(1) (1) 3

1. Amines have a lone pair on the nitrogen atom. $-\ddot{N}<$
Thus, nitrogen has high electron density. It can react with a positively charged species by donating the lone pair. Thus it is a nucleophile.

2.

$$\underset{1}{CH_3} - \underset{2}{\overset{\overset{O}{\|}}{C}} - \underset{3}{CH_2} - \underset{4}{\overset{\overset{O}{\|}}{C}} - \underset{5}{CH_3}$$

Pentan - 2, 4 - dione.

3. $$3H_2(g) + N_2(g) \longrightarrow 2NH_3(g).$$

$$\text{Rate of the Reaction (Instantaneous)} = -\frac{1}{3}\frac{d[H_2]}{dt}$$

where, [ ] represents the molar concentration.

4\. ② ②

4\. FCC -

Number of corner atoms = 8

Contribution of each = $\frac{1}{8}$

Net = $\frac{1}{8} \times 8 = 1$.

Number of facial atoms = 6

Contribution of each = ~~8~~. 1/2

Net = $6 \times \frac{1}{2} = 3$.

Total atoms / unit cell = 1 + 3 = **4**.

When the pressure applied over the solution seperated from the pure solvent by a semi-permeable membrane is greater than the osmatic pressure, then reverse osmosis takes place.

$P_{\text{applied over solution}} > P_{\text{osmatic}}$

where P = pressure pressure .

6. Polyethene monomer -

$H_2C=CH_2$

(Ethene)

Teflon monomer -

$F_2C=CF_2$

(Tetrafluoroethene)

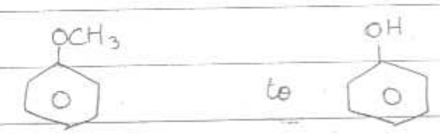
7.

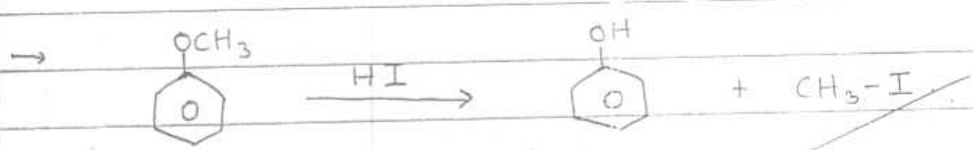
i) $CH_3-CH=CH_2$ to $CH_3-CH(OH)-CH_3$

$CH_3-CH=CH_2 \xrightarrow[\text{② } NaBH_4,\ H_2O]{\text{① } Hg(OAc)_2} CH_3-CH(OH)-CH_3$

OMDM Reaction.

(4) (4)

ii) 



8. Those objects which are non-superimposable over their mirror images are called chiral objects.

$$\underset{5}{H_3C} - \underset{4}{H_2C} - \overset{Br}{\underset{3}{\overset{*}{C}H}} - \underset{2}{CH} = \underset{1}{CH_2}$$

↑

C-3 carbon (*) is the centre of chirality.

(5) (5)

9.

i) Sulphur hexafluoride (SF_6) is less reactive than sulphur tetrafluoride (SF_4) because in SF_6, sulphur is protected from all sides by fluorine atoms. This shields the attack of any other species, ~~In SF6~~ because sulphur is sp^3d^2 hybridized and has octahedral shape.
SF_4 is sp^3d hybridized and has trigonal bipyramidal shape. It can be easily attacked from the side of lone pair.

ii) Noble gases have high ionization energies because of completely filled ~~d~~ orbitals. Moving down a group in the periodic table, the ionisation energy decreases. Xenon has the least ionisation energy of all the noble gases. Thus, it can lose electrons relatively easily ~~than~~ as compared to other noble gases.

10.

P.T.O.

(6) 8

(6)

10. $Fe^{3+} + \bar{e} \longrightarrow Fe^{2+}$ Standard Reduction Potential = 0.77V

Standard Oxidation Potential = −0.77

$Ti^{4+} + \bar{e} \longrightarrow Ti^{3+}$ Standard Reduction Potential = 0.0

If a cell is created using the above half cells, with iron at anode titanium at cathode.

$$E^{\circ}_{cell} = E^{\circ}_{cathode} - E^{\circ}_{Anode} = 0.01 - 0.77 = -0.76V$$

As the cell potential is negative the reaction is not feasible Ti^{4+} can't oxidize Fe^{2+}.

