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PHYSICS **9702/22**

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)	micrometer (screw gauge)/digital calipers	**B1**
1(a)(ii)	take several readings (and average)	**M1**
	along the wire **or** around the circumference	**A1**
1(b)(i)	$\sigma = 4 \times 25 / [\pi \times (0.40 \times 10^{-3})^2] = 1.99 \times 10^8\ \mathrm{N\,m^{-2}}$ **or** $\sigma = 25 / [\pi \times (0.20 \times 10^{-3})^2] = 1.99 \times 10^8\ \mathrm{N\,m^{-2}}$	**A1**
1(b)(ii)	$\%F = 2\%$ **and** $\%d = 5\%$ **or** $\Delta F / F = \dfrac{0.5}{25}$ **and** $\Delta d / d = \dfrac{0.02}{0.4}$	**C1**
	$\%\sigma = 2\% + (2 \times 5\%)$ **or** $\%\sigma = [0.02 + (2 \times 0.05)] \times 100$ $\%\sigma = 12\%$	**A1**
1(b)(iii)	absolute uncertainty $= (12/100) \times 1.99 \times 10^8$ $= 2.4 \times 10^7$	**C1**
	$\sigma = 2.0 \times 10^8 \pm 0.2 \times 10^8\ \mathrm{N\,m^{-2}}$ **or** $2.0 \pm 0.2 \times 10^8\ \mathrm{N\,m^{-2}}$	**A1**

Question	Answer	Marks
2(a)	force × <u>perpendicular</u> distance (of line of action of force) to/from a point	B1
2(b)(i)	$2.4r$ **or** $(1.2 \times 2r)$ **or** $(1.2r + 1.2r)$	A1
2(b)(ii)	(anticlockwise moment =) $6.0 \times r/2 \times \sin\theta$	C1
	$6.0 \times r/2 \times \sin\theta = 2.4r$ $\theta = 53°$	A1
2(b)(iii)	6.0 N	A1

Question	Answer	Marks
3(a)	$p = 1000 \times 9.81 \times 7.0 \times 10^{-2}$ **or** $1000 \times 9.81 \times 1.9 \times 10^{-2}$	C1
	$\Delta p = 1000 \times 9.81 \times (7.0 \times 10^{-2} - 1.9 \times 10^{-2})$ **or** $686 - 186$ $= 500$ Pa	A1
3(b)	$F = pA$ **or** $(\Delta)F = \Delta p \times A$	C1
	upthrust $= 500 \times (5.1 \times 10^{-2})^2 = 1.3$ N **or** upthrust $= (686 - 186) \times (5.1 \times 10^{-2})^2 = 1.3$ N **or** upthrust $= 1000 \times 9.81 \times 5.1 \times 10^{-2} \times (5.1 \times 10^{-2})^2 = 1.3$ N	A1
3(c)	force $= 4.0 - 1.3$ $= 2.7$ N	A1

Question	Answer	Marks
3(d)	extension/*x*/*e* = 2.7 / 30	**C1**
	= 0.09 (m) **or** 9 (cm)	**C1**
	height above surface = 9 – 7 = 2 cm	**A1**
3(e)(i)	mass = 4.0 / 9.81	**C1**
	acceleration = 2.7 / (4.0 / 9.81) = 6.6 m s^{-2}	**A1**
3(e)(ii)	viscous force <u>increases</u> (and then becomes constant)	**M1**
	(weight and upthrust constant so) acceleration decreases (to zero)	**A1**

Question	Answer	Marks
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)	5	**A1**
4(b)(ii)	$T = 1/40$ ($= 2.5 \times 10^{-2}$)	**C1**
	time taken $= 2.5 \times 10^{-2}/2$ $= 1.3 \times 10^{-2}\,\text{s}$ ($1.25 \times 10^{-2}\,\text{s}$)	**A1**
4(b)(iii)	$180°$	**A1**
4(b)(iv)	$v = f\lambda$	**C1**
	$\lambda = 2.0/2.5$ ($= 0.80\,\text{m}$) $v = 0.80 \times 40$ $= 32\,\text{m}\,\text{s}^{-1}$	**A1**

Question	Answer	Marks
5(a)	(coulomb is) ampere second	**B1**
5(b)(i)	$E = V / d$ **or** $E = F / Q$	**C1**
	$F = VQ / d$ $F = (2.0 \times 10^{2} \times 8.0 \times 10^{-19}) / 4.0 \times 10^{-2} = 4.0 \times 10^{-15}$ N	**A1**
5(b)(ii)	arrow pointing to the left labelled 'electric force' **and** arrow pointing downwards labelled 'weight'	**B1**
5(b)(iii)	**1.** resultant force $= \sqrt{[(3.9 \times 10^{-15})^{2} + (4.0 \times 10^{-15})^{2}]}$	**C1**
	$= 5.6 \times 10^{-15}$ N	**A1**
	2. angle $= \tan^{-1} (3.9 \times 10^{-15} / 4.0 \times 10^{-15})$ $= 44°$	**A1**
5(c)	downward sloping line from (0, 2.0)	**M1**
	magnitude of gradient of line increases with time and line ends at (T, 0)	**A1**

Question	Answer	Marks
6(a)	flow of charge carriers	**B1**
6(b)(i)	$nALe$	**B1**
6(b)(ii)	(t is time taken for electrons to move length L) $I = Q / t$	**B1**
	$I = nALe / t$ **or** $I = nALe / (L / v)$ **or** $I = nAvte / t$ **and** $I = nAve$	**B1**
6(c)(i)	ratio = area at X / area at Y $= [\pi d^2 / 4] / [\pi(0.69d)^2 / 4]$ **or** $d^2 / (0.69d)^2$ **or** $1 / 0.69^2$	**C1**
	$= 2.1$	**A1**
6(c)(ii)	**1.** $R = \rho L / A$ **or** $R / L \propto 1 / A$	**C1**
	resistance per unit length $= 1.7 \times 10^{-2} \times$ (area at X / area at Y) $= 1.7 \times 10^{-2} \times 2.1$ $= 3.6 \times 10^{-2}\,\Omega\,\text{m}^{-1}$	**A1**
	2. $P = I^2 R$ **or** $P = V^2 / R$	**C1**
	$R = 3.6 \times 10^{-2} \times 3.0 \times 10^{-3}$ ($= 1.08 \times 10^{-4}\,\Omega$) $P = 0.50^2 \times 1.08 \times 10^{-4}$ **or** $P = (5.4 \times 10^{-5})^2 / 1.08 \times 10^{-4}$ $= 2.7 \times 10^{-5}\,\text{W}$	**A1**

Question	Answer	Marks
6(c)(iii)	(cross-sectional area decreases so) resistance increases	M1
	($P = I^2R$, so) power increases	A1

Question	Answer	Marks
7(a)	lepton(s)	B1
7(b)	protons: 7 **and** neutrons: 6	A1
7(c)	$E = ½mv^2$	C1
	$= 0.80 \times 10^6 \times 1.60 \times 10^{-19}$	C1
	$= 1.28 \times 10^{-13}$ (J) $v^2 = 2 \times 1.28 \times 10^{-13} / 2.2 \times 10^{-26}$ $v = 3.4 \times 10^6\,\text{m s}^{-1}$	A1
7(d)	an (electron) neutrino/$\nu_{(e)}$ is also produced (and this has energy)	B1