
PHYSICS

9702/21

Paper 2 AS Level Structured Questions

May/June 2017

MARK SCHEME

Maximum Mark: 60

Published

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| Question | Answer | Marks |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1(a) | (stress =) force / area or $\text{kg m s}^{-2} / \text{m}^2$ | B1 |
| | $= \text{kg m}^{-1} \text{s}^{-2}$ | A1 |
| 1(b)(i) | $0.58 = 2\pi \times [(4 \times 0.500 \times 0.600^3) / (E \times 0.0300 \times 0.00500^3)]^{0.5}$ | C1 |
| | $E = [4\pi^2 \times 4 \times 0.500 \times (0.600)^3] / [(0.58)^2 \times 0.0300 \times (0.00500)^3]$ $= 1.35 \times 10^{10} \text{ (Pa)}$ | C1 |
| | $= 14 \text{ (13.5) GPa}$ | A1 |
| 1(b)(ii)1. | (accuracy determined by) the closeness of the value(s)/measurement(s) to the true value | B1 |
| | (precision determined by) the range of the values/measurements | B1 |
| 1(b)(ii)2. | l is (cubed so) $3 \times$ (percentage/fractional) uncertainty and T is (squared so) $2 \times$ (percentage / fractional) uncertainty and (so) l contributes more | B1 |

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|-----------------|------------------------------------------------------------------------------------------|--------------|
| 2(a) | resultant force (in any direction) is zero | B1 |
| | resultant torque/moment (about any point) is zero | B1 |
| 2(b)(i) | $a = (v - u) / t$ or gradient or $\Delta v / (\Delta)t$ | C1 |
| | e.g. $a = (8.8 - 4.6) / (7.0 - 4.0) = 1.4 \text{ m s}^{-2}$ | A1 |
| 2(b)(ii) | $s = 4.6 \times 4 + [(8.8 + 4.6) / 2] \times 3$ | C1 |
| | $= 18.4 + 20.1$ | A1 |
| | $= 39 \text{ (38.5) m}$ | |
| 2(b)(iii) | $\Delta E = \frac{1}{2} \times 95 [(8.8)^2 - (4.6)^2]$ | C1 |
| | $= 3678 - 1005$ | A1 |
| | $= 2700 \text{ (2673) J}$ | |
| 2(b)(iv)1. | weight = 95×9.81 (= 932 N) | C1 |
| | vertical tension force = $280 \sin 25^\circ$ or $280 \cos 65^\circ$ (=118.3 N) | C1 |
| | $F = 932 + 118$ $= 1100 \text{ (1050) N}$ | A1 |
| 2(b)(iv)2. | horizontal tension force = $280 \cos 25^\circ$ or $280 \sin 65^\circ$ (= 253.8 N) | C1 |
| | resultant force = 95×1.4 (= 133 N) | C1 |
| | $133 = 253.8 - R$ $R = 120 \text{ (120.8) N}$ | A1 |

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| 3(a) | $\rho = m / V$ | C1 |
| | $V = \pi d^2 L / 4$ or $\pi r^2 L$ | C1 |
| | weight = $2.7 \times 10^3 \times \pi (1.2 \times 10^{-2})^2 \times 5.0 \times 10^{-2} \times 9.81 = 0.60$ N | A1 |
| 3(b)(i) | the point from where (all) the weight (of a body) seems to act | B1 |
| 3(b)(ii) | $W \times 12$ | C1 |
| | $(0.25 \times 8) + (0.6 \times 38)$ | C1 |
| | $W = (2 + 22.8) / 12$ $= 2.1$ (2.07)N | A1 |
| 3(c)(i) | pressure changes with depth (in water) or pressure on bottom (of cylinder) different from pressure on top | B1 |
| | pressure on bottom of cylinder <u>greater than</u> pressure on top or force (up) on bottom of cylinder <u>greater than</u> force (down) on top | B1 |
| 3(c)(ii) | anticlockwise moment reduced and reducing the weight of X reduces clockwise moment or anticlockwise moment reduced so clockwise moment now greater than (total) anticlockwise moment | B1 |

