CBSE Class XI Chemistry Sample Paper – 2 Solution

Section A

- **1.** 2,2 Dimehylpropane< 2-methylbutane < Pentane.
- ClF₃: T- shape BF₃: Trigonal planar

OR

The electron pairs involved in the bond formation are known as bond pairs or shared pairs.

- **3.** It is due to delocalization of Π -electrons in benzene it is highly stable.
- **4.** London smog consists of H₂SO₄ deposited on the particulates suspended in the atmosphere.

Gases responsible for green house effect are CO₂, methane, nitrous oxide, chlorofluro hydrocarbons and ozone.

5. Alkali metals due to low ionization energy absorbs energy from visible region to radiate complementary colour.

Section B

- 6. Iso electronic species are those species (atoms/ions) which have same number of electrons. The iso electronic species for F⁻ is Na⁺ and for Ar is K⁺.
- Metallic character increases down the group and decreases across the period as we move from left to right. Hence the increasing order of metallic character is: P<Si<Be<Mg<Na.

9. Given:

Wavelength of the radiation $= 580 \text{ nm} = 580 \times 10^{-9} \text{ m}$ = $5.8 \times 10^{-7} \text{ m}$

Velocity of radiation, $c = 3 \times 10^8 \text{ m/s}$ c = v

$$=\frac{3 \times 10^{8} \text{ m/s}}{5.8 \times 10^{-7} \text{ m}}$$

= 5.17 × 10¹⁴ s⁻¹
Wave number $v = \frac{1}{\lambda}$
$$= \frac{1}{5.8 \times 10^{-7} \text{ m}}$$

= 1.72 × 10⁶ m⁻¹

10. Root mean square speed is given as:

$$u_{r.m.s} = \sqrt{\frac{3RT}{M}}$$

Here,

$$M = 16 g mol-1$$

R= 8.314 x 10⁷

$$u_{r.m.s} = \sqrt{\frac{3x8.314x10^7 x300}{16}}$$

= 683.9 x10² cm sec⁻¹
= 683.9 m sec⁻¹

OR

The given equation is; $3MnO_2 + 4Al \rightarrow 3Mn + 2Al_2O_3$ Change in oxidation numbers: Mn: 4 to 0, Al: 0 to 2 and 0: -2 to 2 Thus MnO_2 is reduced and Al is oxidized.

11.

For K_2MnO_4 , let the oxidation number of Mn be y

Oxidation Number of each Oxygen atom = -2

Oxidation Number of each K atom = +1

In a molecule, sum oxidation number of various atoms must be equal to zero $\therefore 0 = 2 + y + 4(-2) = y-6$

- ∴y-6 = 0
- y = 6

For HNO_3 , let the oxidation number of N be y

Oxidation Number of each O atom = -2ss

Oxidation Number of each H atom = +1

In a molecule, sum oxidation number of various atoms must be equal to zero.

12. The balanced chemical equation is

 $2CO + O_2 \longrightarrow 2CO_2$ 2mol 1mol 2x22.4L 22.4L

Volume of oxygen required to convert 2 x 22.4 L of CO at N.T.P. = 22.4 L

Volume of oxygen required to convert 5.2 L of CO at N.T.P. = $\frac{22.4}{2 \times 22.4} \times 5.2 = 2.6 \text{ L}$

OR

1 mole of ${}^{12}C$ atoms = 6.022×10^{23} atoms = 12 g

 $\therefore 6.022 \times 10^{23}$ atoms of ¹²C have mass 12g

 \therefore 1 atom of ¹²C would have mass $\frac{12}{6.022 \times 10^{23}}$ g

$$=1.99\times10^{-23}$$
 g

13. Configuration (b) is correct.

According to Hund's rule of maximum multiplicity, pairing of electrons in the orbitals of a particular subshell does not take place until all the orbitals of the subshell are singly occupied. Since in the configuration (a) two electrons are present in 2p_x and no electron is present in 2p_z, it is incorrect as per Hund's Rule.

OR

When n = 5, l = 0, 1, 2, 3, 4. The order in which the energy of the available orbital's 4d, 5s and 5p increases is 5s < 4d < 5p. The total number of orbital's available is 9. The maximum number of electrons that can be accommodated is 18; and therefore 18 elements are there in the 5th period.

