

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

9702/22

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	22

- 1 (a) e.g. time (s), current (A), temperature (K), amount of substance (mol), luminous intensity (cdl)
1 each, max 3 B3 [3]
- (b) density = mass / volume C1
unit of density: kg m^{-3} C1
unit of acceleration: m s^{-2} C1
unit of pressure: $\text{kg m}^{-3} \text{ m s}^{-2} \text{ m}$ B1
 $\text{kg m}^{-1} \text{ s}^{-2}$ B1 [5]
(allow 4/5 for solution in terms of only dimensions)
- 2 (a) 2.4 s A1 [1]
- (b) in (b) and (c), allow answers as (+) or (-)
recognises distance travelled as area under graph line C1
height = $(\frac{1}{2} \times 2.4 \times 9.0) - (\frac{1}{2} \times 1.6 \times 6.0)$ C1
= 6.0m (allow 6m) A1 [3]
(answer 15.6 scores 2 marks
answer 10.8 or 4.8 scores 1 mark)
- alternative solution: $s = ut - \frac{1}{2}at^2$
= $(9 \times 4) - \frac{1}{2} \times (9 / 2.4) \times 4^2$
= 6.0m
(answer 66 scores 2 marks
answer 36 or 30 scores 1 mark)
- (c) (i) change in momentum = $0.78 (9.0 + 4.2)$ (allow 4.2 ± 0.2) C1
= 10.3 N s (allow 10 N s) A1 [2]
- (ii) force = $\Delta p / \Delta t$ or $m\Delta v / \Delta t$ C1
= $10.3 / 3.5 / 0.08$
= 2.9 N A1 [2]
- (d) (i) 2.9 N A1 [1]
- (ii) $g = \text{weight} / \text{mass}$ C1
= $2.9 / 0.78$
= 3.7 m s^{-2} A1 [2]
- 3 (a) product of (magnitude of one) force and distance between forces M1
reference to *either* perpendicular distance between forces
or line of action of forces & perpendicular distance A1 [2]
- (b) (i) 90° B1 [1]
- (ii) $130 = F \times 0.45$ (allow e.c.f. for angle in (i)) C1
 $F = 290 \text{ N}$ A1 [2]
(allow 1 mark only if angle stated in (i) is not used in (ii))

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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) constant <u>phase difference</u>	B1	[1]
	(b) allow wavelength estimate 750 nm \rightarrow 550 nm	C1	
	separation = $\lambda D / x$	C1	
	= $(650 \times 10^{-9} \times 2.4) / (0.86 \times 10^{-3})$ = 1.8 mm	A1	[3]
	(allow 2 marks from inappropriate estimate if answer is in range 10 cm \rightarrow 0.1 mm)		
	(c) no longer complete destructive interference / amplitudes no longer completely cancel	M1	
	so dark fringes are lighter	A1	[2]
6	(a) (i) $E = V / d$	C1	
	= $350 / (2.5 \times 10^{-2})$ = $1.4 \times 10^4 \text{ N C}^{-1}$	A1	[2]
	(ii) force = Eq	C1	
	= $1.4 \times 10^4 \times 1.6 \times 10^{-19}$	M1	
	= 2.24×10^{-15}	A0	[2]
	(b) (i) $F = ma$	C1	
	$a = (2.24 \times 10^{-15}) / (9.1 \times 10^{-31})$ = $2.46 \times 10^{15} \text{ m s}^{-2}$ (allow 2.5×10^5)	A1	[2]
	(ii) $s = \frac{1}{2}at^2$	C1	
	$2.5 \times 10^{-2} = \frac{1}{2} \times 2.46 \times 10^{15} \times t^2$ $t = 4.5 \times 10^{-9} \text{ s}$	A1	[2]
	(c) <i>either</i> gravitational force is normal to electric force <i>or</i> electric force horizontal, gravitational force vertical	B2	[2]
	<i>special case:</i> force/acceleration due to electric field \gg force/acceleration due to gravitational field, allow 1 mark		

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- 7 (a) ∞ A1
 $2R$ A1
 R A1 [3]
- (b) (i) $I_1 + I_3 = I_2 + I_4$ A1 [1]
(ii) $E_2 - E_1 = I_3R$ A1 [1]
(iii) $E_2 = I_3R + 2I_4R$ A1 [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]