**P525/1**
**CHEMISTRY**
**THEORY**
**Paper 1**
**22ⁿᵈ July 2022**
**2 Hours 45 Minutes**

Name : …………………………………………………..………

Signature : ………………………… Personal No : ……………..

**KWGSA**

# KAMPALA WAKISO GIANT SCHOOLS' ASSOCIATION (KWGSA)

National Joint Mock Examination 2022

**Uganda Advanced Certificate of Education**

CHEMISTRY

Paper 1

**2 Hours 45 Minutes**

## INSTRUCTIONS TO CANDIDATES

*This paper consists of* **two** *sections* **A** *and* **B**

*Answer* **all** *questions in section* **A** *and* **six** *questions in section* **B**.

*Answers to* **all** *must be written in the spaces provided.*

*The periodic table, with relevant atomic masses is supplied at the end of the paper*

*Mathematical tables (3-figure tables) are adequate or non-programmable scientific electronic calculators may be used.*

*Illustrate your answers with equations where possible*

*Molar gas volume at stp is 22.4 litres*

*Gas constant,* R, $= 8.314 \text{ JK}^{-1}\text{mol}^{-1}$

*Standard temperature* $= 273K$

*Standard pressure* $= 101325 \text{ Nm}^{-2}$

| Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q15 | Q16 | Q17 | Total |
|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
|    |    |    |    |    |    |    |    |    |     |     |     |     |     |     |     |     |       |

## SECTION A (46 MARKS)
*Attempt **all** questions in this section*

1. Calcium phosphate partially dissociates in water to form a saturated solution of concentrated $3.531 \times 10^{-5} \, gdm^{-3}$ at $25^0$C.

   (a) Write the;

   (i) Equation of the partial dissociation of calcium phosphate in water.

   (01 mark)

   ……………………………………………………………………………

   ……………………………………………………………………………

   (ii) expression for the solubility product $K_{SP}$. (01 mark)

   ……………………………………………………………………………

   ……………………………………………………………………………

   ……………………………………………………………………………

   (b) Calculate the solubility product $K_{SP}$ of calcium phosphate at $25^0$C. (01 mark)

   ……………………………………………………………………………

   ……………………………………………………………………………

   ……………………………………………………………………………

   ……………………………………………………………………………

   ……………………………………………………………………………

   (c) State how the $K_{SP}$ value in (b) above is affected when calcium nitrate is added to the saturated solution of calcium phosphate at $25^0$C. (01 mark)

   ……………………………………………………………………………

   ……………………………………………………………………………

   ……………………………………………………………………………

2. (a) Write the formula and state the chemical nature of oxides by Beryllium and Barium. (03 marks)

| Element | Formula of the oxide | Chemical name |
|---------|---------------------|---------------|
| Beryllium | | |
| Barium | | |

| Phosphorus | | |
|---|---|---|
| | | |

(b) Write the equation(s) for the reaction(s) between the oxide(s) of;
    (i)    Beryllium with Sodium hydroxide solution.    (1$^{1}/_{2}$ marks)

……………………………………………………………………………

……………………………………………………………………………

    (ii)    Barium with dilute mineral acids.    (1$^{1}/_{2}$ marks)

……………………………………………………………………………

……………………………………………………………………………

3. The physical states of Chlorine, Bromine and Iodine at 298K and 760mmHg are gas liquid and solid respectively.
    (a)    State reasons why the physical states vary among the group VII elements.

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

    (b)    Write equation(s) for the reaction(s) that took place when excess Chlorine gas is bubbled into Sodium thiosulphate solution.    (1$^{1}/_{2}$ marks)

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………
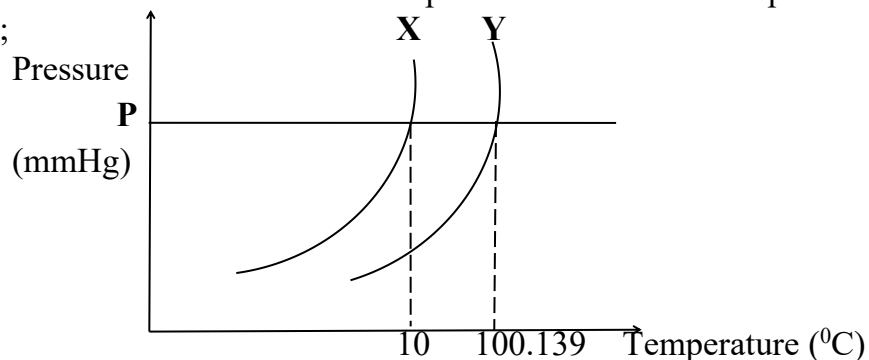
4. 5.5g of nonvolatile substance **B** was dissolved in 12.5g of a solvent. The vapor pressure curves for the solution and pure solvent at constant pressure **P** are shown below;



