FORM 3 TERM 3 APRIL 2022
CHEMISTRY PAPER 3

QUESTION 1   (**20 MARKS)**

You are provided with:
- Solution H which is potassium manganate (VII) solution.
- Solution X which is dilute solution of hydrogen peroxide.
- Solution N which is 0.02M ammonium iron (II) sulphate solution.

You are required to:
- i)   Standardize solution H using solution N.
- ii)   Use the standardized solution H to determine the concentration of solution X.

Procedure 1
1. Fill the burette with solution H.
2. Pipette $25cm^3$ 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.

a) **Table 1**

	I	II	III
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution H used (cm^3)			

(3mks)

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

c) Calculate;
- i)   The number of moles of solution N in $25cm^3$.   (2mks)

ii)   The number of moles of solution H that reacted given the equation for the reaction
        is   (2mks)

$$MnO_4^-{}_{(aq)} + 5Fe^{2+}{}_{(aq)} + 8H^+{}_{(aq)} \longrightarrow Mn^{2+}{}_{(aq)} + 5\ Fe^{3+}{}_{(aq)} + 4H_2O_{(l)}$$

iii)   The concentration of H in moles per litre.   (2mks)

Procedure II
1. Fill the burette with solution H.
2. Using a clean pipette, place $25cm^3$ of solution X into a conical flask.
3. Add $10cm^3$ of 1Msulphuric acid and shake well.
4. Titrate using solution H until a permanent pink colour just appears.
5. Record the reading in table II below.
6. Repeat the titration two more times to complete the table.

d) **Table II**

	I	II	III
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution H used (cm^3)			

(3mks)

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

f) Calculate;
   i) The number of moles of solution H used. (2mks)

   ii) The number of moles of solution X in 25cm^3 if the equation for the reaction is; (2mks)

   $$2MnO_4{}^{2-}{}_{(aq)} + 6H^+{}_{(aq)} + 5H_2O_{2(l)} \longrightarrow 2Mn^{2+}{}_{(aq)} + 8H_2O_{(l)} + 5O_{2(g)}$$

   iii) The concentration of solution X in moles per litre. (2mks)

QUESTION 2 (**11 MARKS**)
You are provided with the following;

- Solid Y
- Sodium chloride solution
- Potassium chloride solution
- Calcium chloride solution

You are required to identify the cations present in solid Y.

The following notes will assist in making the correct observations and inferences.
   Cations are positively charged ions, majority of which are metal ions. Cations can be tested using one or a combination of the following methods;
  a) Flame tests
   - Some cations burn with flames that have distinct colours.
  b) Carrying out precipitation reactions using the following;
   i) Sodium hydroxide
   ii) Aqueous ammonia
   iii) Anions such as CO_3^{2-}, SO_4^{2-}, Cl^- and SO_3^{2-}

   Precipitates are formed as a result of formation of insoluble salts or metal hydroxides. The colour of the precipitate should be noted down when writing the observations. Incase a white precipitate is expected and not observed, then one should record that there is no white precipitate but NOT no observation.

  It is important to note that hydroxide of zinc, lead and aluminium are amphoteric thus can react with sodium hydroxide which is alkaline. Another thing to note is that zinc hydroxide and copper (II) hydroxide dissolve in excess aqueous ammonia due to formation of complex ions.

Procedure
   Carry out the tests below and record your observations and inferences in the spaces provided.
  a) Place all of the solid Y provided in a boiling tube. Add about 10cm^3 of distilled water and shake well. Use about 2cm^3 of the resulting solution to carry out tests (i)to (iii) below. Reserve the remaining portion for test (b).

Observations	Inferences
i) (1mk) To	(1mk)

iTo the first portion, add aqueous sodium hydroxide dropwise until in excess.

Observations	Inferences
	(1mk)
(1mk)	

ii)   To the second portion, add aqueous ammonia dropwise until in excess.

Observations	Inferences
(1mk)	(1mk)

iii)   To the third portion, add about 1cm^3 sodium chloride solution.

Observations	Inferences

(1mk)	(1mk)

b) Procedure

Clean a glass rod and rinse it with distilled water. Dry the glass rod on a Bunsen burner flame. Allow it to cool. Dip it in a little sodium chloride solution and burn it strongly with a non-luminous Bunsen burner flame. Note the colour of the flame and record it in table III below. Clean the spatula thoroughly and repeat the procedure using each of the other solutions and complete table III.

i)   Table III

Solution	Colour of flame
Sodium chloride	
Potassium chloride	
Calcium chloride	
Solution Y	

(2mks)

ii)   From table III, suggest the cation that could be present in solid Y_____ (1mk)

QUESTION 3   (**9 MARKS**)

You are provided with solid F.

Procedure

Carry out the tests below using solid F. write the observations and inferences in the spaces provided.

a) Place all solid F in a dry boiling tube. Add about 15cm^3 of distilled water and shake thoroughly. Use 2cm^3 portions of the solution for tests (b) to (e) below.

Observations	Inferences
(1/2mk)	(1/2mk)

b) To the first portion add two drops of universal indicator and record the color and PH.

Observations	Inferences

(1mk)	(1mk)

c) To the second portion add a spatula and full of sodium carbonate.

Observations	Inferences
	(1mk)
(1mk)	

d) To the third portion add two drops of bromine water.

Observations	Inferences
	(1mk)
(1mk)	

e) To the fourth add three drops of acidified potassium manganate (VII)

Observations	Inferences

(1mk)	(1mk)