**NAME……..... INDEX NO……...…**

**SCHOOL ……. CANDIDATE'S SIGNATURE…..……**

**DATE……..……**

**233/3**
**CHEMISTRY**
**PAPER 3**
**(PRACTICAL)**
**2½ HOURS**

**Instructions to candidates.**

(a) Write your name and index number and school in the spaces provided.
(b) Sign and write the date of examination in the spaces provided above.
(c) Answer **ALL** the questions in the spaces provided in the question paper.
(d) You are not allowed to start working with apparatus for the first 15 minutes of the 2¼ hours allowed for this paper. This is to enable you to read the question paper and make sure you have all the chemicals and apparatus that you may need.
(e) All working **MUST be** clearly shown where necessary.
(f) Mathematical tables and electronic calculators **may be** used**.**

**For Examiner's Use Only**

| Question | Maximum score | Score |
|---|---|---|
| 1 | 13 | |
| 2 | 14 | |
| 3 | 13 | |
| Total Score | 40 | |

1. You are provided with:
- Solid A, 2.0g of dibasic acid, $H_2X$.
- Solution B, 0.5M solution of the dibasic acid, $H_2X$.
- Solution C, sodium hydroxide solution.
- Solution D, 0.02M acidified potassium manganate (VII) solution.

You are required to determine:

(a) The heat of reaction of solid A $H_2X$ with sodium hydroxide solution.

(b) The number of moles of solution E that reacts with 2 moles of acidified potassium manganate (VII) solution.

Procedure 1(a):

Place 40cm³ of distilled water into 100ml beaker. Measure the initial temperature of water and record in table **I below**. Add all the solid A provided at once. Stir the mixture carefully with the thermometer until **all** the solid dissolves. Measure the final temperature and record in table I.

**Table I**

| | | |
|---|---|---|
| Temperature (°C) | | |
| Initial temperature (°C) | | (1½ marks) |

(a) Determine the change in temperature, $\Delta T$. (1½ marks)

_____

_____

_____

_____

(b) Calculate the:

(i) heat change when $H_2X$ dissolves in water. (Assume the heat capacity of the solution is 4.2J/g/°C and density of the solution is 1g/cm³). (1 mark)

(ii) the molar heat of solution, $\Delta H_1$ solution of the acid $H_2X$.
(Molar mass of the acid $H_2X$ is 126g). (2 marks)

Procedure 1(b):

Place 40cm³ of solution B into 100ml beaker. Measure the initial temperature and record in table **II below**. Measure 40cm³ of sodium hydroxide, solution C. Add all the 40cm³ of solution C at once to solution B. Stir the mixture carefully with the thermometer. Measure the final temperature reached and record in table II. (Keep remaining solution B for use in procedure II).

**Table II**

| | | |
|---|---|---|
| Temperature (°C) | | |
| Initial temperature (°C) | | (1½ marks) |

(a) Determine the change in temperature, ΔT. (1½ marks)

(b) Calculate the:

(i) heat change for the reaction. (Assume the heat capacity of the solution is 4.2J/g/°C and density of the solution is 1g/cm³). (1 mark)

(ii) heat for the reaction of one mole of the acid $H_2X$ with sodium hydroxide, $\Delta H_2$. (2 marks)

(c) Given that the $H_2X_{(S)} + 2OH^-_{(aq)} \rightarrow 2H_2O_{(l)} + A^{2-}_{(aq)}$

Determine $\Delta H_3$ using an energy cycle diagram. (2 marks)

Procedure II:

Measure exactly 15cm³ of solution B and put in a 250ml volumetric flask. Add water as you shake up to the mark. Labeled as solution E. Using a pipette filler, pipette 25cm³ of solution E and place in a conical flask. Warm solution E to boiling. Fill the burette with solution D and titrate with hot solution E. Stop just when a permanent change in colour. Record your results in the table **III below**. Repeat the procedure to complete the table **III below**.

| **TABLE III** | I | II | III | |
|---|---|---|---|---|
| Final burette reading (cm³) | | | | |
| Initial burette reading (cm³) | | | | |
| Volume of solution D used (cm³) | | | | (4 marks) |

(a) Calculate the average volume of solution D used. (1 mark)

(b) Calculate the number of moles of solution D reacting. (1 mark)

(c) Calculate the number of moles of solution E used. (1½ marks)

(d) Calculate the number of moles of E which react with 2 moles of potassium managanate (VII). (1½ marks)

2. You are provided with solid X. Carry out the tests below. Record your observations and inferences in the spaces provided.

(a) To about half of soild X, put into a clean, dry test tube and heat strongly. Test any fumes produced using the litmus papers provided..

| Observation | Inferences |
|---|---|
| (1 mark) | (1 mark) |

(b) To the remaining solid X put in a clean boiling tube and add about 10cm³ of distilled water then shake thoroughly, filter the resultant solution. (Keep the filtrate for further tests).

| Observation | Inferences |
|---|---|
| (1 mark) | (1 mark) |

(i) To about 1cm³ of the filtrate; add 3 drops of phenolphthalein indicator.

| Observation | Inferences |
|---|---|
| (½ mark) | (1 mark) |

(ii) To 2cm³ of the filtrate; add 2cm³ of 2M hydrochloric.

| Observation | Inferences |
|---|---|
| (1 mark) | (1 mark) |

(iii) To 2cm³ the filtrate; add sodium hydroxide solution drop wise until in excess.

| Observation | Inferences |
|---|---|
| (1 mark) | (1 mark) |

(iv) Dip a clean glass rod into the remaining filtrate and put into a non-luminous flame.

| Observation | Inferences |
|---|---|
| (½ mark) | (1 mark) |

3. You are provided with solid Y. Carry out the tests below. Write your observations and inferences in the spaces provided.

(a) Put half of solid Y in a clean dry metallic spatula. Ignite in a Bunsen burner flame.

| Observation | Inferences |
|---|---|
| (1 mark) | (1 mark) |

(b) Add the remaining half of solid Y into 10cm³ in a clean boiling tube. Shake well.

(i) To 2cm³ of solution Y, add 3 drops of universal indicator solution.

| Observation | Inferences |
|---|---|
| (1 mark) | (1 mark) |

(ii) To about 2cm³ of solution Y, add 3 drops of acidified potassium manganate (VII) solution.

| Observation | Inferences |
|---|---|
| (1 mark) | (1 mark) |

(iii) To about 2cm³ of solution Y, add 3 drops of bromine water then gently warm.

| Observation | Inferences |
|---|---|
| (1 mark) | (1 mark) |