2001 HIGHER SCHOOL CERTIFICATE EXAMINATION

Chemistry

Section I – Part B (continued)

Marks

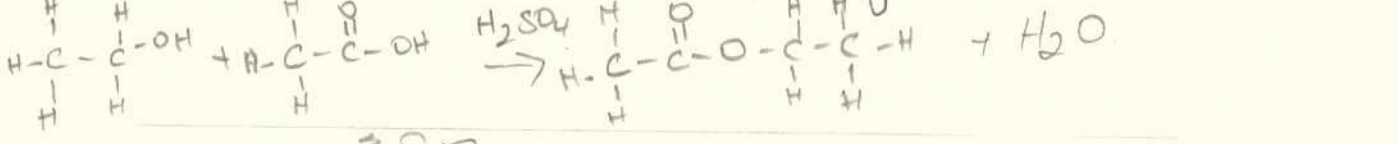
Question 22 (6 marks)

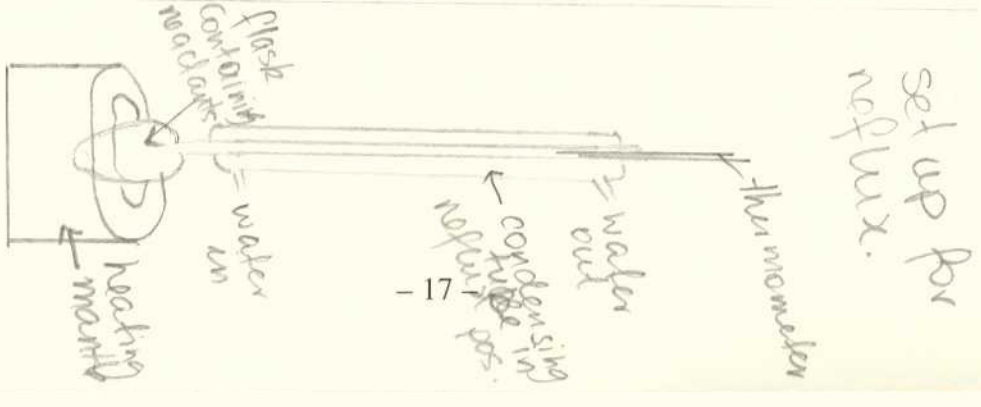
Justify the procedure you used to prepare an ester in a school laboratory. Include relevant chemical equations in your answer. **6**

In the laboratory many esters can be made including ethyl ethanoate (used as a solvent eg nail polish remover). This is done by refluxing ethanol and ethanoic acid with a strong H_2SO_4 catalyst. The mixture is heated using a heating mantle or a water bath so that no flames are exposed to the chemicals (they are highly reactive). It is also due to this reason that the method of refluxing is used, refluxing allows any evaporated substances to condence and continue the reaction.

ALCOHOL + ACID $\xrightarrow{H_2SO_4}$ ESTER + H_2O

ethanol + ethanoic acid $\xrightarrow{H_2SO_4}$ ethyl ethanoate + H_2O





Marks

Question 23 (4 marks)

n = m

A household cleaning agent contains a weak base of general formula NaX. 1.00 g of this compound was dissolved in 100.0 mL of water. A 20.0 mL sample of the solution was titrated with 0.1000 mol L^{-1} hydrochloric acid and required 24.4 mL of the acid for neutralisation.

(a) What is the Brönsted–Lowry definition of a base? **1**

Base is a proton acceptor.

(b) What is the molar mass of this base? **3**

$2HCl_{(aq)} + 2NaX_{(aq)} \longrightarrow 2NaCl + H_2O_{(l)}$

$n(HCl) = cV = .1000 \times 24.4 \times 10^{-3}$

$= 2.4 \times 10^{-3}$ mol

$n(HCl) : n(NaX) = 1 : 1$

$\therefore n(NaX) = 2.4 \times 10^{-3}$ mol

$NaX + H_2O \rightleftharpoons OH^- + NaHX^+$

2.4×10^{-3} mol of base in 20.0 mL ~~sample~~

$\therefore$ in 100 mL there are 0.012 mol of base

$(NaX)\ n = \frac{m}{M}$

$M = \frac{m}{n} = \frac{1.00}{.012} = 83.\dot{3}$ g mol^{-1}

Since Na ≐ 23

the ~~rest~~ rest should add to ≐ 60

$\therefore$ base is $NaHCO_3$ with a molar mass of 84 g mol^{-1}

$NaX \rightleftharpoons Na^+ + HCO_3^-$

Marks

Question 24 (6 marks)

In the early twentieth century, Fritz Haber developed a method for producing ammonia, as shown by the equation:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

(a) Ammonia is used as a cleaning agent. State ONE other use of ammonia. **1**

Used in ~~fertilisers~~ fertilisers

(b) Explain the effect of liquefying the ammonia on the yield of the reaction. **2**

As ammonia (the product) is liquified and removed, this forces the reaction to continue because equilibrium is never reached if the product is continually removed.

(c) Explain why it is essential to monitor the temperature and pressure inside the reaction vessel. **3**

Temperature is important as it controls the rate of reaction and product position of equilibrium. Slight temperature changes can alter the amount of product & reactant which can throw off the delicate balance of the reaction. Pressure must be kept fairly high because this favours the side with fewer molecules ($2NH_3$). If pressure drops, the less NH_3 is formed which is undesirable.