



Cambridge International AS & A Level

PHYSICS

9702/23

Paper 2 AS Level Structured Questions

May/June 2022

MARK SCHEME

Maximum Mark: 60

Published

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This document consists of **16** printed pages.

Question	Answer	Marks
1(a)	$\rho = m / V$	C1
	$V = (4 / 3) \times \pi \times r^3$	C1
	$= (4 / 3) \times \pi \times (3.42 / 2)^3$	
	$(= 20.9 \text{ cm}^3)$	
1(b)	$\rho = 67 / 20.9$	A1
	$= 3.2 \text{ g cm}^{-3}$	
	$\% \rho = \%m + 3 \times \%d$	C1
	$= [(2 / 67) \times 100] + [3 \times (0.02 / 3.42) \times 100]$	
	$= 3.0\% + 3 \times 0.58\%$	A1
	$= 4.7\% \text{ or } 5\%$	

Question	Answer	Marks
2(a)	(time =) displacement / velocity	C1
	(time =) $70.0 / 65.0 \cos 4.30^\circ = 1.08 \text{ (s)}$	A1
2(b)	$s = ut + \frac{1}{2}at^2$	C1
	$= (65 \times \sin 4.30^\circ \times 1.08) - (0.5 \times 9.81 \times 1.08^2)$	
	$s = -0.46 \text{ (m)}$	C1
	height above ground $= 1.66 - 0.46$ $= 1.2 \text{ m}$	A1
2(c)	GPE has decreased	M1
	(total energy conserved so) KE has increased	A1

Question	Answer	Marks
3(a)	(velocity =) change in displacement / time	B1
3(b)(i)	$a = 2400 / 1200$ $= 2.0 \text{ m s}^{-2}$	A1
3(b)(ii)	straight line from the origin with positive gradient (labelled A)	M1
	ending at (20, 40)	A1
3(c)(i)	line starting at origin (with the same gradient as A) and beneath A at all points	B1
	gradient decreasing to zero	B1
	straight horizontal line from $t = 12 \text{ s}$ and ending at $t = 20 \text{ s}$ (and labelled B)	B1
3(c)(ii)	the velocity/speed will increase	B1
	to a new terminal/constant/maximum velocity/speed	B1
	or	
	the car has an acceleration	(B1)
	to a new (higher) terminal/constant/maximum velocity/speed	(B1)

Question	Answer	Marks
4(a)	work (done) = force $\times$ displacement	M1
	(force = mg and distance = Δh)	
	(so) work (done) = $mg\Delta h$ and <u>work</u> = $\Delta E_{(P)}$ (so $\Delta E_{(P)} = mg\Delta h$)	
4(b)	gravitational potential (energy) to heat/thermal (energy)	B1
4(c)(i)	$P = mg(\Delta h) / (\Delta t)$ or Fv	C1
	$P = (0.60 \times 9.81 \times 1.4) / 4.0$ or $0.60 \times 9.81 \times (1.4 / 4.0)$	A1
	= 2.1 W	
4(c)(ii)	$P = I^2 R$ or IV or V^2 / R	C1
	= $0.09^2 \times 47$ or 0.09×4.23 or $4.23^2 / 47$	A1
	= 0.38 W	
4(c)(iii)	efficiency = $P_{\text{out}} / P_{\text{in}} (\times 100)$ or $E_{\text{out}} / E_{\text{in}} (\times 100)$	C1
	= $0.38 / 2.1 (\times 100)$ or $0.38 \times 4.0 / 2.1 \times 4.0 (\times 100)$ = 0.18 or 18%	A1

Question	Answer	Marks
5(a)(i)	power = intensity $\times$ area	C1
	$= 1.3 \times 10^3 \times (\pi \times 0.055^2)$ $= 12 \text{ W}$	
5(a)(ii)	intensity = power / area $= 12 / (\pi \times 0.0015^2)$ $= 1.7 \times 10^6 \text{ W m}^{-2}$	A1
5(b)(i)	$(\lambda =) v / f$ or c / f	C1
	$(\lambda =) 3.0 \times 10^8 / 3.7 \times 10^{15} = 8.1 \times 10^{-8} \text{ (m)}$	A1
5(b)(ii)	ultraviolet	A1

