

Chemistry paper-2025



Paper 02

Chemistry I

- This paper consists of **05** pages.
- Answer all the questions.
- **Use of calculators is not allowed.**
- Write your **Index Number** in the space provided in the answer sheet.
- In each of the questions **1 to 10**, pick one of the alternatives from (1), (2), (3), (4), (5) which is **correct or most appropriate** and underline the your response.

Index Number:

Universal gas constant $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$

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Planck's constant $h = 6.626 \times 10^{-34} \text{ Js}$

Avogadro constant $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

Velocity of light $C = 3 \times 10^8 \text{ ms}^{-1}$

1. The number of electron pairs in the principal quantum number $n = 4$ in an atom is,
 1. 1
 2. 2
 3. 4
 4. 9
 5. 16
2. Which of the following molecule has molecular geometry same as that of SCl_4 ?
 1. PCl_5
 2. ICl_3
 3. TeCl_4
 4. XeF_2
 5. CCl_4
3. The **increasing** order of the O-N-O bond angle of NO_2 , NO_2^- , NO_2^+ and NO_4^{3-} is
 1. $\text{NO}_2 < \text{NO}_2^- < \text{NO}_2^+ < \text{NO}_4^{3-}$
 2. $\text{NO}_2 = \text{NO}_2^- < \text{NO}_4^{3-} < \text{NO}_2^+$
 3. $\text{NO}_2 = \text{NO}_2^- < \text{NO}_2^+ < \text{NO}_4^{3-}$
 4. $\text{NO}_4^{3-} < \text{NO}_2 < \text{NO}_2^- < \text{NO}_2^+$
 5. $\text{NO}_4^{3-} < \text{NO}_2^- < \text{NO}_2 < \text{NO}_2^+$
4. Which factor does **not** belong to the main four important factors that influence the electronegativity of an element in a molecule?
 1. Hybridization
 2. Charge
 3. Molar mass of an element
 4. Oxidation number
 5. Nature of the other atoms to which the atom of interest is attached in the molecule

5. What is the Molar mass of $K_2Cr_2O_7$?

(Molar masses of elements $K = 39.10 \text{ g mol}^{-1}$, $Cr = 52.00 \text{ g mol}^{-1}$, $O = 16.00 \text{ g mol}^{-1}$)

1. $107.10 \text{ g mol}^{-1}$
2. $147.01 \text{ g mol}^{-1}$
3. $333.08 \text{ g mol}^{-1}$
4. $294.20 \text{ g mol}^{-1}$
5. $255.08 \text{ g mol}^{-1}$

6. Determine the molecular formula of a compound with the elemental percentages of $C = 75.95\%$, $N = 17.72\%$ and $H = 6.33\%$ and the molar mass of the compound is 240 g mol^{-1} .

1. C_6H_6N
2. $C_{15}H_{15}N_3$
3. C_5H_5N
4. $C_5H_5N_3$
5. CHN

- For each of the questions 7 to 8, one or more responses out of the four responses (a), (b), (c), and (d) given is/are correct. Select the correct response/responses. In accordance with the instructions given on your answer sheet, mark

- (1) If only (a) and (b) are correct.
- (2) If only (b) and (c) are correct.
- (3) If only (c) and (d) are correct.
- (4) If only (d) and (a) are correct.
- (5) If **any other** number or combination of responses is correct.

Summary of above Instructions

(1)	(2)	(3)	(4)	(5)
Only (a) and (b) are correct	Only (b) and (c) are correct	Only (c) and (d) are correct	Only (d) and (a) are correct	Any other number or combination of responses is correct

7. Which of the following statement is **true** regarding the Cathode rays?

- a) They are not affected by both magnetic field and electric field.
- b) Cathode rays travel in straight lines.
- c) Cathode rays are a beam of particles having mass and possess kinetic energy.
- d) The nature of the cathode rays depends on the nature of the gas taken in the discharge tube or the material of the cathode.

8. Which of the following statements/ postulates were related with the Dalton's atomic theory?

- a) Elements are made out of extremely small, indivisible particles called atoms.
- b) Atoms of one element cannot be changed into atoms of a different element by chemical reactions.
- c) All atoms of a given element are not identical in mass and size.
- d) Compounds are formed by union of two or more atoms of different elements in a simple numerical ratio.

- In question Nos. **9** to **10**, two statements are given in respect of each question. From the Table given below, select the response out of the responses (1), (2), (3), (4), and (5) that **best** fits the two statements and mark appropriately on your answer sheet.

Response	First statement	Second statement
(1)	True	True, and correctly explains the first statement
(2)	True	True, but does not explain the first statement
(3)	True	False
(4)	False	True
(5)	False	False

First Statement	Second Statement
9. The atomic radius tends to decrease from left to right within each period of the periodic table.	The effective nuclear charge is decreased across a period.
10. Intermolecular forces do not exist among the molecules of an ideal gas.	Molecules in an ideal gas do not exhibit attraction or repulsion among them and the volume of these particles is considered negligible when compared to the volume of the container.

Part A – Structured Essay

Please write your answers on the paper itself.

01)

a. Arrange the following in the **decreasing** order of the property indicated in parentheses.

I. Li, Na, Mg, Al, Si (First ionization energy)

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II. O, N, Li, C, Mg (Number of valence electrons)

..... > > > >

III. Li^+ , Na^+ , O^{2-} , F^- , N^{3-} (Ionic radii)

..... > > > >

IV. SO_2 , SO_3 , SO_3^{2-} , SO_4^{2-} , SCl_2 (Electronegativity of sulphur (S) atom)

..... > > > >

b.

I. Select the compound with the highest boiling point from the list below.



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II. Explain your answer to the part (I) above.

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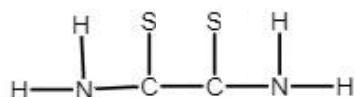
III. State the **main** intermolecular interactions between molecules in each pair shown below.

H_2O (l) / Cl_2 (l)

C_6H_6 (l) / Br_2 (l)

H_2O (l) / CH_3OH (l)

c. The skeleton of Dithiooxamide ($\text{C}_2\text{H}_4\text{N}_2\text{S}_2$) is given below.



I. Draw the **most acceptable** Lewis structure for Dithiooxamide.

II. Draw **four** resonance structures for the above molecule.

III. Based on the structure you have drawn in part (I), state the following regarding the N and C atoms given in the table below.

	N	C
Electron pair geometry		
Shape		
Hybridization		

IV. Draw a schematic diagram of the Lewis structure you have drawn in part (I), showing the approximate values of the bond angles.

d.

I. Determine the molecular formula of a compound containing only Ca, C, and O with the elemental percentages of Ca = 31.25%, C = 18.75%, and the molar mass of the compound is 128 g mol^{-1} . (Ca=40, C=12, O=16)

II. Name the above compound according to the IUPAC nomenclature.

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