CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2012 series

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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2012 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

1	**(a)**	units for D identified as kg m s^{-2} all other units shown: units for A: m^2 units for v^2: m^2 s^{-2} units for ρ: kg m^{-3}	M1	
		$C = \dfrac{\text{kg m s}^{-2}}{\text{kg m}^{-3}\,\text{m}^2\,\text{m}^2\text{s}^{-2}}$ with cancelling / simplification to give C no units	A1	[2]
	(b) (i)	straight line from (0,0) to (1,9.8) ± half a square	B1	[1]
	(ii)	½ $mv^2 = mgh$ or using $v^2 = 2as$	C1	
		$v = (2 \times 9.81 \times 1000)^{1/2} = 140$ m s^{-1}	A1	[2]
	(c) (i)	weight = drag (D) (+ upthrust) Allow mg or W for weight and D or expression for D for drag	B1	[1]
	(ii)	**1.** $mg = 1.4 \times 10^{-5} \times 9.81$	C1	
		$1.4 \times 10^{-5} \times 9.81 = 0.5 \times 0.6 \times 1.2 \times 7.1 \times 10^{-6} \times v^2$	M1	
		$v = 7.33$ m s^{-1}	A0	[2]
		2. line from (0,0) correct curvature to a horizontal line at velocity of 7 m s^{-1}	M1	
		line reaches 7 m s^{-1} between 1.5 s and 3.5 s	A1	[2]
2	**(a)**	(resultant) force = rate of change of momentum / allow proportional to or change in momentum / time (taken)	B1	[1]
	(b) (i)	$\Delta p = (–)\ 65 \times 10^{-3}\ (5.2 + 3.7)$	C1	
		= (–) 0.58 N s	A1	[2]
	(ii)	$F = 0.58 / 7.5 \times 10^{-3}$		
		= 77(.3) N	A1	[1]
	(c) (i)	**1.** force on the wall from the ball is equal to the force on ball from the wall	M1	
		but in the opposite direction (statement of Newton's third law can score one mark)	A1	[2]
		2. momentum change of ball is equal and opposite to momentum change of the wall / change of momentum of ball and wall is zero	B1	[1]
	(ii)	<u>kinetic</u> energy (of ball and wall) is reduced / not conserved so inelastic (Allow relative speed of approach does not equal relative speed of separation.)	B1	[1]

3 **(a)** metal: regular / repeated / ordered arrangement / pattern / lattice or long range order (of atoms / molecules / ions) B1
polymer: tangled chains (of atoms / molecules) or long chains (of atoms / molecules / ions) B1
amorphous: disordered / irregular arrangement or short range order (of atoms / molecules / ions) B1 [3]

(b) metal: straight line or straight line then curving with less positive gradient B1
polymer: curve with decreasing gradient with steep increasing gradient at end B1 [2]

4 **(a)** waves (travels along tube) reflect at closed end / end of tube B1
incident and reflected waves or these two waves are in opposite directions M1
interfere or stationary wave formed if tube length equivalent to $\lambda / 4$, $3\lambda / 4$, etc. A1 [3]

(b) **(i)** **1.** no motion (as node) / zero amplitude B1 [1]

2. vibration backwards and forwards / maximum amplitude along length B1 [1]

(ii) $\lambda = 330 / 880$ (= 0.375 m) C1
$L = 3\lambda / 4$ C1
$L = 3 / 4 \times (0.375) = 0.28\ (0.281)$ m A1 [3]

5 **(a)** **(i)** $I_1 = I_2 + I_3$ B1 [1]

(ii) $I = V / R$ or $I_2 = 12 / 10$ (= 1.2 A) C1
$R = [1/6 + 1/10]^{-1}$ [total $R = 3.75\ \Omega$] or $I_3 = 12 / 6$ (= 2.0 A) C1
$I_1 = 12 / 3.75 = 3.2$ A or $I_1 = 1.2 + 2.0 = 3.2$ A A1 [3]

(iii) power = VI or I^2R or V^2 / R C1

$$x = \frac{\text{power in wire}}{\text{power in series resistors}} = \frac{I_2^2 R_w}{I_3^2 R_s} \text{ or } \frac{VI_2}{VI_3} \text{ or } \frac{V^2/R_w}{V^2/R_s}$$ C1

$x = 12 \times 1.2 / 12 \times 2.0 = 0.6(0)$ allow 3 / 5 or 3:5 A1 [3]

(b) p.d. BC: 12 – 12 × 0.4 = 7.2 (V) / p.d. AC = 4.8 (V) C1
p.d. BD: 12 – 12 × 4 / 6 = 4.0 (V) / p.d. AD = 8.0 (V) C1
p.d. = 3.2 V A1 [3]

6 **(a)** extension is proportional to force / load B1 [1]

(b) $F = mg$ C1
$x = (mg / k) = 0.41 \times 9.81 / 25 = (4.02 / 25)$ M1
$x = 0.16$ m A0 [2]

(c)	**(i)**	weight and (reaction) force from spring (which is equal to tension in spring)	B1	[1]
	(ii)	*F* – weight or 0.06 × 25 = *ma*	C1	
		F = 0.2209 × 25 = 5.52 (N) or 0.22 × 25 = 5.5		
		a = (5.52 – 0.41× 9.81) / 0.41 or 1.5 / 0.41 and (5.5 – 4.02)	C1	
		a = 3.7 (3.66) $\mathrm{m\,s^{-2}}$ gives 3.6 $\mathrm{m\,s^{-2}}$	A1	[3]
(d)		elastic potential energy / strain energy to kinetic energy and gravitational potential energy	B1	
		stretching / extension reduces and velocity increases / height increases	B1	[2]

7	**(a)**		$^{3}_{2}\mathrm{He} + ^{3}_{2}\mathrm{He} \rightarrow ^{4}_{2}\mathrm{He} + 2\,^{1}_{1}\mathrm{p} + Q$		
			A numbers correct (**4** and **1**)	B1	
			Z numbers correct (**2** and **1**)	B1	[2]
	(b)		both <u>nuclei</u> have 2 protons	B1	
			the two isotopes have 1 neutron and two neutrons	B1	[2]
			[allow 1 for 'same number of protons but different number of neutrons']		
	(c)		proton number and neutron number	B1	
			energy – mass	B1	
			momentum	B1	[2]
	(d)	**(i)**	γ radiation	B1	[1]
		(ii)	<u>product</u>(s) must have kinetic energy	B1	[1]
	(e)		13.8 MeV = $13.8 \times 1.6 \times 10^{-19} \times 10^{6}$ (= 2.208×10^{-12})	C1	
			$60 = n \times 13.8 \times 1.6 \times 10^{-13}$		
			$n = 2.7(2) \times 10^{13}\ \mathrm{s^{-1}}$	A1	[2]