NAME:.....INDEX NO.....

SIGNATURE:.....

P525/3

CHEMISTRY PRACTICAL

3¼ HOURS

P525/3

UNNASE PRACTICAL GUIDE

UACE MOCK EXAMINATIONS, 2023

CHEMISTRY PRACTICAL

· 3 HOURS AND 15 MINUTES

INSTRUCTIONS TO CANDIDATES.

- *All questions are compulsory*
- *Answers to be written in the spaces provided*
- *All your work must be in blue or black ink*
- *Any work done on pencil will not be marked*
- *You are not allowed to work with the apparatus for the paper and check whether you have all the chemicals and apparatus.*
- *All working must be clearly shown.*
- *Mathematical tables and silent non- programmable scientific calculators may be used.*

(O=16, Na= 23, S=32, Mn=55)

FOR EAMINER'S USE ONLY		
Q1	30	
Q2	34	
Q3	16	
TOTAL	80	

X/30

1. You are provided with the following.
   FA1: which contains 3.95g of an hydrous sodium thiosulphate, $Na_2S_2O_3$ in $500cm^3$ of solution
   FA2: Which is hydrogen peroxide solution
   Solid T: which is a salt containing manganate (VII) ion.
   5% potassium iodide solution.
   Starch solution

   You are required to determine the;
   (i) Concentration of hydrogen peroxide in $moldm^{-3}$ of FA2
   (ii) Percentage of manganese in T.

   Theory:

   In acidic medium, hydrogen peroxide reacts with Manganes (VII) ions and iodide ions according to the following equations.

   $$2MnO^-_{4(aq)} + 5H_2O_{2(aq)} + 6H^+_{(aq)} \longrightarrow 2Mn^{2+}_{(aq)} + 5O_{2(g)} + 8H_2O_{(i)}$$

   $$H_2O_{2(aq)} + 2I^-_{(aq)} + 2H^+_{(aq)} \longrightarrow I_{2(aq)} + 2H_2O_{(l)}$$

   The iodine liberated reacts with thiosulphate ions according to the following equations.

   $$I_{2(aq)} + 2\,SO_3^{2-}{}_{(aq)} \longrightarrow S_4O^{2-}_{6(aq)} + 2I^-_{(aq)}$$

   PROCEDURES
   PARTA:

   (a) Using a measuring cylinder, transfer exactly $5.0cm^3$ of FA2 into a $250cm^3$ volumetric flask.
   Make the solution up to the mark with distilled water. Label the solution FA3.
   (b) Pipette $10.0cm^3$ of FA3 into a conical flask, add an equal volume of 1M sulphurical acid. Using a measuring cylinder followed by $10cm^3$ of 5% potassium iodide solution. Warm the mixture to 50^0C and titrate with FA1 from the burette until the solution is pale yellow.
   Add starch indicator and continue the titration until the end point. Repeat the titration until you obtain consistent results.

   Record your result in the table below.
   Volume of pipette used ..10.00/10.0/10..... cm^3 (½ marks)
   Table I

Final burette reading (cm^3)	14.50	28.60	19.10
Initial burette reading (cm^3)	0.00	14.50	5.00
Volume of FAI use (cm^3)	14.50	14.10	14.10

TR = 14.10 ± 3

(4½ marks)

Volumes of FAI used for calculating average volume

14.10 and 14.10 ± 0.1 agree. (½ marks)

Calculate the average volume of FAI used. (3 ½ marks)

$\frac{14.10 + 14.10}{2} = 14.10 \pm 0.1$

±0.2

±0.3

±0.4

±0.5

Questions

(a) Calculate the number of moles of iodine that reacted with FAI (2 ½ marks)

Rfm of $Na_2S_2O_3 = (2\times23) + (32\times2) + (3\times16) = 158$

Moles of $Na_2S_2O_3 = \frac{3.95}{158} = 0.025$ moles

500 cm^3 of FA1 contain 0.025 moles of $S_2O_3^{2-}$

14.10 cm^3 of FA1 contain $\frac{0.025 \times 14.10}{500} = 7.05\times10^{-4}$ moles

2 moles of $S_2O_3^{2-}$ react with 1 mole of I_2.

