1 A liquid flows continuously through a chamber that contains an electric heater. When the steady state is reached, the liquid leaving the chamber is at a higher temperature than the liquid entering the chamber. The difference in temperature is Δt.

Which of the following will increase Δt with no other change?

A Increasing the volume flow rate of the liquid ⬭

B Changing the liquid to one with a lower specific heat capacity ⬭

C Using a heating element with a higher resistance ⬭

D Changing the liquid to one that has a higher density ⬭

(Total 1 mark)

2 Two flasks **X** and **Y** are filled with an ideal gas and are connected by a tube of negligible volume compared to that of the flasks. The volume of **X** is twice the volume of **Y**.
X is held at a temperature of 150 K and **Y** is held at a temperature of 300 K

What is the ratio $\dfrac{\text{mass of gas in X}}{\text{mass of gas in Y}}$?

A 0.125 ⬭

B 0.25 ⬭

C 4 ⬭

D 8 ⬭

(Total 1 mark)

3 (a) State **two** assumptions made about the **motion** of the molecules in a gas in the derivation of the kinetic theory of gases equation.

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(2)

(b) Use the kinetic theory of gases to explain why the pressure inside a football increases when the temperature of the air inside it rises. Assume that the volume of the ball remains constant.

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(3)

(c) The ‘laws of football’ require the ball to have a circumference between 680 mm and 700 mm. The pressure of the air in the ball is required to be between 0.60×10^5 Pa and 1.10×10^5 Pa above atmospheric pressure.

A ball is inflated when the atmospheric pressure is 1.00×10^5 Pa and the temperature is 17 °C. When inflated the mass of air inside the ball is 11.4 g and the circumference of the ball is 690 mm.

Assume that air behaves as an ideal gas and that the thickness of the material used for the ball is negligible.

Deduce if the inflated ball satisfies the law of football about the pressure.

molar mass of air = 29 g mol^{-1}

(6)
(Total 11 marks)

4 A cola drink of mass 0.200 kg at a temperature of 3.0 °C is poured into a glass beaker. The beaker has a mass of 0.250 kg and is initially at a temperature of 30.0 °C.

specific heat capacity of glass = 840 J $kg^{-1}K^{-1}$
specific heat capacity of cola = 4190 J $kg^{-1}K^{-1}$

(i) Show that the final temperature, T_f, of the cola drink is about 8 °C when it reaches thermal equilibrium with the beaker.
Assume no heat is gained from or lost to the surroundings.

(2)

(ii) The cola drink and beaker are cooled from T_f to a temperature of 3.0 °C by adding ice at a temperature of 0 °C.
Calculate the mass of ice added.
Assume no heat is gained from or lost to the surroundings.

specific heat capacity of water = 4190 J kg^{-1} K^{-1}
specific latent heat of fusion of ice = 3.34×10^5 J kg^{-1}

mass ____________________ kg

(3)
(Total 5 marks)