2001 HIGHER SCHOOL CERTIFICATE EXAMINATION

Chemistry

Section I – Part B (continued)

Marks

Question 22 (6 marks)

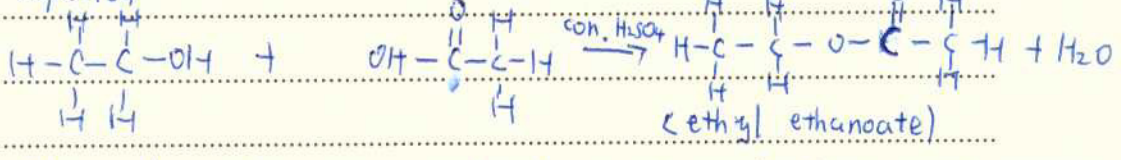
Justify the procedure you used to prepare an ester in a school laboratory. Include relevant chemical equations in your answer. **6**

1. Prepared samples of ethanol and ethanoic acid, which ~~are~~ were the reactants

2. Poured them into reaction flask, added con. H_2SO_4 as catalyst

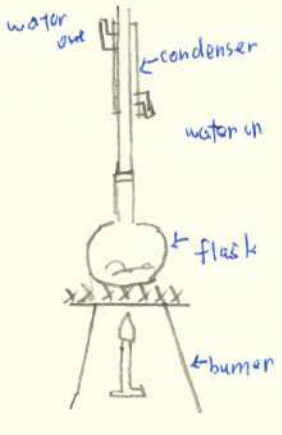
3. Set up apparatuses like the diagrams below after getting tripod, condenser and burner. The apparatuses should be ~~4. Started~~ set up near water tap because water was need to be used in condenser.

4. Started heating the ~~mix~~ reactants in the flask. Under the condition of catalyst, the concentrated H_2SO_4, the following reaction was expected



(ethyl ethanoate)

5. After the reaction was completed, ~~another~~ distillation apparatus was set up to extract ester according to the different boiling points ~~between~~ among ester, ethanol and ethanoic,



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 Lowry Brönsted base is a proton (H^+) acceptor.~~
A Brönsted-Lowry definition of a base is that of a proton (H^+) acceptor.

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

moles of HCl = $0.0244 \times 0.1 = 2.44 \times 10^{-3}$ moles.

[$HCl + NaX \rightarrow NaCl + HX$] molar ratio of 1 : 1 (X must have oxid. number -1)

in 20 mL there were 2.44×10^{-3} moles (base)

in 100 mL there are 0.0122 moles (base)

∴ 1g of base = 0.0122 moles

$n = \frac{m}{M}$ ∴ $M = \frac{m}{n}$

$= 1 \div 0.0122$

$= 81.967$ molar mass

∴ the molar mass of the weak base is approximate 82.

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**

Ammonia is used in fertilisers

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

Liquefying ammonia will increase the yield. Since the equilibrium is under relatively high pressure, by Le Chatelier's principle, it will move to the side with the least moles of gas, which in this case is ammonia.

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

The Haber process is based on a delicate balancing act. Too high a temperature and the yield of ammonia will decrease, too low a temperature & the reaction rate will be too slow. Pressure requires monitoring as the reaction vessel is limited by engineering knowledge. Like temperature, if pressure is too low, the yield of ammonia decreases, and if it is too high the system risks explosion.

Monitoring of temperature & pressure is primarily to maintain optimal yield of ammonia