BOARD OF INTERMEDIATE EDUCATION

JUNIOR INTER CHEMISTRY

MODEL PAPER (ENGLISH VERSION)

TIME: 3 HOURS **MAX.MARKS: 60**

SECTION – A

I. i) Very Short Answer Type questions.

ii) Answer ALL questions.

ii) Each question carries TWO marks. **10 × 2 = 20**

1. What is 'Compressibility factor'? Give its value for ideal gas and real gas.

2. How many number of moles of glucose are present in 900 grams of glucose?

3. What is conjugate Acid - Base pair?

Write conjugate Acid and conjugate base for OH^- ion.

4. Why does the solubility of alkaline earth metal hydroxides in water increase down the group?

5. Give two uses of Na_2CO_3.

6. Define "BOD". Give the possible BOD values of clean water and polluted water.

7. Name two adverse effects caused by "Green house effect".

8. Diamond is hard and has high melting point. Explain why?

9. What is "Synthesis gas"?

10. Write IUPAC names of

a) $H_3C - \overset{\overset{O}{\|}}{C} - CH_3$ b) $CH_3 - CH_2 - CH = CH_2$

SECTION – B

II. i) Short Answer Type questions.

ii) Answer any SIX questions.

iii) Each question carries FOUR marks. **6 × 4 = 24**

11. Write 8 important postulates of kinetic molecular theory of gases.

12. A carbon compound contains 12.8% Carbon, 2.1% Hydrogen, 85.1% Bromine. The molecular weight of the compound is 187.9. Find the molecular formula of the compound.

13. Explain the terms

a) Entropy b) Enthalpy c) extensive property d) intensive property

14. Derive the relation between K_c & K_p for the following equilibrium reaction.

$H_2\ (g) + I_2\ (g) \rightleftharpoons 2\ HI\ (g)$

15. Write about "Position isomerism" and "Functional isomerism" with one example each.

16. How would you prepare Benzene from phenol and acetylene? Explain with equations.

17. Write 2 oxidising & 2 reducing properties of H_2O_2.

18. How does B_2H_6 react with

a) CO b) NH_3 c) H_2O d) $N(CH_3)_3$

SECTION – C

III. i) Long Answer Type questions.

ii) Answer any TWO questions.

iii) Each question carries EIGHT marks. **2 × 8 = 16**

19. How are the quantum numbers n, l and m_l arrived at? Explain the significance of these quantum numbers.

20. What is a periodic property? What is the reason for periodicity? How the following properties vary in a group and in a period? Explain.

a) Nature of oxides b) Electronegativity c) Ionization Enthalpy

21. a) Give four features of molecular orbital theory.

b) Give molecular orbital energy diagram of O_2. Calculate its bond order. Write the magnetic nature of O_2 molecule.

ANSWERS

SECTION – A

1. What is 'Compressibility factor? Give its value for ideal gas and real gas.

A: It is the ratio of actual molar volume of a real gas to the molar volume of ideal gas.

$$Z = \frac{V_{real}}{V_{ideal}} \text{ or } \frac{PV}{nRT}$$

For ideal gas Z = 1, For real gas $Z \neq 1$.

2. How many number of glucose molecules are present in 900 grams of glucose?

A: No. of moles of glucose $= \frac{\text{Wt. of glucose}}{\text{gram molar weight of glucose}} = \frac{900}{180} = 5$

3. What is conjugate acid - base pair? Write conjugate acid and base for OH^- ion.

A: A pair of acid and base differed by a single proton.

Conjugate acid of OH^- = H_2O; Conjugate base of OH^- = O^{-2}

4. Why does the solubility of alkaline earth metal hydroxides in water increase down the group?

A: As lattice enthalpy decreases much more than that of hydration enthalpy with increasesing cationic size.

5. Give two uses of Na_2CO_3.

A: ★ For softening of hard water.

★ In the qualitative & quantitative analysis in laboratory.

6. Define "BOD". Give the possible BOD values of clean water and polluted water.

A: The amount of Oxygen consumed by the micro organisms present in polluted water during 5 days at 20°C temperature.

BOD for pure water = 1 ppm

BOD for polluted water > 17 ppm.

7. Name two adverse effects caused by "Green house effect".

A: ★ Unseasonal rains, cyclones.

★ Melting of polar ice caps. Submerging of costal areas.

