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. **$10 \times 2 = 20$**

1. Write van der Waals equation of state. Give the physical significance of van der Waals parameters.

2. What do you mean by "Significant figures"? Give the number of significant figures present in 100.0

3. What is pH? Calculate pH of a 1.0×10^{-8} M solution of HCl.

4. $[SiF_6]^{-2}$ is known where as $[SiCl_6]^{-2}$ not. Give possible reasons.

5. Classify the following oxides as neutral, acidic, basic or amphoteric.

a) Tl_2O_3 b) Al_2O_3 c) SiO_2 d) CO

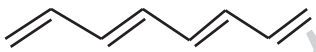
6. An aqueous solution of Na_2CO_3 is alkaline. Why?

7. Give two uses of quicklime.

8. What are the harmful effects caused by Ozone layer depletion?

9. Define the terms "Sink" and "TLV".

10. Write the IUPAC names of the following compounds.

a) $(CH_3)_2\,C(C_2H_5)_2$ b) 

SECTION – B

II. i) Short Answer Type questions.

ii) Answer any SIX questions.

iii) Each question carries FOUR marks. **$6 \times 4 = 24$**

11. State Graham's law of diffusion? Give two applications of this law.

12. What is empirical formula?

Chemical analysis of a Carbon compound gave 10.06% Carbon, 0.84% Hydrogen and 89.10% Chlorine. Calculate the empirical formula of the compound.

13. Define

a) enthalpy of combustion

b) standard enthalpy of formation.

14. State Lechatlier's Principle. Discuss the principle in brief for the industrial synthesis of SO_3.

15. Write any two methods of preparation of diborane. How does it react with

a) CO b) NH_3

16. Explain with one example for the following.

a) Interstitial hydride

b) Ionic hydride

c) Electron deficient hydride

d) Electron rich hydride

17. How does acetylene react with the following?

a) H_2O b) HCl c) Ammonical $AgNO_3$ d) Cl_2

18. Discuss Markovnikov's rule and Kharash effect.

SECTION – C

III. i) Long Answer Type questions.

ii) Answer any TWO questions.

iii) Each question carries EIGHT marks. **$2 \times 8 = 16$**

19. What is a periodic property?

How do the following properties change in group-I and 3rd period? Explain with example.

a) Atomic radius b) Nature of oxides c) Electron Gain enthalpy

20. Write the important postulates of Bohr's model of Hydrogen atom? Discuss the importance of the model to explain various series of line spectra in Hydrogen atom.

21. a) Explain the Geometry of H_2O and NH_3 on the basis of VSEPR theory.

b) Give Molecular Orbital energy diagram of N_2. Calculate its bond order. Write the magnetic nature of N_2 molecule.

ANSWERS

SECTION – A

1. Write van der Waals equation of state. Give the physical significance of van der Waals parameters.

A: $\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$

Where a = Measure of magnitude of intermolecular attractive forces.

b = Measure of magnitude of the actual volume occupied by the gas molecules.

2. What do you mean by "Significant figures"? Give the number of significant figures present in 100.0

A: Meaningful digits with certainty are called significant figures.

No. of significant figures in 100.0 = 4

3. What is pH? Calculate pH of a 1.0×10^{-8} M solution of HCl.

A: Negative logarithm of Hydrogen ion concentration is called pH.

$pH = -log\,[H^+]$

$[H^+] = [H^+]_{HCl} + [H^+]_{H_2O} = 10^{-8} + 10^{-7} = 10^{-7}\,[10^{-1} + 1]$

$= 1.1 \times 10^{-7}$

$pH = -\log [1.1 \times 10^{-7}] = -\,[\log 1.1 - 7 \log 10]$

$= -\,[0.0414 - 7] = -(-6.958)$

$= +6.96.$

4. $[SiF_6]^{-2}$ is known where as $[SiF_6]^{-2}$ not. Give possible reasons.

A: ★ Interaction of lone pair of electrons of Cl^- ion & Si^{+4} ion is not very strong.

★ Due to large ionic size of Cl^-, six such large ions can not be accommodated around small Si^{+4} ion.

