## 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

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.

• CIE will not enter into discussions or correspondence in connection with these mark schemes.

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Page 2	Mark Scheme	Syllabus	Paper
	GCE A/AS LEVEL - OCT/NOV 2006	9702	2

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

Page 3	Mark Scheme	Syllabus	Paper
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4	(a)	(i)	when two (or more) waves meet (at a point)	M1	
		(ii)	there is a change in overall intensity / displacement constant phase difference (between waves)	A1 B1	[3]
	(b)	(i)	$d\sin\theta = n\lambda$ $(10^{-3} / 550) \sin 90 = n \times 644 \times 10^{-9}$ n = 2.8 so two orders (power-of-ten error giving 2800 orders, allow 1/3 only for calculation of n)	B1 C1 C1 A1	[4]
		(ii)	<ol> <li>dsin θ = nλ (either here or in (i) – not both)         θ is greater so λ is greater     </li> <li>when n is larger, Δθ is larger so greater in second order</li> </ol>	B1 M1 A1	[1] [2]
5	(a)		metal: crystalline / lattice / atoms in regular pattern (atoms in regular) pattern that repeats itself (within crystal) polymer: long chains of atoms / molecules chain consists of 'units' that repeat themselves	B1 B1 B1 B1	[2] [2]
	(b)	(i)	e.g. latex is soft / not strong / flows / ductile elastic limit easily exceeded	B1 B1	[2]
		(ii)	(allow any two sensible comments, 1 each) 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) (ii)	$R = \rho L / A$ strain = $\Delta L / L$ either $\Delta R = \rho \Delta L / A$ or $R \propto L$ with $\rho$ and $A$ constant dividing, $\Delta R / R = \Delta L / L$	B1 B1 B1 A0	[3]
	(b)		Young modulus = stress / strain strain = $72.0 / (1.20 \times 10^{-7} \times 2.10 \times 10^{11})$ = $2.86 \times 10^{-3}$ (allow 1/350 $\Delta R = 2.86 \times 10^{-3} \times 4.17 = 1.19 \times 10^{-2} \Omega$ answer given to 3 sig. fig	C1 C1 A1 A1 B1	[5]
7	(a)		both measure (energy / work) / charge for e.m.f., transfer of chemical energy to electrical energy for p.d., transfer of electrical energy to thermal energy / other forms	B1 B1 B1	[3]
	(b)		$I_1 + I_2 = I_3$ <b>1.</b> $E_2 = I_2R_2 + I_3R_3$ <b>2.</b> $E_1 - E_2 = I_1R_1 - I_2R_2$	B1 B1 B1	[1] [1] [1]