

## Chemistry

## Section I – Part B (continued)

Marks

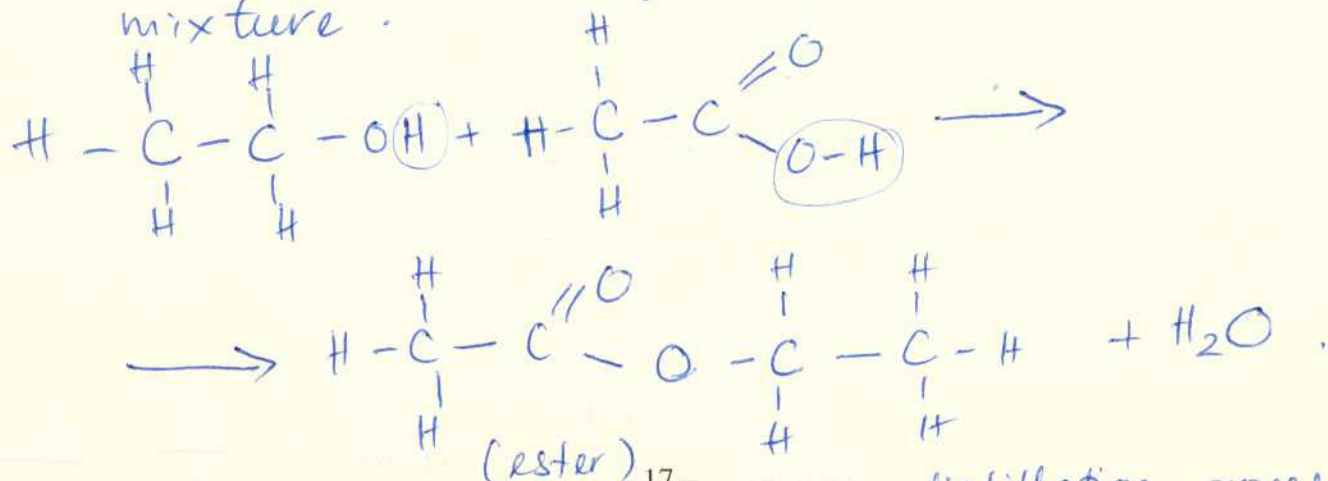
## Question 22 (6 marks)



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

6

An ester is prepared from ethanol and ethanoic acid. These two solutions are measured and mixed in a pear shape flask. Concentrated Sulphuric acid is added into the flask to act as a catalyst to increase the reaction rate. The flask is then connected to a tube with condensers attached, <sup>with one</sup> connected to water tap. The flask is now heated with a bunsen burner and the tap is turned on so that any volatile vapour can quickly be condensed back into the flask, preventing vapour loss. After heating and refluxing, two layers should form, the top layer is the ester and the bottom layer should be the aqueous mixture.



Now the mixture is subject to distillation process where each liquid can be collected orderly. The ester can be collected in the second beaker.

## 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  $0.1000 \text{ mol L}^{-1}$  hydrochloric acid and required 24.4 mL of the acid for neutralisation.

- (a) What is the Brønsted–Lowry definition of a base? 1

A base is a proton acceptor.

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

$$n(\text{HCl}) = cV$$

$$= \frac{24.4}{1000} \times 0.1$$

$$= 0.00244$$

Assuming that 1 mole HCl = 1 mole NaX,

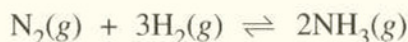
$$0.00244 = \frac{m}{M}$$

$$\therefore M(\text{NaX}) = \frac{1}{0.00244}$$

$$\text{molar mass} = 409.84 \text{ g}$$

## 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

Ammonia <sup>used as</sup> ~~is~~ a direct ingredient in the production of fertilizer

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

By liquefying the ammonia produced, the conc. of  $\text{NH}_3$  gas is decreased, forcing the equilibrium to the right ~~so~~, and thus increasing the products (& hence the ~~yield~~ yield) of the reaction, as according to Le Chatelier's principle.

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

The conditions - temperature & pressure must be monitored to ensure the safe & efficient production of ammonia. The temperature (normally  $525^\circ\text{C}$ ) and the pressure (35 mPa) must be kept ~~under~~ constant to maximise the rate & the yield of the reaction. Furthermore, for safety reasons, the pressure & temperature must be closely monitored.

→ and ensure that the reaction continues as efficiently as possible to produce the yield required in the time desired.