UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2006 question paper

9702 PHYSICS

9702/02 Paper 2 (Structured), maximum raw mark 60

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1	**(a)**	**(i)**	product of force and distance moved	M1	
			(by force) in the direction of the force	A1	[2]
		(ii)	work (done) per unit time (*idea of ratio needed*)	B1	[1]
	(b)		*either* work/time *or* power = (force × distance)/time	M1	
			to give power = force × velocity	A1	[2]
	(c)	**(i)**	kinetic energy (= $\frac{1}{2}mv^2$) = $\frac{1}{2} \times 1900 \times 27^2$	C1	
			power = 692550 / 8.1 = 8.55×10^4 W	A1	[2]
		(ii)	*either* for equal increments of speed, increments of E_K are different	M1	
			so longer time (to increase speed) at high speeds	A1	[2]
			or air resistance increases with speed (M1)		
			so driving force (and acceleration) reduced (A1)		
			or P (= Fv) = mav (M1)		
			(P and m constant) so when v increases, a decreases (A1)		
2	**(a)**		uses a tangent (anywhere), not a single point	C1	
			draws tangent at correct position	B1	
			acceleration = 1.7 ± 0.1	A2	[4]
			(*outside 1.6 → 1.8 but within 1.5 → 1.9, allow 1 mark*)		
	(b)	**(i)**	because slope (of tangent of graph) is decreasing	M1	
			acceleration is decreasing	A1	[2]
		(ii)	e.g. air resistance increases (with speed)		
			(angle of) slope of ramp decreases	B1	[1]
	(c)	**(i)**	scatter of points about line	B1	[1]
		(ii)	intercept / line does not go through origin	B1	[1]
3	**(a)**		helium nucleus OR contains two protons and two neutrons	B1	[1]
	(b)		kinetic energy = $\frac{1}{2}mv^2$	C1	
			$\frac{1}{2} \times 4 \times 1.66 \times 10^{-27} \times v^2 = 1.07 \times 10^{-12}$	A1	
			$v = 1.8 \times 10^7$ m s^{-1}	A0	[2]
	(c)	**(i)**	sum of momenta (in any direction) is constant		
			/ total momemtum is constant	M1	
			in a closed system / no external force	A1	[2]
		(ii)	momentum of francium (= 0) = momentum of α + momentum of astatine	C1	
			$204 \times V = 4 \times 1.8 \times 10^7$	C1	
			$V = 3.5 \times 10^5$ m s^{-1}	A1	[3]
			(*nuclei incorrectly identified, 0/3*		
			nuclei correctly identified but incorrect masses, -1 each error)		
	(d)		another particle / photon is emitted	M1	
			at an angle to the direction of the α-particle	A1	[2]
			(allow 1 mark for 'Francium nucleus is not stationary')		

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4 (a) (i) when two (or more) waves meet (at a point) M1
there is a change in overall intensity / displacement A1
(ii) constant phase difference (between waves) B1 [3]

(b) (i) $d\sin\theta = n\lambda$ B1
$(10^{-3} / 550) \sin 90 = n \times 644 \times 10^{-9}$ C1
$n = 2.8$ C1
so two orders A1 [4]
(*power-of-ten error giving 2800 orders, allow 1/3 only for calculation of n*)

(ii) 1. $d\sin\theta = n\lambda$ (*either here or in* ***(i)*** *– not both*)
θ is greater so λ is greater B1 [1]
2. when n is larger, $\Delta\theta$ is larger M1
so greater in second order A1 [2]

5 (a) metal: crystalline / lattice / atoms in regular pattern B1
(atoms in regular) pattern that repeats itself (within crystal) B1 [2]
polymer: long chains of atoms / molecules B1
chain consists of 'units' that repeat themselves B1 [2]

(b) (i) e.g. latex is soft / not strong / flows / ductile B1
elastic limit easily exceeded B1 [2]
(*allow any two sensible comments, 1 each*)

(ii) more solid / does not flow / stronger / higher ultimate tensile stress
more brittle
elastic limit much higher
increased toughness
(*any two, 1 each*) B2 [2]

6 (a) (i) $R = \rho L / A$ B1
(ii) strain $= \Delta L / L$ B1
either $\Delta R = \rho \Delta L / A$ *or* $R \propto L$ with ρ and A constant B1
dividing, $\Delta R / R = \Delta L / L$ A0 [3]

(b) Young modulus = stress / strain C1
strain $= 72.0 / (1.20 \times 10^{-7} \times 2.10 \times 10^{11})$ C1
$= 2.86 \times 10^{-3}$ (*allow 1/350* A1
$\Delta R = 2.86 \times 10^{-3} \times 4.17 = 1.19 \times 10^{-2}\ \Omega$ A1
answer given to 3 sig. fig B1 [5]

7 (a) both measure (energy / work) / charge B1
for e.m.f., transfer of chemical energy to electrical energy B1
for p.d., transfer of electrical energy to thermal energy / other forms B1 [3]

(b) (i) $I_1 + I_2 = I_3$ B1 [1]
(ii) 1. $E_2 = I_2R_2 + I_3R_3$ B1 [1]
2. $E_1 - E_2 = I_1R_1 - I_2R_2$ B1 [1]

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