5. Classify the following oxides as neutral, acidic, basic or amphoteric.

A: a) TlO_3 b) AlO_3 c) SiO_2 d) CO

a) TlO_3 – Basic b) AlO_3 – Amphoteric

c) SiO_2 – Acidic d) CO – Neutral

6. An aqueous solution of Na_2CO_3 is alkaline. Why?

A: Na_2CO_3 salt is made from strong base NaOH & Weak acid H_2CO_3. Conjugate ion of weak acid is strong. Hence CO_3^{-2} ion undergoes anionic hydrolysis to produce OH^- ions. So the solution is alkaline.

$CO_3^{-2} + 2\,H^+\,OH^- \longrightarrow H_2CO_3 + 2\,OH^-$

7. Give two uses of quick lime.

A: ★ Used in the purificaton of sugar.

★ Used in the manufacture of cement.

8. What are the harmful effects caused by Ozone layer depletion?

A: ★ Damage to fish productivity

★ Skin cancer and Cataract.

9. Define the terms "Sink" and "TLV".

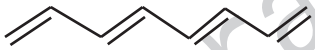
A: **Sink:** The medium which is not only effected by the pollutant but also remains there.

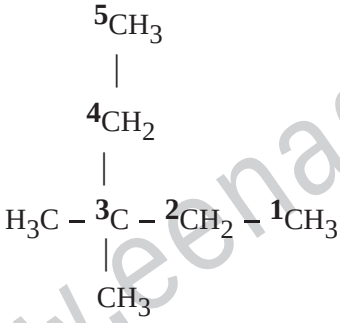
e.g.: Sea water & trees are big sinks for CO_2.

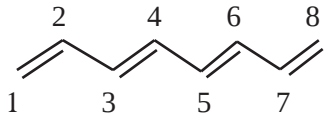
TLV: The permissible level of a toxic polutant in atmosphere. Where a healthy person works in that atmosphere for 8 Hours per day without any adverse effect.

e.g.: TLV for Zn = 1 mg/m^3.

10. Write the IUPAC names of the following compounds.

a) $(CH_3)_2\ C(C_2H_5)_2$ b) 

A: ఎ) 

బి) 

3, 3– Dimethylpentane 1, 3, 5, 7 Octatetra ene

SECTION – B

11. State Graham's law of diffusion? Give two applications of this law.

A: **Graham's law of diffusion:** The rate of diffusion of a gas is inversely proportional to the square root of its density.

$$r \propto \frac{1}{\sqrt{d}}$$

Applications: ★ In the separation of isotopes U^{235} and U^{238}

★ In making Ansil's alarm which detects CH_4 in coal mines.

12. What is "empirical formula"?

Chemical analysis of a Carbon compound gave 10.06% Carbon, 0.84% Hydrogen, and 89.10% Chlorine. Calculate the empirical formula of the compound.

A: **Empirical formula:** The formula that represents simplest ratio of atoms of elements of a molecule.

e.g.: Simple ratio of C : H in Benzene is = 1 : 1

C	H	Cl
$\frac{10.06}{12}$	$\frac{0.84}{1}$	$\frac{89.1}{35.5}$
$\frac{0.84}{0.84}$	$\frac{0.84}{0.84}$	$\frac{2.51}{0.84}$
1	1	3

$\therefore$ Empirical Formula of the compound = $CHCl_3$

13. Define

a) Enthalpy of combustion **b) standard enthalpy of formation.**

A: **a) Enthalpy of Combustion:** The change in enthalpy during complete combustion of 1 mole of a compound in excess of air.

e.g.: $\underline{C} + O_2 \longrightarrow CO_2 \quad \Delta H = -393.5 \text{ K.J. mol}^{-1}$

b) Standard enthalpy of formation: The change in enthalpy during the formation of 1 mole of a compound from its elements in their standard states.

e.g.: C (graphite solid) $+ 2 H_2$ (g) $\longrightarrow CH_4$ (g) $\Delta H = -74.8 \text{ K.J. mol}^{-1}$

14. State Lechatlier's Principle. Discuss the principle in brief for the industrial synthesis of SO_3.

A: **Lechatlier's Principle:** If a system at an equilibrium is disturbed either by change in temperature or pressure or concentration, then that equilibrium will be shifted to the direction in which that effect minimises or nullifies.

$2 SO_2$ (g) $+ O_2$ (g) $\rightleftharpoons$ $2 SO_3$ (g)

Effect of pressure: Optimum pressure 1.5 to 1.7 atmosphere is used instead of high pressure in order to prevent the corrosion of the towers and to get more SO_3.

