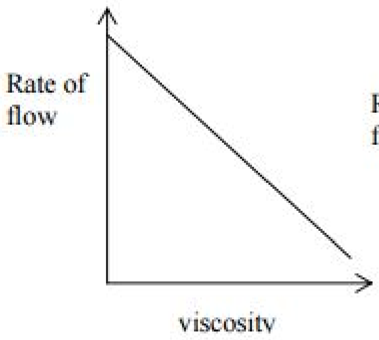
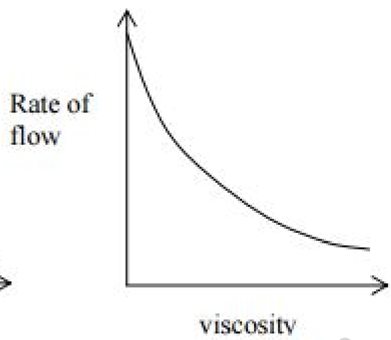
Fluids MS1

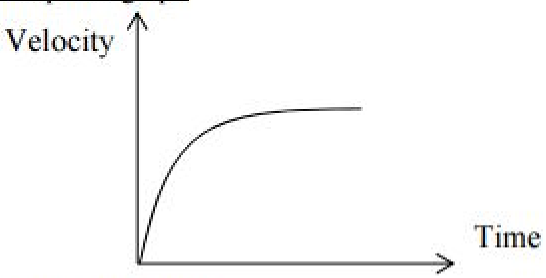
Question Number	Answer		Mark
1	Increase of flow rate as viscosity decreases (accept a straight line or a curve of decreasing gradient) [The graph can but does not have to touch either axis. No part with positive gradient.]   	(1)	1
	Viscosity increases/greater (as the temperature decreases) **Or** becomes more viscous (MP1 must be comparative)	(1)	
	reducing/slowing the (rate of) flow/velocity **Or** increasing the (fluid) friction/resistance/drag	(1)	
	A greater <u>force</u> is required (from the heart)	(1)	3
	Total for question 11		**4**

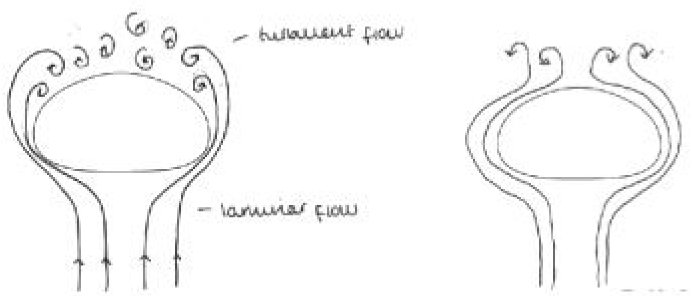
Question Number	Answer		Mark
2	Reference to a tall container containing oil [for tall on diagram accept at least twice as high as wide]	(1)	
	Markers away from top and the bottom	(1)	
	(Measure) distance (between markers) using a metre rule	(1)	
	(Measure) time to fall/travel using a stop watch	(1)	
	Reference to repeating measurements	(1)	**5**
	(For MP3 & 4 the apparatus can be in a separate list or labelled on a diagram. MP1 & 2 normally from a diagram)		
	(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)		
	In a vacuum (the graph is a straight line as) the acceleration is constant/*g*/9.8 m s^{-2}	(1)	
	(because) the only force is the weight/*mg*/gravitational (do not accept gravity)	(1)	
	In oil (the graph curves then becomes horizontal) there is also upthrust **and** drag	(1)	
	as speed increases, drag force increases	(1)	
	Resultant force is/becomes zero **Or** U + D = W	(1)	
	acceleration decreases until terminal velocity is reached **Or** velocity becomes constant when terminal velocity is reached **Or** acceleration becomes zero when terminal velocity is reached	(1)	**6**

