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

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Name of the Student:____
Max. Marks : 27 Marks **Time : 27 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable Answers	Additional guidance	Mark
(i)	• Use of $v = \frac{s}{t}$ (1) • Use of $V = \frac{4}{3}\pi r^3$ (1) • Use of $v = \frac{Vg(\rho_s - \rho_l)}{6\pi r\eta}$ (1) • $\eta = 1.1$ (Pa s) (1)	Example of Calculation $\eta = \frac{\frac{4}{3}\pi\left(\frac{7.0\times10^{-3}\text{ m}}{2}\right)^3 \times 9.81\text{ m s}^{-2} \times (7800 - 1430)\text{kg m}^{-3}}{6\pi \times \frac{7.0\times10^{-3}\text{m}}{2} \times \frac{0.8\text{ m}}{5.3\text{ s}}}$ $\eta = 1.13$ Pa s	4
(ii)	• With the large sphere the speed will be greater so Stokes' law won't apply (1) • The flow is turbulent or not laminar (1)		2
(iii)	**Any one** • Can eliminate human reaction time • Can playback to measure time more accurately • Can check that terminal velocity is reached (1)		1

Q2.

Question Number	Answer		Mark
(a)(i)	Identifies that the two chocolates on the graph are at different temperatures	(1)	
	The greater the temperature of the chocolate, the lower the viscosity	(1)	2
(a)(ii)	Marked anywhere vertically above 10^1 Pa s.	(1)	1
(b)	Use of drag = upthrust	(1)	
	Use of $F = 6\pi r\eta v$	(1)	
	$v = 2.0 \times 10^{-4}$ m s^{-1}	(1)	3
	<u>Example of calculation</u> $v = \frac{3.7 \times 10^{-5}\ \text{N}}{6 \times \pi \times 1.0 \times 10^{-8}\ \text{m} \times 10\ \text{Pa s}}$ $v = 1.96 \times 10^{-4}$ m s^{-1}		
(c)	Problem: Bubbles forming and not rising to the surface to break		
	Solution: Reduce the viscosity of the chocolate **Or** heat up the chocolate	(1)	
	Explanation: The greater the viscosity: the greater the viscous drag **Or** the lower the (terminal) velocity	(1)	
	The bubbles rise slower	(1)	
	OR		
	The lower the viscosity: the lower the viscous drag **Or** the greater the (terminal) velocity	(1)	
	The bubbles are able to rise to the top quicker **Or** the bubblies rise to the top in time before the chocolate sets	(1)	3
	(The 3 marking points can be awarded if seen anywhere within part (c))		
	Total for question		**9**

Q3.

Question Number	Answer		Additional Guidance	Mark
	• Use of $F = 6\pi\eta rv$	(1)	<u>Example of calculation</u>	6
	• Use of $U = mg$ **and** $\rho = \frac{m}{V}$ **and** $V = \frac{4}{3}\pi r^3$	(1)	$F = 6\pi \times 1.0 \times 10^{-3}\ \text{kg m}^{-1}\ \text{s}^{-1} \times 2.5 \times 10^{-7}\ \text{m} \times v$ $V = \frac{4}{3}\pi(2.5 \times 10^{-7}\ \text{m})^3 = 6.5 \times 10^{-20}\ \text{m}^3$	
	• Recognises $W = F + U$	(1)	$U = \rho_w Vg = 1000\ \text{kg m}^{-3} \times 6.5 \times 10^{-20}\ \text{m}^3 \times 9.81\ \text{m s}^{-1}$ $U = 6.4 \times 10^{-16}\ \text{N}$	
	• Use of $v = \frac{s}{t}$	(1)	$W = 2650\ \text{kg m}^{-3} \times 6.5 \times 10^{-20}\ \text{m}^3 \times 9.81\ \text{m s}^{-1}$ $W = 1.7 \times 10^{-15}\ \text{N}$	
	Either			
	• $t = 1.7 \times 10^7$ s • comparison with 6 months and conclusion consistent with their answer	(1)	$F = 1.7 \times 10^{-15}\ \text{N} - 6.4 \times 10^{-16}\ \text{N}$ $F = 1.1 \times 10^{-15}\ \text{N}$ $v = \frac{1.1 \times 10^{-15}\ \text{N}}{6\pi \times 1.0 \times 10^{-3}\text{kg m}^{-1}\text{s}^{-1} \times 2.5 \times 10^{-7}\ \text{m}}$ $v = 2.3 \times 10^{-7}\ \text{m s}^{-1}$	
	Or			
	• $s = 3.3 - 3.6$ m • comparison with 4 m and conclusion consistent with their answer	(1)	$t = \frac{4\ \text{m}}{2.3 \times 10^{-7}\ \text{m s}^{-1}} = 1.7 \times 10^7\ \text{s}$ t =197 days which is 6.6 months accept 1 month = 28 to 31 days giving t = 6.3 to 7.0 months	

Q4.

Question Number	Acceptable answers		Additional guidance	Mark
(i)	• Use of $\rho = \frac{m}{V}$ • $V = 8.1 \times 10^{-6}$ (m^3)	(1) (1)	Example of Calculation. $V = \frac{0.043\ \text{kg}}{5300\ \text{kgm}^{-3}}$ $V = 8.1 \times 10^{-6}\ m^3$	2
(ii)	• Use of $A = \pi r^2$ and $V = Al$ • Use of $R = \frac{\rho l}{A}$ • $R = 2.5\ \Omega$ (ecf from (a)(i))	(1) (1) (1)	Show that value gives 2.50 Ω Example of Calculation. $A = \pi(6 \times 10^{-3}\ \text{mm})^2 = 1.13 \times 10^{-4}\ m^2$ $8.1 \times 10^{-6}\ m^3 = (1.13 \times 10^{-4}\ m^3)\ l$ $l = 0.0716$ m $R = \frac{(4.0 \times 10^{-3}\ \Omega\ \text{m})(0.0716\ \text{m})}{(1.13 \times 10^{-4}\ \text{m}^3)}$ R = 2.54 Ω	3