
PHYSICS

9702/22

Paper 2 AS Level Structured Questions

March 2017

MARK SCHEME

Maximum Mark: 60

Published

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.

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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 \times density <i>or</i> $m = V \times \rho$ $= \frac{4}{3} \pi (23 \times 10^{-2})^3 \times 82$	C1
	weight = $\frac{4}{3} \pi (23 \times 10^{-2})^3 \times 82 \times 9.8 = 41 \text{ N}$	A1
1(b)(ii)	vertical component of tension = $290 \sin 75^\circ$ or $290 \cos 15^\circ (= 280)$	C1
	upthrust = $290 \sin 75^\circ + 41$ $= 320 (321) \text{ N}$	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

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Question	Answer	Marks
2(a)	<u>sum</u> / <u>total</u> momentum of bodies is constant or <u>sum</u> / <u>total</u> momentum of bodies before = <u>sum</u> / <u>total</u> momentum of bodies after	M1
	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 = $\frac{1}{2} \times 12.0 \times 8.0 \times 10^{-2} = 0.48 \text{ J}$ or energy = $\frac{1}{2} \times 150 \times (8.0 \times 10^{-2})^2 = 0.48 \text{ J}$	A1
2(b)(ii)1	$4.0 v_A = 6.0 v_B$	C1
	$E_K = \frac{1}{2}mv^2$	C1
	ratio = $\frac{0.50 \times 4.0 \left(\frac{6.0}{4.0}\right)^2}{0.50 \times 6.0} = 1.5$ or ratio = $\frac{1}{1.5} \times (1.5)^2 = 1.5$	A1
2(b)(ii)2	$0.48 = E_K \text{ of A} + E_K \text{ of B}$ $= E_K \text{ of A} + (E_K \text{ of A} / 1.5) = \frac{5}{3} \times E_K \text{ of A}$	C1
	$E_K \text{ of A} = 0.29 \text{ (0.288) J}$	A1
2(b)(iii)	curve starts from origin and has decreasing gradient	M1
	final gradient of graph line is zero	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	A1
3(b)(ii)	$F_D = 0.40 \text{ (kN) or } 0.40 \times 10^3 \text{ (N)}$	C1
	component of weight = $2.0 \times 10^3 - 0.40 \times 10^3$ = $1.6 \times 10^3 \text{ N}$	A1
3(b)(iii)	$P = Fv$	C1
	= $2.0 \times 10^3 \times 9.0 = 1.8 \times 10^4 \text{ W}$	A1
3(b)(iv)	(driving) force = $1.8 \times 10^4 / 15$ (= 1.2×10^3)	C1
	$F_D = 0.66 \text{ (kN) or } 0.66 \times 10^3 \text{ (N)}$	C1
	acceleration = $(1.2 \times 10^3 - 0.66 \times 10^3) / 850$ = 0.64 (0.635) 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 <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)	$v^2 = u^2 + 2as$ $a = (1.5 \times 10^7)^2 / (2 \times 2.0 \times 10^{-2})$ <p>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. $a = (2.0 \times 10^{-2} \times 2) / (2.67 \times 10^{-9})^2$</p> $= 5.6 \times 10^{15} \text{ m s}^{-2}$	C1 A1
5(c)	$E = F / Q$ $= (9.1 \times 10^{-31} \times 5.6 \times 10^{15}) / 1.6 \times 10^{-19}$ $= 3.2 \times 10^4 \text{ V m}^{-1}$	C1 C1 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 $(I/V) = (I_1/V) + (I_2/V) + (I_3/V)$ <u>and</u> (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 $P = VI$ <u>and</u> $V = IR$	C1
	ratio = $(V^2/8)/(V^2/12) = 12/8$ $= 1.5$	A1
6(b)(v)	(total) current, or I , increases <u>and</u> $P = EI$ or $P = 6I$ or $P \propto I$ or total (circuit) resistance decreases <u>and</u> $P = E^2/R$ 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 $\times 10^{19}$) 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 = $9.3 \times 10^{-13} / 1.8 \times 10^5$ (= 5.17×10^{-18} J)	C1
	= $5.17 \times 10^{-18} / 1.6 \times 10^{-19}$ = 32 (32.3) eV	A1
	<i>or</i>	
	energy = $9.3 \times 10^{-13} / 1.6 \times 10^{-19}$ (= 5.81×10^6 eV)	(C1)
	= $5.81 \times 10^6 / 1.8 \times 10^5$ = 32 (32.3) eV	(A1)