Effect of Temperature: Optimum temperature 673 K is used to get more SO_3.

Effect of Concentration: ★ Addition of SO_2
★ Addition of O_2 } gives more SO_3
★ Removal of SO_3

15. Write any two methods of preparation of diborane. How does it react with

a) CO **b) NH_3**

A: **Preparation of B_2H_6:**

★ B_2H_6 is formed when BF_3 is treated with $LiAlH_4$

$4 BF_3 + 3 LiAlH_4 \longrightarrow 2 B_2H_6 + 3 AlF_3$

★ B_2H_6 is manufactured industrially by the reaction of BF_3 with NaH.

$2 BF_3 + 6 NaH \xrightarrow{450 K} B_2H_6 + 6 NaF$

Reactions of B_2H_6:

★ B_2H_6 reacts with CO to give borane adduct.

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

★ B_2H_6 reacts with NH_3 to give inorganic benzene (Borazole) as final product.

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

16. Explain with one example for the following:

a) Interstitial hydride **b) Ionic hydride**

c) Electron deficient hydride **d) Electron rich hydride**

A: **a) Interstitial hydride:** Non stoichiometric hydride formed by d & f block elements (except 7, 8, 9 groups) and Hydrogen.

e.g.: $NiH_{0.6}$

b) Ionic hydride: Stoichiometric hydride formed by S-Block elements and hydrogen.

e.g.: NaH

c) Electron deficient hydride: The hydride in which central atom do not have Octet configuration. They are formed by 13^{th} group elements and hydrogen.

e.g.: B_2H_6

d) Electron rich hydride: The hydride in which central atom has octet configuration but with some lone pairs.

e.g.: H – $\ddot{O}$ – H

17. How does acetylene react with the following?

a) H_2O b) HC*l* c) Ammonical $AgNO_3$ d) Cl_2

A: a) Acetylene on Warming with water along with $HgSO_4$ & dil. H_2SO_4 gives finally acetaldelyde

$$H-C\equiv C-H + H-OH \xrightarrow[333\ K]{Hg^{+2}/H^+} H-\underset{H}{\overset{|}{C}}=\underset{OH}{\overset{|}{C}}-H \xrightarrow{\text{Tautomerise}} CH_3CHO$$

b) Acetylene on reaction with HC*l* gives 1, 1 dichloro ethane

$$H-C\equiv C-H + 2\,HCl \longrightarrow H-\underset{H}{\overset{H}{\overset{|}{C}}}=\underset{Cl}{\overset{H}{\overset{|}{C}}}-Cl$$

c) Acetylene reacts with ammonical $AgNO_3$ to give a white precipitate of Silver acetylide.

$$H-C\equiv C-H + 2\,AgNO_3 + 2\,NH_4OH \longrightarrow Ag-C\equiv C-Ag + 2\,NH_4NO_3 + 2\,H_2O$$

d) Acetylne reacts with Cl_2 in presence of CCl_4 gives 1, 1, 2, 2 tetrachloroethane.

$$H-C\equiv C-H + 2\,Cl_2 \xrightarrow{CCl_4} H-\underset{Cl}{\overset{Cl}{\overset{|}{C}}}-\underset{Cl}{\overset{Cl}{\overset{|}{C}}}-H$$

18. Discuss Markownikov's rule and Kharasch effect.

A: **Markownikov's rule:** The negative part of the adding reagent (addendum) gets attached to that Carbon atom of the double bond which has least number of H atoms.

$$H-\underset{H}{\overset{H}{\overset{|}{C}}}-\underset{H}{\overset{|}{C}}=C-H + H^+-Br^- \longrightarrow H-\underset{H}{\overset{H}{\overset{|}{C}}}-\underset{H}{\overset{Br}{\overset{|}{C}}}-\underset{H}{\overset{H}{\overset{|}{C}}}-H$$

Kharasch effect (Anti Markownikov's rule): In presence of peroxide, the negative part of addendum gets attached to that Carbon atom of double bond which has more number of H atoms.

$$H-\underset{H}{\overset{H}{\overset{|}{C}}}-\underset{H}{\overset{|}{C}}=C-H + H^+-Br^- \xrightarrow{(C_6H_5CO)_2O} H-\underset{H}{\overset{H}{\overset{|}{C}}}-\underset{H}{\overset{H}{\overset{|}{C}}}-\underset{H}{\overset{H}{\overset{|}{C}}}-Br$$

SECTION – C

19. What is a periodic property? How do the following properties change in group-I and 3rd period? Explain with example.

a) atomic radius b) Nature of oxides c) Electron gain 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.

a) Atomic radius

In 1st group: Atomic radius increases from top to bottom in any group (e.g.: group-I) as the number of orbits (shells) filling with electrons increases (from Li to Cs).

