ST. NOA MAWAGGALI S.S.S

S.4 CHEMISTRY SEMINAR

DATE: 24th/JUNE / 2023

Question 1

(a) The atomic numbers of elements X, Y and Z are 14, 20 and 17 respectively.
- (i) What is atomic number?
- (ii) Write the electronic structures of X, Y and Z.

(b) Z can combine with both X and Y to form compounds.
- (i) Use valency electrons to explain briefly how the atoms X and Z, Y and Z form compounds.
- (ii) Write the structural formula of the compound formed when X combines with Z.

(c) State two properties of the compounds formed between;
- (i) X and Z
- (ii) Y and Z

Question 2

(a) Define the term atom.

(b) Mention the particles found in an atom and give their properties.

(c) Atoms $^{27}_{12}M$ and $^{37}_{17}X$ are of elements **M** and **X** respectively.
- (i) Determine the number of protons and neutrons in the atom of **X**.
- (ii) Using the outermost shell, show how **M** bonds with oxygen.
- (iii) State two properties of the compound formed in c(ii) above.

(d) Briefly describe how **M** bonds with **X**. (Diagram not required)

Question 3

(a) Explain giving example(s) what is meant by
- (i) Basicity of an acid
- (ii) Acid salt

(b) Outline how a pure dry sample of sodium sulphate can be prepared in the laboratory. (Diagram not required)

(c) Define the term solubility.

(d) The table below shows the solubility of salt K in water at different temperatures.

Temperature/^{0}**C**	10	20	30	40	50	60
Solubility, **g/100g of water**	18	20	24	30	38	50

- (i) Plot a graph of solubility of K against temperature.
- (ii) Use your graph to determine;
  - Solubilities of K at 25^0C and 45^0C.
  - The mass of crystals deposited when a solution of K is cooled from 50^0C to 25^0C.

(e) Calculate the mass of K that would dissolve in 45g of water at 25^0C.

Question 4

(a) Briefly describe how crystals of iron(II) sulphate heptahydrate, $FeSO_4.7H_2O$ can be prepared in the laboratory.
(b) State what is observed when ;
   (i)   Crystals of iron(II) sulphate, $FeSO_4.7H_2O$ are heated strongly. Write equations for the reaction(s) that occur.
   (ii)   Concentrated nitric acid is added to a solution of iron(II) sulphate.
(c) Describe a chemical test you would carry out to show that $FeSO_4.7H_2O$ solution contains sulphate ions.

Question 5

(a) Describe the structure of graphite.
(b) State two properties in which graphite differs from diamond.
(c) Graphite was heated in excess air and the gas given off passed through aqueous calcium chloride for a long time.
   (i)   State what was observed.
   (ii)   Write equation(s) for the reaction(s) that take place.
(d) Carbon monoxide reacts with iron(III) oxide according to the equation below.
   $$Fe_2O_{3(s)} + 3CO_{(g)} \longrightarrow 2Fe_{(s)} + 3CO_{2(g)}$$
   If excess carbon monoxide was passed over 3.5g of heated iron(III) oxide, calculate the volume of carbon dioxide evolved at s.t.p.
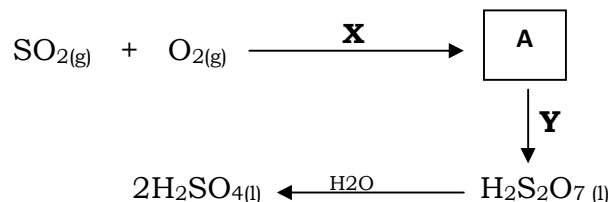
Question 6

(a) (i) Name the process by which sulphur is extracted
   (ii) Describe briefly how sulphur is extracted by the process named in (a) (i) above
(b) Write equations to show how fuming sulphuric acid can be obtained from sulphur.
(c) Concentrated sulphuric acid was added to sugar crystals in a beaker.
   (i)   State what was observed.
   (ii)   Write the equation for the change that occurs.
   (iii)   Name the property of sulphuric acid exhibited in the change described in (c) (i) above.

