



General Certificate of Education  
Advanced Level Examination  
June 2014

**Chemistry**

**CHM6T/P14/TN**

**Unit 6T A2 Investigative Skills Assignment**

**Teachers' Notes**

**Confidential**

The Exams Officer should make two copies of these Teachers' Notes; one copy for the Head of A-level Chemistry and one for the technician. These copies can be released to the Head of A-level Chemistry and the technician at any point following publication but must be kept under secure conditions at all times. Teachers can have sight of the Teachers' Notes but no further copies should be made.

All teacher-assessed marks to be returned to AQA by 15 May

## Teachers' Notes

## Confidential

These notes must be read in conjunction with the **Instructions for the Administration of the Investigative Skills Assignment: A-level Chemistry** published on the AQA Website. Please note that these have been revised for 2014.

### The determination of an equilibrium constant

#### Part 1

In this part of the task, known amounts of ethanoic acid and of propan-1-ol are mixed with sulfuric acid. This part of the investigation should take no more than 30 minutes. These mixtures must then be **left for at least 1 week at room temperature** to reach equilibrium.

#### Part 2

After standing for at least 1 week, water is added to the mixture to 'freeze' the equilibrium and the mixture made up to 250 cm<sup>3</sup> in a volumetric flask. Samples of the diluted equilibrium mixture are then titrated with sodium hydroxide solution to allow the amount of acid at equilibrium to be determined.

Since the components of the equilibrium mixture have pungent odours, teachers should give specific advice to candidates on the disposal of the contents of their conical flask after titration.

#### Materials

Each candidate should have access to the following reagents. Communal burettes should be used in **Part 1**. These burettes will require some refilling by supervisors during the session and are best placed in a fume cupboard or in a well-ventilated laboratory.

Reagent	Quality/concentration	Volume	Note
<b>Part 1 Setting up the equilibrium mixture</b>			
Ethanoic acid*	Pure liquid (may be called 'glacial')		In burette labelled <b>'Ethanoic acid'</b>
Propan-1-ol*	Pure liquid		In burette labelled <b>'Propan-1-ol'</b>
Sulfuric acid	0.95–1.05 mol dm <sup>-3</sup>		In burette labelled <b>'Sulfuric acid'</b>
<b>Part 2 Titrating the equilibrium mixture</b>			
Sodium hydroxide solution	0.190–0.210 mol dm <sup>-3</sup>	150 cm <sup>3</sup>	Labelled <b>'Sodium hydroxide solution'</b>
Phenolphthalein	Standard indicator		Individual supplies <b>not</b> required

\*Technical grade quality only required.

Candidates **must** carry out **Part 2** of the task using their own equilibrium mixture from **Part 1**.

## General

It is the responsibility of the centre to ensure that the investigation works with the materials provided to the candidates **before** candidates carry out the task.

Spare supplies of all chemicals specified in these notes must be available.

Teachers should check that the boiling tubes are properly sealed with cling film before storage. An elastic band may help to ensure a good seal.

It is recommended that the samples are stored at room temperature in a regularly heated laboratory or preparation room so that equilibrium can be established in approximately 1 week.

It is also advised that spare mixtures from **Part 1** are prepared by the centre in case of need. Examples of such need would include:

- spillage or dropping of the sample before placing in the volumetric flask
- making up the volume in the volumetric flask significantly above the mark
- realisation that the sample in the volumetric flask had been insufficiently mixed, ie a heterogeneous mixture.

Please note that in the Marking Guidelines a penalty is imposed in such circumstances.

If you have any queries about the practical work for the ISA, please contact your Assessment Adviser. Contact details for your Assessment Adviser can be obtained by emailing your centre name and number to [science-gce@aqa.org.uk](mailto:science-gce@aqa.org.uk)

## Apparatus

Each candidate will require the following:

### Part 1 Setting up the equilibrium mixture

- boiling tube and label
- cling film
- eye protection

### Part 2 Titrating the equilibrium mixture

- 250 cm<sup>3</sup> volumetric flask and stopper
- plentiful supply of distilled or deionised water
- two filter funnels (suitable for filling a burette and a volumetric flask)
- 50 cm<sup>3</sup> burette and stand
- 25 cm<sup>3</sup> pipette
- pipette filler
- 250 cm<sup>3</sup> conical flask
- two 100 cm<sup>3</sup> beakers
- eye protection.

### Checking the burette reading

In the task, candidates are instructed to have one of their final burette readings checked by their teacher in order to assess their ability to read the burette. If a candidate does not read the burette correctly, the teacher must tell the candidate the correct reading and not award this mark. This is to ensure that a candidate does not lose several accuracy marks because of an incorrect reading.

### Risk assessment and risk management

Risk assessment and risk management are the responsibility of the centre.

### Notes from CLEAPSS

Technicians/teachers should always follow the latest CLEAPSS Hazcards or safety data sheets provided by the supplier for guidance on handling reagents. The worldwide regulations covering the labelling of reagents by suppliers have changed. More details about these changes can be found in CLEAPSS secondary science guidance leaflets, including GL101, which is an introduction to classification, labelling and packaging (CLP): chemical hazard labelling.

### Additional information

AQA might publish additional information about an ISA practical. This will be placed on e-AQA in Secure Key Materials. We will email Exams Officers who have downloaded the particular Teachers' Notes so they can print a copy for the Head of A-level Chemistry. Additional information may cover issues such as suitable suppliers or tips on getting a practical to work.