8. Diamond is hard and has high melting point. Explain. Why?

A: Due to three dimensional polytetrahedron network and presence of strong covalent bonds, it requires high amount of energy to break such strong bonds. So it's hard and has high M.P.

9. What is "Synthesis gas"?

A: Mixture of CO & H_2. It is used in the preparation of Methanol and many Hydrocarbons. So it is known as synthesis gas.

10. Write IUPAC names of

a) $H_3C - \overset{\overset{O}{\|}}{C} - CH_3$ **b)** $CH_3 - CH_2 - CH = CH_2$

A: a) 2 – propanone b) 1 – Butene

SECTION – B

11. Write 8 important postulates of kinetic molecular theory of gases.

A: ★ Tiny particles of gas are called molecules.

★ Molecules are considered hard and spherical.

★ Average kinetic energy ∝ absolute temperature.

★ There are neither attractions nor repulsions between the molecules.

★ Collisions are perfectly elastic.

★ Molecules move randomly in all the directions.

★ Volume of gas molecules is negligible compared to volume of the container.

★ Gravitational force of attraction does not affect motion of the molecules.

12. A carbon compound contains 12.8% Carbon, 2.1% Hydrogen, 85.1% Bromine. The molecular weight of the compound is 187.9. Find the molecular formula of the compound.

A:

C	H	Br
12.8	2.1	85.1
12	1	80
1.06	2.1	1.06
1.06	1.06	1.06
1	2	1

Empirical formula = CH_2Br

E.F. Wt. = $12 + 2 \times 1 + 80 = 94$

$$n = \frac{M.F.Wt}{E.F.Wt} = \frac{187.9}{94} = 2$$

Molecular Formula = $(E.F.)_n = (CH_2Br)_2$

$= C_2H_4Br_2$

13. Explain the terms:

a) Entropy **b) Enthalpy**

c) Extensive property **d) Intensive property**

A: **a) Entropy:** It is a measure of randomness.

$$\Delta S = \frac{q_{rev}}{T}$$

b) Enthalpy: Heat content of a system at constant pressure and temperature.

$\Delta H = H_P - H_R$

c) Extensive property: The property of a system that depends upon the total mass of the material.

e.g.: Mass, volume.

d) Intensive property: The property of a system that does not depend upon the total mass of the material.

e.g.: Density, viscosity.

14. Derive the relation between K_c & K_p for the following equilibrium reaction.

$H_2 (g) + I_2 (g) \rightleftharpoons 2 HI (g)$

A: $K_c = \frac{[HI]^2}{[H_2][I_2]}$

$K_p = \frac{P^2_{HI}}{P_{H_2} \cdot P_{I_2}}$

$K_p = K_c (RT)^{\Delta n}$

$\therefore K_p = K_c (RT)^0$

$\therefore K_p = K_c$

Where $\Delta n = n_{gaseous\ products} - n_{gaseous\ reactants} = 2 - 2 = 0$

15. Write about 'Position isomerism' and "Functional isomerism" with one example each.

A: **Position isomerism:** The isomerism that arises due to the difference in the position of multiple bonds or functional group or substituent.

e.g.: $CH_3 - CH_2 - CH_2 - OH$ (1 – Propanol) & $CH_3 - CH(OH) - CH_3$ (2 – Propanol)

Functional isomerism: The isomerism that arises due to the difference in the functional group.

e.g.: $CH_3\ CH_2OH$ (Ethyl alcohol) & $H_3C - O - CH_3$ (Dimethyl Ether).

16. How would you prepare Benzene from Phenol and acetylene? Explain with equations.

A: ★ C_2H_2 (acetylene) on passing through red hot iron tube at 873 K gives Benzene.

$$3\ C_2H_2 \xrightarrow[873\ K]{\text{Red hot iron tube}} C_6H_6$$

★ C_6H_6 is formed when vapours of phenol are passed over heated Zn.

$$C_6H_5OH + Zn \xrightarrow{\Delta} C_6H_6 + ZnO$$

17. Write 2 oxidising & 2 reducing properties of H_2O_2.

A: **Oxidising properties:**

1. H_2O_2 oxidises PbS (black) to $PbSO_4$ (White)

$$PbS + 4\ H_2O_2 \longrightarrow PbSO_4 + 4\ H_2O$$

2. H_2O_2 oxidises Fe^{+2} to Fe^{+3}

$$2\ Fe^{+2} + H_2O_2 + 2\ H^+ \longrightarrow 2\ Fe^{+3} + 2\ H_2O$$

Reducing properties:

