Rewarding Learning

Centre Number	
71	

Candidate Number

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2009

Chemistry

Assessment Unit AS 3

assessing

Module 3: Practical Examination 2

[ASC32]

ASC32

FRIDAY 15 MAY, MORNING

TIME

2 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Answer **all four** questions.
Write your answers in the spaces provided.

INFORMATION FOR CANDIDATES

The total mark for this paper is 90.
Questions 1 and 2 are practical exercises each worth 25 marks.
Question 3 is a planning exercise worth 20 marks.
Question 4 is a written question testing aspects of experimental chemistry worth 20 marks.
You may have access to notes, textbooks and other materials to assist you.
A Periodic Table of Elements (including some data) is provided.

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
Total Marks	

1 Observation/deduction

Safety goggles must be worn at all times and care should be exercised during this examination.

Answer parts **(a)** and **(b)** of question 1.

(a) You are provided with a mixture of two salts, labelled Y, which have a common anion. Carry out the following experiments on Y. Record your observations and deductions in the spaces below and identify the two salts.

Experiment	Observations	Deductions
(i) Describe the appearance of Y.		
(ii) Make a solution of Y by dissolving a half spatula-measure of Y in a test tube half full of water. Place 1 cm^3 of this solution in a test tube with 1 cm^3 of dilute nitric acid and 1 cm^3 of silver nitrate solution. Add 2 cm^3 of dilute ammonia solution to the test tube.		
(iii) Place a half spatula-measure of Y on a watch-glass and add 3 drops of **concentrated** hydrochloric acid. Use a clean loop of nichrome wire to place a small amount of this acidified sample of Y in a blue Bunsen flame.		
(iv) Place a spatula-measure of Y in a test tube and add 2 cm^3 of dilute sodium hydroxide solution and warm gently. Test any gas evolved with damp Universal Indicator paper.		

Name the **two** salts in Y _____

_____

(b) You are supplied with three halobutanes labelled P, Q and R. Carry out the following experiment and complete the table below. Identify P, Q and R.

Experiment	Observations	Deductions
Place 1 cm^3 of P, Q and R separately in three test tubes. Label the test tubes with their contents. Add 1 cm^3 of ethanol and 1 cm^3 of silver nitrate solution to each test tube. Place the three test tubes in a beaker of water heated to just below boiling point. Leave for 5 minutes.	P	P
	Q	Q
	R	R

P is _____

Q is _____

R is _____ [25]

2 Titration

(a) You are provided with:

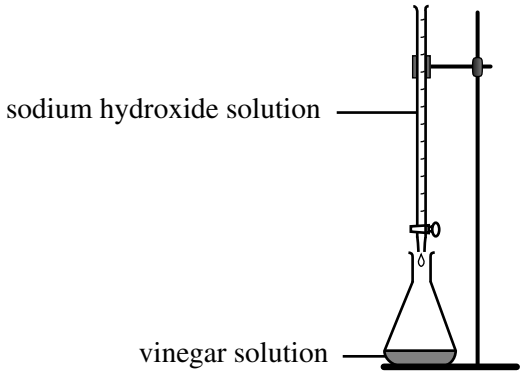
sodium hydroxide solution, 0.1 mol dm^{-3}
vinegar solution of unknown concentration
phenolphthalein indicator

You are required to:

(i) titrate the vinegar solution against the sodium hydroxide solution using phenolphthalein as indicator;

(ii) use your results to determine the concentration of the vinegar.

Procedure



- Rinse out a pipette with the vinegar solution.
- Using the pipette and pipette filler, place 25.0 cm^3 of the vinegar solution in the conical flask.
- Rinse out a burette with the sodium hydroxide solution.
- Fill the burette with the sodium hydroxide solution.
- Add 2 or 3 drops of phenolphthalein indicator to the conical flask, and titrate until the end point is reached.
- Record the results of one rough and two accurate titrations in the table.

Results

	Initial burette reading/cm^3	**Final burette reading/cm^3**	**Titre/cm^3**
Rough			
1st accurate			
2nd accurate			

Average titre _____ cm^3 [15]

Examiner Only	
Marks	Remark

(b) **(i)** State the colour change at the end point.

from _____ to _____ [1]

(ii) Calculate the number of moles of sodium hydroxide used in the titration.

