Properties of Gases

Question 1

(f) What was Gay-Lussac's observation about reactions involving gaseous reactants and products?

Question 2

(j) Calculate the number of moles of nitrogen gas at a pressure of 1.85×10^5 Pa and a temperature of 293 K in the 6.50×10^{-5} m^3 volume inside a new tennis ball. Give your answer correct to one significant figure.

Question 3

(h) State *Charles' law*.

Question 4

(h) What is an *ideal gas*?

Question 5

(e) State *Gay-Lussac's law of combining volumes*.

Question 6

(a) State *Avogadro's law*. (7)

Give **two** assumptions of the kinetic theory of gases. (6)

Give **two** reasons why real gases deviate from ideal gas behaviour. (6)

How many moles of gas are present in a sample containing 1.8×10^{24} atoms of chlorine at s.t.p.? (6)

Question 7

(b) (i) State *Avogadro's law*. (7)

(ii) Carbon dioxide is stored under pressure in liquid form in a fire extinguisher. Two kilograms of carbon dioxide are released into the air as a gas on the discharge of the fire extinguisher. What volume does this gas occupy at a pressure of 1.01×10^5 Pa and a temperature of 290 K? (9)

What mass of helium gas would occupy the same volume at the same temperature and pressure? (6)

(iii) Give **one** reason why carbon dioxide is more easily liquefied than helium. (3)

Question 8

(a) (i) What is an *ideal gas*? (4)

(ii) Give **one** reason why a real gas like carbon dioxide deviates from ideal behaviour. (3)

(iii) Assuming ideal behaviour, how many moles of carbon dioxide are present in 720 cm^3 of the gas at 10 °C and a pressure of 1×10^5 Pa? Give your answer correct to one significant figure. (9)

(iv) How many molecules of carbon dioxide are present in this quantity of carbon dioxide? (3)

(v) The reaction between carbon dioxide and limewater is represented by the following balanced equation.

$$Ca(OH)_2 \quad + \quad CO_2 \quad \longrightarrow \quad CaCO_3 \quad + \quad H_2O$$

What mass of calcium hydroxide is required to react completely with the quantity of carbon dioxide gas given in (iii) above? (6)

Question 9

(b) (i) Define *a mole of a substance*. (7)

(ii) State *Avogadro's law*. (6)

(iii) A foil balloon has a capacity of 10 litres. How many atoms of helium occupy this balloon when it is filled with a 10% (v/v) mixture of helium in air at room temperature and pressure? (12)

3. The relative molecular mass of a volatile liquid can be found by means of a procedure involving the use of either apparatus **A** or apparatus **B** shown below.
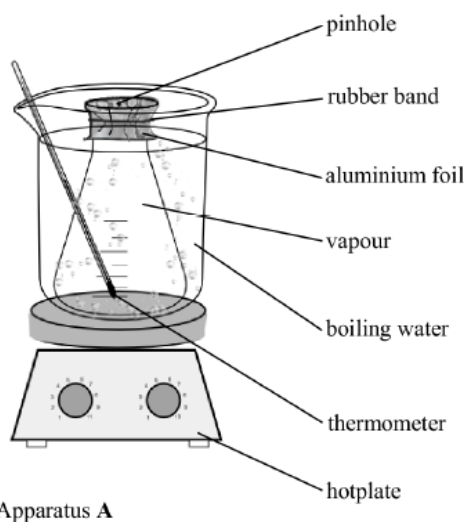
   (a) Give an example of a liquid suitable for use in this experiment.   (5)

   (b) Describe how (i) the mass, (ii) the volume, of the vapour is determined.   (15)
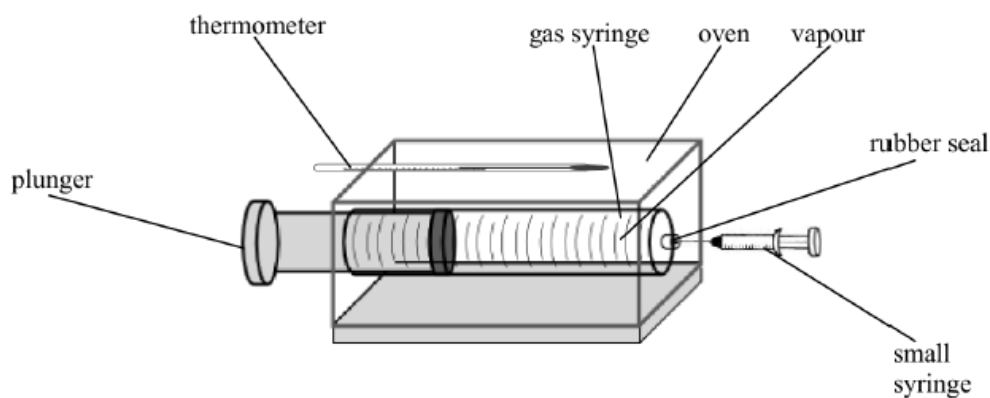
   (c) Explain why the pressure of the vapour is the same as atmospheric pressure.   (6)

   (d) The vapour of 0.63 g of a pure liquid occupies a volume of 330 cm^3 at a temperature of 100 °C and at a pressure of 101 kPa.

   Calculate the number of moles of vapour and hence calculate the relative molecular mass of the volatile liquid.   (15)

   (e) Why is this method unsuitable for liquids that are non-volatile?

   What modern instrumental technique could be used as a more accurate method to measure the relative molecular masses of volatile and non-volatile liquids as well as of solid and gaseous substances?   (9)

Apparatus **A**

Apparatus **B**