Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS **9702/23**

Paper 2 AS Level Structured Questions **October/November 2017**

MARK SCHEME

Maximum Mark: 60

Published

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Question	Answer	Marks
1(a)(i)	work (done) / time (taken) **or** energy (transferred) / time (taken)	**B1**
1(a)(ii)	Correct substitution of base units of all quantities into any correct equation for power. Examples: ($P = E / t$ or W / t gives) $kg\ m^2\ s^{-2} / s = kg\ m^2\ s^{-3}$ ($P = Fs / t$ or mgh / t gives) $kg\ m\ s^{-2}\ m / s = kg\ m^2\ s^{-3}$ ($P = \frac{1}{2}mv^2 / t$ gives) $kg\ (m\ s^{-1})^2 / s = kg\ m^2\ s^{-3}$ ($P = Fv$ gives) $kg\ m\ s^{-2}\ m\ s^{-1} = kg\ m^2\ s^{-3}$ ($P = VI$ gives) $kg\ m^2\ s^{-2}\ A^{-1}\ s^{-1}\ A = kg\ m^2\ s^{-3}$	**A1**
1(b)(i)	units of A: m^2 **and** units of T: K	**C1**
	units of k: $kg\ m^2\ s^{-3} / m^2\ K^4$ $= kg\ s^{-3}\ K^{-4}$	**A1**
1(b)(ii)	curve from the origin with increasing gradient	**B1**

Question	Answer	Marks
2(a)	$\rho = m / V$ **or** $\rho = m / Ah$	**B1**
	$p = F / A$ **or** $p = W / A$	**B1**
	$p = [\rho Ahg] / A$ **or** $p = [\rho Vg] / [V / h]$ (so) $p = \rho gh$	**A1**

Question	Answer	Marks
2(b)(i)	**1.** weight/gravitational (force) upthrust (force)/buoyancy (force) drag/viscous/frictional (force)/fluid resistance/resistance	**B1**
	2. weight = upthrust + viscous (force)	**B1**
2(b)(ii)	• decrease in (gravitational) potential energy (of sphere) due to decrease in height (since $E_p = mgh$) • increase in thermal energy due to work done against viscous force/drag • loss/change of (total) E_p equal to gain/change in thermal energy *Any 2 points.*	**B2**
2(c)(i)	atmospheric pressure = $9.1(0) \times 10^4$ Pa	**A1**
2(c)(ii)	$(\Delta)p = \rho g(\Delta)h$ $(9.15 - 9.10) \times 10^4 = \rho \times 9.81 \times (0.17 - 0.10)$	**C1**
	ρ = 730 (728) kg m^{-3}	**A1**

Question	Answer	Marks
3(a)	sum/total momentum (of system of bodies) is constant **or** sum/total momentum before = sum/total momentum after	**M1**
	for an isolated system/no (resultant) external force	**A1**
3(b)(i)	$p = mv$	**C1**
	$(4.0 \times 6.0 \times \sin\theta) - (12 \times 3.5 \times \sin 30°) = 0$ **or** $(m_A v_A \times \sin\theta) - (m_B v_B \times \sin 30°) = 0$	**M1**
	θ = 61°	**A1**

Question	Answer	Marks
3(b)(ii)	shows the horizontal <u>momentum</u> component of ball A or of ball B as $(4.0 \times 6.0 \times \cos \theta)$ **or** $(12 \times 3.5 \times \cos 30°)$	**C1**
	$(4.0 \times 6.0 \times \cos 61°) + (12 \times 3.5 \times \cos 30°) = 4.0v$ so $v = 12\ (\text{m s}^{-1})$	**A1**
3(b)(iii)	initial E_K $(= ½ \times 4.0 \times 12^2) = 290\ (288)$ (J)	**M1**
	final E_K $(= ½ \times 4.0 \times 6.0^2 + ½ \times 12 \times 3.5^2) = 150\ (145.5)$ (J)	**M1**
	(initial E_K > final E_K) so inelastic [both M1 marks required to award this mark]	**A1**

