Cambridge International AS & A Level

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**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.<br><br>Examples:<br><br>($P = E / t$ or $W / t$ gives) kg $m^2 s^{-2}$ / s = kg $m^2 s^{-3}$<br><br>($P = Fs / t$ or $mgh / t$ gives) kg m $s^{-2}$ m / s = kg $m^2 s^{-3}$<br><br>($P = ½mv^2 / t$ gives) kg $(m s^{-1})^2$ / s = kg $m^2 s^{-3}$<br><br>($P = Fv$ gives) kg m $s^{-2}$ m $s^{-1}$ = kg $m^2 s^{-3}$<br><br>($P = VI$ 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 $m^2 s^{-3}$ / $m^2 K^4$<br>= 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** |

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

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

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| 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 $A_Y / A_X$ $= 120 / 30$<br>$= 4.0$ | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 4(c)(ii) | **1.** $v = f\lambda$ | **C1** |
| | minimum $\lambda = 330 / (800 + 16) = 0.40$ m | **A1** |
| | **2.** $f_o / f_s = v / (v - v_s)$<br>$816 / 800 = 330 / (330 - v_s)$ | **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** |
| | $= 6.68 \times 10^{-15} / 1.6 \times 10^{-19}$<br>$= 4.2\ (4.18) \times 10^{4}\ \text{N C}^{-1}$ | **A1** |
| | **2.** $E = V / d$ | **C1** |
| | $V = 4.18 \times 10^{4} \times 0.045$<br>$= 1.9 \times 10^{3}$ V | **A1** |

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| Question | Answer | Marks |
|---|---|---|
| 5(c) | $a = Eq / m$<br>**or**<br>$F = ma$ **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** $\dfrac{2\times1}{1\times4}$<br>$= 0.50$ | **A1** |

| Question | Answer | Marks |
|---|---|---|
| 6(a)(i) | $P = VI$ | **C1** |
| | $I = 30 / 120$<br>$= 0.25\,\text{A}$ | **A1** |
| 6(a)(ii) | $Q = 0.25 \times 3.0 \times 3600$ (= 2700) | **C1** |
| | number $= (0.25 \times 3.0 \times 3600) / 1.60 \times 10^{-19}$<br>$= 1.7 \times 10^{22}$ | **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** |
| | $A = (6.1 \times 10^{-7} \times 580 \times 10^{-3}) / 480$ $(= 7.37 \times 10^{-10})$ | **C1** |
| | $d = [(4 \times 7.37 \times 10^{-10}) / \pi]^{1/2}$<br>$= 3.1 \times 10^{-5}$ 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:<br>same (rest) mass<br>**or**<br>equal (magnitude of) charge | **B1** |
| | difference:<br>opposite (sign of) charge<br>**or**<br>one is matter and one is antimatter<br>**or**<br>one is an electron and one is an antielectron | **B1** |

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