

Cambridge International Examinations

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PHYSICS 9702/22

Paper 2 AS Level Structured Questions

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MARK SCHEME
Maximum Mark: 60

Published

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Question	Answer	Marks
1(a)	scalars: kinetic energy, power, work	A1
	vectors: acceleration, force, momentum	A1
1(b)(i)	mass = volume × density or $m = V \times \rho$ = $4/3 \pi (23 \times 10^{-2})^3 \times 82$	C1
	weight = $4/3 \pi (23 \times 10^{-2})^3 \times 82 \times 9.8 = 41 \text{ N}$	A1
1(b)(ii)	vertical component of tension = 290 sin75° or 290 cos15° (= 280)	C1
	upthrust = 290 sin75° + 41 = 320 (321) N	A1
1(b)(iii)	the water pressure is greater than the air pressure or the pressure on lower surface (of sphere) is greater than the pressure on upper surface (of sphere)	B1

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Question	Answer	Marks
2(a)	sum/total momentum of bodies is constant	M1
	or <u>sum/total</u> momentum of bodies before = <u>sum/total</u> momentum of bodies after	
	for an isolated/closed system/no (resultant) external force	A1
2(b)(i)	EPE = area under graph or $\frac{1}{2}Fx$ or $\frac{1}{2}kx^2$ and $F = kx$	C1
	energy = $\frac{1}{2} \times 12.0 \times 8.0 \times 10^{-2} = 0.48 \text{J}$	A1
	or energy = $\frac{1}{2} \times 150 \times (8.0 \times 10^{-2})^2 = 0.48 \text{J}$	
2(b)(ii)1	$4.0 \ v_{A} = 6.0 \ v_{B}$	C1
	$E_{\rm K} = \frac{1}{2}mv^2$	C1
	ratio = $\frac{0.50 \times 4.0}{0.50 \times 6.0} \left(\frac{6.0}{4.0}\right)^2 = 1.5$ or ratio = $\frac{1}{1.5} \times (1.5)^2 = 1.5$	A1
2(b)(ii)2	$0.48 = E_{K} \text{ of A} + E_{K} \text{ of B}$ = $E_{K} \text{ of A} + (E_{K} \text{ of A} / 1.5) = 5/3 \times E_{K} \text{ of A}$	C1
	$E_{\rm K}$ of A = 0.29 (0.288) J	A1
2(b)(iii)	curve starts from origin and has decreasing gradient	M1
	final gradient of graph line is zero	A1

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Question	Answer	Marks
3(a)	change of displacement/time (taken)	B1
3(b)(i)	constant velocity, so resultant force is zero	M1
	(so car is) in (dynamic) equilibrium	A1
3(b)(ii)	$F_{\rm D} = 0.40 ({\rm kN}) {\rm or} 0.40 \times 10^3 ({\rm N})$	C1
	component of weight = $2.0 \times 10^3 - 0.40 \times 10^3$ = $1.6 \times 10^3 \text{N}$	A1
3(b)(iii)	P = Fv	C1
	$= 2.0 \times 10^{3} \times 9.0 = 1.8 \times 10^{4} \mathrm{W}$	A1
3(b)(iv)	(driving) force = $1.8 \times 10^4/15$ (= 1.2×10^3)	C1
	$F_{\rm D} = 0.66 ({\rm kN}) {\rm or} 0.66 \times 10^3 ({\rm N})$	C1
	acceleration = $(1.2 \times 10^3 - 0.66 \times 10^3)/850$ = $0.64 (0.635) \mathrm{m s}^{-2}$	A1

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Question	Answer	Marks
4(a)	change in frequency when source moves relative to observer	M1
	refers to 'change in observed/apparent frequency'	A1
4(b)(i)	$f = (950 \times 330)/(330 - 7.5)$	C1
	= 970 (972) Hz	A1
4(b)(ii)	frequency decreases	M1
	from greater than 950 Hz/from 970 (972) Hz/to less than 950 Hz/to 930 (929) Hz/by 40 (43) Hz	A 1

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Question	Answer	Marks
5(a)	to the right/from the left/from A to B/in the same direction as electron velocity	B1
5(b)	$v^2 = u^2 + 2as$ $a = (1.5 \times 10^7)^2/(2 \times 2.0 \times 10^{-2})$ Other alternative calculations for the C1 mark: e.g. $a = 1.5 \times 10^7/2.67 \times 10^{-9}$ e.g. $a = [(1.5 \times 10^7 \times 2.67 \times 10^{-9}) - 2.0 \times 10^{-2}] \times [2/(2.67 \times 10^{-9})^2]$ e.g. $a = (2.0 \times 10^{-2} \times 2)/(2.67 \times 10^{-9})^2$	C1
	$= 5.6 \times 10^{15} \mathrm{ms^{-2}}$	A1
5(c)	E = F/Q	C1
	$= (9.1 \times 10^{-31} \times 5.6 \times 10^{15}) / 1.6 \times 10^{-19}$	C1
	$= 3.2 \times 10^4 \mathrm{V}\mathrm{m}^{-1}$	A1
5(d)	straight line with negative gradient starting at an intercept on the <i>v</i> -axis and ending at an intercept on the <i>t</i> -axis.	B1

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Question	Answer	Marks
6(a)	$I = I_1 + I_2 + I_3$	B1
	$(V/R) = (V/R_1) + (V/R_2) + (V/R_3) \text{ or } (I/V) = (I_1/V) + (I_2/V) + (I_3/V)$ and (so) $1/R = 1/R_1 + 1/R_2 + 1/R_3$	A1
6(b)(i)	e.m.f. is total energy available per unit charge	B1
	energy is dissipated in the internal resistance/resistor/r	B1
6(b)(ii)1	Energy = EQ	C1
	$= 6.0 \times 2.5 \times 10^{3}$ $= 1.5 \times 10^{4} \mathrm{J}$	A1
6(b)(ii)2	number = $2.5 \times 10^3 / 1.6 \times 10^{-19}$ = $1.6 \times 10^{22} (1.56 \times 10^{22})$	A1
6(b)(iii)	$1/4.8 = 1/12 + 1/R_X$ $R_X = 8.0 \Omega$	A1
6(b)(iv)	$P = V^2/R$ or P = VI and $V = IR$	C1
	ratio = $(V^2/8)/(V^2/12) = 12/8$ = 1.5	A1
6(b)(v)	(total) current, or I , increases and $P = EI$ or $P = 6I$ or $P \propto I$ or total (circuit) resistance decreases and $P = E^2/R$ or $P = 36/R$ or $P \propto 1/R$	B1

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Question	Answer	Marks
7(a)	number of protons = 83 and number of neutrons = 129	A1
7(b)	$\lambda = 3.8 \times 10^{-12}$	C1
	$f = 3.0 \times 10^8 / 3.8 \times 10^{-12}$	C1
	$f = 7.9 \times 10^{19} (7.89 \times 10^{19}) \text{Hz}$	A1
7(c)	use an electric field (at an angle to the beam)	M1
	α is deflected and γ is undeflected	A1
7(d)	either	
	energy = $9.3 \times 10^{-13} / 1.8 \times 10^5$ (= 5.17×10^{-18} J)	C1
	= $5.17 \times 10^{-18} / 1.6 \times 10^{-19}$ = $32 (32.3) \text{ eV}$	A1
	or	
	energy = $9.3 \times 10^{-13} / 1.6 \times 10^{-19}$ (= 5.81×10^{6} eV)	(C1)
	= $5.81 \times 10^6 / 1.8 \times 10^5$ = $32 (32.3) \text{ eV}$	(A1)

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