ChemEve-2025

Paper 04

Chemistry I

VNS

Instructions:

- *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 your response.*

Index Number:

Universal gas constant R = 8.314 J K^{-1} mol^{-1} Avogadro constant N$_A$ = 6.022 x 10^{23} mol^{-1}

Planck's constant h = 6.626 x 10^{-34} J s   Velocity of light C = 3 x 10^8 m s^{-1}

1) The correct set of four quantum numbers for the valence electron of rubidium atom (Z = 37) is

   1. 5, 0, 0, $+\frac{1}{2}$
   2. 5, 1, 0, $+\frac{1}{2}$
   3. 5, 1, 1, $+\frac{1}{2}$
   4. 5, 0, 1, $+\frac{1}{2}$
   5. 0, 1, 5, $-\frac{1}{2}$

2) If N$_A$ is Avogadro's number then number of valence electrons in 4.2 g of nitride ions (N$_3{}^-$) is, (N = 14)
   1. 4.2 N$_A$
   2. 2.4 N$_A$
   3. 1.6 N$_A$
   4. 3.2 N$_A$
   5. 2.3 N$_A$

3) The correct statement for the molecule, CsI$_3$ is
   1. It is a covalent molecule.
   2. It contains Cs$^+$ and 3I$^-$ ions.
   3. It contains Cs^{3+} and I$^-$ ions.
   4. It contains Cs$^+$, I$^-$ and lattice I$_2$ molecule.
   5. It contains Cs$^+$ and I$_3{}^-$ ions.

4) The ratio of masses of O$_2$ and N$_2$ in a particular gaseous mixture is 1: 4. The ratio of number of their molecule is, (N=14, O=16)
   1. 1 : 4
   2. 7: 32
   3. 1: 8
   4. 2:7
   5. 3:1

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5) The 2.5 mg of methanol is dissolved in 500.0 g of water. What is the concentration of methanol in Parts per million (ppm).

1. 55.0 ppm
2. 49.9 ppm
3. 5.0×10^3 ppm

4. 4975.1 ppm
5. 499.9 ppm

6) The number of molecules in 8.96 liter of a gas at 0 °C and 1atm pressure,

1. 6.023×10^{23}
2. 12.04×10^{23}
3. 18.06×10^{23}

4. 24.08×10^{22}
5. 9.03×10^{22}

- 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(s) are **true**?
   a. Electrons have both wave and particle nature.
   b. A proton is heavier than a neutron.
   c. Each atom contains electron, proton and neutron.
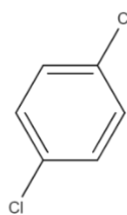   d. Each ion contains at least one proton.

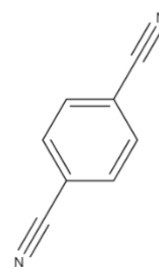8) For which of the following molecule is/are $\mu \neq 0$?

a.   b.   c.   d.

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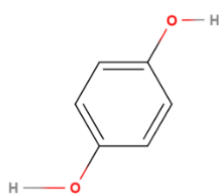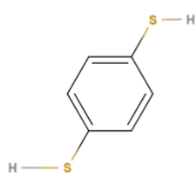
- In question Nos. **9** to **10**, two statements are given in respect of each question. From the Table given below, select the response out of the responses (1), (2), (3), (4), and (5) that **best** fits the two statements and mark appropriately on your answer sheet.

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 radius of the H atom is the same as the radius of the He^+ ion.	A hydrogen atom and He^+ have one electron in each.
10) ICl_2^- and NO_2 are linear in shape.	Molecules with the same atomic number usually have the same shape.

