KCSE TRIAL 2021

CHEMISTRY PAPER 3

1. You are provided with:

   Solid G, magnesium powder.
   Solution N, 0.5 M Ferrous ammonium sulphate hexahydrate.
   Solution M, containing 3.68 g/l, acidified potassium manganate (VII).

   You are required to determine the:

   -Molar enthalpy of displacement of iron (II) ions with **Solid G**.
   -Mass of magnesium that reacts with **Solution N.**

   Procedure 1
   Using a measuring cylinder, place exactly 100 ml of **solution N** in 250 ml plastic beaker. Allow to stand for about a minute. Measure the initial temperature of the solution and record it in table 1.
   Add all of the **solid G** at once to the solution. Stir the mixture carefully with the thermometer and record the highest temperature reached in table 1. **Retain the mixture for use in procedure II.**

(a) Table 1

Final temperature (^{o}C)	
Initial temperature (^{o}C)	
Change in temperature, ΔT	

(2 marks)

   Procedure 1I
   Filter the mixture obtained in **procedure I** into a 250 ml volumetric flask. Wash the residue with distilled water and add into the flask. Add more water to make up to the mark. Label this as **solution F**.

   Using a pipette and a pipette filler, place 25.0 ml of **solution F** into a 250 ml conical flask. Titrate **solution F** with **Solution M** until a permanent pink colour just appears. Record the readings in table 2.

   Repeat the titration two more times and complete table 1.

(b) Table 2

Titration number	I	II	III
Final burette reading			
Initial burette reading			

Volume of **Solution M** used, cm^3			

(4 marks)

(c) Calculate the average volume of **Solution M** used. (1 mark)

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(d) Given the equation for the reaction between manganate (VII) and iron (II) as:
$$MnO^-_{4(aq)} + 5Fe^{2+}_{(aq)} + 8H^+_{(aq)} \rightarrow Mn^{2+}_{(aq)} + 5Fe^{3+}(aq) + 4H_2O_{(l)}$$
Calculate the number of moles of:
(i) Potassium manganate (VII) used. (K = 39, Mn = 55, O = 16) (1 mark)
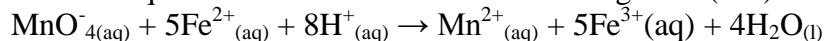
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(ii) Iron (II) ions in 25.0 ml **solution F**. (1 mark)

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(iii) Iron (II) ions in 250 ml **solution F**. (1 mark)

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(iv) Iron (II) ions in 100 ml **solution N** after the reaction with magnesium. (1 mark)

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(v) Iron (II) ions in 100 ml **solution N** before the reaction with magnesium. (1 mark)

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(vi) Iron (II) ions that reacted with magnesium. (1 mark)

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(e) Calculate the mass of magnesium that reacted. (Mg = 24)   (1 mark)

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(f) Calculate the:
   (i) Heat change for the displacement reaction of iron (II) with magnesium.
      (Assume for the mixture, specific heat capacity = 4.2 $Jg^{-1}K^{-1}$ and density = 1.0 gcm^{-3})
                                                                              (1 mark)

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   (ii) Molar enthalpy of displacement of iron (II) with magnesium.   (1 mark)

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

(a) Place **about half** of **solid L** in a clean test-tube and add about 8 ml of distilled water and
    shake. **Retain the other half of solid L for use in part (c) while the solution is for use in
    part (b) (i) to (iv).**

Observations	Inferences

 (1 mark)   (1 mark)

(b) Divide the solution obtained in part (a) above into four portions.
(i) To the first portion, add 2 M ammonium hydroxide solution drop-wise until in excess.

Observations	Inferences

(1 mark)   (1 mark)

(ii) To the second portion add 2 – 3 drops of barium nitrate solution.

Observations	**Inferences**

(1 mark)   (1 mark)

(iii) To the third portion add about equal volume of chlorine water.

Observations	**Inferences**

(1 mark)   (1 mark)

(iv) To the fourth add 2 – 3 drops of lead (II) nitrate solution.

Observations	**Inferences**

(1 mark)   (1 mark)

(c) Clean a metallic spatula and rinse it with distilled water. Dry the spatula on a Bunsen burner using non-luminous flame for about one minute and then allow it to cool. Place a little of **solid L** on the spatula and heat it strongly with a non-luminous flame.

Observations	**Inferences**

(1 mark)   (1 mark)

3. You are provided with:

Solid W
Bromine water
Acidified potassium manganate (VII)
Sodium carbonate

Solid W is suspected to be an organic compound.

(a) Using the reagents provided describe the tests that could be performed consecutively to confirm which type of organic compound is **Solid W**. Record the tests and expected observations in the spaces provided.

(i)

Test 1	Expected Observations
(1 mark)	(1 mark)

(ii)

Test 2	Expected Observations
(1 mark)	(1 mark)

(iii)

Test 3	Expected Observations

(1 mark)   (1 mark)

(b) Carry out the tests described in (a) above using **solid W** and record the observations and inferences in the spaces provided.

(i) Test 1

Observations	Inferences

(1 mark)   (1 mark)

(ii) Test 2

Observations	Inferences

(1 mark)   (1 mark)

(iii) Test 3

Observations	Inferences

(1 mark)   (1 mark)