

Chemistry

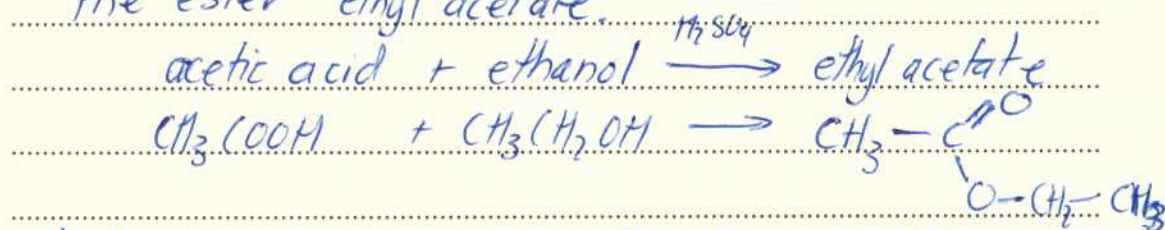
Section I – Part B (continued)

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

To produce an ester we collected a bunsen burner, refluxing unit and ~~beaker~~ flask. Into the flask we added acetic acid and ethanol, then we placed the beaker in a water bath to maintain safe and consistent heating throughout the experiment. We then attached the refluxing unit to two water pipes so that when we began the experiment the gases would be condensed and not released as alcohol vapour ~~to the~~ in the air which is harmful to humans. The experiment produced the ester ethyl acetate.



In the experiment we used sulfuric acid to act as a catalyst which sped up the experiment which would otherwise occur too slowly at room temp.

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 Brønsted–Lowry definition of a base?
- 1

base is proton acceptor hence a new result is
form \Rightarrow a new base and conjugate acid

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

$$C_{\text{HCl}} = 0.1000 \text{ mol/L}$$

$$V_{\text{HCl}} = 24.4 \text{ mL} = 0.0244 \text{ L}$$

$$n_{\text{HCl}} = CV = 0.1000 \times 0.0244$$

$$= 2.44 \times 10^{-3} \text{ moles of HCl acid.}$$

1:1 ratio

$$n_{\text{NaX}} = 2.44 \times 10^{-3} \text{ moles}$$

$$V_{\text{NaX}} = 20 \text{ mL} = 0.02 \text{ L}$$

$$C_{\text{NaX}} = \frac{n}{V} = \frac{2.44 \times 10^{-3}}{0.02} = 0.122 \text{ mol/L of dilute acid.}$$

• let the $n_{\text{NaX}} = 2.44 \times 10^{-3}$ be the moles of the base

• let the mass $m_{\text{NaX}} = 1.00 \text{ g}$

• so, $n = \frac{m}{M}$, \neq

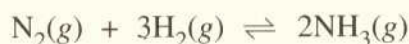
$$M = \frac{m}{n}$$

$$= \frac{1.00}{2.44 \times 10^{-3}}$$

$$= 2.44 \times 10^{-3} \text{ g/mol}$$

Question 24 (6 marks)

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



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

refrigeration. - cooling

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

• liquefying the yield ammonia, shifts the equilibrium reaction to the right; so that more ammonia is produced constantly, increasing the yield.

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

• essential to monitor as the temperature and pressure inside the vessel affects the yield. Temperature must be kept at a compromise. High temp. increases the yield, but takes a longer amount of time. Pressure must be continually monitored. High pressure increases the yield but can become dangerous, and unstable. Temperature + pressure maintained at a compromise, ~~between~~ to increase the efficiency of the process, keep down costs and ensure safety.