Name of the Student:_____
Max. Marks : 21 Marks **Time : 21 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	**EITHER** • Calculation of mean t **(1)** • Use of $s = ut$ **(1)** • Use of $v = \frac{2r^2g(\rho B - \rho C)}{9\eta}$ **(1)** • Cocoa content = 30% **Or** viscosity at 35% = 4.5 (Pa s) **(1)** • Conclusion consistent with their graph value **(1)** **OR** • Viscosity at 35% = 4.5 (Pa s) **(1)** • Use of $v = \frac{2r^2g(\rho B - \rho C)}{9\eta}$ **(1)**	Example of calculation $t = \frac{(9.6 + 9.9 + 9.6)\ \text{s}}{3} = 9.7\ \text{s}$ $v = \frac{0.225\ \text{m}}{9.7\ \text{s}} = 0.0232\ \text{m s}^{-1}$ $\eta = \frac{2 \times (4.25 \times 10^{-3}\ \text{m})^2 \times 9.81\ \text{m s}^{-2} \times (7750 - 1330)\ \text{kg m}^{-3}}{9 \times 0.0232\ \text{m s}^{-1}}$ η = 10.9 Pa s, so cocoa content is 30% (from graph) Cocoa content is 30% so not consistent **Or** viscosity value is 4.5 Pa s so not consistent Time taken would be 4.0 s so not consistent with mean time	5

	• Use of $s = ut$ to calculate time to fall T_{fall} **(1)** • Calculation of mean t **(1)** • Conclusion consistent with calculated value of T_{fall} **(1)**		

(ii)	An explanation that makes reference to the following points: **EITHER** • The temperature may not have been constant **(1)** • So the viscosity value would have varied **(1)** **OR** • There may have been reaction time error **(1)** **Or** There may have been parallax error in reading the distance fallen by the ball **(1)** • So the velocity of the ball may have been inaccurate **(1)** **OR** • There may have been an extra drag force • So terminal velocity would have been reduced	If no other marks scored then allow MAX 1 for reference to ball not falling at terminal velocity Allow a reference to eddies **Or** turbulent flow	**2**

Q2.

Question Number	Acceptable answers		Additional guidance	Mark
	• Use of $pV = NkT$	(1)	Example of calculation $p_1 V_1 = NkT_1$	
	• Conversion of T in K	(1)	$p_1 V_1 / T_1 = NkT_1 = p_2 V_2 / T_2$ $V_1 / 293\ \text{K} = 2800\ \text{m}^3 / 393\ \text{K}$	
	• Use of $\rho = m/V$ to determine mass of air in the balloon	(1)	Volume of gas before heating, $V_1 = 2087\ \text{m}^3$ mass of air in balloon	
	• Calculation of total mass = mass of air at 120 °C + passengers + balloon	(1)	$= 1.2\ \text{kg m}^{-3} \times 2087\ \text{m}^3$ $= 2505\ \text{kg}$ Total mass with 5 passengers	
	• Use of $W = mg$	(1)	$= (2505 + 340 + 380)\ \text{kg} = 3225\ \text{kg}$ $W = 3225\ \text{kg} \times 9.81\ \text{N kg}^{-1} = 31\ 637\ \text{N}$	
	• $W = 31\ 600$ N, which is less than 33 000 N, so the balloon can take off		$31\ 600\ \text{N} < 33\ 000\ \text{N}$	6

Q3.

Question Number	Acceptable Answer		Additional Guidance	
(i)	An explanation that makes reference to the following points: **Either**		**Accept:** use ratchet to close up micrometer to avoid squashing the wire	
	• Take readings in different positions/orientations along the wire (and calculate a mean)	(1)		
	• As wire diameter may not be uniform	(1)	MP2 accept cross section for diameter MP2: accept to reduce the effect of random error	
	OR			
	• Check (and correct for) for zero error	(1)		
	• Zero error reduces the accuracy of the measurement Or Zero error moves the value away from the true value	(1)	MP2 accept systematic error not changed by repeat measurements	2