Name…… School ……

Admission number---------- Class----------

Stream…… Signature----------

233/3

CHEMISTRY

Paper 3

PRACTICAL

2 hours 15 minutes

SUKELLEMO CHEMISTRY P 3 MARKING SCHEME

Instructions to candidates

- Answer all the questions in the spaces provided
- You are not allowed to start working with the apparatus for the first 15 minutes of the time allowed for this paper. This time is to enable you to read the question paper and make sure you have all the chemicals and the apparatus that you may need.
- Mathematical tables and silent calculators may be used.
- All working must be clearly shown where necessary.

FOR EXAMINER'S USE ONLY

Question	Maximum Score	Candidate's score
1	23	
2	09	
3	08	
Total		

Question One

You are provided with

- Aqueous sulphuric VI acid labelled **solution A**
- **Solution B** containing 8.0 g per litre of sodium carbonate
- An aqueous solution of substance C, labelled **solution C**

You are required to determine the:

- Concentration of solution A
- Enthalpy of reaction between sulphuric VI acid and substance C

PROCEDURE

A. Using a pipette and a pipette filler, place 25.0 cm^3 of **solution A** into a 250ml volumetric flask. Add distilled water to make 250cm^3 of solution. Label this **solution D**. Fill the burette with solution D. Clean the pipette and use it to place 25cm^3 of **solution B** into a conical flask, then add 2 drops of methyl orange indicator provided and then titrate with solution D. Record your results in **table 1.** Repeat the titration 2 more times and complete the table.

Table 1

	1	2	3
Final burette reading (cm^3)	***18.1***	***18.1***	***18.1***
Initial burette reading (cm^3)	***0.0***	***0.0***	***0.0***
Volume of solution D used (cm^3)	***18.1***	***18.1***	***18.1***

(3 marks)

Complete table----1 mk

Decimal----------1/2 mk

Accuracy----------1 mk

Principles of averaging----1 mk

Final answer---------- 1/2mk

Total 4 marks

Calculate the:

a). Average volume of solution D used.

$$\frac{(\mathbf{18.1} + \mathbf{18.1} + \mathbf{18.1})}{\mathbf{3}}$$

= 18.1 cm^3

b). Concentration of sodium carbonate in solution B. (Na = 23, O =16, C=12).

(1mark)

RFM of Na_2CO_3 = 106

8/106 ---------- ½ mk

= 0.0754717 M ……..1/2 mk

c). Concentration of sulphuric VI acid in solution D. (2 marks)

$Na_2CO_{3\,(aq)}$ + $H_2SO_{4\,(aq)}$ ⟶ $Na_2SO_{4\,(aq)}$ + $CO_{2\,(aq)}$ + $H_2O_{\,(l)}$

Moles of Na_2CO_3 used = $(\frac{25}{1000})$ * 0.0754717 = 0.00188679

Moles of sulphuric acid in soln D = 0.00188679

18.1 cm^3 contains 0.00188679 moles

1000 cm^3 contains $(\frac{1000}{18.1})$**** 0.00188679***

= 0.10424254 M

d). concentration of sulphuric VI acid in solution A (2 marks)

moles of acid in 250cm^3soln D = moles of acid in 25$cm^3$of soln A

= 250/1000 * 0.10424245= 0.02606064

Molarity = $(\frac{1000}{25})$**** 0.02606064= 1.0424M***

B. Label six test tubes as 1,2,3,4,5 and 6. Empty the burette, clean and fill it with **solution A.** From the burette, place 2cm^3 of solution A into test tube number 1, from the same burette place 4cm^3 of solution A into test tube number 2. Repeat the process for test tube numbers 3,4,5 and 6 as shown in table 2. Clean the burette and fill it with **solution C.** From the burette, place 14 cm^3 of solution C into a boiling tube. Measure the initial temperature of solution C and record it in **table 2.** Add contents of test tube number 1 to the boiling tube containing solution C. Stir the mixture with the thermometer. Note and record the highest temperature reached in table 2. Repeat the process with the other volumes of solution C given in **table 2** and complete the table

Table 2

Test tube number	1	2	3	4	5	6
Volume of solution **A** (cm^3)	**2**	**4**	**6**	**8**	**10**	**12**
Volume of solution **C** (cm^3)	**14**	**12**	**10**	**8**	**6**	**4**
Initial temperature of solution **C** (^{0} C).	***22.0***	**22.0**	***22.0***	***22.0***	**22.0**	***22.0***
Highest temperature of mixture (^{0} C).	***24.0***	***28.0***	***31.0***	***31.0***	***28.0***	***26.0***
Change in temperature ΔT (^{0} C)	***2.0***	***6.0***	***9.0***	***9.0***	***6.0***	***4.0-------***

Complete table ------ 3mks

Decimal----------1 mk

Accuracy ----------1 mk

Trend ----------1 mk continuous rise in temperature of mixture ½ mk followed by a constant then continuous decrease/ or continuous decrease (6 marks)

i. On the grid provided, draw a graph of ΔT (vertical axis) against volume of solution A used.

