Name: ………………………………………………………………………………………. Class: ………… Adm.No. ……………

School: ……………………………………………………………………………………… Date: ………………………………………

 Sign:………………………………………..

**233/2**

**CHEMISTRY**

**Paper 2**

**DECEMBER 2021**

**Time: 2 hours**

**M O K A S A II J O I N T E X A M I N A T I O N - 2021**

**Kenya Certificate to Secondary Education**

**CHEMISTRY PAPER 2**

**TIME: 2 HOURS**

**INSTRUCTIONS TO CANDIDATES**

* *Write your name, admission number, date and school in the spaces provided.*
* *Answer all the questions in the spaces provided.*
* *All working must be clearly shown where necessary.*
* *Scientific calculators may be used.*

**FOR OFFICIAL USE ONLY**

|  |  |  |
| --- | --- | --- |
| **QUESTION** | **MAXIMUM SCORE** | **CANDIDATES SCORE** |
| 1 | 13 |  |
| 2 | 10 |  |
| 3 | 10 |  |
| 4 | 11 |  |
| 5 | 12 |  |
| 6 | 12 |  |
| 7 | 12 |  |
| **TOTAL** | **80** |  |

This paper consists of **13** printed pages. Candidates are advised to check and to make sure all pages are as indicated and no question is missing.

1.

I. (a) The grid below represents part of the periodic table. Study the information in it

and answer the questions that follow. The letters do not represent the actual symbols of the elements.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  | **I** |
|  | **G** |  |  |  |  | **A** |  | **J** |
| **F** | **B** |  | **C** |  | **D** |  | **E** | **K** |
|  |  |  |  |  |  |  |  | **L** |
|  |  |  |  |  |  |  | **H** | **M** |

 (i) Select an element that can form an ion with a charge of -2. Given a reason

for your answer. **(1 mark)**

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

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

 (ii) What type of structure would the oxide of G have? **(1 mark)**

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

(iii) How does the reactivity of H and E compare? Give a reason for your answer. **(1 mark)**

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 (b) 1.3g of B reacts completely when heated. 1.2 litres of chlorine gas at s.t.p (1 mole

 of any gas at s.t.p occupies 22.4 litres at s.t.p)

 (i) Write an equation for the reaction between B and chlorine. **(1 mark)**

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

 (ii) Determine the relative atomic mass of B. **(2 marks)**

 (c) Explain how you would expect the following to compare.

 (i) Atomic radius of **F** and **B** **(1 mark)**

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

 (ii) The pH value of the aqueous solution of the oxide of **B** and **D**. **(2 marks)**

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

II. Study the information below and answer the questions (the letters do not represent the actual symbols of the elements).

|  |  |  |
| --- | --- | --- |
| Elements  | Electronic configuration | LE (kJ/mol) |
| **J** | 2.1 | 519 |
| **K** | 2.8.1 | 494 |
| **L** | 2.8.8.1 | 418 |

 (a) What is ionization energy?  **(1 mark)**

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

 (b) Explain why element **L** has the lowest ionization energy. **(1 mark)**

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

 (c) Write an equation for the reaction between **K** and water. **(1 mark)**

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

 (d) Using dots (⦁) and crosses (×) show bonding in the compound between J and

 chlorine. **(1 mark)**

2. (a) Explain how one could distinguish between ethane and ethene gases using

 bromine water. **(2 marks)**

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

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

 (b) Study the flow chart below and answer the questions that follow.

Polymerization

**I**

$$CH\_{3}CH\_{2}CH\_{3}$$

**II**

$$Br\_{2}$$

**F**

$$CH\_{3}CH=CH\_{2}$$

$$W+ H\_{2}O$$

$$CH\_{3}CH\_{2}CH\_{2}OH$$

 **B**

  **V**

Na

$$CH\_{3}CH\_{2}COOH$$

 (i) Identify substances **B** and **F** by giving their names. **(2 marks)**

 **B** ………………………………………………………………………

 **F** ………………………………………………………………………

 (ii) Write an equation to show how substance **W** and water are formed.

  **(1 mark)**

………………………………………………………………………………………………………….......................………………………………………………………………………………………………………….......................

 (iii) Give the general formula of the polymer **V**. **(1 mark)**

………………………………………………………………………………………………………….......................

 (iv) Name the process **I** and **II**.

 **I** ………………………………………………………………….  **(1 mark)**

 **II** …………………………………………………………………. **(1 mark)**

 (v) Give the conditions required for the process named above to occur.