14.

(a) NH₃: *sp*³

(b)C₂H₂: *sp*

Dipole moment of CCl₄ molecule is zero. Dipole moment is a vector quantity. In symmetrical molecule dipoles of individual bonds cancel each other giving resultant dipole moment as zero.

OR

In the formation of PCl $_5$, one s, three p and one d orbitals are involved in hybridization and give sp 3 d hybrid state.

The ground state and excited state outer electronic configuration of phosphorus (15) are as:

(a) P (ground state)



sp³d hybrid orbitals filled by electron pairs donated by five Cl atoms.

The longer nature of axial bonds is due to stronger repulsive interactions experienced by the axial bond pairs from equatorial bond pairs.

15.

(i) 1 mole of N_2 is 28 g react with 3 mol of H_2 which is 3 g of H_2 28 g react of N_2 with 3 g of H_2

 $\therefore 2000 \text{ g of } \text{N}_2 \text{ react with } \text{H}_2 = \frac{2000 \times 6}{28}$

 \mathbf{N}_{2} is the limiting agent while \mathbf{H}_{2} is the excess reagent.

 $28 \text{ g of } \text{N}_2 \text{ gives } 2 \text{mol } \text{NH}_3 = 34 \text{ g } \text{NH}_3$

:.2000 g of N₂ will produce NH₃ = $\frac{34}{28} \times 2000$ g

= 2428.57 g

(ii) H₂ will left unreacted.

(iii) Mass left unreacted = 1000 g - 428.6 g= 2428.57 g

16.

(a) Intensive properties: The properties which depends only on the nature of the substance and not on the amount of the substance are called intensive properties Example: Density

Adiabatic process: A process in which no heat flows between the system and the surroundings is called an adiabatic process i.e. q = 0.

$$\begin{array}{l} \mathsf{G} = \mathsf{H}\text{-}\mathsf{TS} \\ \mathsf{Change in Gibbs energy, } \Delta\mathsf{G} = \mathsf{G}_2 - \mathsf{G}_{1'} \\ \mathsf{Enthalpy change, } \Delta\mathsf{H} = \mathsf{H}_2 - \mathsf{H}_{1'} \\ \mathsf{Entropy change, } \Delta\mathsf{S} = \mathsf{S}_2 - \mathsf{S}_1 \\ \Delta\mathsf{G} = \Delta\mathsf{H} - \mathsf{T}\Delta\mathsf{S} \\ \Delta\mathsf{S}_{\mathsf{total}} = \Delta\mathsf{S}_{\mathsf{system}} + \Delta\mathsf{S}_{\mathsf{surrounding}} \\ \Delta\mathsf{S}_{\mathsf{total}} = \Delta\mathsf{S}_{\mathsf{system}} - \frac{\Delta\mathsf{H}_{\mathsf{sys}}}{\mathsf{T}} \\ \mathsf{[Since } \Delta\mathsf{S}_{\mathsf{surr}} = \frac{\Delta\mathsf{H}_{\mathsf{surr}}}{\mathsf{T}} , \Delta\mathsf{H}_{\mathsf{surr}} = -\Delta\mathsf{H}_{\mathsf{sys}} \mathsf{]} \\ \mathsf{Dropping subscript system:} \\ \Delta\mathsf{S}_{\mathsf{total}} = \Delta\mathsf{S} - \frac{\Delta\mathsf{H}}{\mathsf{T}} \\ \mathsf{Multiply by T} \\ \mathsf{T}\Delta\mathsf{S}_{\mathsf{total}} = \mathsf{T}\Delta\mathsf{S} - \Delta\mathsf{H} \\ -\mathsf{T}\Delta\mathsf{S}_{\mathsf{total}} = \Delta\mathsf{H} - \mathsf{T}\Delta\mathsf{S} = \Delta\mathsf{G} \\ \Delta\mathsf{G} = -\mathsf{T}\Delta\mathsf{S}_{\mathsf{total}} \\ \end{array}$$

17.

