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

+ Esterification involved distilling
the reaction [carboxylic acid + alkanol (⇌)]
                    (alkyl)alkanoate + water]
solution was boiled, using boiling chips
for even heat distribution, to
cause vaporisation of soln.
Refluxing at high temperatures (to increase yield)
of the mixture to form the water
and alkanoate so as not to
allow volatile reagents to escape.
The apparatus – cooling condenser"
contained water, running into and
out of, so as to cool the vapour →
which could be reused in the reaction
to produce optimum yield of the ester.
A water bath would protect volatile/flammable
reactants from flame.

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 proton exceptor

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

$C = \dfrac{n}{V}$

$n = \dfrac{m}{mm}$

$mm \times n = m$

1g of NaX   100ml H_2O 0.1mol L^{-1} HCl
20ml   24.4ml of HCl

$mm = 22.99 + x$

NaX + HCl ⟶ NaCl + XH

Conc. of HCl = $\dfrac{0.1}{24.4}$ = 4.098×10^{-3}

∴ Conc. of NaX = 4.098×10^{-3}

$C \times V = n$ $n = 4.098 \times 10^{-3} \times 20$

$mm = \dfrac{m}{n}$ = 0.08196.... mol L^{-1} NaX
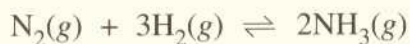
$mm = \dfrac{1}{0.08196...}$

$mm = 12.2$

Question 24 (6 marks)

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

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

$\Downarrow T =$ liquid.

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

~~production of~~ fertilisers

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

By decreasing the temperature, the ammonia liquifies and therefore the yeild is increased as decreased temperatures (according to Le Chattlier's) favours the exothermic reaction, (ie the poduction of NH_3).

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

Temperature because a lower temperature according to Le Chatliers principle favours the exothermic reaction, in this case the production of NH_3. A compromise temperature must be mointored as lower temperature produces slower reaction rates and is ∴ not economical.

Pressure must be because increased pressure increases the production of NH_3 due to Le Chattlers principle which states that increased pressure favours the reaction that has the no. of molecules (ie NH_3 ratio 4:2). It must be monitored aswell because pressure is expensive.