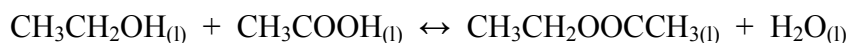


# CHEMISTRY

## Lab 13: Determination of the equilibrium constant for an esterification reaction.

**Aim:** To determine the equilibrium constant for the following esterification reaction and compare the experimental value with the actual value which is 4.0:



You must also determine if the reaction is endothermic or exothermic. At room temperature the reaction is slow and requires the use of an acid catalyst. You may find the  $K_c$  directly for the forward reaction or indirectly by calculating first the  $K_c$  for the reverse reaction. You will be divided into groups and half of you will use the direct method and the other half the indirect method.

### Procedure:

Make up the following equilibrium mixtures in a large test tube 3 times.

1. MIXTURE A (groups A):  $1.0 \text{ cm}^3$  of  $5.0 \text{ moldm}^{-3} \text{ H}_2\text{SO}_4$  +  $1.0 \text{ cm}^3$  water +  $4.0 \text{ cm}^3$  +  $\text{CH}_3\text{CH}_2\text{OOCCH}_3$

MIXTURE B (groups B):  $1.0 \text{ cm}^3$  of  $5.0 \text{ moldm}^{-3} \text{ H}_2\text{SO}_4$  +  $2.0 \text{ cm}^3 \text{ CH}_3\text{COOH}$  +  $3.0 \text{ cm}^3 \text{ CH}_3\text{CH}_2\text{OH}$

2. Stopper the test tubes and allow the mixtures to reach equilibrium over a period of one week at three different temperatures
3. Titrate the mixtures against  $2.0 \text{ NaOH (aq)}$ .
4. Also, groups A titrate  $1.0 \text{ cm}^3$  of  $5.0 \text{ moldm}^{-3} \text{ H}_2\text{SO}_4$  against  $2.0 \text{ moldm}^{-3} \text{ NaOH (aq)}$  and groups B titrate  $1.0 \text{ cm}^3$  of  $5.0 \text{ moldm}^{-3} \text{ H}_2\text{SO}_4$  +  $2.0 \text{ cm}^3 \text{ CH}_3\text{COOH}$  against  $2.0 \text{ moldm}^{-3} \text{ NaOH (aq)}$
5. Make a note of the following density values  $\text{CH}_3\text{CH}_2\text{OOCCH}_3 = 0.901 \text{ gcm}^{-3}$ , water =  $1.00 \text{ gcm}^{-3}$ ,  $\text{CH}_3\text{CH}_2\text{OH} = 0.791 \text{ gcm}^{-3}$ ,  $\text{CH}_3\text{COOH} = 1.05 \text{ gcm}^{-3}$  and  $\text{H}_2\text{SO}_4 = 1.84 \text{ gcm}^{-3}$
6. Calculate the concentrations of the reactants and products at equilibrium and find the  $K_c$ .