SIR ARTHUR LEWIS COMMUNITY COLLEGE

ACADEMIC YEAR (2024/2025) – SEMESTER TWO

END OF SEMESTER EXAMINATION

COURSE TITLE	**:**	**Fundamentals of Chemistry I**
COURSE CODE	**:**	**CHM002**
LECTURER	**:**	**Lyndelle Lubruin**
DATE	**:**	**April 30, 2025**
TIME	**:**	**1 p.m.**
DURATION	**:**	**2 Hours**
STUDENT ID #	**:**	_____

INSTRUCTIONS

1. This is a TWO hour examination consisting of TWO Sections and a Periodic Table.

   Section A – 30 Multiple Choice Questions
   Section B – 4 Structured Questions

2. Answer ALL questions for each section in the SPACES provided.

3. For numerical problems, ALL working must be shown for full marks.

4. Use of pocket electronic calculators is permitted.

Section	Number	Marks Earned	Maximum Marks
Section A Multiple choice	1 – 25		25 marks
Section B Structured Questions	1		15 marks
	2		25 marks
	3		20 marks
	4		15 marks
	TOTAL		**100 marks**

DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO

SECTION A – MULTIPLE CHOICE

Shade the letter that corresponds to the correct answer for each question.

1. Which of the following is **NOT true** about Chemistry?

   A. Theories used in Chemistry are tentative, changing with emerging empirical data.
   B. Chemistry is a collection of facts used to study the molecular world around us
   C. Scientific data must support conclusions made when engaging in scientific investigations in Chemistry.
   D. Chemistry is a branch of science focused on the properties of substances and the changes they undergo.

2. _____ is the branch of chemistry that uses **qualitative** and **quantitative** observation to identify and measure the physical and chemical properties of substances.

   A. Biochemistry
   B. Analytical Chemistry
   C. Organic Chemistry
   D. Inorganic Chemistry

3. Which of the following BEST identifies the steps in using the **Scientific Method** in the most logical order?

   A. Observe phenomena
      Formulate hypothesis
      Design an investigation
      Collect and analyze experimental data
      Draw conclusions
      Share results

   B. Design an investigation
      Formulate hypothesis
      Observe phenomena
      Draw conclusions
      Collect and analyze experimental data
      Share results

   C. Formulate hypothesis
      Observe phenomena
      Collect and analyze experimental data
      Share results
      Draw conclusions
      Design an investigation

   D. Observe phenomena
      Collect and analyze experimental data
      Formulate hypothesis
      Draw conclusions
      Share results
      Design an investigation

4. Which of the following is NOT a characteristic of a **Pure Substance**?

   A. Indefinite composition
   B. Shows only one spot when analyzed by chromatography
   C. Fixed melting points and boiling points
   D. Can be either an element or a compound

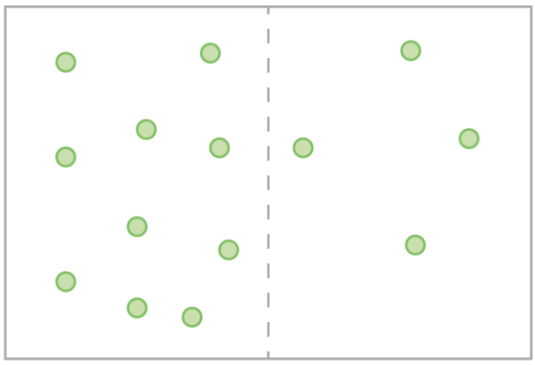
5. All the following are examples of matter **EXCEPT**

A. Atom
B. Light
C. Air
D. Salt

6. Which of the following substances is a **homogeneous** mixture?

A. Milk
B. Air
C. Toothpaste
D. Muddy water

7. The diagram shows atoms of helium in a box. The box is divided into two sections of equal volume by a **membrane** which is **fully permeable** to **helium**.



Left **Right**

Which of the following scenarios is most likely to occur?

A. There will be a net movement of the helium atoms from the top of the box to the bottom of the box.
B. There will be a net movement of helium atoms from left to right
C. There will be no net movement of helium atoms
D. There will be a net movement of helium atoms from right to left

8. To which period of the Periodic table does the element **Sulphur (** ${}^{32}_{16}S$ **)** belong?

A. 6
B. 3
C. 2
D. 1

9. Atoms are **Neutral**. This means that:

A. they have no charged particles
B. they have the same number of neutrons and protons
C. their valence shells have the same number of electrons as an inert gas
D. the number of positive charges in the atom equals the number of negative charges.

