

MINISTRY OF EDUCATION AND HIGHER EDUCATION

FORM FOUR EXAMS, 2021

CHEMISTRY



P/LAND NATIONAL EXAMINATION BOARD

MINISTRY OF EDUCATION AND HIGHER EDUCATION
PUNTLAND NATIONAL EXAMINATIONS BOARD

Code Number

FORM FOUR EXAMINATION, 2021
TIME: 2 HOURS AND 10 MINUTES FOR READING

CHEMISTRY

Instructions to candidates

- Answer all the questions
- This paper consists of 11 pages, count it and if any is missing inform your invigilator
- Do not write your **name and roll number** on the exam paper
- Make sure that **student's profile** is attached to the exam paper, if not, inform you invigilator.
- No extra paper is allowed.
- If you make a mistake, **cross out the incorrect answer and write your correct answer.**

This exam paper consists of following parts

Parts	Marks
Part one: Multiple Choice questions	14 marks
Part two: Structured question	86 marks
Total: 100 Marks	

For the markers only

PARTS	MARKS
Part one	
Part two	
TOTAL	%



SOM EXAMS

Use this page for through work, it will not be marked.

This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dashed lines, one above and one below the writing area, providing a guide for letter height and placement. The lines are evenly spaced and extend across the entire width of the page. There is no text or other markings on the paper.

PART ONE: MULTIPLE CHOICE QUESTIONS (14 MARKS)

1- The diagram below shows the electron arrangement of unknown element.

Which group and period in the periodic table does it belong?

A- Group 7 and period 2

B- group 6 and period 2

C- Group 5 and period 7

D- Group 8 and period 4



2- Which electron configuration would you expect to be for ${}_{13}\text{Al}$ atom in its ground state?

A- $1s^2 2s^2$

B- $1s^2 2s^2 2p^6$

C- $1s^2 2s^2 2p^6 3s^2 3p^1$

D- $1s^2 2s^2 2p^6 3s^2$

3- Which of the following elements has the lowest first ionization energy.

A- Lithium

B- Sodium

C- Potassium

D- Rubidium

4- Which of the following atoms will gain 3 electrons to achieve a stable electron configuration.

A- ${}_{16}\text{S}$

B- ${}_{15}\text{P}$

C- ${}_{17}\text{Cl}$

D- ${}_{35}\text{Br}$

5- Which molecule has a linear arrangement of the component atoms?

A- H_2O

B- BF_3

C- CO_2

D- CH_4

6- Which of the following **DOES NOT** describe ammonia (NH_3)?

A- Ionic compound

B- Pyramidal shape

C- Polar molecule

D- Covalent molecule

7- The half equation that occurs at the anode during the electrolysis of molten Sodium chloride is:

A- $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$

B- $\text{Cl}_2 + 2\text{e}^- \rightarrow 2\text{Cl}^-$

C- $\text{Na}^+ + 1\text{e}^- \rightarrow \text{Na}$

D- $\text{Na} \rightarrow \text{Na}^+ + 1\text{e}^-$

8- When iron(III) oxide is heated with carbon monoxide, iron is produced.



What happens to the iron oxide during this reaction?

A- The iron oxide burns

B- the iron oxide is neutralized

C- The iron oxide is oxidized

D- The iron oxide is reduced

9- Phenolphthalein indicator turns the color of alkalis from colorless to:

A- Blue

B- Red

C- Pink

D- Yellow

10- What is the concentration in mole/dm³ of a solution of sodium chloride (NaCl)

Containing 0.073 moles in 0.03 dm³?

A- 3.1 mol/dm³

B- 2.4 mol/dm³

C- 4.1 mol/dm³

D- 5.7 mol/dm³



11-The five ionization energies of boron are:

801

2427

3660

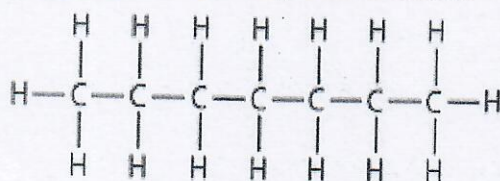
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32828

Which of the following represents the second ionization of boron?