Question	Answer	Marks
4(a)	displacement of particles/vibration(s)/oscillation(s) is parallel to/along the direction of energy/propagation	**B1**
4(b)	period = 1 / 800 $(= 1.25 \times 10^{-3}\ \text{s})$	**C1**
	time-base setting $= 1.25 \times 10^{-3} / 2.5$	**C1**
	$= 5.0 \times 10^{-4}\ \text{s cm}^{-1}$	**A1**
4(c)(i)	$I \propto A^2$	**C1**
	$(I_X / I_Y =) [r_Y / r_X]^2 = [A_X / A_Y]^2$	**C1**
	ratio A_Y / A_X $= 120 / 30$ $= 4.0$	**A1**

Question	Answer	Marks
4(c)(ii)	**1.** $v = f\lambda$	**C1**
	minimum $\lambda = 330 / (800 + 16) = 0.40$ m	**A1**
	2. $f_o / f_s = v / (v - v_s)$ $816 / 800 = 330 / (330 - v_s)$	**C1**
	$v_s = 6.5\ \text{m s}^{-1}$	**A1**

Question	Answer	Marks
5(a)	force <u>per</u> unit positive charge	**B1**
5(b)(i)	$s = \frac{1}{2}at^2$	**C1**
	$a = (2 \times 0.045) / (1.5 \times 10^{-7})^2 = 4(.0) \times 10^{12}\ \text{m s}^{-2}$	**A1**
5(b)(ii)	$F = 1.67 \times 10^{-27} \times 4.0 \times 10^{12} = 6.7\ (6.68) \times 10^{-15}$ N	**A1**
5(b)(iii)	**1.** $E = F / Q$	**C1**
	$= 6.68 \times 10^{-15} / 1.6 \times 10^{-19}$ $= 4.2\ (4.18) \times 10^{4}\ \text{N C}^{-1}$	**A1**
	2. $E = V / d$	**C1**
	$V = 4.18 \times 10^{4} \times 0.045$ $= 1.9 \times 10^{3}$ V	**A1**

Question	Answer	Marks
5(c)	$a = Eq / m$ **or** $F = ma$ **and** $F = Eq$	**C1**
	ratio $= \dfrac{(2\times1.6\times10^{-19})\times(1.67\times10^{-27})}{(1.6\times10^{-19})\times(4\times1.66\times10^{-27})}$ **or** $\dfrac{2\times1}{1\times4}$ $= 0.50$	**A1**

Question	Answer	Marks
6(a)(i)	$P = VI$	**C1**
	$I = 30 / 120$ $= 0.25\,\text{A}$	**A1**
6(a)(ii)	$Q = 0.25 \times 3.0 \times 3600$ (= 2700)	**C1**
	number $= (0.25 \times 3.0 \times 3600) / 1.60 \times 10^{-19}$ $= 1.7 \times 10^{22}$	**A1**
6(b)	$R = V / I$ **or** $R = P / I^2$ **or** $R = V^2 / P$	**C1**
	$= 120 / 0.25$ **or** $= 30 / 0.25^2$ **or** $= 120^2 / 30$ $= 480\,\Omega$	**A1**

Question	Answer	Marks
6(c)	$R = \rho l / A$	**C1**
	$A = (6.1 \times 10^{-7} \times 580 \times 10^{-3}) / 480$ (= 7.37×10^{-10})	**C1**
	$d = [(4 \times 7.37 \times 10^{-10}) / \pi]^{1/2}$ $= 3.1 \times 10^{-5}$ m	**A1**
6(d)	temperature decreases and so resistance decreases	**B1**

Question	Answer	Marks
7(a)	nucleons = 23	**B1**
	neutrons = 11	**B1**
7(b)	similarity: same (rest) mass **or** equal (magnitude of) charge	**B1**
	difference: opposite (sign of) charge **or** one is matter and one is antimatter **or** one is an electron and one is an antielectron	**B1**