- (a) When a system under equilibrium be subjected to a change in temperature, pressure or concentration, then the equilibrium shifts in such a direction so as to undo the effect of change.
- (b)
 - (i) On adding Fe_2O_3 the equilibrium will remain unaffected.
 - (ii) By removing CO₂, the equilibrium will be shifted in the forward direction
 - (iii) By removing CO, the equilibrium will be shifted in the backward direction.

OR

- (a) The equilibrium will shift the backward direction as the increase in temperature will be compensated by absorbing heat. It is an exothermic reaction.
- (b) The equilibrium will shift in the forward direction since the reaction will shift to the direction of lesser number of moles.
- (c) The equilibrium will shift in the forward direction so that additional SO₂ is used up.
- **18.** The given redox reaction is

 $Zn(s) + 2Ag^{+}(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$

Since Zn gets oxidized to Zn²⁺ ions, and Ag⁺ gets reduced to Ag metal, therefore oxidation occurs at the zinc electrode and reduction occurs at the silver electrode. Thus, galvanic cell corresponding to the above reaction may be depicted as:

 $Zn \mid Zn^{2+}(aq) \mid \mid Ag^{+}(aq) \mid Ag$

- (i) Since oxidation occurs at the zinc at the zinc electrode, therefore, electrons accumulate on the zinc electrode and hence, zinc electrode is negatively charged.
- (ii) The ions carry current. The electrons flow from Zn to Ag electrode while the current flows from Ag to Zn electrode.
- (iii) The reactions occurring at the two electrodes are:
 - $Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^{-}$

 $Ag^{+}_{(aq)} + e^{-} \rightarrow 2Ag_{(s)}$

OR

	Substance oxidized	Substance reduced	Oxidising agent	Reducing agent
(i)	$C_6H_6O_{2(aq)}$	AgBr _(s)	AgBr _(s)	$C_6H_6O_{2(aq)}$
(ii)	HCHO ₍₁₎	$\left[Ag(NH_3)_2 \right]_{(aq)}^{+}$	$\left[Ag \big(NH_3 \big)_2 \right]_{(aq)}^{+}$	HCHO ₍₁₎
(iii)	$N_2H_{4_{(1)}}$	H ₂ O ₂₍₁₎	H ₂ O ₂₍₁₎	N ₂ H ₄₍₁₎

19.

(a)
$$\text{Na}_2\text{O}_2 + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2\text{O}_2$$

(b) $2KO_2 + 2H_2O \rightarrow 2KOH + H_2O_2 + O_2$

(c) $Na_2O + CO_2 \rightarrow Na_2CO_3$

20.

- (a) 2-Phenylethanoic acid
- (b) Propane-1, 2, 3-triol
- (c) 3-Bromobutanoyl chloride

21.

(a) If the Lassaigne's extract gives a blood red colouration with FeCl₃, it indicates that the compound contains both N and S. During fusion, sodium thiocyanate is formed which gives blood red colouration.

3NaSCN + FeCl₃ \rightarrow Fe(SCN)₃ + 3NaCl Blood red

- (b) Ċ (CH₃)₃ is most stable since it is a tertiary free radical and therefore has the maximum hyper conjugation .Larger the number of alkyl groups attached to the carbon atom carrying the odd electron, greater is the delocalisation of the odd electron and hence more stable is the free radical.
- (c) The organic compound is fused with sodium because it reacts with some of the elements present in the organic compound and form corresponding sodium salts.

22.

- (i) Biochemical Oxygen Demand (BOD): It is a measure of dissolved oxygen that would be needed by the micro-organisms to oxidize organic and inorganic compounds present in polluted water.
- (ii) Ozone Hole: Depletion of ozone layer over Antarctica leading to the formation of a hole in the stratosphere over Antarctica is called ozone hole.
- (iii) Green Chemistry: Chemistry and chemical processes involving the minimum use and generation of harmful substances is called green chemistry.

23.