10. What is the total number of valence electrons in an atom with the **electronic configuration 2.8.5?**

(a) 2
(b) 8
(c) 5
(d) 15

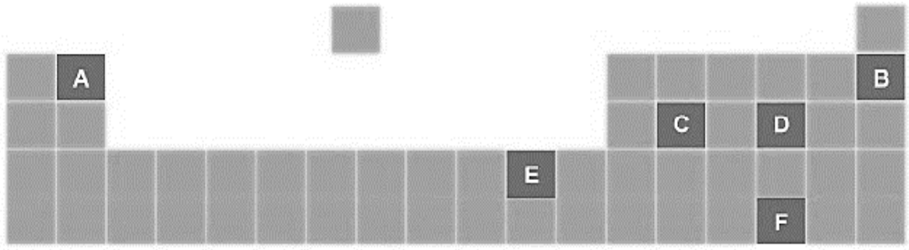


Figure 1: The Periodic Table

Questions 11 – 13 are based on the Periodic Table shown in Figure 1 above.

11. Which element is an **inert monoatomic gas** at **room temperature**?

    A. A
    B. B
    C. C
    D. D

12. Which **two elements** are in the **same group**?

    A. A and B
    B. C and D
    C. D and F
    D. E and F

13. Which **two elements** will form an **ionic bond**?

    A. E and D
    B. C and D
    C. A and E
    D. B and F

14. To which **period** does element $^{39}_{20}\boldsymbol{X}$ belong?

    A. 2
    B. 3
    C. 4
    D. 1

15. When **combining** with **non-metallic atoms**, **metallic atoms** will
    A. lose electrons and form negative ions
    B. gain electrons and form negative ions
    C. lose electrons and form positive ions
    D. gain electrons and form positive ions

16. Which of the four substances described below is MOST likely consistent of a **giant covalent structure**?

    A. Melting point 1500ºC, molten substance is a poor electrical conductor
    B. Melting point 1150º, molten substance readily conducts electricity
    C. Melting point 480ºC, molten substance readily conducts electricity
    D. Melting point 20ºC, molten substance does not conduct electricity

17. **Electronegativity** is a concept that is useful along with other concepts in

    A. predicting the polarity of a bond
    B. deciding how many electrons are involved in a bond
    C. formulating a statement of the octet rule
    D. determining the charge on a polyatomic ion

18. What is the name given to the compound with the formula **N_2O_5**?

A. Nitrogen pentoxide
B. Pentanitrogen dioxide
C. dinitrogen pentoxide
D. dihydrogen pentoxide

19. What is the charge of **iron** in the following compound: **$Fe_2(SO_4)_3$**?

A. +1
B. +2
C. +3
D. +4

20. Which of the chemical formulae shown below is **INCORRECT**?

A. KI
B. $Na(NO_3)_2$
C. $CaCl_2$
D. $MgSO_4$

21. **Solution A** has a **pH of 8** and reacts with **ethanoic acid** to produce a **salt and water**. Which of the following BEST identifies **Solution A**?

A. Strong Acid
B. Weak Acid
C. Strong Base
D. Weak Base

22. Which of the following are properties of **bases**?

I Sour Taste
II pH level greater than 7
III Turns red litmus blue
IV Turns blue litmus red

A. I and II only
B. I, II and III only
C. II and III only
D. I, II and IV only

23. Which of the following **indicators** identifies the specific **pH** of a **substance**?

A. Phenolphthalein
B. Litmus paper
C. Methyl orange
D. Universal indicator

24. Which of the following salts can be made by **titration method**?

A. sodium sulfate
B. calcium carbonate
C. copper (II) oxide
D. ammonia

25. John tested **substance X** with **red litmus paper** and **universal indicator**. The substance X **did not change the colour** of the **litmus paper** and **turned green** in the presence of the **universal indicator** solution indicating a **pH of 5**.

Which of the following substances is MOST likely substance X?

A. CH_3COOH
B. HCl
C. NaOH
D. NH_3

TOTAL 25 MARKS

END OF MULTIPLE-CHOICE QUESTIONS

MOVE ON TO SECTION B

SECTION B

Answer ALL questions in the spaces provided

1. A chemistry student planned an experiment to test a hypothesis. The procedure used in the experiment is identified in **Figure 2** below.