Part A – Structured Essay

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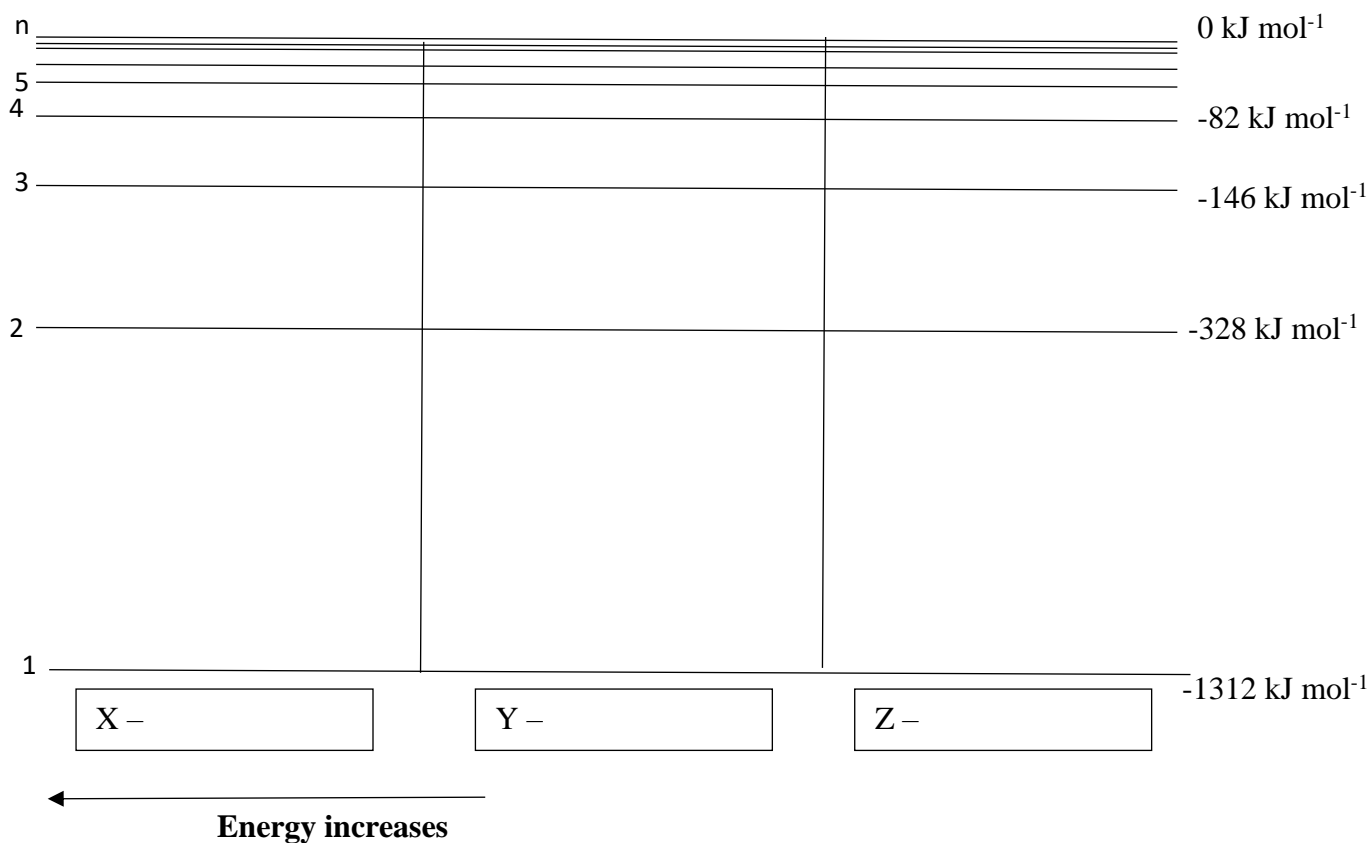
01)

A. A, B, and C are three lines corresponding to different series (Lyman, Balmer, Paschen) of the emission spectrum of hydrogen. The ionization energy of hydrogen can be calculated from line A. The frequency of B is lower than that of A and C and it belongs to highest energy line in that series. The C line belongs to the lowest energy line in that series.

    I.   Identify the series of hydrogen spectra corresponding to X, Y, and Z in the energy diagram below.
    II.   Draw the three lines (A, B, and C) on the energy diagram below.

n				0 kJ mol^{-1}

5
4   -82 kJ mol^{-1}

3   -146 kJ mol^{-1}

2   -328 kJ mol^{-1}

1   -1312 kJ mol^{-1}

X –	Y –	Z –

⟵ **Energy increases**

    III.   Calculate the frequency associated with line B.

    IV.   Calculate the wavelength of line B.

B.
    I.   Write the complete electron configuration of element X with atomic number 25 in its ground state.

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II.   How many unpaired electrons does a ground-state X atom possess? ……………………………

III.   Write down the set of quantum numbers corresponding to the last electron of that atom.

……
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C.

   I.   Write an example for each of the following to illustrate the discontinuity of matter.

      a. Solid

      ……

      b. Liquid

      ……..

      c. Gas

      ……..

  II.   Write down the Dalton law of partial pressure in words.

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III. ^{14}N and ^{15}N are the two naturally occurring isotopes of nitrogen. The relative abundances of $^{14}N_2$, ^{14}N-^{15}N, and $^{15}N_2$ in mole percent are 50, 30, and 20. A bulb contains 100 moles of natural nitrogen gas at 127 $^{\circ}C$. Under these conditions, the density of the gas in the container is 1.435 g dm^{-3}.

      a. Calculate the volume of the container.

      b. Calculate the partial pressure of $^{14}N_2$.

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