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**PHYSICS****9702/21**

Paper 2 AS Level Structured Questions

**May/June 2017**

MARK SCHEME

Maximum Mark: 60

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**Published**

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

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

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

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

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

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

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Question	Answer	Marks									
7(a)(i)	(proton is uud so) $(2/3)e + (2/3)e - (1/3)e = e$	<b>B1</b>									
7(a)(ii)	(neutron is udd so) $(2/3)e - (1/3)e - (1/3)e = 0$	<b>B1</b>									
7(b)(i)	<table border="1" data-bbox="808 347 1429 501"> <tbody> <tr> <td></td> <td><math>\beta^-</math></td> <td><math>\beta^+</math></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>		$\beta^-$	$\beta^+$	nucleon number	90	64	proton number	39	28	<b>B1</b>
	$\beta^-$	$\beta^+$									
nucleon number	90	64									
proton number	39	28									
7(b)(ii)	weak (nuclear force/interaction)	<b>B1</b>									
7(b)(iii)	$\beta^-$ decay: electron and (electron) antineutrino $\beta^+$ decay: positron and (electron) neutrino <i>all correct</i>	<b>B1</b>									