BINDURA UNIVERSITY OF SCIENCE EDUCATION

SCIENCE AND MATHEMATICS EDUCATION DEPARTMENT

DCH003: CHEMISTRY PRACTICALS

Time: **2Hours**

ANSWER ALL QUESTIONS. EACH QUESTION CARRIES 25 MARKS

1a. Explain the importance of practical work in chemistry to both the teacher and the learners [8 marks]

b. How does potassium permanganate act as a self indicator? [1 mark]

c. In the titration of potassium permanganate with oxalic acid, why is the oxalic acid solution warmed in the beginning? [2marks]

d. How is the strength of a solution calculated? [3 marks]

v

f. List some limitations of the volumetric analysis. [3 marks]

g. What volume of concentrated sulphuric acid is required to make 5 litre of 0.5 M H_2SO_4 solution? The concentrated sulphuric acid is 98% H_2SO_4 by mass and its density is 1.84 g cm^{-3}. [5 marks]

2. A group of students was required to determine the concentration of a solution of hydrochloric acid, HCl, provided for a titration competition. In each titration, a 25.00 cm^3 aliquot of a freshly standardised solution of 0.2450 M sodium hydroxide, NaOH, was pipetted into a conical flask and titrated against the HCl solution. An appropriate indicator was added. The experiment was repeated until three concordant results were obtained. The data for these titrations is shown in the following table

Volume of aliquot of NaOH	**25.00 cm^3**
Concentration of NaOH solution	**0.250 M**
Mean titre of HCl solution	**13.49 cm^3**

a. Based on these results, what is the concentration of HCl ? [4 marks]

b. The experimental value of the concentration of HCl obtained from these titrations was less than the actual value. What could possibly be the reason for this? [1 mark]

c. A solution contains 28.6 g/dm^3 of a metal ethane-dioate, MC_2O_4, 25 cm^3 of this solution of MC_2O_4 was placed in a titration flask together with excess dilute sulphuric acid, the titration flask solution reacted with 20.0 cm^3 of 0.1 $moldm^{-3}$ $KMnO_4$.

i. Write a balanced ionic equation for the reaction between $KMnO_4$ and MC_2O_4 [2 marks]

ii. calculate number of moles of MC_2O_4 in 1 dm^3 of solution [3 marks]

iii. Calculate the M_r of metal M in MC_2O_4 [3marks]

d. E300 is an antioxidant used in wines. The maximum concentration of E300 in drinks is 150 mg dm^{-3}.

A student took 250.0 cm^3 of wine and added 25.0 cm^3 of 0.00500 mol dm^{-3} potassium iodate, followed by excess potassium iodide solution.

$IO_3^- + 5I^- + 6H^+ \rightarrow 3I_2 + 3H_2O$

Some of the iodine formed reacted with the E300 in the wine.

$C_6H_8O_6 + I_2 \rightarrow C_6H_6O_6 + 2H^+ + 2I^-$

The amount of unreacted iodine was found by titrating with 0.00500 mol dm^{-3} sodium thiosulphate using a starch indicator. A titre of 20.40 cm^3 was recorded.

$I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$

Determine the concentration of E300 in the wine and hence whether within the limit allowed.

[7 marks]

e. The concentration of an ethanedioate solution can be found by titration with acidified potassium manganate(VII).

$5C_2O_4^{2-} + 2MnO_4^- + 16H^+ \rightarrow 10CO_2 + 2Mn^{2+} + 8H_2O$

A student dissolved potassium ethanedioate-1-water crystals in 100 cm^3 water. 25.0 cm^3 of this solution reacted with 18.40 cm^3 of 0.0500 mol dm^{-3} potassium manganate(VII) solution. Calculate the mass of $K_2C_2O_4 \cdot H_2O$ used to make up the original solution. [5 marks]

3. Design a practical to determine the enthalpy change of neutralization. Given the following materials:

Materials:

- 2 polystyrene cups
- Thermometer
- 50 mL burette
- 250 mL conical flask
- Stirring rod
- Stop watch
- 1.0 M hydrochloric acid
- 1.0 M sodium hydroxide
- Balance

[25 marks]

4. Two substances, **C** and **D**, were analysed. Solid **C** was a salt and solution **D** was an aqueous solution of chromium(III) chloride.

The tests on solid **C**, and some of the observations, are in the following table.

Test	Observation
Tests on solid **C** Solid **C** was added to distilled water in a test-tube and shaken to dissolve. The solution was divided into two portions in test-tubes, and the following tests carried out. Appearance of the solution. The pH of the first portion of the solution was tested.	 colourless liquid pH = 7
Dilute nitric acid was added to the second portion of the solution followed by aqueous silver nitrate.	cream precipitate
A flame test was carried out on solid **C**.	yellow flame colour

(a) Identify solid **C**. [2 marks]

(b) Describe the appearance of solution **D**. [1 mark]

(c) Tests were carried out on solution **D**.

Complete the observations for tests 1, 2 and 3.

(i) Test 1

Drops of aqueous sodium hydroxide were added to solution **D**. Excess aqueous sodium hydroxide was then added to the mixture.

What are the observations ? [3 marks]

(ii) Test 2

Excess aqueous ammonia was added to solution **D**.

What are the observations ? [2 marks]

(iii) Test 3

Dilute nitric acid was added to solution **D** followed by aqueous silver nitrate.

What are the observations ? [1 mark]

(d) Chromium(III) can be converted to chromium(VI). Chromium(VI) is hazardous.

Suggest **one** safety precaution when using chromium(VI). [1 mark]

(e) Two solids, **L** and **M**, were analysed. Solid **L** was copper(II) chloride and solid **M** was a different salt.

The tests on the solids, and some of the observations, are shown.

Tests on solid L

(i) Describe the appearance of solid **L**. [1mark]

(ii) Distilled water was added to solid **L** and shaken to dissolve. What was observed [1 mark]

The solution was divided into four equal portions in four test-tubes and the following tests carried out.

(iii) Drops of aqueous ammonia were added to the first portion of the solution.

Excess ammonia solution was then added to the mixture and shaken.

What are the observations [4 marks]

(iv) Excess aqueous sodium hydroxide was added to the second portion of the solution. What is the observation [1 mark]

(v) Dilute nitric acid was added to the third portion of the solution followed by aqueous silver nitrate.

What is the observation [1mark]

(vi) Dilute nitric acid was added to the fourth portion of the solution followed by aqueous barium nitrate.

What is the observation [1 mark]

Tests on solid M

Tests are carried out and the following observations made.

Tests on solid **M**	Observations
Appearance of the solid.	white crystals
The solid was heated and the gas given off was tested with damp red litmus paper.	a sublimate formed on the sides of the test-tube litmus paper turned blue
Solid **M** was dissolved in water to form a solution. Aqueous sodium hydroxide was added to the solution and the mixture heated. The gas given off was tested.	pungent gas evolved pH paper showed pH 10
Dilute nitric acid was added to the solution followed by aqueous silver nitrate.	yellow precipitate

g. Identify solid M. [2 marks]

h. Give 5 limitations of qualitative analysis practicals [5 marks]

**********END OF EXAM**********