Pressure P (mmHg) vs Temperature (°C); curves X and Y, with dashed lines at 100.139; values 10, 100.139 on temperature axis.

(a) Identify the curve for the solution. (02 marks)

……………………………………………………………………………………

……………………………………………………………………………………

(b) Calculate the molecular mass of **B**. (02 marks)

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

(c) State **two** limitations of your calculations in (b) (02 marks)

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

**5.** A solution contains 50g of ethane-1,2- diol and 40.0g of water.

(a) Calculate the boiling point of the solution (04 marks)

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

(b) State any assumptions you made in the calculations. (02 marks)

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

**6.** Name a reagent that can be used to distinguish between each member of the following pairs of compounds. In each case, state what would be observed when the reagent is added top each compound.

(a) $CH_3CH_2CH_2OH$ and $CH_3CH_2\overset{\displaystyle CH_3}{\underset{\displaystyle CH_3}{C}}-OH$          (03 marks)

Reagent:

…………………………………………………………………………………

Observations

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

(b) $CH_3CH_2CH_2NH_2$ and $CH_3CH_2CH_2NHCH_3$     (03 marks)
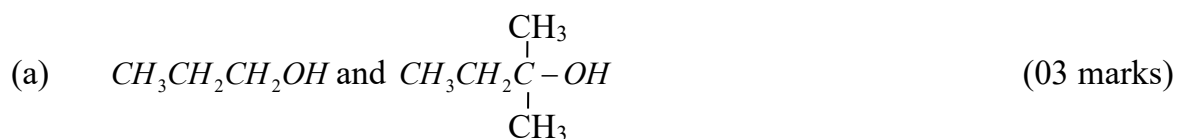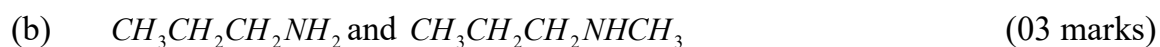
Reagent:

…………………………………………………………………………………

Observations

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

**7.** Ammonium Chloride undergoes hydrolysis when dissolved in water according to the equation.

$$NH_4\,(aq) + aq \rightleftharpoons NH_3\,(aq) + H^+(aq)$$
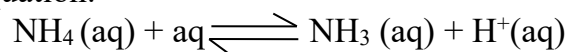
If the hydrolysis is constant for ammonium Chloride, $K_b$, at $25^0C$ is $5.6 \times 10^{-10}$. Calculate

(a) If the hydrolysis is constant for ammonium Chloride, $K_b$, at $25^0C$ is $5.6 \times 10^{-10}$. Calculate

    (i) PH of 0.1M solution of ammonium Chloride.     (03 marks)

…………………………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

(ii)   the percentage hydrolysis of 0.1M of solution of ammonium
       Chloride.                                                    (03 marks)

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

**8.**   (a)   Define the term **heat precipitation**.                        (02 marks)

……………………………………………………………………………

……………………………………………………………………………

(b)   250cm$^3$ of 0.5M Silver Nitrate solution was added to 15.0cm at 0.5M
      sodium Chloride solution in an insulated container. The temperature of the
      resulting mixture rose by 3$^0$C. Assuming that the container has negligible
      heat capacity and the heat capacity of the resulting mixture is 4.21g$^{-10}$C$^{-3}$.
      Calculate the heat of precipitation of silver Chloride.          (04 marks)

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

**9.**   The table below shows the tests carried out on a solution of Substance **Z** and the
       observations that were made.

| Tests | Observations |
|---|---|
| (i) To a solution of **Z** was added dilute sodium hydrogen solution drop wise until in excess | Green precipitate insoluble in excess alkali |
| (ii) To a solution of **Z** was added aqueous ammonia drop wise until in excess | Green precipitate dissolves in excess ammonia to form a solution |

| (iii) To a solution of **Z** was added dilute Nitric acid followed by silver nitrate solution drop wise until in excess. | White precipitate dissolves in excess ammonia to form a colourless solution. |
|---|---|

