

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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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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:  $\text{kg m}^{-3}$  ..... C1  
unit of acceleration:  $\text{m s}^{-2}$  ..... 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  $4.2 \pm 0.2$ ) ..... 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  
=  $2.9 / 0.78$   
=  $3.7 \text{ m s}^{-2}$  ..... 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)  $90^\circ$  ..... 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 ..... C1  
 when (deforming) force is removed, returns to original shape / size ..... 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 phase difference ..... B1 [1]
- (b) allow wavelength estimate 750 nm  $\rightarrow$  550 nm ..... C1  
 separation =  $\lambda D / x$  ..... C1  
 $= (650 \times 10^{-9} \times 2.4) / (0.86 \times 10^{-3})$   
 $= 1.8 \text{ mm}$  ..... 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  
 $= 2.24 \times 10^{-15}$  ..... 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  $2.5 \times 10^5$ ) ..... 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) *either* gravitational force is normal to electric force  
*or* electric force horizontal, gravitational force vertical ..... B2 [2]  
*special case:* force/acceleration due to electric field  $\gg$  force/acceleration  
 due to gravitational field, allow 1 mark

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- 7 (a)  $\infty$  ..... 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 /  $\gamma$  ..... B1 [1]  
(ii) alpha /  $\alpha$  ..... B1 [1]  
(iii) gamma /  $\gamma$  ..... B1 [1]  
(iv) beta /  $\beta$  ..... B1 [1]