_____

_____ [2]

(iii) Write the equation for the reaction of sodium hydroxide with ethanoic acid, CH_3COOH.

_____ [2]

(iv) Deduce the number of moles of ethanoic acid present in 25.0 cm^3 of the vinegar solution.

_____ [1]

(v) Calculate the number of moles of ethanoic acid present in 1 dm^3 of the vinegar solution.

_____

_____

_____ [2]

(vi) Convert your value of moles of ethanoic acid calculated in **(v)** into grams of ethanoic acid.

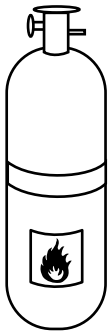
_____

_____ [2]

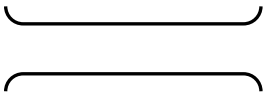
3 Planning

You are required to plan an experiment to determine the empirical formula of an o titanium by heating titanium in a stream of oxygen. You are provided with the follow apparatus:

an oxygen cylinder

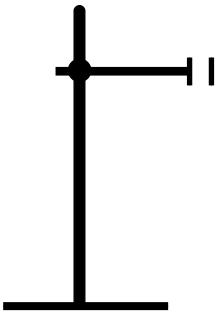


a hard glass tube

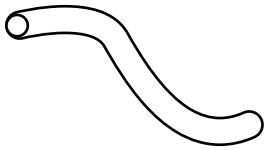


a sample of titanium powder

two clamp stands



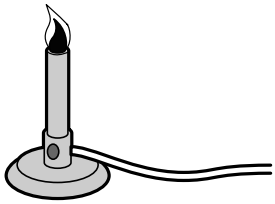
rubber tubing



two bungs with glass tubing

a ceramic container

Bunsen burner



An appropriate procedure would involve:

- measuring the mass of the ceramic container plus titanium,
- passing oxygen gas over the heated titanium,
- allowing the apparatus to cool,
- measuring the mass of the titanium oxide remaining after the reaction.

(a) Draw a **labelled** diagram to show how the apparatus would be arranged to carry out the experiment.

[3]

(b) Before the cylinder is used, a test is carried out to see if the gas inside is oxygen. Describe a suitable test.

_____

_____ [2]

(c) Titanium has a melting point of 1660 °C which is similar to that of iron.

(i) Explain whether the titanium will melt during the experiment.

_____

_____ [1]

(ii) The titanium could be a solid lump or powdered before it is weighed. Explain if there is any advantage in powdering the titanium.

_____

_____ [2]

(d) State **two** weighings that would be made to determine the mass of titanium used.

_____

_____ [2]

(e) To ensure that the titanium has reacted completely, the ceramic container holding the titanium can be weighed, heated again and reweighed. What result would be expected?

_____

_____ [1]

(f) Hot titanium reacts with water vapour to produce titanium oxide and hydrogen.

(i) Explain how the presence of water vapour in the oxygen gas would affect the results of the experiment.

_____

_____ [1]

(ii) Suggest how you could modify the apparatus to remove any traces of water vapour from the oxygen supply.

_____

_____ [1]

(g) At the end of the experiment, the heat was removed, but oxygen was left to flow over the titanium oxide before it was weighed. Suggest **one** reason why this procedure was carried out.

_____

_____ [1]

(h) In this experiment, 3.6 g of titanium was oxidised to form 6.0 g of titanium oxide. Calculate the empirical formula of the titanium oxide.

_____

_____

_____

_____ [3]

(i) This experiment can be used to determine the formulae of other metal oxides.

(i) Name **one** other metal that could be used.

_____ [1]

(ii) Name **one** metal that cannot be used.

_____ [1]

(iii) Explain why the metal chosen in part **(ii)** cannot be used.