1. Place 25 ml of tap water in a glass beaker and label the beaker A
2. Place 25 ml of hot water in another glass beaker and label the beaker B
3. Place 25 ml of cold water in a third beaker and label beaker C
4. Place one drop of red dye in each beaker and start the timer
5. Measure the time taken for the water to turn completely pink in each beaker. Do not stir, just observe, and record the time taken

Figure 2: Experimental Procedure

(a) (i) What process is being investigated in the experiment? (1 mark)

_____

(ii) State ONE other example of this process in everyday living (1 mark)

_____

(b) Identify based on the procedure shown in **Figure 2** above:

(i) THREE variables to be controlled (3 marks)

_____

_____

(ii) The manipulating variable (1 mark)

_____

(iii) The responding variable (1 mark)

_____

(c) (i) Suggest a possible hypothesis for the experiment (2 marks)

_____

_____

_____

(ii) Giving a reason for your answer, suggest one way that the experimental procedure in **Figure 2** above could be improved. (2 marks)

_____

_____

_____

(d) (i) Identify an instrument that could be used to **measure the volume of water** needed in the experiment. (1 mark)

_____

(ii) If the temperature of the hot water is **65°F**, Calculate its temperature in Kelvin. (3 marks)

_____

_____

_____

_____

TOTAL 15 MARKS

2. All matter is composed of elements. Elements are made up of one kind of atom and are the building blocks of matter.

(a) Complete the table below with information on some common elements (8 marks)

Element	**Symbol**	**Group Number**	**Mass Number**	**Atomic Number**	**Number of Neutrons**	**Electronic configuration**
	Si		28		14	
	Ne		20			2.8
Chlorine				17	18	
Potassium			39	19		

(b) **Group 2 Metals** are called the **Alkaline Earth Metals**.

(i) State FOUR properties of Group 2 elements (4 marks)

_____

_____

_____

(ii) Explain the following trends in properties **DOWN** Group 2:

a) The atomic radius increases **DOWN** Group 2 (2 marks)

_____

_____

_____

_____

_____

b) Chemical reactivity increases **DOWN** Group 2 (2 marks)

_____

_____

_____

_____

_____

(iii) **Magnesium**, the **second Alkaline Earth metal** has three isotopes with the following natural abundance as shown in the table below

Isotope	Natural Abundance
$^{24}_{12}Mg$	79%
$^{25}_{12}Mg$	10%
$^{26}_{12}Mg$	11%

a) What is an **isotope**? (1 mark)

_____

_____

b) Give **ONE example** of a **radioactive isotope** and its use. (2 marks)

_____

_____

c) Using the information from the table above, calculate the **relative atomic mass** for Magnesium. (3 marks)

_____

_____

_____

(iv) Draw a labelled diagram showing the structure of a **Calcium atom** with the chemical notation $\mathbf{^{40}_{20}Ca}$. Your diagram should show the number of protons, neutrons, and electrons and where they are found in the atom.

(3 marks)

TOTAL 25 MARKS

3. The chemistry of many elements is to attain an outer electron structure like that of the chemically stable noble gases.

(a) (i) How is **covalent bonding** different from **ionic bonding**? (2 marks)

_____

_____

(b) Classify the bond between these pair of elements as **ionic** or **covalent**. (5 marks)

(i) Sulfur and oxygen _____

(ii) Potassium and bromine _____

(iii) Zinc and sulphur _____

(iv) Carbon and chlorine _____

(v) Phosphorus and chlorine _____

(c) Classify the bonding in the following molecules as **polar covalent** or **non-polar covalent**. (4 marks)

(i) H_2O _____

(ii) H_2 _____

(iii) CH_4 _____

(iv) HF _____

(d) Draw **dot and cross diagrams** to **show bonding** between the following pairs of elements. Write the **chemical formula** and **name** of the compound in each case.

(i) $^{7}_{3}Li$ **and** $^{16}_{8}O$ (5 marks)

Chemical Formula: _____

Name of Compound: _____

(ii) $^{35}_{17}Cl$ **and** $^{19}_{9}F$ (4 marks)

Chemical Formula: _____

Name of Compound: _____

TOTAL 20 MARKS

4. Most inorganic compounds can be classified as **acids, bases,** or **salts**.

(a) Write the chemical formula of the following inorganic compounds (5 marks)

(i) Sulphur trioxide _____

(ii) Ammonium nitrate _____

(iii) Iron (II) Chloride _____

(iv) Sulfuric acid _____

(v) Lithium Sulfate _____

(b) Name the products formed from the following acid reactions

(i) Magnesium + nitric acid (2 marks)

_____

(ii) Sodium carbonate + hydrochloric acid (2 marks)

_____

(c) You have been asked to prepare a sample of the soluble salt, sodium chloride.

(i) Identify the solutions needed to make this salt (2 marks)

_____

_____

(ii) Identify the apparatus needed to prepare sodium chloride (3 marks)

_____

_____

_____

_____

(iii) State the technique used for preparing the sodium chloride (1 mark)

_____

TOTAL 15 MARKS

END OF EXAMINATION!!