

**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.

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Page 2	Mark Scheme	Syllabus	Paper
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- 1 (a) (i) product of force and distance moved  
(by force) in the direction of the force M1  
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 =  $692550 / 8.1 = 8.55 \times 10^4$  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 =  $1.7 \pm 0.1$  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) B1 [1]  
(angle of) slope of ramp decreases
- (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<sup>-1</sup> A0 [2]
- (c) (i) sum of momenta (in any direction) is constant M1  
/ total momentum is constant A1 [2]  
in a closed system / no external force
- (ii) momentum of francium (= 0) = momentum of  $\alpha$  + momentum of astatine C1  
 $204 \times V = 4 \times 1.8 \times 10^7$  C1  
 $V = 3.5 \times 10^5$  m s<sup>-1</sup> 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  $\alpha$ -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) there is a change in overall intensity / displacement	M1 A1	[3]	
	(ii)	constant phase difference (between waves)	B1		
4 (b)	(i)	$d \sin \theta = n \lambda$ $(10^{-3} / 550) \sin 90 = n \times 644 \times 10^{-9}$ $n = 2.8$ so two orders <i>(power-of-ten error giving 2800 orders, allow 1/3 only for calculation of n)</i>	B1 C1 C1 A1	[4]	
	(ii)	1.	$d \sin \theta = n \lambda$ (either here or in (i) – not both) <u><math>\theta</math> is greater so <math>\lambda</math> is greater</u>	B1	[1]
		2.	when $n$ is larger, $\Delta \theta$ is larger so greater in second order	M1 A1	[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 <i>(allow any two sensible comments, 1 each)</i> (ii) more solid / does not flow / stronger / higher ultimate tensile stress more brittle elastic limit much higher increased toughness <i>(any two, 1 each)</i>	B1 B1 B2	[2] [2]	
6 (a)	(i)	$R = \rho L / A$	B1	[3]	
	(ii)	strain = $\Delta L / L$ <i>either <math>\Delta R = \rho \Delta L / A</math> or <math>R \propto L</math> with <math>\rho</math> and <math>A</math> constant</i> dividing, $\Delta R / R = \Delta L / L$	B1 B1 A0		
6 (b)		Young modulus = stress / strain strain = $72.0 / (1.20 \times 10^{-7} \times 2.10 \times 10^{11})$ $= 2.86 \times 10^{-3}$ <i>(allow 1/350)</i> $\Delta R = 2.86 \times 10^{-3} \times 4.17 = 1.19 \times 10^{-2} \Omega$ 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]	
7 (b)	(i)	$I_1 + I_2 = I_3$	B1	[1]	
	(ii)	1. $E_2 = I_2 R_2 + I_3 R_3$ 2. $E_1 - E_2 = I_1 R_1 - I_2 R_2$	B1 B1 B1	[1] [1] [1]	