KCSE PREDICTIONS 2019
CHEMISTRY PAPER 3

Q1. You are provided with:

Solution P: Iron (II) ammonium Sulphate crystals
$FeSO_4 \cdot (NH_4)_2SO_4 \cdot xH_2O$ 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 $FeSO_4 \cdot (NH_4)_2SO_4 \cdot xH_2O$.
- Determine the value of x in $FeSO_4 \cdot (NH_4)_2SO_4 \cdot xH_2O$

Procedure I

i) Fill a clean burette with solution Q.
Record the initial burette reading in the Table I below.

ii) 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.

iii) Record your results in Table I below.

iv) 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:

$5\ Fe^{2+}_{(aq)} + 8H^{+}_{(aq)} + MnO^{-}_{4(aq)} \rightarrow 5Fe^{3+}_{(aq)} + 4H_2O_{(l)} + Mn^{2+}_{(aq)}$

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 $FeSO_4 \cdot (NH_4)_2SO_4 \cdot xH_2O$. {1 mark}

f) Given that, Fe = 56, N = 14, S = 32, O = 16, determine the value of x in the formula $FeSO_4 \cdot (NH_4)_2SO_4 \cdot xH_2O$ {2 marks}

Q2. You are provided with:

Solution R: I M solution of an unknown acid.

Solution T: I 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

i) Using a 50 ml measuring cylinder measure 40 cm^3 of solution R into a 100 ml plastic beaker.

ii) Measure the steady temperature, T_1 of solution R and record in Table II below.

iii) With a clean 100 ml measuring cylinder, measure 5 cm^3 of solution T.

iv) 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.

v) **Rinse** the measuring cylinders, thermometer and the 100 ml plastic beaker.

vi) 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 (^oC)								
Initial temp. T_1 (^oC)								

Temp. change ΔT (^oC)								

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 cm^3 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}	

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 cm^3 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}