19 A falling sphere viscometer is a device used to determine the viscosity of a liquid. A sphere falls through a cylinder containing a liquid, and the terminal velocity of the sphere is measured.

(a) State why the temperature of the liquid should **not** increase during the measurement.

(1)

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(b) A scientist measured the terminal velocity of an aluminium sphere as it fell through glycerol.

(i) Show that the weight of the sphere is about 4.8×10^{-3} N.

density of aluminium = $2.70 \times 10^{3}\,\text{kg}\,\text{m}^{-3}$
diameter of sphere = $7.00 \times 10^{-3}\,\text{m}$

(4)

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(ii) The terminal velocity of the sphere was $4.05 \times 10^{-2}\,m\,s^{-1}$.

Deduce whether Stokes' law applied to the falling sphere.

density of glycerol = $1.26 \times 10^{3}\,kg\,m^{-3}$
viscosity of glycerol = $9.50 \times 10^{-1}\,Pa\,s$

(3)

(iii) State one condition that must be met for Stokes' law to apply.

(1)

(c) A scientist used the viscometer to measure the viscosity of blood. The viscosity of blood is typically in the range 3×10^{-3} Pa s to 4×10^{-3} Pa s.

Explain why the scientist should use an aluminium sphere with a much smaller diameter than the sphere used with the glycerol. Do not include calculations in your answer.

viscosity of glycerol = 9.50×10^{-1} Pa s

(5)

(Total for Question 19 = 14 marks)

DO NOT WRITE IN THIS AREA