(a) Wurtz reaction: Alkyl halides on treatment with sodium in dry ether give higher alkanes. This is called Wurtz reaction and is used to prepare higher alkanes with even number of carbon atoms. Example:

 $CH_{3}Br$ + 2Na + $BrCH_{3} \xrightarrow{Ether} CH_{3} - CH_{3} + 2NaBr$ Bromomethane Ethane (b) Friedel –Crafts alkylation reaction: It is the reaction of benzene with alkyl halide in presence of anhydrous aluminium chloride. The reaction results in the formation of alkyl benzene

Example:

 C_6H_6 + $CH_3Cl \xrightarrow{Anhydrous} C_6H_5CH_3$ + HClBenzene Toluene

24.

(a) $H_{3}BO_{3} \xrightarrow{\Delta} HBO_{2} + H_{2}O$ Orthoboric Metaboric acid acid $4HBO_{2} \xrightarrow{\Delta} H_{2}B_{4}O_{7} \longrightarrow 2B_{2}O_{3} + H_{2}O$ tetraboric boron acid trioxide (b) $2NH_{3} + B_{2}H_{6} \longrightarrow 2BH_{3} \cdot NH_{3}$ Borane ammonia complex

25.

(a)
$$2A_{(g)} + B_{(g)} \rightarrow 2D_{(g)}$$

 $\Delta u0 = -10.5 \text{ kJ}$
 $\Delta S^0 = -44 \text{ J/K}$
 $R = 8.314 \text{ JK}^{-1}\text{mol}^{-1}$
 $T = 298 \text{ K}$
 $\Delta H = \Delta u - \Delta n_g RT$
 $\Delta n_g = 2 - (2+1)$
 $= -1$
Substituting values in equation;
 $\Delta H = -10.5 \times 10^3 + (-1) + 8.314 \times 298$
 $= 10500 - 2477.57$
 $= -12977.57 \text{ J}$
We have,
 $\Delta G = \Delta H - T\Delta S$
 $= -12977.57 - [(298) \times (-44)]$
 $= -12977.57 + 13112$
 $= 134.43 \text{ J}$

The reaction will be non-spontaneous. This is because the value of ΔG is positive.

No. of moles of Al $=\frac{60}{27}$

$$=2.22 \text{ mol}$$
Molar heat capacity (C) = 24 Jmol⁻K⁻

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Rise in temperature (\Delta T) = 55 - 35
= 20 °C
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Heat evolved(q)=C×m×T = 24×2.22×20 q=1065.6J Heat evolved(q)=1.06kJ

OR

- (a) Bond energy is the amount of energy required to dissociate one mole of bonds present between the atoms in the gaseous phase. As molecules dissociate completely into atoms in the gaseous phase therefore bond energy of a diatomic molecule is called enthalpy of atomization.
- $\begin{array}{ll} \mbox{(b) } C_{(s)} + 2H_{2(g)} \rightarrow CH_{4(g)} & \Delta_r H = -74.8 \ kJ \\ C_{(s)} \rightarrow C_{(g)} & \Delta_r H^0 = +719.6 \ kJ \\ H_{2(g)} \rightarrow 2H_{(g)} & \Delta_r H^0 = +435 \ kJ \end{array}$

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\begin{array}{ll} C_{(s)}+2H_{2(g)}\rightarrow C_{(g)} &+4~H_{(g)}\\ C_{(s)}-2H_{2(g)}-CH_{4(g)}\\ 0=C_{(g)}+4~H_{(g)}-CH_{4(g)}\\ \Delta_r H=&719.6+2(435.4)+74.8\\ \Delta_r H=&+1665.2~kJ \end{array}
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This gives the enthalpy of dissociation of four moles C-H bons.

Hence bond energy for C-H bond

$$=\frac{1665.2}{4}$$

= 416.3 kJ / mol

- (a) [SiF₆]²⁻ is known whereas [SiCl₆] ²⁻ is not known since six large size atoms i.e. six chlorine atoms cannot be accommodated around Si but six small size atoms (F atoms) can be comfortably accommodated.
- (b) Diamond is a covalent solid but has a high melting point due to its three dimensional network structure involving strong C-C bonds. These bonds are difficult to break and therefore diamond has high melting point.
- (c) Due to inert pair effect, lead shows an oxidation state of +2. Hence PbX₂ is more stable than PbX₄.
- (d) Boron is unstable to form BF₆ $^{3-}$ ion due to non- availability of d-orbitals in the valence shell. Therefore the maximum covalency of boron cannot exceed 4 and thus does not form BF₆ $^{3-}$ ion.
- (e) The Boron atom in BF₃ has only six electrons in the valence shell and thus needs 2 more electrons to complete its octet. Therefore, it easily accepts a pair of electrons from nucleophiles. Thus BF₃ can act as a Lewis acid.