(a)    Identify
       (i)    The cation in **Z**.                                                    (01 mark)

       ……………………………………………………………………………………
       ……………………………………………………………………………………

       (ii)    The anion in **Z**.                                                   (01 mark)

       ……………………………………………………………………………………
       ……………………………………………………………………………………

(b)    Write an ionic equation for the reaction leading to the formation of the white precipitate.                                                    ($1^1/_2$ marks)

       ……………………………………………………………………………………
       ……………………………………………………………………………………

(c)    Write formula of the final product in test (ii).                    ($1^1/_2$ marks)

       ……………………………………………………………………………………
       ……………………………………………………………………………………

## SECTION B (54 MARKS)
*Attempt any* **six** *questions from this section*

10.    (a)    State the oxidation state of Chromium in;
              (i)    Potassium Chromate                                      (03 marks)

              ……………………………………………………………………………
              ……………………………………………………………………………

              (ii)    Potassium dichromate                                   (03 marks)

              ……………………………………………………………………………
              ……………………………………………………………………………

       (b)    Acidified Potassium dichromate was reacted with Potassium iodide.
              (i)    State what was observed.                              (01 mark)

              ……………………………………………………………………………
              ……………………………………………………………………………

(ii) Write the half equation and overall equation for the reaction.

Half equations                                                    (1½ marks)

……………………………………………………………………………

……………………………………………………………………………

Overall equations                                                 (1½ marks)

……………………………………………………………………………

……………………………………………………………………………

(c) Potassium chromate was added to aqeous lead (II) Nitrate.
  (i) Write the ionic equation for the reaction.

……………………………………………………………………………

……………………………………………………………………………

  (ii) Write an equation for the hydrolysis of Sodium ethanoate in water.
                                                                   (02 marks)

……………………………………………………………………………

……………………………………………………………………………

**11.** (a) Write an expression for the hydrolysis constant, $K_h$ of sodium ethanoate.

……………………………………………………………………………………

……………………………………………………………………………

(b) Calculate;
  (i) The value of $K_h$ of sodium ethanoate and indicate units.
      ($K_a$ for $CH_3COOH$ is $1.8 \times 10^{-5}$, $K_w = 1 \times 10^{-14}$)          (04 marks)

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

……………………………………………………………………………

(ii) the P.H of a 0.1M sodium ethanoate solution (03 marks)

……………………………………………………………………………
……………………………………………………………………………
……………………………………………………………………………
……………………………………………………………………………
……………………………………………………………………………
……………………………………………………………………………

(c) State what would be the effect on the PH of the solution in c(ii) if 1cm$^3$ of 0.1M ethanoic acid was added to it.

……………………………………………………………………………
……………………………………………………………………………

12. (a) Write a general outer configuration for elements in the group II of the periodic table

……………………………………………………………………………
……………………………………………………………………………
……………………………………………………………………………
……………………………………………………………………………

(b) Describe the reactions, if any, between each of the following elements, beryllium, magnesium and calcium with;
(i) warm dilute sulphuric acid.
Beryllium

……………………………………………………………………
……………………………………………………………………
……………………………………………………………………

Magnesium

……………………………………………………………………
……………………………………………………………………
……………………………………………………………………

Calcium

……………………………………………………………………
……………………………………………………………………
……………………………………………………………………

(ii)     Warm concentrated sodium hydroxide solution.
Beryllium

…………………………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

Magnesium

…………………………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

Calcium

…………………………………………………………………………

…………………………………………………………………………

…………………………………………………………………………

**13.**     Lead (II) Sulphate was shaken with $1dm^3$ of water..
(a)     Write an expression for the solubility product of Lead (II) sulphate.

…………………………………………………………………………..………

………………………………………………………………………………..

(b)     5g of lead (II) sulphate was shaken with $1dm^3$ of water. Determine the percentage of lead (II) sulphate that dissolved.

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

(c)     0.05M Sulphuric acid was used instead of water in (b), calculate the percentage of lead (II) sulphate that dissolved and state any assumptions you make.

…………………………………………………………………………………

…………………………………………………………………………………

…………………………………………………………………………………

..................................................................................................

