

Cambridge International AS & A Level

PHYSICS**9702/21**

Paper 2 AS Level Structured Questions

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MARK SCHEME

Maximum Mark: 60

Published

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Question	Answer	Mark
1(a)	scalar and vector have magnitude	B1
	vector has direction (and scalar does not have direction)	B1
1(b)(i)	$r = [(3 \times 28) / 4\pi]^{1/3}$ $= 1.9 \text{ cm}$	A1
1(b)(ii)	percentage uncertainty in $V = (0.5 / 28) \times 100$ (= 1.79%)	C1
	percentage uncertainty in $r = 1.79 / 3$ = 0.6%	A1

Question	Answer	Mark
2(a)(i)	arrow upwards ($\uparrow$) and labelled upthrust / U	B2
	arrow downwards ($\downarrow$) and labelled weight / W / mg	
	arrow downwards ($\downarrow$) and labelled tension / T	
	1 mark: One or two correctly labelled arrows	
	2 marks: Three correctly labelled arrows	
2(a)(ii)	$U = T + W$ or upthrust = tension + weight	C1
	$\rho Vg = T + W$	C1
	$V = [(4.00 \times 10^2) + (3.39 \times 10^4)] / (1.23 \times 9.81)$	A1
	$V = 2.84 \times 10^3 \text{ m}^3$	
2(a)(iii)	$m = W / g$ or $a = F / m$	C1
	$a = (4.00 \times 10^2) / [(3.39 \times 10^4) / 9.81]$	C1
	$a = 0.12 \text{ m s}^{-2}$	A1
2(b)	there is air resistance (which increases with speed)	B1
	(average) resultant force is less (than weight)	B1
	(average) acceleration is less (than g / 9.81, so speed is less than 100 m s^{-1})	B1
2(c)(i)	(extension $\Rightarrow$) $2.5 \times 2.4 \times 10^{-5} = 6.0 \times 10^{-5} \text{ (m)}$	A1

Question	Answer	Mark
2(c)(ii)	$E_{(p)} = \frac{1}{2} Fx$ or $E_{(p)} = \frac{1}{2} kx^2$ and $F = kx$	C1
	$E_{(p)} = \frac{1}{2} \times 4.00 \times 10^2 \times 6.0 \times 10^{-5}$ or $E_{(p)} = \frac{1}{2} \times 6.7 \times 10^6 \times (6.0 \times 10^{-5})^2$ $E_{(p)} = 0.012 \text{ J}$	A1
2(c)(iii)	longer extension or smaller spring constant	M1
	elastic potential energy is greater	A1

Question	Answer	Mark
3(a)	displacement	A1
3(b)(i)	$a = \text{gradient}$ or $a = \Delta v / (\Delta t)$ or $a = (v - u) / t$	C1
	e.g. $a = (0.30 - 0.12) / (0.35 - 0.15)$	A1
	$a = 0.90 \text{ m s}^{-2}$	
3(b)(ii)	$(0.25 \times 0.48) + (0.75 \times 0.12) = (0.25 v) + (0.75 \times 0.30)$	C1
	or	
	$(0.48 - 0.12) = (0.30 - v)$	
	or	
	$(\frac{1}{2} \times 0.25 \times 0.48^2) + (\frac{1}{2} \times 0.75 \times 0.12^2) = (\frac{1}{2} \times 0.25 \times v^2) + (\frac{1}{2} \times 0.75 \times 0.30^2)$	
3(c)	$v = (-)0.060 \text{ m s}^{-1}$	A1
	direction: to the left / from the right / opposite to (its) initial velocity / opposite to (initial / final) velocity of B	B1
	sketch: horizontal line from (0, 0.48) to (0.15, 0.48)	B1
	horizontal line from (0.35, -0.06) to (0.5, -0.06)	B1
	straight line between (0.15, 0.48) and (0.35, -0.06)	B1

Question	Answer	Mark
4(a)	(when two or more) waves meet / overlap (at a point) (resultant) displacement is the sum of the individual displacements	B1
4(b)	$\lambda = ax / D$	C1
	$\lambda = [(0.65 \times 10^{-3}) \times (1.7 \times 10^{-3})] / 1.9$	C1
	$\lambda = 5.8 \times 10^{-7} \text{ m}$	A1
4(c)(i)	waves are out of phase by a quarter of a cycle / period or when one wave has maximum/minimum displacement, the other wave has zero displacement	B1
4(c)(ii)	(statement 2 is) not correct (because) waves do not have phase difference of 180° / not in antiphase or one wave has some displacement when other has no displacement or the displacements of the waves are not always equal and opposite	B1
4(d)	more diffraction (of light/waves by slits) or light/waves are more spread (by slits) or light/waves (from slits) have less intensity	B1
	more (bright/dark) fringes or bright fringes are less bright / are dimmer / have lower intensity or no change to fringe spacing/separation/width	B1

Question	Answer	Mark
5(a)	sketch: approximately horizontal line above horizontal dashed line from $t = 0$ to $t = t_1$ and approximately horizontal line below horizontal dashed line from $t = t_1$ to $t = t_2$	A1
5(b)	$I = P / A$	C1
	$A = \pi \times 0.028^2$ or $\pi \times 2.8^2$ ($= 2.46 \times 10^{-3}$ or 24.6)	C1
	$P = 4.7 \times 10^{-3} \times 2.46 \times 10^{-3}$ $= 1.2 \times 10^{-5} \text{ W}$	A1

Question	Answer	Mark
6(a)(i)	$(I \Rightarrow) 16 / 320 = 0.050 \text{ (A)}$	A1
6(a)(ii)	$R = (25 - 16) / 0.050$ or $R = (9 / 16) \times 320$ or $R = (25 / 0.050) - 320$	C1
	$R = 180 \text{ (}\Omega\text{)}$	C1
	$R_{(\text{LDR})} = [(1 / 180) - (1 / 240)]^{-1}$ $= 720 \text{ }\Omega$	A1
	or	
	$I = (25 - 16) / 240$ $(= 0.0375 \text{ A})$	(C1)
	$I_{(\text{LDR})} = 0.050 - 0.0375$ $(= 0.0125 \text{ A})$	(C1)
	$R_{(\text{LDR})} = 9.0 / 0.0125$ $= 720 \text{ }\Omega$	(A1)

Question	Answer	Mark
7(a)	a (very) small proportion of (alpha) particles are deflected (back) through large angles / angles greater than 90°	B1
	a large proportion of (alpha) particles pass straight through / deflected by small angles	B1
7(b)	electromagnetic wave / electromagnetic radiation	A1
7(c)	neutrino classified as a lepton only <u>and</u> positron classified as a lepton only	B1
	neutron classified as a baryon and a hadron and not as a lepton	B1
7(d)(i)	1.32 u	A1
7(d)(ii)	working states or implies 3 quarks and each quark has a charge of $(+) \frac{2}{3}(e)$	B1
	any combination of 3 quarks comprised of one or more of up / charm / top	B1