



SIR ARTHUR LEWIS COMMUNITY COLLEGE
ACADEMIC YEAR (2024/2025) - SEMESTER TWO
END OF SEMESTER EXAMINATION

COURSE CODE : CHM112
COURSE TITLE : General Chemistry I
LECTURER(S) : Jada-Ann Vite'
DATE : Wednesday 7th May 2025
TIME : 1:00 PM
DURATION : 2 Hours
STUDENT ID # : _____

GENERAL INFORMATION AND INSTRUCTIONS

- Students must sign **IN** and **OUT** on the examination class list.
- Write your ID number on the question paper.
- This paper has 2 compulsory sections and a Periodic Table. Answer ALL questions on this paper.
- Section 1 consists of 40 multiple choice questions.
- Section 2 consists of 2 short answer questions.

Section	Number	Marks Earned	Moderated Mark	Maximum Marks
Section 1	1-40			40
Section 2	1			10
	2			10
Total				60

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

Section A – Multiple Choice Questions – Each question is worth 1 mark each.

Instruction: Shade the correct answer.

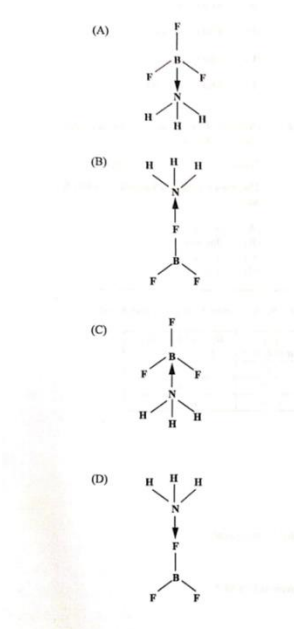
- Which of the following best defines molarity?
 - Moles of solute per liter of solvent
 - Moles of solute per liter of solution
 - Grams of solute per liter of solution
 - Moles of solvent per liter of solution
- Which of the following is the correct relationship between mass, moles, and molar mass?
 - $\text{Moles} = \text{Mass} \times \text{Molar Mass}$
 - $\text{Moles} = \text{Mass} / \text{Molar Mass}$
 - $\text{Mass} = \text{Moles} / \text{Molar Mass}$
 - $\text{Molar Mass} = \text{Moles} \times \text{Mass}$
- How many moles are in 25.25g of Mg?
 - 2.10g
 - 1.03g
 - 1.04g
 - 0.962g
- How many grams of NaOH are needed to prepare 250 mL of a 0.5 M solution?
 - 5.0 g
 - 10.0 g
 - 15.0 g
 - 20.0 g
- For complete reaction, 0.25g of a monobasic acid requires 10cm³ of 0.2 mol/dm³ sodium hydroxide. What is the relative molecular mass of the acid in g/mol?
 - 12.5
 - 62.5
 - 125
 - 250
- When 86g of the ionic salt, CaSO₄.xH₂O, is heated so that all of its water of crystallization is driven off and 68.0 g of CaSO₄ remain, the value of x is
 - 1
 - 2
 - 3
 - 4
- The simplest formula for a compound that contains 50% S and 50% O by mass is
 - SO
 - SO₂
 - S₂O
 - S₂O₄
- The second ionization energy of calcium is 1150 kJ/mol. Which of the following equations represents this statement?

	kJ/mol
A. $\text{Ca}_{(g)} \rightarrow \text{Ca}^{2+}_{(g)} + 2e$	-1150
B. $\text{Ca}^{+}_{(g)} \rightarrow \text{Ca}^{2+}_{(g)} + e$	-1150
C. $\text{Ca}_{(g)} \rightarrow \text{Ca}^{2+}_{(g)} + 2e$	+1150
D. $\text{Ca}^{+}_{(g)} \rightarrow \text{Ca}^{2+}_{(g)} + e$	+1150

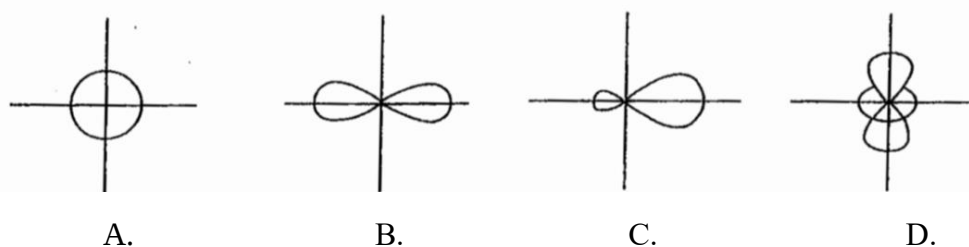
9. Which of the following ions has the **greatest** polarizing power?
- Be^{2+}
 - Ca^{2+}
 - Li^+
 - Sr^{2+}
10. Which of the following factors increases the first ionization energy of an atom?
- Increased screening by inner electrons
 - Larger number of valence electrons
 - Greater nuclear charge
 - Larger atomic radius
11. The isotopes of an element have:
- The same number of neutrons but different numbers of protons
 - The same number of protons but different numbers of neutrons
 - The same atomic mass but different atomic numbers
 - The same number of neutrons and protons
12. Which of the following species has a structure with a bond angle less than 109° ?
- NF_3
 - NH_4^+
 - CH_4
 - BF_3
13. An ion Z^{3+} contains 23 protons. What is the electronic configuration of Z^{3+} ?
- $[\text{Ar}]3\text{d}^{10}4\text{s}^1$
 - $[\text{Ar}]3\text{d}^2$
 - $[\text{Ar}]3\text{d}^34\text{s}^2$
 - $[\text{Ar}]3\text{d}^64\text{s}^2$
14. A π bond results from the overlapping of
- Two s orbitals
 - One s and one p orbital
 - Two p orbitals end on
 - Two p orbitals sideways
15. The bonds in SO_4^{2-} are best described as
- Covalent and polar
 - Ionic and polar
 - Polar, covalent and single
 - Polar, covalent and double
16. The bond angles in the PH_3 molecule are the same as that of NCl_3 . Its shape would BEST be described as
- Bipyramidal
 - Pyramidal
 - Tetrahedral
 - Trigonal
17. Which of the following solids has a giant molecular lattice?
- Copper
 - Carbon dioxide
 - Magnesium oxide
 - Silicon dioxide