Question 7

(a) Sulphur dioxide can be prepared in the laboratory using sodium sulphite and sulphuric acid.
   (i)   Outline how a dry sample of sulphur dioxide can be prepared in the laboratory using sodium sulphite and sulphuric acid.
   (ii)   Name one other suitable substance that reacts with sodium sulphite to produce sulphur dioxide in the laboratory.
(b) Write an equation for the reaction in (a)(ii)

(c) The flow diagram below shows a series of chemical reactions in order to prepare sulphuric acid from sulphur dioxide.

$$SO_{2(g)} \;+\; O_{2(g)} \xrightarrow{\;\;\textbf{X}\;\;} \boxed{\textbf{A}}$$

$$\downarrow \textbf{Y}$$

$$2H_2SO_{4(l)} \xleftarrow{\;\;H2O\;\;} H_2S_2O_{7\;(l)}$$

    (i)   Name the chemical reagents **X** and **Y**.

    (ii)   State the condition leading to the formation of substance **A** other than addition of **X**

(d) Explain the reaction of sulphur dioxide with acidified potassium dichromate.

(e) State one use of sulphur dioxide gas in the paper industry.

Question 8

(a) With the aid of a labeled diagram, describe how a dry sample of oxygen gas can be prepared from sodium peroxide in the laboratory.

(b) Write an equation for the reaction leading to the formation of oxygen from sodium peroxide.

(c) state what is observed and write an equation for the reaction that takes place when a piece of burning sodium metal is lowered in a gas jar containing:

    (i)   little oxygen

    (ii)   excess oxygen

(d) The product in c(i) was dissolved in water, and a sample of the resultant solution was added dropwise until in excess to a solution containing cation **X**. A blue precipitate insoluble was observed.

    (i)   identify **X**

    (ii)   Explain what is observed when excess ammonia is added to a solution containing cation **X.**

(e) Write equation for the reaction that takes place when sulphur is burnt in oxygen.

(f) State two uses of oxygen gas.

Question 9

(a) Using a well labeled diagram, describe how ammonia gas can be prepared in the laboratory.

(b) State two conditions under which ammonia can react with oxygen and write equation in each case to show the reaction that takes place.

(c) The product in one of the reactions in (b) is used in the production of nitric acid on a large scale. Identify the product and write equation(s) to show how it is converted into nitric acid.

(d) Explain the reaction of nitric acid with copper.

Question 10

(a) An organic compound Q contains 52.17% carbon, 13.04% hydrogen and the rest being oxygen. 0.46g on vaporization occupied 224cm^3 at s.t.p
      (i)   Determine the empirical formula of Q.
      (ii)   Calculate the molecular mass and hence the molecular formula of T.
(b) Describe how Q can be prepared from maize grains.
(c) State two uses of Q.
(d) Write equation and conditions for the reaction leading to formation of ethene from Q.
(e) Ethene produced in (d) above reacts to form polymer Z.
      (i)   Define the term polymer.
      (ii)   Write equation for the polymerization of ethene.
      (iii)   Name polymer Z.

Question 11

The scheme below was used to prepare soap.
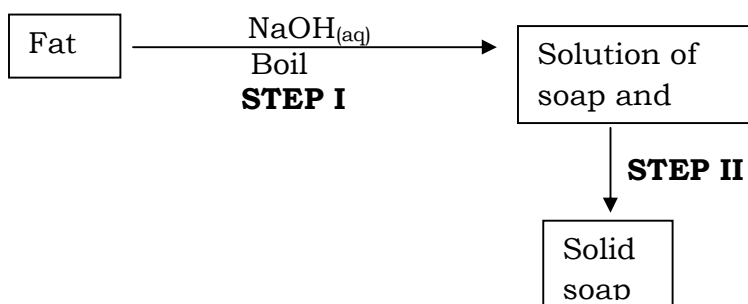
(a) Define the following terms;
    (i)   Soap
    (ii)   Saponification
(b) Name one chemical substance that can be added in step I and state the purpose of adding it.
(c) State one source of fat from which soap prepared.
(d) Briefly explain how soap can remove dirt from linen when linen is washed.
(e) When soap is used for washing using hard water, lathering does not occur immediately, when soapless detergent is used for washing in the same water, there is immediate lathering. Explain the observation.

Question 12

Alkenes can undergo polymerization.

(a) (i) Explain what is meant by the term polymerization.
(ii) Distinguish between synthetic and natural polymer. In each case, give two examples.
(b) State two advantages of synthetic polymers over natural polymers.
(c) Distinguish between thermosetting plastic and thermo softening plastic and in each case, give one example.