Moles of I_2 that reacted $= \frac{1}{2} \times 7.05\times10^{-4} = 3.52\times10^{-4}$ moles

(b) Determine the concentration of FA2 in $moledm^{-3}$ (3 marks)

1 mole of I_2 is produced by 1 mole of H_2O_2 (FA3).

10 cm^3 of FA3 contain 3.525×10^{-4} moles of H_2O_2

250 cm^3 of FA3 contain $\frac{3.525\times10^{-4}\times250}{10} = 8.8125\times10^{-3}$ moles

Dilution does not affect number of moles

5 cm^3 of FA2 contain 8.8125×10^{-3} moles of H_2O_2

1000 cm^3 of FA2 contain $\frac{8.8125\times10^{-3}\times1000}{5}$ moles

$= 1.7625$ moles of H_2O_2

PROCEDURE

PART B

(c) Weigh accurately about 0.8g of T and transfer it into a 250cm^3 volumetric flask. Add about 100cm^3 of 1 M sulphuric acid followed by 15cm^3 of FA2. Make the solution upto the mark with distilled water and allow to stand for about five minutes. Label the solutions FA4.

(d) Pipette 10.0cm^3 of FA4 into a conical flask, add an equal volume of 1M sulphuric acid using a measuring cylinder, followed by10cm^3 of 5%potassium iodide solution. Warm the mixture to 50°c and titrate with FA1 from the burette until the solution is pale yellow. Add starch indicator and continue the titration until the end point.
Repeat the titration until you obtain consistent results. Record your results in table 11 below.

RESULTS:

Mass of weighing bottle + T ..... 2·80 ✓ ..... g (½ mk)

Mass of empty weighing bottle ..... 2·00 ✓ ..... g (½ mk)

Mass of T used ..... 0·80 ✓ ..... g (½ mk) (2)

Volume of pipette used ..... 10·00 / 10·10 / 10 ✓ ..... cm^3 (½ mk)

Table II

Final burette reading (cm^3)	23·70	46·20	27·50
Initial burette reading (cm^3)	1·00	23·70	5·00
Volume of FA1 used (cm^3)	22·70 ✓	22·50 ✓	22·50 ✓

(4½)

TR = 22·50 ± 3

(4 ½ mks)

Volumes of FA1 used for calculating average volume ..... (½ mk)

22·50 and 22·50 (agree ± 0·1) ✓

∴ Calculate the average of FA1 used ..... 2½ (3½ mks)

$\frac{22·50 + 22·50}{2} = 22·50$ ± 0·1 ✓

± 0·2 ✓

± 0·3 ✓

± 0·4 ✓

± 0·5 ✓

Questions:

(a) Calculate the number of moles of

(i) Iodine that reacted with thiosulphate ions in FA1

1½ mark (2½ mks)

500 cm^3 of FA1 Contain 0.025 moles of $S_2O_3^{2-}$

22.50 cm^3 of FA1 Contain $\left(\frac{0.025 \times 22.50}{500}\right) = 1.125 \times 10^{-3}$ mol

2 moles of $S_2O_3^{2-}$ react with 1 mole of I_2.

Moles of I_2 $\therefore = \frac{1}{2} \times 1.125 \times 10^{-3} = 5.625 \times 10^{-4}$ moles of I_2

(ii) Excess hydrogen peroxide obtained in 250cm^3

1½ mark (2½ mks)

1 mole of I_2 is produced by 1 mole of H_2O_2.

10 cm^3 of FA4 Contain 5.625×10^{-4} moles of H_2O_2.

$\Rightarrow$ 250 cm^3 of FA4 Contain $\left(\frac{5.625 \times 10^{-4} \times 250}{10}\right)$

$= 0.0140625$ moles of H_2O_2

(iii) Hydrogen peroxide that reacted with T

1½ marks (2½ mks)

Originally

1000 cm^3 of FA2 Contain 1.7625 moles of H_2O_2.