11. The conductivity of a solution is defined as the conductance of solu of unit volume taken in a conductivity cell with electrodes of unit area seperated by unit distance.

Molar conductivity of a solution is defined as the conductance of the solution taken in a conductivity cell with electrodes unit distance apart but having area large enough to accomodate the volume of the solution containing one mole electrolyte.

12. de-Broglie Relation - $\lambda = \frac{h}{p}$

where h is plank's constant.

b) $|\Psi|^2$ represents the electron probability density ie. probability of finding the electron in a particular region.

13.

a) Mordant Dye - In a mordant dye the dye particles are connected to the fabric in the form of ligands.
The metal ion of the dye diffused in the fabric and the dye particles act as ligand to the metal atom.

Detergent - they are salts of long chain fatty acids These are derived from animal fats but synthesized ~~commercially~~ chemically. They are capable of working in hard water

eg. Cetyltrimethylammonium chloride (anionic detergent)

-½

b) Liquid propellant consist of liquid fuel and liquid oxidizer.

eg. Fuel - liquid hydrogen

Oxidizer - liquid oxygen.

14.

i) Rosenmund Reduction.

$$CH_3-\overset{O}{\overset{\|}{C}}-OH \xrightarrow[\text{Quinoline Sulphur}]{H_2,\ Pd-BaSO_4} CH_3-\overset{O}{\overset{\|}{C}}-H$$

Ethanoic Acid　　　　　　　　Ethanal.

(5)

Cannizaro Reaction -

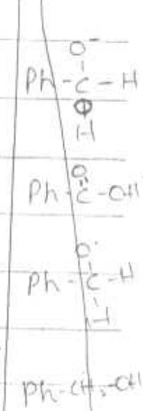
ii) $2\ Ph - \overset{O}{\overset{\|}{C}} - H \xrightarrow{NaOH} Ph - \overset{O}{\overset{\|}{C}} - O^- Na^+ + Ph - CH_2 - OH$

Benzaldehyde

iii) Fischer Esterification.

$CH_3 - \overset{O}{\overset{\|}{C}} - OH + CH_3OH \xrightarrow{HCl} CH_3 - \overset{O}{\overset{\|}{C}} - OCH_3 + H_2O$

Ethanoic Acid — Ethanol — Ethyl Ethanoate



15.

a) Amines have a lone pair on nitrogen atom which can be easily donated to positively charged species. Thus, amines can accept a proton - H^+. Amines are therefore basic.
In amides the lone pair of ~~oxygen~~ nitrogen is involved in resonance with the oxygen atom. This lone pair cannot be donated and thus amides are neutral.

(10) (10)

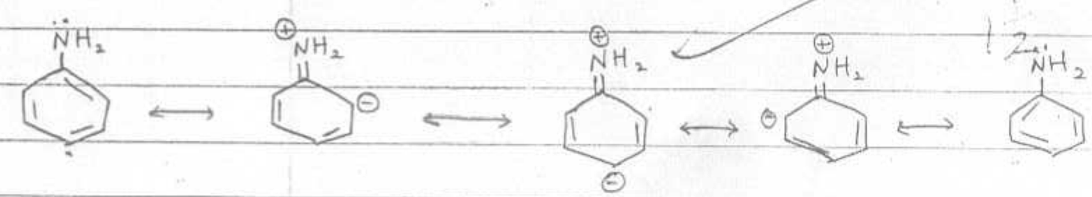
eg $CH_3 - \overset{\overset{O}{\|}}{C} - \ddot{N}H_2 \longleftrightarrow CH_3 - \overset{\overset{O^{\ominus}}{|}}{C} = \overset{\oplus}{N}H_2$

c) In aromatic amines, the lone pair of nitrogen is involved in resonance with the phenyl ring. Thus, the lone pair cannot be easily donated.

In aliphatic amines, there is no resonance and the lone pair of nitrogen can be easily donated.

~~That~~ Therefore, aliphatic amines are better bases ~~than~~ than aromatic a

eg.



