wave (with approx. same amplitude and) with correct phase difference	B1	[1]
6	**(a)**	**(i)**	movement/flow of charged particles	B1	[1]
		(ii)	work done per unit charge (transferred)	B1	[1]
	(b)		straight line through origin	B1	
			resistance = V/I, with values for V and I shown	M1	
			= 20 Ω	A0	[2]
			(using the gradient loses the last mark)		
	(c)	**(i)**	0.5 A	A1	[1]
		(ii)	*either* resistance of each resistor is 20 Ω *or* total current = 0.8 A	C1	
			either combined resistance = 10 Ω *or* $R = E/I$ = 10 Ω	A1	[2]
	(d)	**(i)**	10 V	A1	[1]
		(ii)	power = EI	C1	
			= 10 × 0.2 = 2.0 W	A1	[2]

7	**(a)**	**(i)**	*either* helium nucleus *or* particle containing two protons and two neutrons	B1	[1]
		(ii)	allow any value between 1 cm and 10 cm	B1	[1]
	(b)	**(i)**	energy = $(8.5 \times 10^{-13})/(1.6 \times 10^{-13})$ = 5.3 MeV	M1 A0	 [1]
		(ii)	number = $(5.3 \times 10^{6})/31$ = 1.7×10^{5} (*allow 2 s.f. only*)	C1 A1	 [2]
		(iii)	number per unit length = (1.7×10^{5}) / **(a)(ii)** correct numerical value correct unit	 A1 B1	 [2]