1. H_2O_2 reduces $HOCl$ to Cl^-

$$HOCl + H_2O_2 \longrightarrow H_3O^+ + Cl^- + O_2$$

2. H_2O_2 reduces I_2 to I^-

$$I_2 + H_2O_2 + 2\ OH^- \longrightarrow 2\ I^- + 2\ H_2O + O_2$$

18. How does B_2H_6 react with

a) CO b) NH_3 c) H_2O d) $N(CH_3)_3$

A: a) B_2H_6 gives adduct compound with CO.

$$B_2H_6 + 2\ CO \longrightarrow 2\ BH_3 . CO$$

b) B_2H_6 on heating with NH_3 finally gives Borazole.

$$3\ B_2H_6 + 6\ NH_3 \xrightarrow[120°C]{\Delta} 3\ B_2H_6 . 2\ NH_3 \xrightarrow[200°C]{\Delta} 2\ B_3N_3H_6 + 12\ H_2$$

c) B_2H_6 on reaction with water gives boric acid.

$$B_2H_6 + 6\ H_2O \longrightarrow 2\ H_3BO_3 + 6\ H_2$$

d) B_2H_6 on reaction with $N(CH_3)_3$ gives adduct compound.

$$B_2H_6 + 2\ N(CH_3)_3 \xrightarrow{\Delta} 2\ [(CH_3)_3N \longrightarrow BH_3]$$

SECTION – C

19. How are the quantum numbers n, l and m_l arrived at? Explain the significance of these quantum numbers.

A: The solutions given by Schrodinger wave equation corresponding to the possible energy levels occupied by the electron. These quantised energy levels & corresponding wave functions are characterised by the quantum numbers n, l and m_l (But not by spin quantum number).

Principal Quantum number (n):

★ It was proposed by Niels – Bohr.

★ It is denoted by 'n'.

★ 'n' values can be denoted either by K, L, M, N, ... or by 1, 2, 3, 4, ...

★ As 'n' value increased the size, energy of the orbit increases.

★ It also represents the distance between the electron and nucleus.

★ In any atom, the number of shells = n

★ In any orbit, maximum number of orbitals = n^2

★ In any orbit maximum number of electrons = $2n^2$.

★ Energy of electron in nth orbit $E_n = \frac{-13.6}{n^2}$ eV/ atom.

★ This quantum number describes the size and energy of the orbit.

Azimuthal Quantum number (l):

★ It was proposed by Sommerfeld.

★ It is denoted by 'l'

★ 'l' values are ranging from 0 to n – 1.

★ It represents number of sub-shells in a shell.

★ The sub-shells are s, p, d, f.

★ The first shell contains only one sub - shell (s).

★ The second shell contains two sub - shells s, p.

★ The third shell contains three sub - shells s, p, d.

n	l	sub-shell notation
1	0	1 s
2	0	2 s
2	1	2 p
3	0	3 s
3	1	3 p
3	2	3 d
4	0	4 s
4	1	4 p
4	2	4 d
4	3	4 f

★ The fourth shell contains 4 sub-shells s, p, d, f.

★ The number of sub-shells in an orbit = n

★ The number of orbitals in a sub shell = $2l + 1$.

★ The number of electrons present in a sub-shell = $2(2l + 1)$ i.e. 2 electrons in s, 6 e^- in p, 10 e^- in d, 14 e^- in f sub-shells.

★ This quantum number describes the shape of the orbital.

l	sub-level	shape
0	s	spherical
1	p	dumb-bell
2	d	double dumb-bell
3	f	4 fold dumb-bell

Value of *l*	0	1	2	3	4	5
Sub shell notation	s	p	d	f	g	h
Number of orbitals	1	3	5	7	9	11

3. Magnetic quantum number (m_l):

★ It was proposed by Lande in order to explain "Zeeman effect" and "Stark effect".

★ It can be denoted by 'm' or m_l.

★ 'm' values are ranging from $-l$ to 0 to $+l$.

★ The total number of 'm' values = $2l + 1$.

★ 'm' values are 1, 3, 5, 7 if the '*l*' values are 0, 1, 2, 3 respectively.

★ The energy of all the obitals present in a sub-shell is same.

★ This quantum number describes orientation of the orbitals in space.

