2001 HIGHER SCHOOL CERTIFICATE EXAMINATION

Chemistry

Section I – Part B (continued)

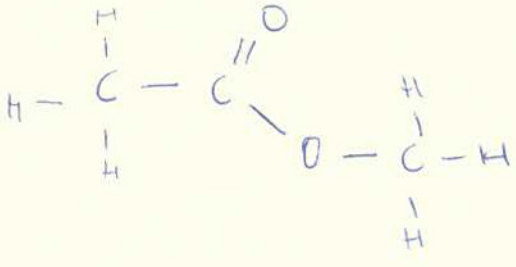
Marks

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**

An alkanol was added to an alkanoic acid, to give an ester. Concentrated sulfuric acid was added to ~~me~~ act as a catalyst and ~~speed up~~ the reaction. Heating also increases the rate of reaction therefore ~~wha~~ we heated the mixture using a bunsen ~~burner~~ burner. Alkanols have a fairly low boiling point so ~~wha~~ we used refluxing to cool (and condense) any alkanol that evaporated to it would return to the solution (also speeding up the reaction). An example of an ester we made was methyl ethanoate from methanol and acetic (ethanoic) acid.

$CH_3OH + CH_3COOH \rightarrow CH_3COOCH_3 + H_2O$



Marks

Question 23 (4 marks)

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**

A Base is a proton acceptor.

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

$n = \frac{1}{NaX}$

$n = \frac{1}{22.99 + X_{MM}}$

$n = \frac{mass}{Molar\ Mass\ NaX}$

$n = \frac{1}{MM\ NaX}$

$20 \times 10^{-3} \times C_{NaX} = 24.4 \times 10^{-3} \times 0.1000$

$20 \times 10^{-3} \times C_{NaX} = 2.44 \times 10^{-3}$

$C_{NaX} = \frac{2.44 \times 10^{-3}}{20 \times 10^{-3}}$

$C_{NaX} = 0.122$

$0.122 \times 100 = 12.2$

$n = 12.2 \times 20 \times 10^{-3}$

$n =$

$n = cV$

$= 20 \times 10^{-3} \times 0.122$

$n = 2.44 \times 10^{-3}$

diluted by factor 100!

$n = CV$

1g in 100mL

$2.4 \times 10^{-3} = \frac{1}{MM}$

$MM = \frac{1}{2.44 \times 10^{-3}}$

Molar Mass NaX $= 409.8$

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**

Fertilises

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

Liquefying the ammonia would effectively reduce the gas molecules on the right hand side to none. The equilibrium would shift to the right and the yield of the reaction would increase.

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

Temperature and pressure must be monitored to maintain an optimum yield. Increasing the pressure shifts the equilibrium right by Le chatelier, but if the pressure is too high then the vessel will explode so the pressure is monitored at 25x atmospheres and the vessel has very thick walls. If temp ↑, the ~~rea~~ rate of reaction increases ~~by~~ but equilibrium shifts ← As temp ↓ ~~equilib~~ equilibrium shifts → but the reaction occurs very slowly. An optimum temperature of 700K is therefore maintained & must be monitored.