- A) $B(g) \rightarrow B^{2+}(g) + 2e$ $\Delta H = +2427 \text{ kJmol}^{-1}$
 B) $B^+(g) \rightarrow B^{2+}(g) + 2e$ $\Delta H = +2427 \text{ kJmol}^{-1}$
 C) $B(g) \rightarrow B^{2+}(g) + 2e$ $\Delta H = -2427 \text{ kJmol}^{-1}$
 D) $B^+(g) \rightarrow B^{2+}(g) + 2e$ $\Delta H = -2427 \text{ kJmol}^{-1}$

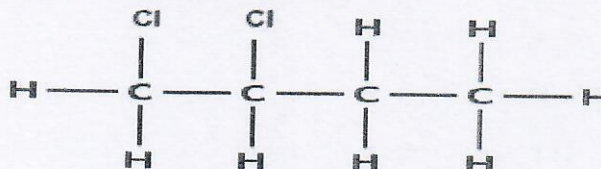
12-An organic compound is shown by this formula.



What type of formula is this?

- A) Molecular formula
 B) General Formula
 C) Structural formula
 D) Displayed formula

13-What is the correct name of the compound below?



- A) 3,4-dichlorobutane
 B) 1,2-dichlorobutene
 C) 3,4-dichlorobutene
 D) 1,2-dichlorobutane

14- Enthalpy is the total energy content of the reacting materials. It is given the symbol:

- A) ΔH
 B) H
 C) Δ
 D) Σ

PART TWO: STRUCTURAL QUESTIONS (86 MARKS)**Question One: (9 marks)**

- 1- The modern periodic table is a table displaced all the elements, their symbols, atomic number and mass number.

The image shows a standard periodic table of elements. It is organized into groups (columns) and periods (rows). The groups are labeled I through VII, with additional groups III, IV, V, VI, and VII shown for the transition elements. The elements are arranged in order of increasing atomic number. The table includes element symbols, atomic numbers, and mass numbers. The transition elements are labeled 'The transition elements'. The lanthanides and actinides are shown as separate rows at the bottom, labeled 'Lanthanides' and 'Actinides' respectively.

A) How the elements are arranged in the periodic table? (1M)

B) How many groups of elements are there in the periodic table? (1M)

C) Which group of elements in the periodic table is called alkali metals? (1M)

D) Which group in the periodic table has two electrons in their outer shells? (1M)

E) Name the only non-metal that is liquid at room temperature. (1M)

F) The element sulphur is in the periodic table.

i) Is sulphur metal or non-metal? (1M)

ii) Which period of the periodic table it belongs to? (1M)

iii) Write its group number in the periodic table? (1M)

G) Explain why noble gases are unreactive? (1M)



Question Two: (12 marks)

1- Fluorine and chlorine both react similarly with sodium to form sodium fluoride and sodium chloride.

a) Explain why fluorine and chlorine react similarly with sodium. (1M)

b) Fluorine forms diatomic molecules, (F₂). Fluorine atoms have 9 electrons.

i) The bond in a fluorine molecule, Is it ionic or covalent? (1M)

ii) Draw a diagram using dot and cross to show the bonding in a fluorine molecule (F₂) (1M)

2- There are two isotopes of the element of chlorine.



a) Describe, in terms of sub-atomic particles, write one similarity and one difference between the two isotopes of chlorine.

