

**KCSE PREDICTIONS 2019**  
**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  $250 \text{ cm}^3$  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  $25.0 \text{ cm}^3$  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 ( $\text{cm}^3$ )			
Initial burette reading ( $\text{cm}^3$ )			
Volume of solution Q used ( $\text{cm}^3$ )			

{3 marks}

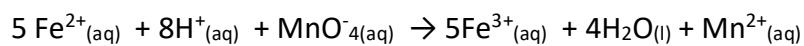
Complete the table above by filling volume of solution Q used.

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:



i) Determine the number of moles of the Iron (II) salt solution P in 25.0 cm<sup>3</sup> 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  $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot x\text{H}_2\text{O}$  {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,  $\Delta H$  of Sodium hydroxide, solution T.

#### Procedure II

- Using a 50 ml measuring cylinder measure 40 cm<sup>3</sup> 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<sup>3</sup> of solution T.
- Pour this solution T into the 100 ml beaker containing 40 cm<sup>3</sup> 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 <sup>3</sup> )	40	35	30	25	20	15	10	5
Volume of solution T (cm <sup>3</sup> )	5	10	15	20	25	30	35	40
Final temp. $T_2$ (°C)								
Initial temp. $T_1$ (°C)								

Temp. change $\Delta T$ ( $^{\circ}\text{C}$ )								

- 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,  $\Delta T$  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  $\text{H}^+$  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 =  $4.2 \text{ kJ/Kg/K}$ . Assume density of solution =  $1 \text{ g/cm}^3$ )



{2 marks}	{2 marks}

- b) i) Put all solid W into a clean test-tube. Add about 5 cm<sup>3</sup> 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}

- 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}