WJEC (Eduqas) Chemistry A-level

SP PI5.1 - Determination of an Equilibrium Constant

Methods and images taken from the WJEC practical handbook

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Aim

To determine the **equilibrium constant** for the reaction of ethanol with ethanoic acid.

Apparatus and Chemicals

- Communal burette of glacial CH_3COOH (ethanoic acid)
- Communal burette of CH_3CH_2OH (ethanol)
- Communal burette of deionised H_2O
- Communal burette of 1.0 mol dm^{-3} of HCl solution
- 2 x 100 cm^3 conical flask with stopper
- 2 x 250 cm^3 conical flask
- 50 cm^3 burette and funnel
- Burette clamp and stand
- 1.0 cm^3 measuring cylinder (or 1 cm^3 pipette with filler)
- 100 cm^3 measuring cylinder
- Deionised water in wash bottle
- Standard solution of 0.1 mol dm^{-3} sodium hydroxide solution
- Phenolphthalein

Safety Considerations

★ 1.0 mol dm^{-3} HCl solution - irritant
★ Glacial CH_3COOH - irritant
★ CH_3CH_2OH - flammable
★ 0.1 mol dm^{-3} NaOH solution - irritant

Method

Part 1

1. Prepare the **control flask** and **reaction flask** by mixing the appropriate chemicals in the quantities listed in the table below:
2. **Stopper, label and shake** both flasks and leave them for at least one week.
3. Using the densities and volumes given for each reagent, calculate the initial amount of CH_3CH_2OH, CH_3COOH and H_2O in moles. You should assume that 2.0 cm^3 of the 1.0 mol dm^{-3} HCl solution adds an extra 2.0 cm^3 of H_2O to the mixture.

All volumes in cm^3

		The control	The mixture
Reagent	**Density/g cm^{-3}**		
glacial ethanoic acid	1.05	0.0	6.0
ethanol	0.79	0.0	6.0
water	1.00	18.0	6.0
1 mol dm^{-3} hydrochloric acid	1.00	2.0	2.0
Total volume		20.0	20.0

Part 2

1. Empty the contents of the control flask mixture into a 250 cm^3 conical flask.
2. Add 100 cm^3 of deionised H_2O and 2 drops of **phenolphthalein** to the flask.
3. **Titrate** the mixture against the standard solution of NaOH. Record the results of this titration.
4. Transfer 1.0 cm^3 of the reaction mixture to a 250 cm^3 conical flask.
5. Add 100 cm^3 of deionised water and 2 drops of phenolphthalein to the flask.
6. Swirl the flask and titrate the mixture against the standard solution of sodium hydroxide solution as quickly as possible.
7. Repeat steps 4 to 6 with further 1.0 cm^3 samples of the equilibrium mixture until you have **three concordant results**.
8. Use the results of the titrations to calculate the **equilibrium constant** of the reaction.