Similarity _____ (1M)

Difference _____ (1M)

3- The electronegativity values can be used to predict the polarity of a bond.

a) Explain the term electronegativity. (2M)

b) Show the polarity of each bond by adding δ^+ or δ^- to each bond of the following molecules. Like this: $\text{H}-\text{Cl}$ $\text{H}^{\delta+}-\text{Cl}^{\delta-}$

i) $\text{O} \text{ --- } \text{H}$ _____ (1M)

ii) $\text{H} \text{ ---- } \text{N}$ _____ (1M)

iii) $\text{F} \text{ ----- } \text{B}$ _____ (1M)

iv) $\text{H} \text{ ---- } \text{I}$ _____ (1M)

c) Pairs of electron in molecules may be present as bonding or as lone pairs.

i) How many lone pairs that water molecule have?

 (1M)

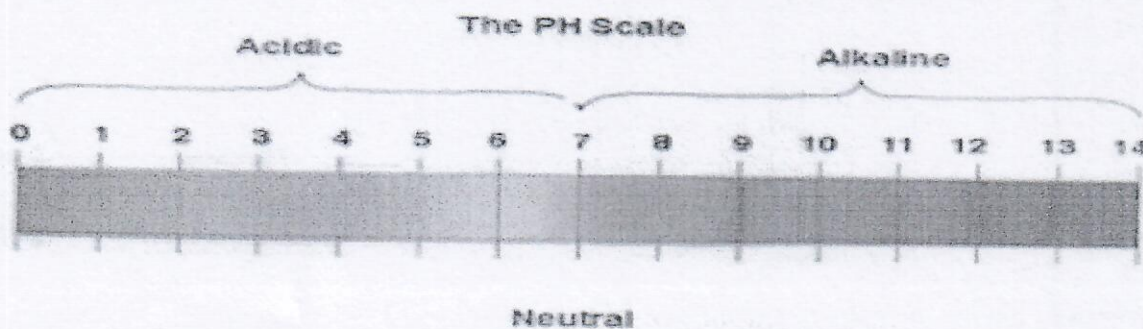
Question three: (18 marks)

1- Use the words in the box to complete the sentences below. (7M)

Formation Conductors	Graphite Hydrogen	Carbon	Electrolysis Homologous series
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- Hydrocarbons are organic compounds containing only _____ and _____
- _____ series is a set of compounds with the same functional group and have similar chemical properties.
- Standard enthalpy change of _____ is enthalpy change when one mole of compound formed from its elements under standard conditions
- All metals are good electrical _____
- Diamond and _____ are allotropes of carbon
- _____ is a way to decompose compounds using electrical energy.

2- Form 3 students measured the PH of these substances, (lemon juice, sodium chloride, potassium hydroxide, ammonia and hydrochloric acid), using the PH scales. They found that the substances had PH values of (1, 4, 7, 11, 14).



- a) Match the substance against their respective PH values. One example is done for you.

(5M)

Substance	PH value
Sugar	7
Lemon juice	
Salt	
Potassium hydroxide	
Ammonia	
Hydrochloric acid	



3- In a chemical equation, sodium carbonate reacts with hydrochloric acid.

Here is a balanced equation for the reaction.

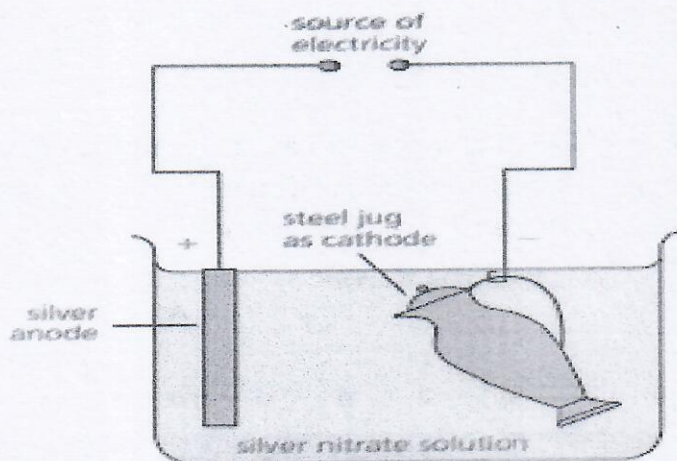


a) How many moles of hydrochloric acid react with one mole of sodium carbonate? _____ (1M)

b) How many moles of sodium chloride are formed in the reaction?
_____ (1M)

c) How many moles of carbon dioxide are produced in the reaction?
_____ (1M)