In 3rd Period: Atomic radius decreases from left to right in 3rd period as the differentiating electron enters into the same 3rd, shell. So nuclear charge increases, atomic radius decreases (from Na to Ar).

b) Nature of Oxides

In 1st Group: All the elements present in first group are metals, so they form basic oxides. The basic nature of these oxides increases from Li to Cs.

In 3rd period: As the metallic nature decreases, basic Nature of oxides decreases from Na to C*l*. As the non metallic nature of oxides increases from left to right in 3rd period i.e. from Na to C*l*, acidic nature increases.

Na_2O	MgO	Al_2O_3	SiO_2	P_4O_{10}	SO_3	Cl_2O_7
Strong basic oxide	Weak basic oxide	Amphoteric oxide	Weak acidic oxide	Acidic oxide	Strong acidic oxide	Very strong acidic oxide

c) Electron gain enthalpy

In 1st group: Electron gain enthalpy decreases from Li to Cs in 1st group elements as atomic radius increases from top to bottom, the amount of energy released decreases from top to bottom (due to decrease of attraction between nucleus and added electron).

In 3rd period: Electron gain enthalpy increases from Na to C*l* in 3rd period as atomic radius decreases, the attraction between nucleus and added electron increases (energy released increases).

20. Write the important postulates of Bohr's model of Hydrogen atom? Discuss the importance of this model to explain various series of line spectra in Hydrogen atom.

A: Bohr's model of atom is a modification of Rutherford's model of atom. It is based on Planck's quantum theory and Hydrogen spectrum.

Postulates:

★ Electrons revolves round the nucleus in fixed, circular paths called 'orbits'.

★ Orbits are denoted by K, L, M, N... or 1, 2, 3, 4...

★ Each orbit is associated with definite amount of energy called energy levels.

★ Electrons neither emit nor absorb energy when they revolve in a orbit called 'Stationary orbit'.

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

★ When electron jumps from higher orbit to lower orbit it emits energy.

★ When electron jumps from lower orbit to higher orbit it absorbs energy.

★ Energy absorbed or emitted by electron is given by $\Delta E = E_2 - E_1 = hv$

★ The angular momentum of an electron is integral multiple of $\frac{h}{2\Pi}$ i.e $mvr = \frac{nh}{2\Pi}$

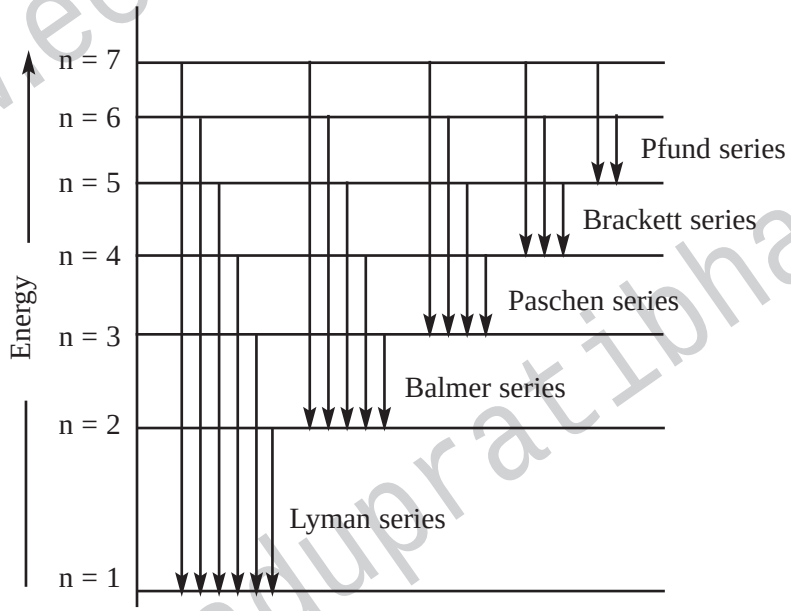
★ Radius of n^{th} orbit $r_n = \frac{n^2h^2}{4\Pi^2me^2z}$