 **I** ……………………………………………………………………  **(1 mark)**

 **II** ……………………………………………………………………  **(1 mark)**

3. The diagram below shows the extraction of sodium metal using the Down’s cell. Study it and answer the questions that follow.

 Gas

Sodium chloride

Molten sodium

$$-ve$$

$$-ve$$

$$ ve$$

Steel gauze cylinder

$$+ve$$

(a) Explain why in this process sodium chloride is mixed with calcium chloride.

 **(2 marks)**

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

 (b) Why is the anode made of graphite and not iron? **(1 mark)**

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

(c) State **two** properties of sodium metal that make it possible for it to be collected as shown in the diagram. **(2 marks)**

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

 (d) What is the function of the steel gauze cylinder? **(1 mark)**

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

(e) Write ionic equations for the reactions which take place at;

 I Cathode **(1 mark)**

 ……………………………………………………………………………………………………………...

 ……………………………………………………………………………………………………………...

 II Anode **(1 mark)**

 ……………………………………………………………………………………………………………...

 ……………………………………………………………………………………………………………...

 (f) Give one industrial use of sodium metal. **(1 mark)**

……………………………………………………………………………………………………………...……………………………………………………………………………………………………………...

(g) Why is sodium metal stored under kerosene? **(1 mark)**

 ……………………………………………………………………………………………………………...

 ……………………………………………………………………………………………………………...

4. (a) In an experiment, hydrogen chloride gas was prepared and reacted with

aluminium turnings to form a solid P and gas L as shown in the diagram.

Aluminium

Solid **P**

Liquid **Q**

**X**

Gas **L**

Heat

$$NaCl\_{(s)}$$

Concentrated sulphuric acid

Water

(i) Name:

Solid **P** - ……………………………………………………………………. **(1 mark)**

Gas **L** - ………………………………………………………………………. **(1 mark)**

Liquid **Q** - …………………………………………………………………… **(1 mark)**

(ii) Give the name of another substance that could serve the same purpose as the concentrated sulphuric acid. **(1 mark)**

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

(iii) Write a chemical equation that will occur in the reaction flask X.**(1 mark)**

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

 (b) Explain the following observations:-

 (i) When blue litmus paper was dipped into the water in the beaker at the

end of the experiment it turned red. **(1 mark)**

…………………………………………………………………………………………………………..

 (ii) Solid **P** collects away from the heated aluminium. **(1 mark)**

 …………………………………………………………………………………………………………..

 (c) (i) Write an equation for the reaction that takes place between ammonia gas

and hydrogen chloride gas. **(1 mark)**

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

 (d) Calculate the mass of the product that would be formed when 4000 cm3 of

hydrogen chloride gas reacts completely with excess ammonia gas.

(H = 1, N = 14, Cl = 35.5, Molar gas volume at r.t.p = 24 litres) **(3 marks)**

5. (a) Distinguish between exothermic and endothermic reaction.

 Exothermic **(1 mark)**

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

 ………………………………………………………………………………………………………………………….

 Endothermic **(1 mark)**

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

 ………………………………………………………………………………………………………………………….

 (b) Changes of state are either exothermic or endothermic. Name a change of state

that is;

(i) exothermic …………………………………………………………………… **(1 mark)**

(ii) endothermic …………………………………………………………………….. **(1 mark)**

 (c) When pure water is heated at 1 atmospheric pressure at sea level, the

temperature of the water does not rise beyond 1000C even with continued heating. Explain this observation. **(2 marks)**

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

 ………………………………………………………………………………………………………………………….

 (d) Study the energy level diagram below and answer the questions that follow.

$$∆H\_{6}$$

$$Na\_{(s)}+\frac{1}{2}Cl\_{2(g)}$$

$$∆H\_{1}$$

$$∆H\_{2}$$

$$Na\_{(g)}+\frac{1}{2}Cl\_{2(g)}$$

$$Na\_{(g)}+Cl\_{(g)}$$

$$∆H\_{3}$$

$$Na^{+}\_{(g)}+e+Cl\_{(g)}$$

Path of reaction

$$NaCl\_{(s)}$$

$$∆H\_{5}$$

$$∆H\_{4}$$

$$Na^{+}\_{(g)}+Cl^{-}\_{(s)}$$

Energy

 (i) Give the names of the energy changes represented by $∆H\_{1}$ $∆H\_{4} ∆H\_{5 }∆H\_{6}$

 $∆H\_{1}$ ……………………………………………………………………………… **(1 mark)**

 $∆H\_{4}$ …………………………………………………………………………….... **(1 mark)**

 $∆H\_{5}$ ………………………………………………………………………………. **(1 mark)**

 $∆H\_{6}$ ………………………………………………………………………………. **(1 mark)**

 (ii) When is $∆H\_{5}$ endothermic? **(1 mark)**

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

 (iii) Show the relationship between $∆H\_{1} ∆H\_{2} ∆H\_{3} ∆H\_{4} ∆H\_{5} and ∆H\_{6}.$

 **(1 mark)**

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

6. (a) What is the electronic arrangement of nitrogen in $NO\_{3}^{-}$ ? **(1 mark)**

 (b) Study the standard electrode potentials below and answer the questions that follow. (The letters do not represent the actual symbols of the elements.