18. Which of the following characteristics of oxygen BEST explains why the first ionization energy of oxygen is lower than that of nitrogen?
- A. A smaller atomic radius
 - B. Greater shielding by inner electrons
 - C. Greater effective nuclear charge
 - D. Repulsion between the paired 2p electrons
19. Which of the following pairs of elements would be expected to form the compound with the MOST ionic character?
- A. Li and F
 - B. Li and I
 - C. Rb and F
 - D. Rb and I
20. The van der Waals forces consist of
- A. Permanent dipole-permanent dipole interactions
 - B. Induced dipole-induced dipole interactions
 - C. Permanent dipole-induced dipole covalent interactions
 - D. Dipole-dipole; dipole-induced dipole ionic interactions
21. What shape describes the molecule water?
- A. Linear
 - B. Trigonal planar
 - C. Tetrahedral
 - D. Non-linear
22. How many hydrogen bonds can be formed with the oxygen atom in a molecule of water?
- A. 1
 - B. 2
 - C. 3
 - D. 4
23. What is the main difference between a covalent and an ionic bond?
- A. Covalent bonds involve electron transfer, while ionic bonds involve electron sharing
 - B. Ionic bonds involve electron transfer, while covalent bonds involve electron sharing
 - C. Covalent bonds form between metals, while ionic bonds form between nonmetals
 - D. Ionic bonds only exist in gases, while covalent bonds exist in solids

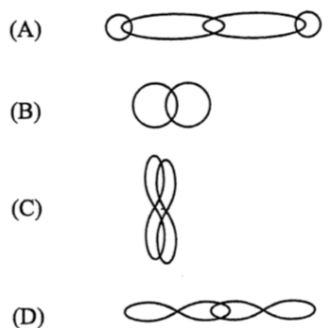
24. Which of the following structures correctly illustrates the coordinate bonding between BF_3 and NH_3 ?



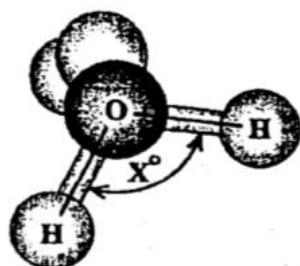
25. Which of the diagrams below BEST represents an sp^3 orbital?



26. Which of the following diagrams represents a pi bond?



27. What is the value of X in the following diagram?



- A. 104.5
- B. 109.5
- C. 120
- D. 180

28. Which of the following is the configuration of Cu (I) ion?
- [Ar] 3d¹⁰
 - [Ar] 3d⁸ 4s²
 - [Ar] 3d⁹ 4s¹
 - [Ar] 3d¹⁰ 4s¹
29. The intermolecular forces which are present in ice are
- Ionic bonds
 - Covalent bonds
 - Hydrogen bonds
 - Van der Waals forces
30. The valence electrons for a Ca atom are found in the
- 3s orbital
 - 4s orbital
 - 3p orbital
 - 4p orbital

31. This question refers to the following standard enthalpies of combustion for carbon, hydrogen and octane.

ΔH_c°	kJ/mol
Carbon	-394
Hydrogen	-286
Octane	-5476

The standard enthalpy of formation of octane, ΔH°_f is calculated using

- ΔH°_f (octane) = $-8(-394)-9(-286)-5476$
 - ΔH°_f (octane) = $-8(-394)-9(-286)-(-5476)$
 - ΔH°_f (octane) = $8(-394)+9(-286)-(-5476)$
 - ΔH°_f (octane) = $8(-394)-9(-286)-(-5476)$
32. The standard enthalpy changes for two reactions are as follows:
- $$2\text{Fe}_{(s)} + \frac{1}{2} \text{O}_{2(g)} \rightarrow \text{Fe}_2\text{O}_{3(s)} \quad \Delta H^\circ = -822 \text{ kJ/mol}$$
- $$\text{C}_{(s)} + \frac{1}{2} \text{O}_{2(g)} \rightarrow \text{CO}_{(g)} \quad \Delta H^\circ = -110 \text{ kJ/mol}$$

What is the standard enthalpy change for the reaction?

