**Kenya Certificate of Secondary Education**

**233/3- CHEMISTRY –PAPER 3 (Practical)**

**Nov. 2021 2 1/4 hours**

**Name................................................................Adm number.....................**

**Candidates Signature........................................Date..................................**

**QUESTION 1** (**20 MARKS)**

You are provided with:

* Solution **H**, which is acidified potassium manganate (VII) solution.(KMnO4)
* Solution **X**, containing 5.0g of a dibasic acid, H2A.2H2O
* Solution **N**, containing 24.5g of ammonium iron (II) sulphate solution.

(NH4)2Fe(SO4)2. 6H2O

You are required to:

1. Standardize solution H using solution N.
2. Use the standardized solution H to determine the concentration of the dibasic acid, H2A.2H2O, solution **X** and then the formula mass of **A**

**Procedure 1**

1. Fill the burette with solution H.
2. Pipette 25cm3 of solution N and transfer it into a conical flask.
3. Titrate solution N against solution H until a permanent pink colour just appears.
4. Record the results in table 1 below.
5. Repeat the titration two more times to complete the table.
6. **Table 1**

|  |  |  |
| --- | --- | --- |
| **I** | **II** | **III** |
| Final burette reading (cm3) |  |  |  |
| Initial burette reading (cm3) |  |  |  |
| Volume of solution H used (cm3) |  |  |  |

(3marks)

1. Determine the average volume of solution H used. (1mark)

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1. Calculate;
2. The concentration of solution N in moles per liter (RFM of B is 392) (1marks)

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1. The number of moles of iron (II) ions in 25cm3 of solution N (1marks)

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1. Using the ionic equation for the reaction between manganate (VII) and iron (II) ions given below, calculate the concentration of manganate (VII) ions in solution H in moles per liter. (1marks)

MnO4-(aq) + 8H+(aq) + 5Fe2+(aq)  Mn2+(aq) + 5Fe2+(aq) +4H2O

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**Procedure II**

1. Fill the burette with solution H.
2. Using a clean pipette, place 25cm3 of solution X into a conical flask. Heat this solution to about 70oC
3. Titrate using solution H until a permanent pink colour just appears. Shake thoroughly during the titration
4. Record the reading in table II below.
5. Repeat the titration two more times to complete the table.
6. **Table II**

|  |  |  |
| --- | --- | --- |
| **I** | **II** | **III** |
| Final burette reading (cm3) |  |  |  |
| Initial burette reading (cm3) |  |  |  |
| Volume of solution H used (cm3) |  |  |  |

(3marks)

1. Determine the average volume of solution H used. (1mark)

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1. Calculate;
2. The number of moles of the manganate (VII) ions in the average volume of solution H above. (1marks)

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1. Given that 2 moles of manganate (VII) ions react with 5 moles of the dibasic acid H2A.2H2O. Calculate the number of moles of the dibasic acid H2A.2H2O in the 25cm3 of solution X (1mark),

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1. The concentration of solution X in moles per litre. (1marks)

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1. Calculate the formula mass of A in the dibasic acid. H2A.2H2O(H=1, O=16.0) (2marks)

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2. You are provided with:

- A solution of sodium hydroxide labeled B.

- A solution of sulphuric(vi)acid labeled C.

You are required to determine the concentration of the alkali using the following procedure.

**PROCEDURE:**

(i) Place 40cm3 of sodium hydroxide solution into a 250 ml plastic beaker.

(ii) Measure 60cm3 of sulphuric (vi) acid solution.

(iii) Determine the temperature of sodium hydroxide solution at half a minute intervals for two minutes and record it in the table below.

(iv) At 2 ½ minutes, place the 60cm3 of solution C into the plastic beaker while stirring and resume taking the temperature in the 3rd minute.

(v) Complete the table below.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Time in minutes | 0 | ½ | 1 | 1 ½ | 2 | 2 ½ | 3 | 3 ½ | 4 |
| Temperature in 0C |  |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Time in minutes | 4 ½ | 5 | 5 ½ | 6 | 6 ½ | 7 |
| Temperature in 0C |  |  |  |  |  |  |

(2 marks)

(a) Plot a graph of temperature against time. (3 marks)



(b) From the graph, determine the highest temperature change. (1 mark)

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(c) Determine the heat evolved in this experiment (Density of solution = 1 g/cm3 specific heat capacity of solution = 4.2 Jg-1 K-1) (1 marks)

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(d) Given that the molar heat of neutralization is 56KJ/mole, determine the number of moles of sodium hydroxide used in the neutralization reaction above. (1 marks)

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(e) Determine the molarity of sodium hydroxide. (2 marks)

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3

a). You are provided with 10cm3 of solution of liquid M, carry out the tests bellow and write the observations and inferences in the space provided.

1. To about 1cm3of solution M add 2M NaOH (aq)

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

1. To to 1cm3of solution M and 3 drops of Ba(NO3)2 (aq)

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

1. To the mixture in (ii) above add HCl dropwise until excess

|  |  |
| --- | --- |
| Observations | Inferences |
| (1mark) | (1mark) |

1. To 1cm3 of solution M add H+/K2Cr2O7

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

b)

(i) To 2cm3 of R add 2-3 drops of Br2 (aq) water

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

(ii) To 2cm3 of R add 3 drops of H+/K2Cr2O7

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

(iii) To 2cm3 of R drop blue and red litmus paper

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