Question	Answer	Marks
5(b)(iii)	$d \sin \theta = n\lambda$ or $(1/N) \times \sin \theta = n\lambda$	C1
	$d = 1 / 2400 \times 10^3 \text{ (m)}$ $= 4.2 \times 10^{-7} \text{ (m)}$ or $N = 2400 \times 10^3 \text{ (m}^{-1}\text{)}$	C1
	$n = 4.2 \times 10^{-7} \times \sin 90^\circ / 8.1 \times 10^{-8}$ or $\sin 90^\circ / 2400 \times 10^3 \times 8.1 \times 10^{-8}$ $n = 5.2$ or 5.1 or when $n = 5$, $\theta = 76.4^\circ$ and when $n = 6$, $\sin \theta > 1$ (so) $n = 5$	B1
	number of maxima $= (2 \times 5) + 1$ $= 11$	A1
	the wavelength has increased	M1
5(b)(iv)	(so) number of maxima decreases	A1

Question	Answer	Marks
6(a)(i)	line passes through (0,0) and is in first and third quadrants only	M1
	gradient of line becoming less steep in both quadrants and roughly symmetrical	A1
6(a)(ii)	(as I increases) the temperature (of the filament wire/lamp) increases	B1
	(as I / temperature / V increases) the resistance (of wire/lamp) increases	B1
	(as I / temperature / V increases the graph curves because) ratio V/I increases or ratio I/V decreases	B1
6(b)	$R = \rho L / A$	C1
	$= (5.6 \times 10^{-8} \times 5.8) / 3.4 \times 10^{-8}$	A1
	$= 9.6 \, \Omega$	

Question	Answer	Marks																														
6(c)	<table><tr><th colspan="2">position of switches</th><th colspan="3">ammeter readings</th></tr><tr><th>S₁</th><th>S₂</th><th>X / A</th><th>Y / A</th><th>Z / A</th></tr><tr><td>open</td><td>open</td><td>0</td><td>0</td><td>0</td></tr><tr><td>open</td><td>closed</td><td>1.0</td><td>0</td><td>1.0</td></tr><tr><td>closed</td><td>open</td><td>2.0</td><td>2.0</td><td>0</td></tr><tr><td>closed</td><td>closed</td><td>3.0</td><td>2.0</td><td>1.0</td></tr></table> second row: both values correct (B1) third row: all three values correct (B1) fourth row: X = Y + Z (any values) (B1) all three values correct (B1)	position of switches		ammeter readings			S ₁	S ₂	X / A	Y / A	Z / A	open	open	0	0	0	open	closed	1.0	0	1.0	closed	open	2.0	2.0	0	closed	closed	3.0	2.0	1.0	B4
position of switches		ammeter readings																														
S ₁	S ₂	X / A	Y / A	Z / A																												
open	open	0	0	0																												
open	closed	1.0	0	1.0																												
closed	open	2.0	2.0	0																												
closed	closed	3.0	2.0	1.0																												

Question	Answer	Marks
7(a)(i)	${}^{18}_9\text{F} \rightarrow {}^{18}_8\text{O} + {}^0_{(+)}\beta^{(+)} + {}^{(0)}_{(0)}\nu_{\text{e}}$ ν or neutrino (B1) ${}^0_{(+)}\beta^{(+)}$ (B1) ${}^{18}_8\text{O}$ (B1)	B3
7(a)(ii)	up quark to down quark	B1
7(b)(i)	must be three (anti)quarks as largest (negative) quark charge is $(-)\frac{2}{3}$ (e) or mesons can only have a charge of 0 or ± 1 (e) (so hadron is) a baryon	M1
		A1
7(b)(ii)	any combination of three from: antiup (quark) / up antiquark and/or anticharm (quark) / charm antiquark and/or antitop (quark) / top antiquark	B1