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

9702/21 Paper 2 (AS Structured Questions), maximum raw mark 60

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1	10^{-9}	B1	
	c	B1	
	mega	B1	
	tera	B1	[4]
2	**(a)** scalar	B1	
	scalar	B1	
	vector	B1	[3]
	(b) **(i)** **1** gradient (of graph) is the speed/velocity (*can be scored here or in* ***2***)	B1	
	initial gradient is zero	B1	[2]
	2 gradient (of line/graph) becomes constant	B1	[1]
	(ii) speed = (2.8 ± 0.1) m s^{-1}	A2	[2]
	(*if answer > ±0.1 but ≤ ±0.2, then award 1 mark*)		
	(iii) curved line never below given line and starts from zero	B1	
	continuous curve with increasing gradient	B1	
	line never vertical or straight	B1	[3]
3	**(a)** *either* energy (stored)/work done represented by area under graph		
	or energy = average force × extension	B1	
	energy = ½ × 180 × 4.0 × 10^{-2}	C1	
	= 3.6 J	A1	[3]
	(b) **(i)** *either* momentum before release is zero	M1	
	so sum of momenta (of trolleys) after release is zero	A1	
	or force = rate of change of momentum (M1)		
	force on trolleys equal and opposite (A1)		
	or impulse = change in momentum (M1)		
	impulse on each equal and opposite (A1)		[2]
	(ii) **1** $M_1V_1 = M_2V_2$	B1	[1]
	2 $E = ½ M_1V_1^2 + ½ M_2V_2^2$	B1	[1]
	(iii) **1** $E_K = ½mv^2$ and $p = mv$ combined to give	M1	
	$E_K = p^2 / 2m$	A0	[1]
	2 m smaller, E_K is larger because p is the same/constant	M1	
	so trolley B	A0	[1]

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4	**(a)**	when a wave (front) passes by/incident on an edge/slit	M1	
		wave bends/spreads (into the geometrical shadow)	A1	[2]
	(b)	$\tan\theta = \frac{38}{165}$		
		$\theta = 13°$	C1	
		$d \sin\theta = n\lambda$	C1	
		$d = 2.82 \times 10^{-6}$	C1	
		number = $(1/d =)\ 3.6 \times 10^{5}$	A1	[4]
	(c)	P remains in same position	B1	
		X and Y rotate through 90°	B1	[2]
	(d)	*either* screen not parallel to grating *or* grating not normal to (incident) light	B1	[1]
5	**(a)**	region/area where a charge experiences a force	B1	[1]
	(b) **(i)**	left-hand sphere (+), right-hand sphere (–)	B1	[1]
	(ii) **1**	correct region labelled C within 10 mm of central part of plate otherwise within 5 mm of plate	B1	[1]
	2	correct region labelled D area of field not included for **(b)(ii)1**	B1	[1]
	(c) **(i)**	arrows through P and N in correct directions	B1	[1]
	(ii)	torque = force × perpendicular distance (between forces)	C1	
		$= 1.6 \times 10^{-19} \times 5.0 \times 10^{4} \times 2.8 \times 10^{-10} \times \sin 30$		
		$= 1.1 \times 10^{-24}$ N m	A1	[2]
6	**(a)** **(i)**	$P = VI$	C1	
		$60 = 12 \times I$		
		$I = 5.(0)$ A	A1	[2]
	(ii)	*either* $V = IR$ *or* $P = I^2R$ or $P = V^2 / R$	C1	
		either $12 = 5 \times R$ *or* $60 = 5^2 \times R$ or $60 = 12^2/R$	M1	
		$R = 2.4\ \Omega$	A0	[2]
	(b)	$R = \rho L/A$	C1	
		$A = \pi \times (0.4 \times 10^{-3})^2\ (= 5.03 \times 10^{-7})$	C1	
		$L = (2.4 \times 5.03 \times 10^{-7})/(1.0 \times 10^{-6})$		
		$= 1.2$ m	A1	[3]
	(c)	resistance is halved	M1	
		either current is doubled *or* power $\propto 1/R$	M1	
		power is doubled	A1	[3]

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7 **(a)** nuclei/atoms with same proton number/atomic number B1
nuclei/atoms contain different numbers of neutrons/different atomic mass ..... B1 [2]

(b) **(i)** 92 ..... A1 [1]

(ii) 146 ..... A1 [1]

(c) **(i)** mass = $238 \times 1.66 \times 10^{-27}$ C1
$= 3.95 \times 10^{-25}$ kg ..... A1 [2]

(ii) volume = $\frac{4}{3}\pi \times (8.9 \times 10^{-15})^3$ $(= 2.95 \times 10^{-42})$ C1
density = $(3.95 \times 10^{-25})/(2.95 \times 10^{-42})$
$= 1.3 \times 10^{17}$ kg m^{-3} ..... A1 [2]

(d) nucleus contains <u>most</u> of mass of atom B1
either nuclear diameter/volume <u>very much</u> less than that of atom
or atom is mostly (empty) space ..... B1 [2]

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