4- The diagram below shows how to electroplate a steel jug with silver.



a) Which substance is connected to the anode? (1M)

b) Which substance is connected to the cathode? (1M)

c) Name the electrolyte used in the reaction. (1M)

Question four (14 marks)

- 1- Categorize these metals as those extracted from their ores by carbon or carbon monoxide and those extracted by electrolysis. (7M)

Iron, Magnesium, Aluminum, Zinc,
Lead, Potassium, Sodium, Calcium

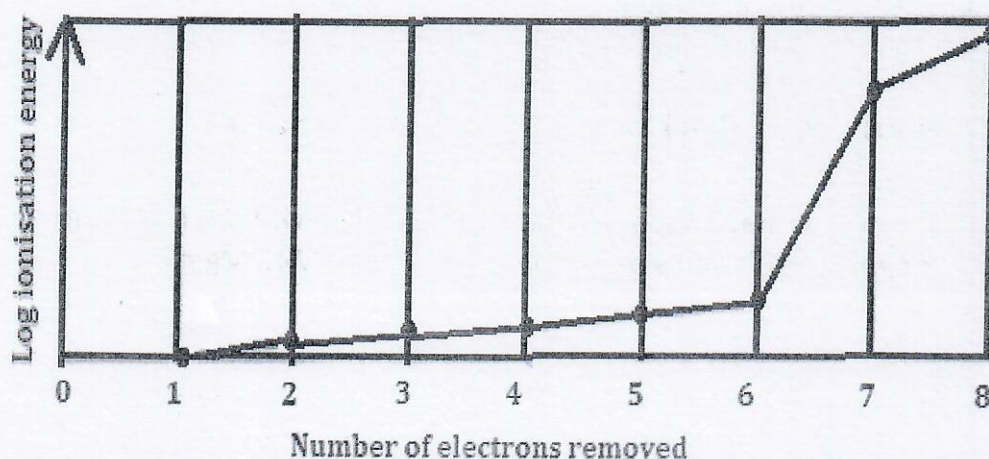
One example is done for you

Metals extracted by carbon	Metals extracted by electrolysis
	Sodium

- 2- Successive ionization energy provides evidence for the arrangement of electrons in an atom. The graph below shows the eight successive ionization energy of oxygen.

Study it and answer the questions that follow.

(7m)

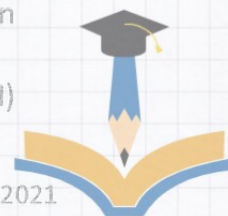


- a) Explain the term "ionization energy"?

(2M)

- b) Write the equation, including state symbols to represent the second ionization energy of oxygen. ($\Delta H_{I2} = 3390 \text{ kJ/mol}$)

(2M)



c) Between which two ionization energies is there a large difference in ionization energy? _____ (1M)

d) An element has the following electronic configuration: $1s^2 2s^2 2p^6 3s^2 2p^6$

i) Which block of the periodic table does it belong?

_____ (1M)

ii) Name that element. _____ (1M)

Question Five: (16 marks)

1- Calculate the relative formula mass of the following:

RAMs= (Na=23, O=16, H=1, Ca=40, Cl= 35.5)

a) NaOH _____ (1M)

b) CaCl_2 _____ (1M)

2- Balance these chemical equation:

a) $\text{Mg (s)} + \text{O}_2 \text{ (g)} \rightarrow \text{MgO (s)}$ (2M)

b) $\text{C}_3\text{H}_8 \text{ (g)} + \text{O}_2 \text{ (g)} \rightarrow \text{CO}_2 \text{ (g)} + \text{H}_2\text{O (l)}$ (3M)

3- A result showed that 2.4 g of magnesium combined with 1.6 g of oxygen.
Find the empirical formula of magnesium oxide. (RAMs, Mg = 24, O = 16)
Show all your work.

