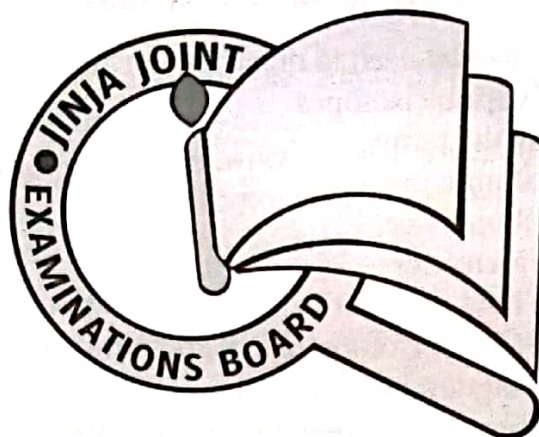P525/2

CHEMISTRY

Paper 2

December 2020

2½ hours.

JINJA JOINT EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

MOCK EXAMINATIONS DECEMBER, 2020

CHEMISTRY

(Principal Subject)

Paper 2

2 hours 30 minutes.

INSTRUCTION TO CANDIDATES:

Answer **FIVE** questions including three questions from section A and any **two** from section **B**.

Write answers in the answer booklet provided

Begin each question on a fresh page.

Mathematical tables and graph papers are provided.

Non-programmable scientific electronic calculators may be used.

Use equations where necessary to illustrate your answers

Where necessary use ($Cu = 64$, $S = 32$, $O = 16$, $Br = 79.9$. $H = 1$)

Faraday's constant is 96500c

Turn Over

SECTION A

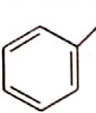### (Answer three questions from this section)

1 The mass spectrometer can be used to determine the relative atomic mass of elements consisting of various isotopes
   (a)   What is meant by the terms;
      (i)   Relative atomic mass   (01 mark)
      (ii)   Relative abundance   (01 mark)
      (iii)   Relative intensities   (01 mark)
   (b)   Briefly describe how the relative atomic mass of magnesium metal which consists of three isotopes can be determined using a mass spectrometer (Diagram not required)   (06 marks)
   (c)   The relative atomic mass of magnesium with isotopes $^{24}_{12}Mg$, $^{25}_{12}Mg$, and $^{26}_{12}Mg$ is 24.3, if the percentage abundance of $^{25}_{12}Mg$ and $^{26}_{12}Mg$ is equal,
      (i)   Calculate the percentage abundance of each isotope of magnesium   ($1\frac{1}{2}$ marks)
      (ii)   Sketch the mass spectrum of magnesium.   (02 marks)
   (d)   The table below shows the results of radioactive decay of a radioactive isotope of magnesium $^{26}_{12}Mg$. Use the data to plot a graph of log (mass) against time   (04 marks)

Mass of $^{26}_{12}Mg$ (g)	18.7	14.6	11.3	8.8	6.9	5.4
Time (S)	300	600	900	1200	1500	1800

   (e)   Using the graph plotted in (d) above determine the,
      (i)   Order of radioactive decay of $^{26}_{12}Mg$ (01 mark)
      (i)   Rate constant and hence half life of $^{26}_{12}Mg$ ($1\frac{1}{2}$ marks)
      (iii)   Original mass of $^{26}_{12}Mg$ (01 mark)

2 A saturated bromo compound, X, $C_nH_{2n-1}Br$ contains 49.08% by mass of bromine.
   (a)   (i)   Determine the molecular formula of X   (02marks)
      (ii)   Write the structural formula and name of X   (01mark)
   (b)   Phenol was reacted with X;
      (i)   State the condition(s) for the reaction   (01mark)
      (ii)   Write the equation and mechanism for the reaction that took place   (04 marks)

   (c)   X can be distinguished from Bromobenzene;
      (i)   Name the reagent(s) that can be used to distinguish the two compounds and State what is observed   (03mark)
      (ii)   Using relevant illustrations and equations explain the difference in observations   (05marks)
   (d)   Using equations while stating conditions for each step clearly show how X can be converted to Hexan-1,6-dioic acid   (04marks)

3 (a)   Describe, using equations where applicable, the reactions of chromium with;
      (i)   Air

(ii)   Sulphuric acid   (08marks)

(iii)   Sodium hydroxide

(b)   (i)   Explain why chromium is considered a typical transition metal

                                                  (02marks)

(ii)   State five ways in which the chemistry of chromium is similar to that of aluminium   (05 marks)

(c)   (i)   State what is observed when a small piece of magnesium ribbon is dropped into a solution of chromium(III) sulphate   (02marks)

(ii)   Explain the observation in c(i) above   (03marks)

4   Explain the following observations

(a)   Hydrogen fluoride is a liquid at 19°C while hydrogen chloride is a gas.