### Teacher results

A teacher must carry out the task, using similar apparatus and samples of the same stock solutions/chemicals as the candidates, in order to obtain teacher results. This must **not** be done in the presence of candidates.

Teacher results:

- are required for each group of candidates
- must be recorded on the Teacher Results Sheet
- are used to assess the accuracy of candidates' results
- must be included with the sample sent to the moderator.

In order to ensure that each candidate can be matched to the appropriate teacher result, teachers must:

- complete all details on each Teacher Results Sheet
- ensure that all candidates complete all details on the Candidate Results Sheet, clearly identifying their teaching group and/or teacher.

### Centres with more than one teaching set

Centres may wish to divide their candidates into manageable groups and to conduct the task at different times. This is acceptable provided that candidates in a later session are given a solution of sodium hydroxide whose concentration is slightly different from that given to candidates in the earlier sessions.

Each centre must arrange for all of their candidates to complete a particular ISA Written Test on the same day within the assessment window.

### Data Sheet

Centres should be aware that the three tables of data on the Data Sheet have been relabelled for the 2014 assessments. As a consequence, centres must ensure that candidates use the version provided at the end of the ISA Written Test and not any version previously supplied.

### Information to be given to candidates

Candidates **must not** be given information about an ISA assessment until 1 week before Part 1.

One week before Part 1, candidates should be given the following information.

The aim of this task is the determination of an equilibrium constant. The main areas of the specification in the Written Test include Section 3.1.2 (Amount of Substance), Section 3.2.10 (Alcohols), Section 3.4.2 (Equilibria), Section 3.4.3 (Acids and Bases) and Section 3.4.5 (Compounds Containing the Carbonyl Group).

There **must** be no further discussion and candidates **must not** be given any further resources to prepare for the assessment.

**ISA CHM6T/P14 Teacher Results Sheet**Centre Number 

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Teacher Name ..... Teacher Group .....

**Results**

Please record your titration results in the table below. Indicate the average titre you obtained and the concentration of the sodium hydroxide solution used by the group (to 3 significant figures).

Final burette reading / cm <sup>3</sup>				
Initial burette reading / cm <sup>3</sup>				
Volume of NaOH used / cm <sup>3</sup>				
Tick the titres to be used in calculating the average titre				

Average titre / cm <sup>3</sup>		Concentration of NaOH(aq)	..... mol dm <sup>-3</sup>
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**This sheet may be photocopied**

## Task Sheet

### The determination of an equilibrium constant

Some esters are sweet-smelling organic compounds that have a range of uses as pleasant flavours and odours.

In this task, you will investigate the reaction in which ethanoic acid and propan-1-ol form a pleasant-smelling liquid ester. The reaction is slow and sufficient time must be allowed for this mixture to establish an equilibrium. You will then carry out an experiment to determine the equilibrium constant,  $K_c$ , for the reaction.

The task is in two parts.

**Part 1** Known amounts of ethanoic acid and of propan-1-ol are mixed with sulfuric acid and left for at least 1 week to reach equilibrium.

**Part 2** This equilibrium mixture is added to a large volume of water that effectively stops the reversible reaction. Samples of this diluted equilibrium mixture are then titrated with sodium hydroxide solution in order to determine the amount of acid in this mixture.

#### Procedure

- **Wear eye protection at all times.**
- **Assume that all substances are toxic, flammable and irritant.**

#### Part 1 Preparing the equilibrium mixture

- 1 Label a boiling tube with your name.
- 2 Use the burettes supplied to prepare a mixture in this boiling tube by adding  $6.0 \text{ cm}^3$  of ethanoic acid,  $6.0 \text{ cm}^3$  of propan-1-ol, followed by  $2.0 \text{ cm}^3$  of dilute sulfuric acid. It is important that these volumes are measured as accurately as possible.
- 3 Seal the boiling tube tightly with cling film.  
Swirl the mixture so that the contents are thoroughly mixed.  
Leave this mixture for at least 1 week to reach equilibrium.  
You will use this mixture in Part 2 of the task.

## Part 2 Titrating the equilibrium mixture

- 1 Rinse a clean 250 cm<sup>3</sup> volumetric (graduated) flask with distilled or deionised water. Use a funnel to transfer all the contents of the boiling tube you prepared in Part 1 into the flask. Rinse the boiling tube with distilled or deionised water twice and add these washings to the volumetric flask.
- 2 Use distilled or deionised water to make up the solution in the volumetric flask to 250 cm<sup>3</sup>. Stopper the flask, then invert and shake the contents **thoroughly**. You may see two layers in the flask. In this case, continue inverting and shaking the flask until the two layers are thoroughly mixed.
- 3 Use a pipette filler to rinse a pipette with the diluted equilibrium mixture from the volumetric flask. You may find it helpful to pour some of the diluted equilibrium mixture into a beaker first. Use the pipette to transfer 25.0 cm<sup>3</sup> of the diluted equilibrium mixture to a 250 cm<sup>3</sup> conical flask.
- 4 Add 3 or 4 drops of phenolphthalein indicator to the conical flask.
- 5 Rinse a burette with the sodium hydroxide solution provided. Set up the burette and use a clean funnel to fill it with the 0.200 mol dm<sup>-3</sup> 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 whole of the mixture in the conical flask first turns pink. The pink colour may fade after a short time. You should ignore this. Record this burette reading in your table.
- 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. Show 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 results in **Section A** of the Written Test.