General Certificate of Education
Advanced Level Examination
June 2011

Chemistry CHM6T/P11/task

Unit 6T A2 Investigative Skills Assignment

Task Sheet

Determination of an equilibrium constant

While investigating the reasons why human sweat has its characteristic smell, a student isolated a liquid. By performing laboratory tests this liquid was found to be propanoic acid CH_3CH_2COOH

The student examined the acid-catalysed esterification reaction between propanoic acid and ethanol in which a pleasant-smelling liquid is formed. This reaction establishes an equilibrium and the student carried out an experiment to determine the equilibrium constant, K_c, for the reaction.

In the experiment, known amounts of propanoic acid and of ethanol were mixed with a sulfuric acid catalyst and left for a number of days to reach equilibrium. Samples of the equilibrium mixture were then titrated with sodium hydroxide solution to allow the amount of acid at equilibrium to be determined.

You will perform the Task in two parts as follows.

Part 1 Prepare a mixture of propanoic acid, ethanol and acid catalyst and allow this to reach equilibrium.

Part 2 Titrate a sample of this equilibrium mixture with sodium hydroxide solution.

Wear eye protection at all times.

Assume that all substances are toxic, flammable and irritant.

Procedure

Part 1 Preparing the equilibrium mixture

1 Label a boiling tube with your name.

2 Use the burettes supplied to prepare a mixture in your boiling tube by adding 7.00 cm^3 of propanoic acid, 7.00 cm^3 of ethanol, followed by 2.00 cm^3 of dilute sulfuric acid.

3 Swirl the mixture, cover tightly with some cling film and leave the mixture to reach equilibrium for at least one week. You will complete the Task at a later stage.

Part 2 Titrating the equilibrium mixture

1 Rinse a clean 250 cm^3 volumetric (graduated) flask with distilled or deionised water.
Use a funnel to transfer the contents of the boiling tube you prepared in **Part 1** into the flask.
Rinse the boiling tube with water and add the washings to the volumetric flask.

2 Use distilled or deionised water to make up the solution in the volumetric flask to exactly 250 cm^3.
Stopper the flask, then invert and shake the contents **thoroughly**. You may see two layers in the flask. In this case, continue shaking the flask until the two layers become a uniform mixture.

3 Use a pipette filler to rinse the pipette with the diluted equilibrium mixture from the volumetric flask. You may find it helpful to pour some of this solution into a beaker first. Use the pipette to transfer 25.0 cm^3 of the diluted equilibrium mixture to a 250 cm^3 conical flask.

4 Add 3 or 4 drops of phenolphthalein indicator to the conical flask.

5 Rinse the burette with the sodium hydroxide solution provided. Set up the burette and use a funnel to fill it with the sodium hydroxide solution. Record the initial burette reading in a table of your own design on the Candidate Results Sheet.

6 Add the sodium hydroxide solution from the burette until the mixture in the conical flask just turns pink. Record this burette reading in your table. The colour may fade after a short time. You should ignore this.

7 Dispose of the contents of your conical flask as instructed by your teacher.

8 Rinse the conical flask with distilled or deionised water.
Repeat the titration until you obtain a minimum of **two** concordant titres.
You should do no more than five titrations.

Have one of your final burette readings checked by your teacher.

9 Calculate and record the average titre on the Candidate Results Sheet.
Indicate clearly the titres you used to calculate this average titre.

You are not required to carry out any further calculations on the Candidate Results Sheet.
You will use your result to determine a value for the equilibrium constant in **Section A** of the Written Test.

ISA CHM6T/P11 Candidate Results Sheet

Centre Number | | | | | | Teacher Group .....

Candidate Name ..... Candidate Number | | | | |

Results

Record your titration results in an appropriate table in the space below.

For Teacher's use only					
B		R		P	
C		A			

Average titre / cm^3.....