                                                  $(3\frac{1}{2}$ marks)

(b)   When sodium hydroxide is added to manganese(II)chloride, a white precipitate is formed that is insoluble in excess sodium hydroxide but turns brown on standing $(4\frac{1}{2}$ marks)

(c)   Carbon tetrachloride molecule is non-polar yet the bonds in it are polar

                                                  $(4\frac{1}{2}$ marks)

(d)   Phenol is a stronger acid than Cyclohexanol $(3\frac{1}{2}$ marks)

(e)   A Mixture of 50cc of 0.1M ammonium hydroxide solution and 50cc of 0.1M solution of hydrochloric acid gives a solution which is less than seven.

                                                  (04marks)

SECTION B: Attempt two (2) questions

5   (a)   Write equations to show how each of the following compounds can be synthesized. In each case, indicate a mechanism for the reaction.

(i)   [structure: benzene ring with COCH₃ group]   from   Benzene   (03 marks)

(ii) $(CH_3)_2C=N-OH$ from   Propanone   (05 marks)

(b)   Name the reagent(s) that can be used to differentiate between the compounds in each of the following pairs. In each case, state what would be observed and write the equation(s) for the reaction if any when each member of the pairs is treated with the reagent(s) stated.

(i)   Phenol and cyclohexanol   (04 marks)

(ii)   Ethanal and Phenylmethanal   (04 marks)

(c)   Using equations while stating conditions for each step clearly show how 2-bromopropane can be converted to phenol   (04marks)

6   (a)   The melting points of Magnesium, Silicon and sulphur are 650°C, 1423°C, and 120°C respectively. Explain the difference in the melting   point of the elements

                                                   (06 marks)

(b) (i) Name the type of bond that exists in the hydride of Magnesium, Silicon and Sulphur. $(1\frac{1}{2}marks)$

(ii) Write the equation to show the reaction of any of the hydrides in (i) with water $(4\frac{1}{2}marks)$

(08 marks)

(c) Describe the reactions of the oxide of silicon with;
(i) hydrofluoric acid
(ii) Sodium hydroxide
(iii) water

7 (a) (i) Write balanced equations to illustrate the main stages of the contact process (03marks)

(ii) Explain the conditions used in the contact process to ensure maximum yield. (05marks)

(b) Sulphuric acid vapour dissociates when heated according to the equation:

$$H_2SO_{4(g)} \rightleftharpoons H_2O_{(g)} + SO_{3(g)}$$

Write an expression for the equilibrium constant Kp, for the reaction and state its units $(1\frac{1}{2}$ marks$)$

(c) The following data shows the equilibrium partial pressure of sulphuric acid vapour, steam and sulphurtrioxide at two different temperatures and a pressure of 1atm;

Temperature (K)	Partial pressures (Pa)		
	H_2SO_4	H_2O	SO_3
400	4.5	3.2	2.9
493	470	300	270

(i) Calculate the equilibrium constant, Kp at each temperature. Hence deduce with an explanation whether the dissociation sulphuric acid vapour is exothermic or endothermic (04marks)

(ii) Explain the effect of increasing pressure on the equilibrium position and equilibrium constant Kp at 400K $(2\frac{1}{2}$ marks$)$

(d) (i) Sketch the structure and name the shape of the sulphuric acid molecule (02marks)

(ii) Explain why sulphuric acid molecule adopts the shape named. (02marks)

8 (a) (i) What is meant by the term **ore**? (01mark)

(ii) Write the formula and name of **one** ore from which copper is extracted. (01marks)

(b) Describe how pure copper can be extracted from the ore in (a)(ii) above. $(11\frac{1}{2}marks)$

(c) Discuss the reactions of copper with
(i) Concentrated hydrochloric acid

(ii)   Nitric acid

(d)   Few drops of potassium hexacyanoferrate(II) solution were added to copper(II) sulphate solution ;   (04marks)

    (i)   State what would be observed.   (01mark)

    (ii)   Write equation for the reaction.   (1½marks)