..................................................................................................

..................................................................................................

**14.** 0.9875 of an impure potassium manganate (VII) was dissolved in water 250cm$^3$ of solution. When 20.0cm$^3$ of this solution was acidified with dilute Sulphuric acid warmed and titrated against Sodium ethanedioate (Oxalate) solution, made by dissolving 1.67g of anhydrous sodium ethanedioate solution was used.

(a)   Write an ionic equation for the reaction between sodium ethanedioate and potassium manganate (VII).                                              (01 mark)

..................................................................................................

..................................................................................................

(b)   Determine the molar concentration of manganese (VII) ions.    (03 marks)

..................................................................................................

..................................................................................................

..................................................................................................

..................................................................................................

..................................................................................................

..................................................................................................

(c)   Calculate the percentage purity of potassium manganate (VII)    (03 marks)

..................................................................................................

..................................................................................................

..................................................................................................

..................................................................................................

..................................................................................................

..................................................................................................

(d)   Name **one** compound which is a common impurity in potassium manganate (VII)

..................................................................................................

..................................................................................................

**15.** In the extraction of aluminium from bauxite, the crude one is purified by first digesting with sodium hydroxide solution.

(a)   Describe what takes place when bauxite is digested sodium hydroxide and write equation for the reaction taking place.                          (02 marks)

..................................................................................................................

..................................................................................................................

..................................................................................................................

..................................................................................................................

..................................................................................................................

..................................................................................................................

(b)     Sulphur dioxide is oxidized to sulphur tri-oxide according to the equation.
        $SO + O_2$ (g) $\rightleftharpoons$ $2SO_3$ (aq). The enthalpy of the forward reaction at
        $25^0C$ is $-96KJMol^{-1}$.

    (a)     Describe giving reasons the effect on the position of equilibrium of;
        (i)      increasing the temperature from $25^0C$ to $100^0C$.     (02 marks)

..................................................................................................

..................................................................................................

..................................................................................................

..................................................................................................

        (ii)     Excess Oxygen.                                              (02 marks)

..................................................................................................

..................................................................................................

..................................................................................................

..................................................................................................

(b)     At $700^0C$ and total pressure of one atmosphere, the partial pressures at
        equilibrium of Sulphur dioxide and Oxygen are 0.27 and 0.41 atmosphere
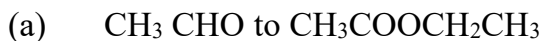        respectively.
    (i)      Calculate the equilibrium constant $K_P$ for the reaction.     (01 mark)

..................................................................................................

..................................................................................................

..................................................................................................

..................................................................................................

..................................................................................................

    (ii)     How is sulphuric acid obtained from sulphur trioxide?     (01 mark)

..................................................................................................

..................................................................................................

...........................................................................................

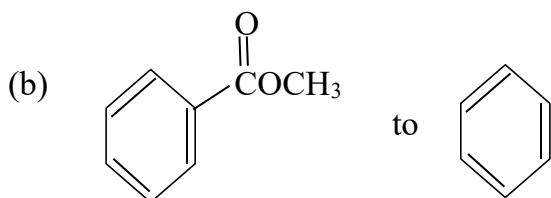...........................................................................................

**15.** Write equations to show how each of the following conversions can be affected. Indicate the reagents and conditions for the reaction in each case.
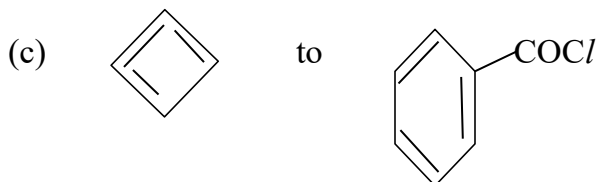
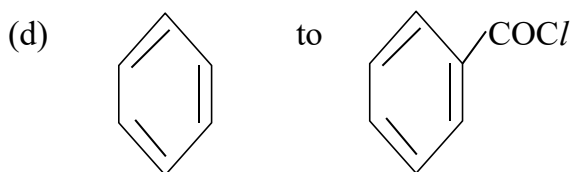(a)  $CH_3CHO$ to $CH_3COOCH_2CH_3$

...........................................................................................

...........................................................................................

(b)

to

...........................................................................................

...........................................................................................

(c)

to

...........................................................................................

