Practice Question Set For A-Level
Subject : Physics
Paper-2 Topic : 4_Materials

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Name of the Student:____

Max. Marks : 22 Marks **Time : 22 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable answers		Additional guidance	Mark
(i)	• Use of (breaking) stress = F/A • Use of $A = \pi r^2$ • Diameter = 1.06 mm and choose 1.22 mm because it is the thinnest wire with stress lower than the breaking stress	(1) (1) (1)	<u>Example of calculation</u> For max stress, 3.10×10^8 N m^{-2} = 28 kg × 9.81 N kg^{-1}/A $A = 8.86 \times 10^{-7}$ m^2 8.86×10^{-7} m^2 = πr^2 $r = 5.3 \times 10^{-4}$ m diameter = 1.06 mm	3
(ii)	• Use of stress = F/A and $A = \pi r^2$ (ecf for radius from (b)(i)) • Use of Young modulus = stress / strain and strain = $\Delta x/x$ • Extension =1.3 cm	(1) (1) (1)	Allow ecf for radius of wire chosen in part (b)(i), but not for the calculated radius or area <u>Example of calculation</u> stress = 28 kg × 9.81 N kg^{-1}/ π (1.22 × 10^{-3} m / 2) ^{2} strain = 2.34×10^8 Pa / 200 GPa = 0.00117 extension = 0.00117 × 11.2 m = 0.0132 m	3

Q2.

Question Number	Acceptable Answer		Additional Guidance	Mark
	• Use of half resolution to calculate % uncertainty • % uncertainty in $V = 3 \times$ % uncertainty in r • % uncertainty in ρ = (% uncertainty in m + % uncertainty in V) • Use of % uncertainty to calculate upper value of density • Upper value of density 2596 (kg m^{-3}) [2616 (kg m^{-3}) if "show that" value used] • Glass is in the range and Quartz isn't, so it may not be genuine Allow use of half resolution in either r or m to calculate minimum V and maximum m and then calculate maximum ρ for MP1 → MP4 ECF from (a)	(1) (1) (1) (1) (1) (1)	% uncertainty in $r = \frac{0.005\text{ cm}}{5.06\text{ cm}} \times 100\,\% = 0.10\,\%$ % uncertainty in $m = \frac{0.5\text{ g}}{175\text{ g}} \times 100\,\% = 0.29\,\%$ % uncertainty in $\rho = (3 \times 0.1\%) + 0.29\% = 0.59\%$ Range $= \pm\frac{0.6}{100} \times 2580\text{ kg m}^{-3} = \pm 15.5\text{ kg m}^{-3}$ Density range = 2565 → 2596 kg m^{-3}	6

Q3.

Question Number	Acceptable Answer		Additional Guidance	Mark
	• new spring constant = 11 N m^{-1} • Use of $T = 2\pi\sqrt{\frac{m}{k}}$ • Use of $f = 1/T$ • f = 1.5 Hz	(1) (1) (1) (1)	Example of calculation: $k = 22/2 = 11\text{ N m}^{-1}$ $T = 2\pi\sqrt{\frac{0.12\text{ kg}}{11\text{ N m}^{-1}}} = 0.66\text{ s}$ $f = 1/0.66\text{ s} = 1.5\text{ Hz}$	4

Q4.

Question Number	Acceptable Answers		Additional guidance	Mark
(i)	• Use of $v = \frac{s}{t}$	(1)	<u>Example of Calculation</u>	
	• Use of $V = \frac{4}{3}\pi r^3$	(1)	$v = \frac{0.5}{3.9} = 0.13\ (\mathrm{m\ s^{-1}})$	
	• Use of $v = \frac{Vg(\rho_s - \rho_l)}{6\pi r\eta}$	(1)	$\eta = \frac{\frac{4}{3}\pi(4 \times 10^{-3})^3 \times 9.81 \times (7800 - 1300)}{6\pi \times 4 \times 10^{-3} \times 0.13} = 1.8\ \mathrm{Pa\ s}$	
	• η =1.8 Pa s	(1)	Accept kg $\mathrm{m^{-1}s^{-1}}$ / N s $\mathrm{m^{-2}}$	4

Question Number	Acceptable Answers		Additional guidance	Mark
(ii)	5cm (no mark)		Accept wider for 5.0 cm	
	• Laminar flow **Or** less/no turbulent flow	(1)		
	• So Stoke's law applies **Or** sphere falls at a more constant rate	(1)		2