Question Number	Answer		Mark
3	Volume/weight of displaced fluid/magma increases (as the bubble expands)	**(1)**	
	Upthrust increases (while the weight of the bubble remains constant)	**(1)**	
	There is now a greater upwards resultant force	**(1)**	**3**
	Basaltic because it has the lowest viscosity	**(1)**	
	Low(est) drag force (on the bubbles)	**(1)**	**2**
	Cooling will increase the viscosity	**(1)**	**1**

Question Number	Answer	Mark
4	**(QWC – work must be clear and organised in a logical manner using technical terminology where appropriate)** (When submerged) there is an upthrust acting on the ball **Or** there is a force equal to the weight of water displaced **Or** the ball is less dense than water **(1)** upthrust > weight of the ball (+ drag) **(1)** Creates an upwards acceleration **Or** there is an upwards resultant force **(1)**	3

Question Number	Answer	Mark
5	<u>Resistance</u> (of a fluid) to flow **(1)**	1
	<u>Rate of flow</u> is inversely proportional to the viscosity **Or** <u>rate of flow</u> decreases with increasing viscosity (and vice versa) **(1)** The time to empty the cup is proportional to the viscosity **Or** the time to empty the cup is inversely proportional to the flow rate **Or** the time to empty the cup decreases as viscosity decreases **Or** the time to empty the cup decreases as the flow rate increases **(1)** (Accept converse explanation in terms of time increasing for MP2)	2
	The temperature was greater on the first day **Or** the temperature was lower (on the second day) **Or** the paint/room was colder (on the second day) **Or** the time is greater when the temperature is lower **Or** the time is lower when the temperature is greater **(1)**	1

Question Number	Answer	Mark
6	Initially: constant acceleration **(1)** Decreasing acceleration followed by constant velocity **(1)** <u>Example of graph</u> 	2
	Drag increases with speed (this may be implied following a description of acceleration) **(1)** When drag = weight (− upthrust) **(1)** No resultant force **Or** there is no (further) acceleration **Or** the forces are in equilibrium **(1)**	3

	Density of air is negligible compared to density of water **Or** mass/weight of air displaced is negligible/tiny compared to the mass/weight of the raindrop **Or** the upthrust is negligible/tiny compared to the mass/weight of the raindrop **(1)**	1
	Use of $v = s/t$ **(1)** $v = 7.1 \text{ m s}^{-1}$ **(1)** <u>Example of calculation</u> $v = \frac{1100 \text{ m}}{2.6 \text{ min} \times 60}$ $v = 7.05 \text{ m s}^{-1}$	2
	See or use of $\rho V g = 6\pi r \eta v$ **(1)** See $V = \frac{4}{3}\pi r^3$ **and** values substituted into above equation **(1)** $r = 2.4 \times 10^{-4}$ m (ecf from part (b)(i) for terminal velocity) **(1)** <u>Example of calculation</u> Weight of raindrop $= \frac{4}{3} \times \pi \times r^3 \times 1.0 \times 10^3 \text{ kg m}^{-3} \times 9.81 \text{ N kg}^{-1}$ Drag force $= 6 \times \pi \times r \times 1.8 \times 10^{-5} \text{ Pa s} \times v$ $\frac{4}{3}\pi \times r^3 \times 1.0 \times 10^3 \text{ kg m}^{-3} \times 9.81 \text{ N kg}^{-1} = 6 \times \pi \times r \times 1.8 \times 10^{-5} \text{ Pa s} \times 7.1 \text{ m s}^{-1}$ $r^2 = \frac{9 \times 1.8 \times 10^{-5} \text{Pa s} \times 7.1 \text{ m s}^{-1}}{2 \times 1.0 \times 10^3 \text{ kg m}^{-3} \times 9.81 \text{ N kg}^{-1}} = 1.04 \times 10^{-7}$ $r = 2.42 \times 10^{-4}$ m	3
	Laminar air flow around main body of rain drop **(1)** (minimum of 2 lines either side) Some turbulence at the top of the rain drop **(1)** (must not start below the top 1/3rd of the rain drop) (1 mark max for correct drawing of laminar and turbulent flow around the rain drop but upside down. Labels and arrows not required) <u>Example of diagram</u> 	2