...........................................................................................

(d)

to

# THE PERIODIC TABLE

| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1<br>H<br>1.0 | | | | | | | | | | | | | | | | 1<br>H<br>1.0 | 2<br>He<br>4.0 |
| 3<br>Li<br>6.9 | 4<br>Be<br>9.0 | | | | | | | | | | | 5<br>B<br>10.8 | 6<br>C<br>12.0 | 7<br>N<br>14.0 | 8<br>O<br>16.0 | 9<br>F<br>19.0 | 10<br>Ne<br>20.2 |
| 11<br>Na<br>23.0 | 12<br>Mg<br>24.3 | | | | | | | | | | | 13<br>Al<br>27.0 | 14<br>Si<br>28.1 | 15<br>P<br>31.0 | 16<br>S<br>32.1 | 17<br>Cl<br>35.4 | 18<br>Ar<br>40.0 |
| 19<br>K<br>39.1 | 20<br>Ca<br>40.1 | 21<br>Sc<br>45.0 | 22<br>Ti<br>47.9 | 23<br>V<br>50.9 | 24<br>Cr<br>52.0 | 25<br>Mn<br>54.9 | 26<br>Fe<br>55.8 | 27<br>Co<br>58.9 | 28<br>Ni<br>58.7 | 29<br>Cu<br>63.5 | 30<br>Zu<br>65.7 | 31<br>Ga<br>69.7 | 32<br>Ge<br>72.6 | 33<br>As<br>74.9 | 34<br>Se<br>79.0 | 35<br>Br<br>79.9 | 36<br>Kr<br>83.8 |
| 37<br>Rb<br>35.5 | 38<br>Sr<br>87.6 | 39<br>Y<br>88.9 | 40<br>Zr<br>91.2 | 41<br>Nb<br>92.9 | 42<br>Mo<br>95.9 | 43<br>Tc<br>98.9 | 44<br>Ru<br>101 | 45<br>Rh<br>103 | 46<br>Pd<br>106 | 47<br>Ag<br>108 | 48<br>Cd<br>112 | 49<br>In<br>115 | 50<br>Sn<br>119 | 51<br>Sb<br>122 | 52<br>Te<br>128 | 53<br>I<br>127 | 54<br>Xe<br>131 |
| 55<br>Cs<br>133 | 56<br>Ba<br>137 | 57<br>La<br>139 | 72<br>Hf<br>178 | 73<br>Ta<br>181 | 74<br>W<br>184 | 75<br>Re<br>186 | 76<br>Os<br>190 | 77<br>Ir<br>192 | 78<br>Pt<br>195 | 79<br>Au<br>197 | 80<br>Hg<br>201 | 81<br>Ti<br>204 | 82<br>Pb<br>207 | 83<br>Bi<br>209 | 84<br>Po<br>(209) | 85<br>At<br>(210) | 86<br>Rn<br>(222) |
| 87<br>Fr<br>(223) | 88<br>Ra<br>(226) | 89<br>Ac<br>(227) | | | | | | | | | | | | | | | |

| 57<br>La<br>139 | 58<br>Ce<br>140 | 59<br>Pr<br>141 | 60<br>Nd<br>144 | 61<br>Pm<br>(145) | 62<br>Sm<br>152 | 63<br>Sm<br>150 | 64<br>Eu<br>152 | 65<br>Tb<br>159 | 66<br>Dy<br>162 | 67<br>Ho<br>165 | 68<br>Er<br>167 | 69<br>Tm<br>169 | 70<br>Yb<br>173 | 71<br>Lu<br>175 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 89<br>Ac<br>(227) | 90<br>Th<br>232 | 91<br>Pa<br>231 | 92<br>U<br>238 | 93<br>Np<br>237 | 94<br>Pu<br>(244) | 95<br>Am<br>(243) | 96<br>Cm<br>(247) | 97<br>Bk<br>(247) | 98<br>Cr<br>251 | 99<br>Es<br>(254) | 100<br>Fm<br>(257) | 101<br>Mv<br>(256) | 102<br>No<br>(254) | 103<br>Lw |

1.  $\begin{matrix} 1 \\ H \end{matrix}$ ◤ **Indicates atomic number.**

2.  $\begin{matrix} H \\ 1.0 \end{matrix}$ ◤ **Indicates relative atomic mass.**

**END**