15 cm^3 of FA2 Contain $\left(\frac{1.7625 \times 15}{1000}\right)$

$= 0.0264375$ moles of H_2O_2

$\Rightarrow$ Moles of H_2O_2 reacted $= 0.0264375 - 0.0140625$

$= 0.012375$ moles

(b) Determine the percentage of Manganese in T (04 mks)

5 moles of H_2O_2 reacted with 2 moles of MnO_4^-

0.012375 moles of H_2O_2 react with $\left(\frac{2}{5} \times 0.012375\right)$ (03 mark)

$= 0.00495$ moles.

1 mole of MnO_4^- contain 1 mole of Mn^{2+} atoms

0.00495 moles of MnO_4^- contain 0.00495 moles of Mn atom

Mass of Mn = $55 \times 0.00495 = 0.27225$ g

% of Mn in T = $\frac{0.2722}{0.8} \times 100 = 34.03\%$

2. You are provided with substance P which contains two cations and two anions. You are required to carry out the following tests to identify the ions present in P. Record your observations and deductions in the table below. Identify any gas(es) evolved. (32 marks) 34

TESTS	OBSERVATION	DEDUCTION
(a) Heat two spatula endfuls of P in a dry test tube strongly until there is no further change.	• White solid • Colourless condensate (liquid) which turns white anhydrous $CuSO_4$ blue • Colourless gas, turns blue litmus paper red forms white ppt with Calcium hydroxide solution • Yellow residue when hot and white on cooling.	Hydrated salt or water of crystallization CO_2 : CO_3^{2-} / HCO_3^- / $C_2O_4^{2-}$ / CH_3COO^- (4 Max) ZnO : Zn^{2+}
(b) To two spatula endfuls of P, add 5cm3 of distilled water. Shake thoroughly and filter. Keep both the filtrate and residue. Divide the filtrate into three parts. (i) To the first part of the filtrate, add 4 drops of Lead (II) nitrate solution followed by dilute nitric acid.	• Partially soluble • White residue • Colourless filtrate White ppt Soluble in acid with effervescence	Non transition cations in both residue and filtrate 3½ CO_3^{2-} for any one $C_2O_4^{2-}$ SO_3^{2-}
(ii) To the second part of the filtrate, add half a spatula endful of solid		

sodium hydrogen carbonate followed by 4 – 5 drops of aqueous iodine solution.	Effervescence of bubble of colourless gas turn lime water milky Brown solution turns Colourless	CO_2 gas . SO_3^{2-} present. (D3)
(iii) Use the third part of the filtrate to carry out a test of your own choice to confirm one of the anions in P. Test: Add 2-3 drops of acidified potassium manganate (VII) solution or acidified $K_2Cr_2O_7$ solution	Purple solution turned colourless. Orange solution to green	SO_3^{2-} Confirmed. (½)
(c) Wash the residue twice with water. Transfer it into a test and add dilute nitric acid dropwise until there is no further change (warm of necessary). Add dilute sodium hydroxide solution dropwise until in excess. Filter and keep both the filtrate and residue.	Effervescence/ bubbles of a colourless gas turns Lime water milky Colourless solution White ppt insoluble in excess White residue. Colourless filtrate	CO_2 gas hence CO_3^{2-} Confirmed. Non transition cation, Ba^{2+}, Ca^{2+}, Mg^{2+} Ba^{2+}/ Ca^{2+}/ Mg^{2+}. (0 of ½) Zn^{2+}/ Al^{3+}/ Pb^{2+}/ Sn^{2+}
(d) Acidify the filtrate using dilute nitric acid. Divide the solution into three parts	White precipitate Soluble in acid	~~Zn^{2+}~~/ Al^{3+}/ Pb^{2+}, Sn^{2+}/ Sn^{4+}. (0 of ½)
(i) To the first part of the acidified filtrate add 3 -4 drops of dilute Sulphric acid	No white ppt or No observable change	Pb^{2+} absent ∴ Al^{3+}/ Zn^{2+}/ Sn^{2+}/ Sn^{4+}/ (0 of ½)
(ii) To the second part of the acidified filtrate add dilute	White ppt soluble in excess to a colourless solution	Zn^{2+} present. (0 of ½)