Question 13

Dilute nitric acid reacts with marble chips at room temperature according to the following equation;

$$CaCO_{3(s)} + 2HNO_{3(aq)} \longrightarrow Ca(NO_3)_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$$
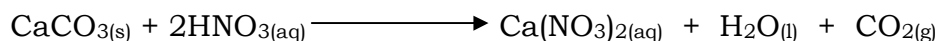
(a) State how the rate of reaction would be affected if;
   (i)   Marble chips were ground into powder
   (ii)   Nitric acid was further diluted
(b) Explain in each case the effect of the actions taken in a(i) and (ii) on the rate of reaction as stated by you.
(c) The table below shows variation in time for completion of a reaction when volumes of 2M nitric acid was added separately to equal masses of marble chips contained in different beakers.

Volume of 2M Nitric acid /cm³	60	40	29	21	15	11	8	7
Time of completion of reaction /min	0	10	20	30	40	50	60	70

   (i)   Plot a graph of volume of nitric acid (vertical axis) against time (horizontal axis)
   (ii)   Using your graph, describe the effect of concentration of nitric acid on the rate of reaction.
(d) Using the graph, determine
   (i)   The volume of nitric acid used at 15 minutes.
   (ii)   The rate of reaction at 25 minutes.

Question 14

(a) What is meant by the term 'rate of a chemical reaction'?
(b) Explain how the following factors affect the rate of a chemical reaction.
   (i)   Temperature
   (ii)   Surface area
   (iii) Concentration of reactants
(c) The table below shows the variation of volume of hydrogen gas collected at various time intervals when 2gm of zinc powder was reacted with excess 2M hydrochloric acid.

Time (minutes)	0	1	2	3	4	5	6	7	8
Volume of hydrogen /cm³	0	40	56	65	71	75	77	78	78

   (i)   Plot a graph of volume of hydrogen collected against time.
   (ii)   State why excess 2M Hydrochloric acid was used.
   (iii) From the graph, determine the rate of reaction at 2 minutes and at 5 minutes. Comment on the values of the rate obtained.
   (iv)   Explain the shape of the graph in (i) above.
(d) If the experiment was repeated using zinc granules instead of zinc powder, sketch graphs on the same axes showing how rate of reaction would vary.

(e) Draw a labeled diagram to show how the rate of production of hydrogen gas can be determined.

Question 15

Iron metal can be extracted from its ore by the method of reduction.

(a) (i) Define the term 'ore'.
(ii) Name the chief ore from which iron can be extracted and write its chemical formula.
(iii) Name the major impurity in the ore.
(b) Describe with the aid of equations how;
(i)   Impure iron can be extracted from its ore using coke.
(ii)   The impurity can be removed using limestone.
(c) One of the bi products of extraction of iron is slag.
(i)   Write the chemical formula of slag.
(ii)   Give two uses of slag.
(d) Stainless steel is an alloy containing iron. What is the difference between stainless steel and iron?

Question 16

(a) Sodium metal is extracted by the electrolysis of molten sodium chloride to which calcium chloride has been added.
(i)   Give a reason for the addition of calcium chloride.
(ii)   Name the material that can be used as the cathode and another that can be used as the anode.
(iii)   Write equation for the reaction that take place at each electrode.
(iv)   Describe how the product at the cathode can be collected
(v)   Name one other element that can be extracted by a similar method.
(b) Name one place in Uganda where a plant for the extraction of sodium could be constructed. Give a reason for your answer.
(c) State what would be observed and write equation for the reaction that would take place when sodium metal;
(i)   Is dropped in a beaker of cold water.
(ii)   Is reacted with chlorine gas.

Question 17

(a) Define the term 'enthalpy of neutralization'.
(b) Given 60cm^3 of 2M sulphuric acid and a solution of 2M sodium hydroxide. Describe an experiment you can carry out to determine the enthalpy of neutralization of sulphuric acid. (Diagram not required)
(c) 50cm^3 of 1M sulphuric acid and 50cm^3 of 2M sodium hydroxide both at 20.5^{0}C were mixed in a plastic beaker. The mixture was stirred and its maximum temperature was 30.5^{0}C.
(i)   Write an equation for the reaction.
(ii)   Calculate the number of moles of the acid that reacted.

(iii)   Calculate the molar heat of neutralization of the acid.

Question 18

(a) (i) What is water pollution?
(ii) How can you tell that water is polluted? Give two ways.
(b) (i) What is sewage?
(ii) How does sewage pollute water?
(iii) Describe how urban sewage is treated.
(iv) How can sewage be useful to the society?