

STAREHE BOYS HIGH SCHOOL MOCK 2015

CHEMISTRY PAPER 3

Q1. You are provided with:

Solution P: Iron (II) ammonium Sulphate crystals

$\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot x\text{H}_2\text{O}$ containing 9.8 g in 250 cm^3 of solution

Solution Q: 0.02 M of acidified Potassium manganate (VII)

You are required to:

- Determine the Relative Formula Mass of $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot x\text{H}_2\text{O}$.
- Determine the value of x in $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot x\text{H}_2\text{O}$

Procedure I

- Fill a clean burette with solution Q.
Record the initial burette reading in the Table I below.
- Pipette 25.0 cm^3 of solution P into a clean conical flask and titrate it with solution Q from the burette. Stop titrating when the solution in the conical flask JUST turns pink.
- Record your results in Table I below.
- Repeat the above procedure two more times and record your results in Table I below.

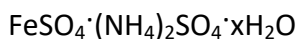
a) Table I

Experiment	1	2	3
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution Q used (cm^3)			

{3 marks}

Complete the table above by filling volume of solution Q used.

- b) Calculate the average volume of solution Q used. {1 mark}
(Show clearly your working)
- c) Calculate the number of moles of solution Q that reacted. {1 mark}
- d) Given that the ionic equation for the reaction is:
$$5 \text{Fe}^{2+}_{(\text{aq})} + 8\text{H}^{+}_{(\text{aq})} + \text{MnO}^{-}_{4(\text{aq})} \rightarrow 5\text{Fe}^{3+}_{(\text{aq})} + 4\text{H}_2\text{O}_{(\text{l})} + \text{Mn}^{2+}_{(\text{aq})}$$
- i) Determine the number of moles of the Iron (II) salt solution P in 25.0 cm^3 of the solution used. {1 mark}
- ii) Determine the molarity of the Iron (II) salt solution P. {1 mark}
- iii) Calculate the concentration of the Iron (II) salt solution P in grams per litre. {1 mark}
- e) Determine the Relative Formula Mass of the salt $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot x\text{H}_2\text{O}$. {1 mark}
- f) Given that, Fe = 56, N = 14, S = 32, O = 16, determine the value of x in the formula



{2 marks}

Q2. You are provided with:

Solution R: 1 M solution of an unknown acid.

Solution T: 1 M solution of Sodium hydroxide.

You are required to:

- Determine the basicity of the unknown acid solution R.
- Find the heat of neutralization, ΔH of Sodium hydroxide, solution T.

Procedure II

- Using a 50 ml measuring cylinder measure 40 cm^3 of solution R into a 100 ml plastic beaker.
- Measure the steady temperature, T_1 of solution R and record in Table II below.
- With a clean 100 ml measuring cylinder, measure 5 cm^3 of solution T.
- Pour this solution T into the 100 ml beaker containing 40 cm^3 of solution R. Stirring gently with a thermometer, measure the highest temperature, T_2 of the mixture and record in Table II below.
- Rinse** the measuring cylinders, thermometer and the 100 ml plastic beaker.
- Repeat the procedure above using the volumes of solution R and solution T as indicated in Table II below. Remember to **rinse the apparatus after each experiment**.

Table II

Experiment number	1	2	3	4	5	6	7	8
Volume of solution R (cm^3)	40	35	30	25	20	15	10	5
Volume of solution T (cm^3)	5	10	15	20	25	30	35	40

Final temp. T_2 ($^{\circ}\text{C}$)								
Initial temp. T_1 ($^{\circ}\text{C}$)								
Temp. change ΔT ($^{\circ}\text{C}$)								

- a) i) Complete the Table II by filling the temperature change. {4 marks}
- ii) On the provided graph paper, plot a graph of Temperature change, ΔT against the volume of solution T used. {2 marks}
- iii) What is the maximum rise in temperature? {1 mark}
- iv) Using information from the graph, calculate the number of moles of the unknown acid, solution R needed to produce the temperature change above. {1 mark}
- v) Using the graph, determine the number of moles of Sodium hydroxide needed for complete neutralization of the acid. {1 mark}
- vi) Calculate the number of moles of H^+ ions per mole of acid. {1 mark}
(Basicity of the acid)
- vii) Using the experimental results, calculate the molar heat of neutralization of Sodium hydroxide. {1 mark}
(Specific heat capacity of water = 4.2 kJ/Kg/K . Assume density of solution = 1 g/cm^3)

Q3. You are provided with:

- 0.5 g solid V
- 0.5 solid W

You are required to carry out the tests below to identify solid V and solid W.

Record your observations and inferences in the spaces provided.

- a) i) Put all solid V provided into a clean test-tube. Add about 5 cm³ of dilute 2 M Nitric (V) acid and warm briefly. Filter the mixture in a test-tube and **retain** the filtrate.

Observations	Inferences
{1 mark}	X

- ii) Divide the filtrate obtained in a(i) above into two portions. To the first portion add about 3 – 4 drops of aqueous 2 M Sodium hydroxide solution followed by excess.

Observations	Inferences
{2 marks}	{1 mark}

- iii) To the second portion add about 3 – 4 drops of aqueous 2 M Ammonia solution followed by

excess.

Observations	Inferences
{2 marks}	{2 marks}

- b) i) Put all solid W into a clean test-tube. Add about 5 cm³ of dilute nitric (V) acid. Test for any gas produced. **Retain** the sample in the test-tube.

Observations	Inferences
{2 marks}	{1 mark}

- ii) Divide the sample obtained in b(i) above into two portions.
To the first portion, add a few drops of aqueous 2 M Sodium hydroxide solution followed by excess.

Observations	Inferences
{2 marks}	{1 mark}

- iii) To the second portion, add a few drops of aqueous 2 M Ammonia solution followed by excess.

Observations	Inferences

{1 mark}	{1 mark}
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c) Give the chemical formula of:

i) the anion present in solid W. {1 mark}

ii) the cation present in: i) solid V {½ mark}

ii) solid W {½ mark}