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|----------|-----------------------------------------------------------------------|-----------|
| 4(a) | (two) waves travelling (at same speed) in opposite directions overlap | B1 |
| | waves (are same type and) have same frequency/wavelength | B1 |
| 4(b)(i) | $\lambda = 12 / 250 (= 0.048 \text{ m})$ | C1 |
| | distance = 1.5×0.048 = 0.072 m | A1 |
| 4(b)(ii) | $T = 1 / 250$ = 0.004 (s) or 4 (ms) | C1 |
| | 1. curve drawn is mirror image of that in Fig. 4.2 and labelled P | A1 |
| | 2. horizontal line drawn between A and B and labelled Q | A1 |

| Question | Answer | Marks |
|----------|--------------------------------------------------------------------------------------------|-----------|
| 5(a) | observed frequency is different to source frequency when source moves relative to observer | B1 |
| 5(b) | $360 = (400 \times 340) / (340 \pm v)$ | C1 |
| | $v = 38 (37.8) \text{ m s}^{-1}$ | A1 |
| | away (from the observer) | B1 |

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|-----------|-------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 6(a) | volt / ampere | B1 |
| 6(b)(i) | $R_T = [1/3.0 + 1/6.0]^{-1} + 4.0 (= 6.0 \Omega)$ | C1 |
| | $I = 1.5 / 6.0$ | C1 |
| | $= 0.25 \text{ A}$ | A1 |
| 6(b)(ii) | $V_B = 0.5 \text{ V}$ | A1 |
| | $I = 0.5 / 3.0$ $= 0.17 (0.167) \text{ A}$ | |
| 6(b)(iii) | $P = I^2 R$ or VI or V^2/R | C1 |
| | ratio = $(0.167^2 \times 3.0) / (0.25^2 \times 4.0)$ $= 0.33$ | A1 |
| 6(c)(i) | vary/change/different radius/diameter/ <u>cross-sectional</u> area (of wire) | B1 |
| 6(c)(ii) | $v = I / Ane$ | C1 |
| | ratio = $\frac{(I_B / A_B)}{(I_C / A_C)}$ or $\frac{I_B \times A_C}{I_C \times A_B}$ | |
| | $(R \propto 1/A \text{ so})$ ratio = $\frac{I_B \times R_B}{I_C \times R_C} = \frac{0.167 \times 3.0}{0.25 \times 4.0}$ $= 0.50$ | A1 |
| 6(d)(i) | 0.25 A to 0.13 (0.125) A or halved | A1 |
| 6(d)(ii) | no change | A1 |

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| Question | Answer | Marks | | | | | | | | | |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|-----------|----------------|----|----|---------------|----|----|-----------|
| 7(a)(i) | (proton is uud so) $(2/3)e + (2/3)e - (1/3)e = e$ | B1 | | | | | | | | | |
| 7(a)(ii) | (neutron is udd so) $(2/3)e - (1/3)e - (1/3)e = 0$ | B1 | | | | | | | | | |
| 7(b)(i) | <table border="1" data-bbox="808 347 1429 502"> <tbody> <tr> <td></td> <td>β^-</td> <td>β^+</td> </tr> <tr> <td>nucleon number</td> <td>90</td> <td>64</td> </tr> <tr> <td>proton number</td> <td>39</td> <td>28</td> </tr> </tbody> </table> <p><i>all correct</i></p> | | β^- | β^+ | nucleon number | 90 | 64 | proton number | 39 | 28 | B1 |
| | β^- | β^+ | | | | | | | | | |
| nucleon number | 90 | 64 | | | | | | | | | |
| proton number | 39 | 28 | | | | | | | | | |
| 7(b)(ii) | weak (nuclear force/interaction) | B1 | | | | | | | | | |
| 7(b)(iii) | β^- decay: electron and (electron) antineutrino β^+ decay: positron and (electron) neutrino <i>all correct</i> | B1 | | | | | | | | | |