OR

(a)

Carbon monoxide: Industrial Preparation:

$$2C_{(s)} + O_{2(g)} \xrightarrow{\text{Limited}} 2CO_{(g)}$$

Lab preparation:

$$\text{HCOOH} \xrightarrow{\text{Conc.H}_2\text{SO}_4} \text{CO+H}_2\text{O}$$

Carbon dioxide: Industrial preparation:

$$C_{(s)} + O_{2(g)} \xrightarrow{Excess} Air \rightarrow CO_{2(g)}$$

Lab Preparation:

 $\mathrm{CaCO}_{_{\!\!\!\!3(\mathrm{s})}} + 2\mathrm{HCl}_{_{\!\!\!(\mathrm{aq})}} \ \rightarrow \ \mathrm{CaCl}_{_{\!\!\!2(\mathrm{aq})}} + \mathrm{CO}_{_{\!\!2(g)}} + \mathrm{H}_{_2}\mathrm{O}_{_{\!\!(\mathrm{I})}}$

(b) Member of group 14 that

(i) forms the most acidic oxide = Carbon (i.e. CO₂)(ii) is used as semiconductor = Silicon and Germanium

(c) Structure of Diborane:

Each boron atom in diborane is sp³ hybridised. Four sp³ hybrid orbitals adopt tetrahedral arrangement. Two hybrid orbitals of each B atom overlaps with 1s

orbital of two H atoms. Of the two hybrid orbitals left on each B atom one contains an unpaired electron while other is vacant. Hybrid orbital containing unpaired electron of one boron atom and vacant hybrid orbital of second boron atom overlaps simultaneously with 1s orbital of H atom to form B-H-B bond, a three centre electron pair bond. The four terminal B-H bonds are regular two centre-two electron bonds while the two bridge (B-H-B) bonds can be described in terms of three centre-two electron bonds



27.

(a) Alkyne X is C₅H₈. Since it does not react with sodamide or ammoniacal cuprous chloride, the triple bond must not be terminal.
 Therefore X = CH₂ CH₂ CH₂ C = C CH₂ (Pont 2 unc)

Therefore, $X = CH_3-CH_2-C = C-CH_3$ (Pent-2-yne)

Hydrocarbon 'Y' is an alkene because it decolourises bromine water.

From the product of ozonolysis, the structure of alkene can be predicted.



(b) Since it does not decolourise bromine water, it is an arene. Its formula is C₂H₂CH₂CH₂

$$\begin{array}{ccc} C_{6}H_{5}CH_{2}CH_{3} & \xrightarrow{[0]}{K_{2}Cr_{2}O_{7}} \rightarrow & C_{6}H_{5}COOH \\ \end{array}$$
(Z) Benzoic acid

The other three isomers are: o-Xylene, m-Xylene and p-Xylene



OR

One mole of the hydrocarbon (A) adds on one mole of bromine to form $C_5H_{10}Br_2$ therefore, (A) must be an alkene having molecular formula C_5H_{10} . The position of double bond is indicated by ozonolysis as:

$$\begin{array}{cccc} CH_{3} & H & CH_{3} \\ | & | & | \\ CH_{3}-C=0 & + & 0=C-CH_{3} \longrightarrow & CH_{3}-C=CH-CH_{3} \\ \end{array}$$
Propanone Ethanal 2-Methylbut-2-ene (A)

Therefore, compound (A) is 2-Methylbut-2-ene. With alkaline KMnO₄, it forms a compound $C_5H_{12}O_2$.

$$\begin{array}{c} CH_{3} \\ | \\ CH_{3}-C=CH-CH_{3} \\ \end{array} \xrightarrow{alk KMnO_{4}} CH_{3}-C-CHOH-CH_{3} \\ | \\ OH \\ (C_{5}H_{12}O_{2}) \end{array}$$