
PHYSICS**9702/22**

Paper 2 AS Level Structured Questions

March 2017

MARK SCHEME

Maximum Mark: 60

Published

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

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Question	Answer	Marks
1(a)	scalars: kinetic energy, power, work vectors: acceleration, force, momentum	A1 A1
1(b)(i)	mass = volume $\times$ density <i>or</i> $m = V \times \rho$ = $\frac{4}{3} \pi (23 \times 10^{-2})^3 \times 82$ weight = $\frac{4}{3} \pi (23 \times 10^{-2})^3 \times 82 \times 9.8 = 41 \text{ N}$	C1 A1
1(b)(ii)	vertical component of tension = $290 \sin 75^\circ$ or $290 \cos 15^\circ (= 280)$ upthrust = $290 \sin 75^\circ + 41$ = $320 (321) \text{ N}$	C1 A1
1(b)(iii)	the water pressure is greater than the air pressure <i>or</i> the pressure on lower surface (of sphere) is greater than the pressure on upper surface (of sphere)	B1

Question	Answer	Marks
2(a)	<u>sum / total</u> momentum of bodies is constant 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	M1 A1
2(b)(i)	EPE = area under graph or $\frac{1}{2}Fx$ or $\frac{1}{2}kx^2$ and $F = kx$ energy = $\frac{1}{2} \times 12.0 \times 8.0 \times 10^{-2} = 0.48 \text{ J}$ or energy = $\frac{1}{2} \times 150 \times (8.0 \times 10^{-2})^2 = 0.48 \text{ J}$	C1 A1
2(b)(ii)1	$4.0 v_A = 6.0 v_B$	C1
	$E_K = \frac{1}{2}mv^2$	C1
	ratio = $\frac{0.50 \times 4.0 \left(\frac{6.0}{4.0}\right)^2}{0.50 \times 6.0 \left(\frac{4.0}{4.0}\right)} = 1.5$ or ratio = $\frac{1}{1.5} \times (1.5)^2 = 1.5$	A1
2(b)(ii)2	$0.48 = E_K \text{ of A} + E_K \text{ of B}$ = $E_K \text{ of A} + (E_K \text{ of A} / 1.5) = 5/3 \times E_K \text{ of A}$ $E_K \text{ of A} = 0.29 (0.288) \text{ J}$	C1 A1
2(b)(iii)	curve starts from origin and has decreasing gradient final gradient of graph line is zero	M1 A1

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	
3(b)(ii)	$F_D = 0.40 \text{ (kN)}$ or $0.40 \times 10^3 \text{ (N)}$	C1
	component of weight $= 2.0 \times 10^3 - 0.40 \times 10^3$ $= 1.6 \times 10^3 \text{ N}$	
3(b)(iii)	$P = F_V$	C1
	$= 2.0 \times 10^3 \times 9.0 = 1.8 \times 10^4 \text{ W}$	
3(b)(iv)	(driving) force $= 1.8 \times 10^4 / 15$ ($= 1.2 \times 10^3$)	C1
	$F_D = 0.66 \text{ (kN)}$ or $0.66 \times 10^3 \text{ (N)}$	
	acceleration $= (1.2 \times 10^3 - 0.66 \times 10^3) / 850$ $= 0.64 \text{ (0.635) m s}^{-2}$	
		A1

Question	Answer	Marks
4(a)	change in frequency when source moves relative to observer	M1
	refers to 'change in <u>observed</u> / <u>apparent</u> 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	A1

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. $a = (2.0 \times 10^{-2} \times 2) / (2.67 \times 10^{-9})^2$ $= 5.6 \times 10^{15} \text{ m s}^{-2}$	C1
5(c)	$E = F / Q$ $= (9.1 \times 10^{-31} \times 5.6 \times 10^{15}) / 1.6 \times 10^{-19}$ $= 3.2 \times 10^4 \text{ V m}^{-1}$	A1
5(d)	straight line with negative gradient starting at an intercept on the v-axis and ending at an intercept on the t-axis.	B1

Question	Answer	Marks
6(a)	$I = I_1 + I_2 + I_3$	B1
	$(V/R) = (V/R_1) + (V/R_2) + (V/R_3)$ 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
	$= 6.0 \times 2.5 \times 10^3$ $= 1.5 \times 10^4 \text{ J}$	A1
6(b)(ii)2	number = $2.5 \times 10^3 / 1.6 \times 10^{-19}$ $= 1.6 \times 10^{22}$ (1.56×10^{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

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 <u>and</u> γ is undeflected	A1
7(d)	<i>either</i>	
	energy = $9.3 \times 10^{-13} / 1.8 \times 10^5 (= 5.17 \times 10^{-18} \text{ J})$	C1
	= $5.17 \times 10^{-18} / 1.6 \times 10^{-19}$ = 32 (32.3) eV	A1
	<i>or</i>	
	energy = $9.3 \times 10^{-13} / 1.6 \times 10^{-19} (= 5.81 \times 10^6 \text{ eV})$	(C1)
	= $5.81 \times 10^6 / 1.8 \times 10^5$ = 32 (32.3) eV	(A1)