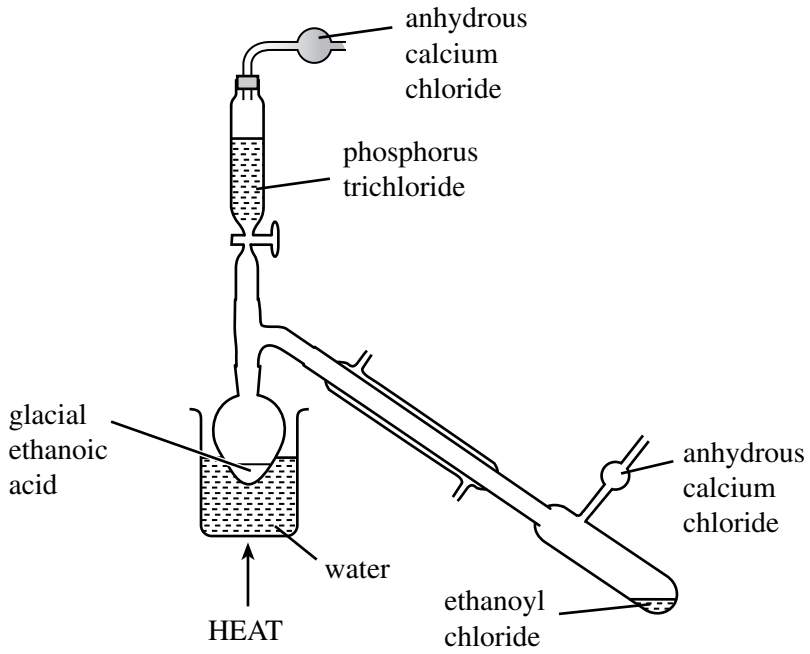
_____

_____ [1]

4 Ethanoyl chloride, CH_3COCl, is a colourless liquid (boiling point 52 °C) with a pungent smell. It is readily hydrolysed to form ethanoic acid and hydrogen chloride. Ethanoyl chloride may be prepared by the action of phosphorus trichloride, PCl_3, on glacial (pure) ethanoic acid as described below.

$$3CH_3COOH + PCl_3 \rightarrow 3CH_3COCl + H_3PO_3$$

Place 10 cm^3 of glacial ethanoic acid in a flask and set up the apparatus below.



Add 5 cm^3 of phosphorus trichloride dropwise. Once addition is complete, heat the mixture to 80–90 °C until distillation ceases.
Transfer the distillate to a clean flask and redistil, collecting the fraction between 50–55 °C. Store the ethanoyl chloride in a dry, stoppered bottle.

(a) Phosphorus trichloride undergoes rapid hydrolysis, fuming in moist air to form phosphorous acid, H_3PO_3, and hydrogen chloride.

(i) Explain the term **hydrolysis**.

_____ [2]

(ii) Write the equation for the hydrolysis of phosphorus trichloride.

_____ [2]

(iii) Suggest why the preparation of ethanoyl chloride should be carried out in a fume cupboard.

_____ [1]

(b) **(i)** What should be added to the flask to ensure smoother boiling?

_____ [1]

(ii) On the diagram opposite, label with an arrow, where the water should enter the condenser. [1]

(iii) Suggest why the tubes containing anhydrous calcium chloride are necessary.

_____

_____ [2]

(c) Name the organic impurity which could be present in the distillate collected between 80–90 °C.

_____ [1]

(d) Suggest why ethanoic acid has a much higher boiling point than ethanoyl chloride.

_____

_____ [2]

(e) **(i)** A student used 10 cm^3 of ethanoic acid in this preparation. If the density of ethanoic acid is 1.05 $g\,cm^{-3}$, calculate the mass of ethanoic acid used.

_____ [1]

(ii) Calculate the number of moles of ethanoic acid used.

_____ [1]

(iii) Calculate the relative molecular mass of ethanoyl chloride.

_____ [1]

(iv) Calculate the maximum mass of ethanoyl chloride which could be made from 10 cm^3 of ethanoic acid.

_____

_____ [1]

(v) The percentage yield was found to be 84%. Calculate the mass of ethanoyl chloride obtained.

_____

_____ [2]

(f) Both ethanoic acid and ethanoyl chloride react with alcohols to produce esters. Compare these esterification reactions using equilibrium and kinetic considerations.

_____

_____

_____ [2]

THIS IS THE END OF THE QUESTION PAPER