Sub-level	*l* value	m values	no. of orbitals
s	0	0	1
p	1	−1, 0, +1	3
d	2	−2, −1, 0, +1, +2	5
f	3	−3, −2, −1, 0, +1, +2, +3	7

20. What is a periodic property? What is the reason for periodicity? How the following properties vary in a group and in a period? Explain.

a) Nature of oxides b) Electronegativity c) Ionization enthalpy.

A: Periodic property: The repetition of similar property of elements at regular intervals (2, 8, 8, 18, 18, 32) when they are arranged in increasing order of their atomic numbers.

Reason: Similar outer electronic configuration (in a group) of elements.

e.g.: Li ($2s^1$), Na ($3s^1$), K ($4s^1$)

a) Nature of oxides

In a group: Metallic nature of the elements increases from top to bottom. Basic nature of oxides increases from top to bottom in a group. Acidic nature of oxides decreases from top to bottom in a group.

e.g.: Li_2O – weak basic oxide; K_2O – strong basic oxide.

In a period: Basic nature (metallic nature of elements) decreases, acidic nature (non-metallic nature) increases from left to right in a period.

e.g.: Na_2O – strong basic oxide

Al_2O_3 – Amphoteric oxide

Cl_2O_7 –strong acidic oxide.

b) Electronegativity

In a group: Electronegativity decreases from top to bottom in a group. As the atomic radius increases, the tendency of attraction of nucleus and electron decreases.

In a period: Electronegativity increases from left to right in a period. As the atomic radius decreases, the tendency of attraction of electron by increases.

e.g.: Na is least electronegative, Cl is most electronegative.

c) Ionization enthalpy (I.E.)

In a group: I.E. decreases from top to bottom in a group. As the atomic radius increases, attraction of valence electron by the nucleus decreases. Hence the energy required to remove outer most electron decreases.

In a period: I.E. increases from left to right in a period. As the atomic radius decreases, attaction of valence electron by the nucleus increases. Hence the energy required to remove outer most electron increases.

21 a) Give four features of molecular orbital theory.

b) Give molecular orbital energy diagram of O_2. Calculate its bond order. Write the magnetic nature of O_2 molecule.

A: a) Features of M.O.T.:

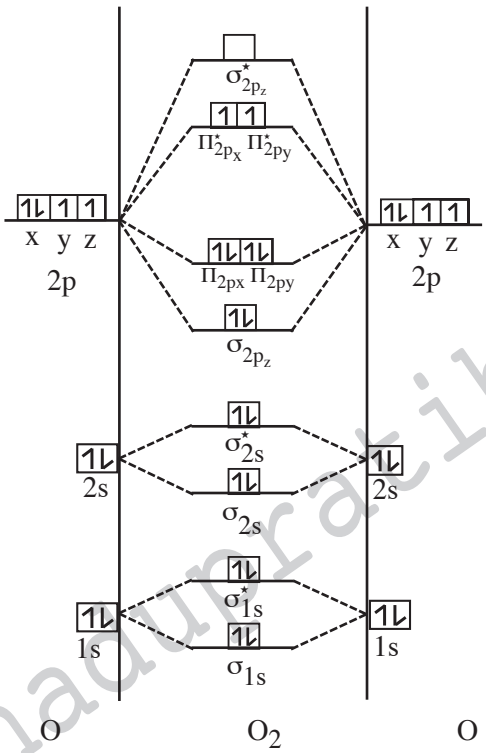
★ Molecular orbitals are formed by Linear Combination of Atomic Orbitals (L.C.A.O.) method.

★ No. of M.O.'s produced = No. of A.O.'s that combine.

★ Sigma M.O.'s are formed due to axial over lapping of a atomic orbitals. Pi M.O.'s are formed due to parallel (side wise) overlapping of A.O.'s.

★ Filling of electrons in M.O.'s takes place according to Aufbau principle, Hund's rule and Pauli's exclusion principle.

b) M.O.E.D. of O_2



M.O. Configuration of $O_2 = \sigma_{1s}^2\ \sigma^*_{1s}{}^2\ \sigma_{2s}^2\ \sigma^*_{2s}{}^2\ \sigma_{2p_z}{}^2\ \Pi_{2p_x}^2 = \Pi_{2p_y}^2\ \Pi^*_{2p_x}{}^1 = \Pi^*_{2p_y}{}^1$

Bond order of $O_2 = \frac{1}{2}\ (N_b - N_a) = \frac{1}{2}\ (10 - 6) = 2$

As 2 M.O.'s are half - filled, O_2 is paramagnetic.

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