ammonia solution dropwise until in excess.		
(iii) Use the third part of the acidified filtrate to carry out a test of your own choice to confirm one of the cations in P. Test: Solid NH_4Cl; $Na_2HPO_4(aq)$ $NH_3(aq)$ in excess	White ppt soluble in excess ammonia.	Zn^{2+} Confirmed - 02
(e) Dissolve the residue from part (c) in a minimum amount of dilute nitric acid. Divide the resultant solution into five parts.	Colourless solution	Ca^{2+} or Mg^{2+} or Ba^{2+} present 01
(i) To the first part of the acidic solution, add dilute sodium hydroxide solution dropwise until in excess.	White ppt insoluble in excess	Ca^{2+} or Mg^{2+} or Ba^{2+} present 01/2
(ii) To the second part of the acidic solution add ammonia solution dropwise until in excess.	White ppt insoluble	Ba^{2+} or Mg^{2+} present. 01/2
(iii) To the third part of the acidic solution add 3 drops of potassium chromate (VI) solution followed by Ethanoic acid	No observable change or No yellow ppt	Ba^{2+} absent Probably Mg^{2+} present. 01/2

(iv) To the fourth part of the acidic solution, add excess sodium hydrogen carbonate solution and heat the mixture.	White ppt forms on heating	Mg^{2+} ✓ (01)
(v) Use the fifth part of the acidic solution to carry out a test of your own choice to confirm the second cation in P. ✓ accept Test: Add $NH_4Cl_{(s)} + Na_2HPO_{4(aq)} + NH_{3(aq)}$ in excess.	White ppt ✓ insoluble in excess ammonia. ✓	Mg^{2+} ✓ Confirmed ✓ (02)

(f) Identify the

(i) cations in P Zn^{2+} ✓ and Mg^{2+} ✓ (02)

(ii) anions in P CO_3^{2-} ✓ and SO_3^{2-} ✓

3. You are provided with substance R which is an organic compound. You are requested to carry out the tests on R to determine the nature of R. Record your observations and deductions in the table below. (18 marks). $\frac{X}{16}$

TESTS	OBSERVATIONS	DEDUCTIONS
(a) Burn a small amount of R on a spatula end or on a porcelain dish	Colourless liquid burns with yellow non sooty flame.	Aliphatic saturated compound with a low Carbon content. ✓ (2)
(b) To 1cm³ of R, add about 5cm³ of distilled water		

and shake. Divide the mixture into three parts. (i) To the first part add sodium carbonate solution	Miscible with water to a colourless solution - No effervescence	Polar compounds of low molecular mass - Carboxylic acid absent (1½)
(ii) To the second part add Neutral iron (III) chloride solution.	No purple/violet colouration	Phenol absent. (1½)
(iii) To the third part add 5 drops of acidified Potassium dichromate (VI) solution and heat the mixture	No observable change	Non reducing compound. Ketone or tertiary alcohol probably present (2)
(c) To 1cm³ of R, add an equal volume of water, followed by about 4 – 5 drops of Brady's reagent.	Yellow ppt	Ketone present (2)
(d) To 1cm³ of R, add tollens reagent and warm.	No silver mirror	Aldehyde absent ∴ Ketone present (2)
(e) To 1cm³ of R, add about 3cm³ of iodine solution followed by sodium hydroxide solution dropwise until the colour of iodine is discharged.	Pale yellow ppt	Ketone of form $CH_3C(=O)-$ present (1½)

(f) Describe the nature of R. Aliphatic (1) Ketone (2) of form $CH_3C(=O)-$ (1½)

END