★ Energy of electron in n^{th} orbit $= E_n = -\frac{2\Pi^2me^4z^2}{n^2h^2}$

Spectrum of H-atom:

Of all the atomic spectra, the Hydrogen specturm is the simplest specturm. H atom has only one electron, but it gives 5 series of spectral lines. When H_2 gas is heated or exposed to light or subjected to electric discharge. Electrons of different H atoms get excited to different higher orbits and de excites to differet lower orbits in different manner with the emission of energy and give 5 series of spectral lines. Wave length of a spectral line in H atom can be calculated by using Rydberg's equation.

$$\overline{\upsilon} = \frac{1}{\lambda} = R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$



S.No.	Name of the series	n_1	n_2	spectral region
1	Lyman	1	2, 3, 4, ...	Ultra Violet
2	Balmer	2	3, 4, 5, ...	Visible
3	Paschen	3	4, 5, 6, ...	Near Infra Red
4	Brackett	4	5, 6, 7, ...	Infra Red
5	Pfund	5	6, 7, 8, ...	Far Infra Red

If $n_2 - n_1 = 1$ (H_α)

$n_2 - n_1 = 2$ (H_β)

$n_2 - n_1 = 3$ (H_γ)

From Lyman series to Pfund series, λ increases, E, υ decreases. The spectral lines get closer and closer as we move from n_2 = 2 to 3 to 4 to 5 etc.

21. a) Explain the geometry of H_2O and NH_3 on the basis of VSEPR theory.

b) Give molecular orbital energy diagram of N_2. Calculate its bond order. Write the magnetic nature of N_2 molecule.

A: a) H_2O

The Central atom in H_2O is Oxygen.

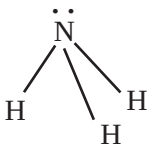
$O = 1s^2 \boxed{2s^2 2p_x^2\ 2p_y^1\ 2p_z^1}$

In the valency shell of Oxygen there are 2 lone pairs and 2 bond pairs. These 4 electron pairs orient tetrahedrally. Due to L.P. – L.P repulsion > L.P. – B.P. repulsion the bond angle decreases from 109°28' to 104.5°. So molecule gets angular (V) Shape.

NH_3

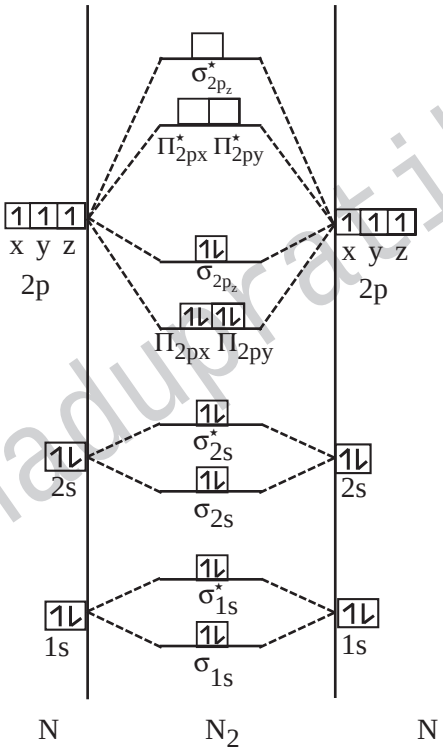
The central atom in NH_3 is Nitrogen.

$N = 1s^2\ 2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^1$



'N' has 3 bond pairs and one lone pair in its valency shell. These 4 electron pairs orient tetrahedrally. Due to L.P.-L.P. repulsion > L.P. - B.P. repulsion > B.P. - B.P. repulsion, the bond angle decreases from 109°28' to 107°. So molecule gets pyramidal shape.

b) M.O.E.D. of N_2



M.O. Configuration of N_2

$\sigma_{1s^2}\ \sigma^{\star}_{1s^2}\ \sigma_{2s^2}\ \sigma^{\star}_{2s^2}\ \Pi_{2p_x^2} = \Pi_{2p_y^2}\ \sigma_{2p_z^2}$

Bond order of $N_2 = \frac{1}{2}(N_b - N_a) = \frac{1}{2}(10 - 4) = 3$

As all the molecular orbitals are paired with electrons, N_2 molecule is dia magnetic.

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