(3marks)

ii. From the graph, determine:

a). The maximum change in temperature (1 mark)

10.5 ^{0}C

- ✓ ***Correct value of ΔT from a correctly extrapolated graph with showing----1 mk***
- ✓ ***Award 1/2mk for correct showing on an extrapolated graph even if the reading of ΔT is missing***

b). The volume of solution A required to give the maximum change in temperature.
(1 mark)

6.8 cm^3

- ✓ ***Correct value of V from a correctly extrapolated gragh-------1 mark***
- ✓ ***Award ½ mk for correct showing on an extrapolated gragh even if the reading is missing***

iii. Calculate the :

a). Number of moles of sulphuric VI acid required to give the maximum change in temperature. (1 mark)

$(\frac{6.8}{1000})$ * **1.0424---------- ½ mk**

= 0.00708832 ---------- ½ mk

b). Molar enthalpy of reaction between sulphuric VI acid and substance C (in kiloJoules per mole of sulphuric VI acid used).

(Assume the specific heat capacity of the solution is 4.2 J/g/K and density of the solution is 1g/cm^3) (2 marks)

Heat evolved = 16*4.2*10.5

= 704.6 J or 0.7046 kJ ---------- ½ mk

0.00708832 → ***0.7046 kJ***

1 mole → $(0.7046/0.00708832)$ ---------- ***1mk***

= - 99.402965 ½ mk

Question Two.

You are provided with **solid Y.** Carry out the following tests and write observations and inferences in the spaces provided.

a). Place about one half of solid Y in a dry test tube and heat it strongly. Test any gas produced using blue and red litmus papers.

Observations	**Inference.**
Colourless liquid formed on the cooler parts of the test tube ½ mk ***Colourless gas with pungent smell ½ mk*** ***Red litmus turns blue ½ mk*** ***Blue litmus remains blue ½ mk*** 2 marks	***Hydrated compound ½ mk*** ***NH_4^+ present ½ mk*** 1 mark

b). Place the rest of solid Y in a boiling tube. Add about 10cm^3 of distilled water. Shake well and use 2cm^3 portions for each of the tests below.

To one portion add aqueous ammonia dropwise until excess.

Observations	**Inferences**
White precipitate insoluble in excess ***1 mark***	***Al^{3+} , Pb^{2+}, Mg^{2+} present*** ***1 mark***

ii). To the second portion add 1cm^3 of hydrochloric acid

Observations	Inference
No white precipitate ***No bubbles*** ***1 mark***	***Mg 2+ Al3+ present 1mk*** ***award Pb2+ absent ½ mk*** ***SO_3^{2-}, CO_3^{2-}absent 1mk*** ***2 marks***

iii). To the third portion, add two drops of lead (II) nitrate and heat the mixture to boiling.

Observations	Inference
White precipitate ***1 mark***	***SO_4^{2-}present*** ***1 mark***

Question Three

You are provided with an organic compound solid Z. Carry out the following tests. Record the observations and inferences in the spaces provided,

a. Place all solid Z in a boiling tube. Add about 10cm^3 of distilled water and shake. Retain the solution for use in procedure (b) (i), (ii) and (iii)

Observations	Inferences
Dissolves to form a colourless solution ***1 mark***	***Polar compound***

b. Use about $2cm^3$ portions of the mixture in a test tube for tests (i), (ii) and (iii)

i. To the first portion, add all the sodium carbonate provided.

Observations	Inferences
No effervessence ***1 mark***	***RCOOH absent*** ***Award ½ mk for H^+absent*** ***1 mark***

ii. To the second portion, add two drops of acidified potassium manganate (VII) and warm the mixture

Observations	Inferences
Purple H/KMnO4 turns colourless ***1 mark***	***C C / C C ½ mk*** ***And*** ***ROH present ½ mk*** ***1mark***

iii. To the third portion, add about $2cm^3$ of acidified Potassium dichromate (VI) , heat the mixture to boiling and allow to stand for 2 minutes.

Observations	Inferences
Orange H/K2CrO7 turns green ***1 mark***	***ROH present*** ***1 mark***