

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2009 question paper
for the guidance of teachers

9702 PHYSICS

9702/21

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.

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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE A/AS LEVEL – May/June 2009	9702	21
1	(a) (i) micrometer (screw gauge) / travelling microscope	B1	[1]
	(ii) <i>either</i> ohm-meter or voltmeter and ammeter or multimeter/avo on ohm setting	B1	[1]
	(iii) <i>either</i> (calibrated) c.r.o. or a.c. voltmeter and $\times \sqrt{2}$	B1	[1]
	(b) density = mass / volume	C1	
	= $580 / 6^3 = 2.685 \text{ g cm}^{-3}$...(<i>allow 2.68, 2.69, 2.7</i>)	A1	
	% uncertainty in mass = $(10 / 580) \times 100 = 1.7\%$	C1	
	% uncertainty in volume = $3 \times (0.1 / 6) \times 100 = 5.0\%$	C1	
	uncertainty in density = 0.18 g cm^{-3}		
	density = $2.7 \pm 0.2 \text{ g cm}^{-3}$	A1	[5]
	(<i>answer $2.69 \pm 0.09 \text{ g cm}^{-3}$ scores 4 marks</i>)		
2	(a) ball moving in <u>opposite</u> direction (after collision)	B1	[1]
	(b) (i) change in momentum = $1.2 (4.0 + 0.8)$	C2	
	(<i>correct values, 1 mark; correct sign {values added}, 1 mark</i>) = 5.76 N s ...(<i>allow 5.8</i>)	A1	[3]
	(ii) force = $\Delta p / \Delta t$ or $m\Delta v / \Delta t$	C1	
	= $5.76 / 0.08$ or $1.2 \times 4.8 / 0.08$	C1	
	= 72 N	A1	[3]
	(c) $5.76 = 3.6 \times V$	C1	
	$V = 1.6 \text{ m s}^{-1}$	A1	[2]
	(d) <i>either</i> speed of approach = 4.0 m s^{-1} and speed of separation = 2.4 m s^{-1}	M1	
	not equal and so inelastic	A1	
	or kinetic energy before = 9.6 J and kinetic energy after collision = 4.99 J	M1	
	kinetic energy after is less / not conserved so inelastic	A1	[2]
3	(a) product of (magnitude of one) force and distance between forces	M1	
	reference to <i>either</i> perpendicular distance between forces or line of action of forces and perpendicular distance	A1	[2]
	(b) (i) 90°	B1	[1]
	(ii) $130 = F \times 0.45$ (<i>allow e.c.f. for angle in (i)</i>)	C1	
	$F = 290 \text{ N}$	A1	[2]
	(<i>allow 1 mark only if angle stated in (i) is not used in (ii)</i>)		

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4	(a) (i) change of shape / size / length / dimension when (deforming) <u>force is removed</u> , returns to original shape / size	C1 A1	[2]
	(ii) $L = ke$	B1	[1]
	(b) $2e$	B1	
	$\frac{1}{2}k$...(allow e.c.f. from extension)	B1	
	$\frac{1}{2}e$ and $2k$	B1	
	$\frac{3}{2}e$...(allow e.c.f. from extension in part 2)	B1	
	$\frac{2}{3}k$...(allow e.c.f. from extension)	B1	[5]
5	(a) <i>either</i> phase difference is π rad / 180° <i>or</i> path difference (between waves from S_1 and S_2) is $\frac{1}{2}\lambda / (n + \frac{1}{2})\lambda$. <i>either</i> same amplitude / intensity at M <i>or</i> ratio of amplitudes is 1.28 / ratio of intensities is 1.28^2	B1 B1 B1	[2]
	(b) path difference between waves from S_1 and $S_2 = 28$ cm wavelength changes from 33 cm to 8.25 cm minimum when $\lambda = (56$ cm,) 18.7 cm, 11.2 cm, (8.0 cm) so two minima	B1 B1 B1 B1	[4]
6	(a) (i) $E = V / d$ $= 350 / (2.5 \times 10^{-2})$ $= 1.4 \times 10^4$ N C ⁻¹	C1 A1	[2]
	(ii) force = Eq $= 1.4 \times 10^4 \times 1.6 \times 10^{-19}$ $= 2.24 \times 10^{-15}$	C1 M1 A0	[2]
	(b) (i) $F = ma$ $a = (2.24 \times 10^{-15}) / (9.1 \times 10^{-31})$ $= 2.46 \times 10^{15}$ m s ⁻² ...(allow 2.5×10^5)	C1 A1	[2]
	(ii) $s = \frac{1}{2}at^2$ $2.5 \times 10^{-2} = \frac{1}{2} \times 2.46 \times 10^{15} \times t^2$ $t = 4.5 \times 10^{-9}$ s	C1 A1	[2]
	(c) <i>either</i> gravitational force is normal to electric force <i>or</i> electric force horizontal, gravitational force vertical <i>special case:</i> force/acceleration due to electric field \gg force/acceleration due to gravitational field, allow 1 mark	B2	[2]

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
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- 7 (a) (i) R B1 [1]
- (ii) $0.5R$ B1 [1]
- (iii) $2.5R$...(*allow e.c.f. from (ii)*) B1 [1]
- (b) (i) $I_1 + I_2 = I_3$ B1 [1]
- (ii) $E_2 = I_3R + I_2R$ B1 [1]
- (iii) $E_1 - E_2 = 2I_1R - I_2R$ B1 [1]
- 8 (a) rate of decay / activity / decay (of nucleus) is not affected by external factors / environment / surroundings B2 [2]
(If states specific factor(s), rather than giving general statement above, then give 2 marks for two stated factors, but 1 mark only if one factor stated)
- (b) (i) gamma / γ B1 [1]
- (ii) alpha / α B1 [1]
- (iii) gamma / γ B1 [1]
- (iv) beta / β B1 [1]