 $A^{+}\_{(aq)}+e^{-} A\_{(s)} E^{ϑ}=-2.92V$

 $B^{+}\_{(aq)}+e^{-} B\_{(s)} E^{ϑ}=+0.52V$

 $C^{+}\_{(aq)}+e^{-} \frac{1}{2}C\_{2(g)} E^{ϑ}=0.00V$

 $\frac{1}{2}D\_{2(g)}+e^{- } D^{-}\_{(aq)} E^{ϑ}=+1.36V$

 $E^{2+}\_{(aq)}+2e^{-} E\_{(s)} E^{ϑ}=-0.44V$

 (i) With reasons, identify the;

 I Strongest reducing agent. **(1 mark)**

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

 II the reference electrode. **(1 mark)**

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

 (ii) Write the overall equation for the reaction that will be obtained when half

 cells of B and E are connected. **(1 mark)**

 ………………………………………………………………………………………………………………………….

 ………………………………………………………………………………………………………………………….

 ………………………………………………………………………………………………………………………….

 (iv) Explain whether the reaction represented below can take place.

 **(2 marks)**

 $2A^{+}\_{(aq)}+E\_{(s)} 2A\_{(s)}+E^{2+}\_{(aq)}$

 (v) Draw the cell diagram obtained when the half cells in (ii) are combined.

 **(2 marks)**

 (c) In an experiment to electroplate a copper spoon with silver, a current of 0.5A was passed for 18 minutes.

 (i) Sketch a diagram to show how the experiment was carried out. **(2 marks)**

 (ii) Calculate the amount of silver deposited on the spoon.

 (IF = 96500C, Ag = 108) **(2 marks)**

7. The flow chart below shows the stages involved in manufacture of sulphuric (VI) acid by

 the contact process. Study it and answer the questions that follow.

Air

 Air

$$SO\_{2(g)}$$

Heat exchanger

$$SO\_{2}+O\_{2}$$

Chamber

Purifier and Drier

Solid **P**

Gas **R**

 **Q**

Water

Catalytic chamber

Absorption Tower

Diluter

VI

 (a) Apart from Sulphur, identify other substance that can be used as solid **P**.

 **(1 mark)**

 ……………………………………………………………………………………………………………………….

 (b) What is the function of the purifier? **(1 mark)**

 ……………………………………………………………………………………………………………………….

 ……………………………………………………………………………………………………………………….

 (c) Give **two** functions of the heat exchanger. **(1 mark)**

 ……………………………………………………………………………………………………………………….

 ……………………………………………………………………………………………………………………….

 (d) State the optimum conditions for the reaction to take place at the catalytic chamber. **(1 mark)**

 ……………………………………………………………………………………………………………………….

 ……………………………………………………………………………………………………………………….

 (e) Name;

 (i) gas **R**. ……………………………………………………………………………… **(1 mark)**

 (ii) substance **Q** ……………………………………………………………………**…. (1 mark)**

 (f) Write equations for reactions taking place at the:-

 (i) Catalytic chamber **(1 mark)**

 ……………………………………………………………………………………………………………………….

 (ii) Absorption Tower **(1 mark)**

 ……………………………………………………………………………………………………………………….

 (g) Explain why Gas **R** cannot be dissolved in water to form sulphuric (VI) acid.

 **(1 mark)**

 ……………………………………………………………………………………………………………………….

 ……………………………………………………………………………………………………………………….

 (h) Exhaust gases this process are passed through chimneys lined with calcium hydroxide to avoid pollution.

 (i) Name this process **(1 mark)**

 ……………………………………………………………………………………………………………………….

 (ii) Write the equation for the reaction taking place. **(1 mark)**

 ……………………………………………………………………………………………………………………….

 (i) State the observation made when concentrated sulphuric (VI) acid is poured into a beaker containing sugar crystals. Name the property of conc. sulphuric acid.

 **(1 mark)**

 ………………………………………………………………………………………………………………………..

 .……………………………………………………………………………………………………………………….