_____ (3M)

4- Write full balanced chemical equation, including state symbols for the reaction between:

a) Zinc and sulphuric acid

_____ (3M)



- b) Chemicals show a range of different structures. (3M)

Complete the table below by using these structures

Giant ionic giant metallic Simple molecular

Compound	Structures
Sodium chloride (NaCl)	
Ammonia (NH ₃)	
Copper metal (Cu)	

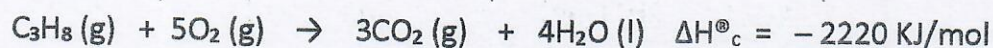
Question Six: (11 marks)

- 1- Propane is a gas at room temperature. It is used as a fuel.

a) Give one property of propane that makes it suitable for use as a fuel.

_____ (1M)

- b) The standard enthalpy change of combustion of propane is represented by an equation like this:



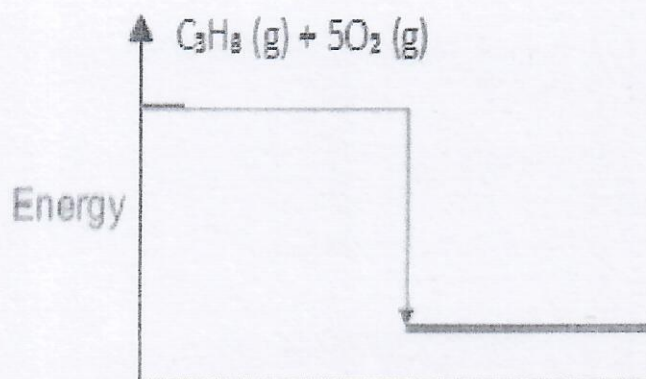
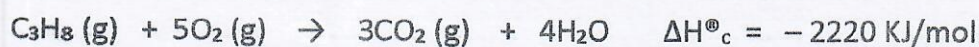
i) Is the reaction endothermic or exothermic

(1M)

ii) State what is meant by standard enthalpy of combustion?

(2M)

- c) Complete and label the enthalpy level diagram by using enthalpy change of combustion of propane. (2M)



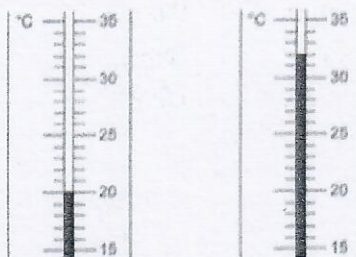
- 2- The Figure below shows the thermometer in one experiment before and after the student added a metal to the sulphuric acid solution.

Use the figure to complete Table.

(3)

Before adding metal

After adding metal



Temperature before adding metal in °C	
Temperature after adding metal in °C	
Change temperature(ΔH) in °C	

- 3- Magnesium ribbon reacts with hydrochloric acid like this:



- a) If a 2 gram piece of magnesium ribbon was reacted an excess of hydrochloric acid, what would happen to the rate of a reaction if the concentration of acid was increased? Explain your answer. (1M)

- b) If a 2 gram piece of magnesium ribbon was cut into six pieces then reacted with an excess of hydrochloric acid, what would happen to the rate of reaction? Explain your answer. (1M)

Question Seven: (6 marks)

- 1- Name the following compounds.

- a) $\text{CH}_3 \text{ CH}_3$ _____ (1M)
 b) $\text{CH}_3 \text{ CH} = \text{CH CH}_3$ _____ (1M)
 c) $\text{CH}_3 \text{ CH}_2 \text{ CH}_2\text{OH}$ _____ (1M)
 d) $\text{CH}_3 \text{ COOH}$ _____ (1M)

- 2- Write the general formula for:

- a) Alkane _____ (1M)
 b) Alkene _____ (1M)

End