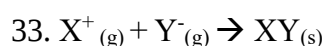
$\text{Fe}_2\text{O}_{3(s)} + 3\text{C}_{(s)} \rightarrow 2\text{Fe}_{(s)} + 3\text{CO}_{(g)}$ in kJ/mol?

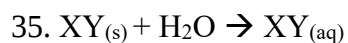
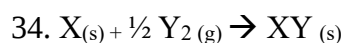
- 932
- 712
- 492
- +492

Items 33-35 refers to the following options

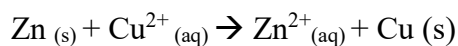
- Enthalpy of formation
- Lattice energy
- Enthalpy of solution
- Enthalpy of hydration

Select the most appropriate term from the options above to describe each process. Each option may be used once, more than once, or not at all. **Write the correct answer beside the question.**





36. What is the standard heat of reaction ΔH_r at 101.325 kPa or pressure and 298K, for the equation given below?



$$\Delta H^\circ_f = +64.4 \text{ kJ/mol for } Cu^{2+}$$

$$\Delta H^\circ_f = -152.4 \text{ kJ/mol for } Zn^{2+}$$

$$\Delta H^\circ_f = 0 \text{ kJ/mol for both Zn and Cu}$$

- A. +217 kJ/mole
 - B. +88.0 kJ/mole
 - C. -88.0 kJ/mole
 - D. -217 kJ/mole
37. A reaction that absorbs heat from the surroundings is classified as:
- A. Exothermic
 - B. Endothermic
 - C. Spontaneous
 - D. Catalyzed
38. Which of the following is NOT an endothermic process?
- A. Ice melting
 - B. Water boiling
 - C. Water evaporating
 - D. Water condensing
39. The high melting point of graphite can be attributed to
- A. Delocalized electrons
 - B. Hexagonal arrangement of the carbon atoms
 - C. Strong covalent bonds within the layers
 - D. Van der Waals' forces between the layers
40. Which of the following describes potassium bromide?
- A. A network of covalently bonded atoms
 - B. A substance which boils at 59 °C and decomposes at high temperature
 - C. A solid with a very high molar enthalpy of vaporization and in a liquid state, does not conduct electricity
 - D. A non-conducting solid which melts to form a liquid that conducts electricity

Section 2 – Each question in this section is worth 10 marks.

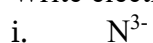
Instruction: Answer all questions in the spaces provided.

Question 1

- (a) Aluminium fluoride (AlF_3) and phosphorus trifluoride (PF_3) have very different physical properties.
- i. Draw dot-and-cross diagrams to illustrate the bonding in these compounds and give one reason for the difference in their physical properties.

[3 marks]

- (b) Write electronic configurations for the following:



[2 marks]

- (c) List three (3) factors which influence the size of the first ionization energy of an element.

[3 marks]

- (d) The first ionization energies of the elements in group 1 are shown below:

Element	First Ionization energy/ kJmol^{-1}
Li	520
Na	500
K	420
Rb	400
Cs	380

Explain the change in the first ionization energy as proton number increases

[2 marks]

Question 2

(a) Bond energies can be used to estimate the enthalpies of reactions in which bonds are broken and new bonds are formed. Consider the **gas-phase** reaction between methane (CH₄) and chlorine to produce methyl chloride (CH₃Cl) and hydrogen chloride.

Write a balanced equation to represent the reaction above.

[3 marks]

(b) Using bond energy values from table 1, calculate the enthalpy change of reaction, ΔH_{rxn} , for the equation above.

TABLE 1: BOND ENERGY VALUES

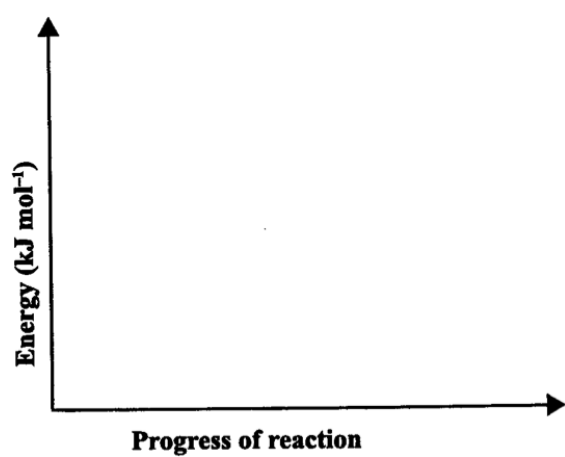
Bond	Energy (kJ mol ⁻¹)
H—H	436
F—F	158
Cl—Cl	244
H—F	562
H—Cl	431
C—C	350
C—H	410
C—Cl	340
C—O	360
S—H	347

[4 marks]

(c) Is the reaction in (b) exothermic or endothermic?

[1 mark]

(d) On the axes provided below, draw the energy-profile diagram for the reaction.



[2 marks]

END OF EXAMINATION