16. i) $^{239}_{94}Pu + {}^{4}_{2}He \longrightarrow {}^{243}_{97}X + {}^{0}_{-1}e$

ii) $^{209}_{83}X + {}^{4}_{2}He \longrightarrow {}^{211}_{85}At + {}^{1}_{0}n + {}^{1}_{0}n$

13

iii) $^{246}_{96}Cm + ^{12}_{6}C \longrightarrow ^{254}_{102}X + 4\,^{1}_{0}n$

17.

ii) Co - $3d^7\,4s^2$ [↑↓|↑↓|↑|↑|↑] [↑↓]

Co^{3+} - $3d^6$ [↑↓|↑|↑|↑|↑] [ ]

$[Co(NH_3)_6]^{3+}$ - As NH_3 is a strong ligand it will pair up the electrons of Co^{3+}.

[↑↓|↑↓|↑↓| |] [ ]

Hybridization - d^2sp^3

Shape - Octahedral

Magnetic Property - It is diamagnetic because there are no unpaired electrons.

$\mu = 0$ B.M.

(P.T.O.)

iii) Ni - [↑↓|↑↓|↑↓|↑|↑] [↑↓]

Ni^{2+} - [↑↓|↑↓|↑↓|↑|↑] [ ]

$[NiCl_4]^{2-}$ - Cl^- is a weak ligand and it does not pair up the electrons of Ni^{2+}.

[↑↓|↑↓|↑↓|↑|↑] [ ]

Hybridization - sp^3

Shape - Tetrahedral

Magnetic Property - It is paramagnetic because of two unpaired electrons.

$\mu = \sqrt{2 \times 4} = \sqrt{8}$ B.M.

18.

i) Transition elements have unpaired electrons in their d-orbitals. These electrons are shared by other similar metal atoms to form bonds with each other. Higher the number of unpaired electrons, higher

(13) (13)

greater is the bond strength. Due to this interatomic bonding a high energy is required to seperate the atoms. Enthalpy of atomisation is therefore high.

ii) Transition elements and their compounds are good catalysts because of the following two reasons.

1. Transition metals can easily form complexes.
2. Transition metals can exhibit different oxidation states.

19.

i) Multimolecular Colloids - The individual particles in free state are smaller than colloidal dimension. In the solution many such particles aggregate to form larger particles which have colloidal dimensions. Colloids formed from such colloids are called multimolecular colloids

eg. sulphur sol, gold sol.

ii) Macromolecular Colloids - The colloidal particles are generally polymers which have high molecular mas[s]. The molecules of ~~the~~ are of colloidal dimensions. In the colloid they exist a[s] individual particles.
Colloids ~~a~~ of such particles are called macromolecular colloids.

eg starch sol.

20. $2\,Cr(s) + 3\,Cd^{2+}(aq.) \longrightarrow 2\,Cr^{3+}(aq.) + 3\,Cd(s)$

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

$= -0.4 - (-0.74)$ V

$= -0.4 + 0.74$ V

$= $ ~~0.34~~ $\boxed{0.34\ V}$

(15) (15)

$\Delta_r G^\circ = - n \times F \times E^\circ$

where, $n \rightarrow$ number of electrons involved in the reaction

$F \rightarrow$ Faraday's constant

$E^\circ \rightarrow$ Standard cell potential.

$\Delta_r G^\circ = - 6 \times 96500 \times 0.34$ J/mol

$= - 196860$ J/mol

$= \boxed{-196.86 \text{ KJ/mol}}$

21. $a = a_0 e^{-kt}$ for first order reaction

where, a_0 initial concentration

a concentration at time t.

k rate constant.

$a = a_0 e^{-60t}$

P.T.O.

$\frac{0.6}{600} = \frac{1}{100}$

$\ln 10 = \frac{\log 10}{\log e}$

$= 2.3 \log 10$

$kt = 2.3$

$t = \frac{2.3}{k}$

96500 × 6 = 579000

$\frac{2.3}{60}$ seconds

579000 × 0.34

= 5790 × 34

= 5790 × 34

23160

17370

196860

$\ln a = \ln a_0 - kt$

$kt = \ln a_0 - \ln a$

$kt = \ln \frac{a_0}{a}$

$$\frac{a_0}{10} = a_0 e^{-60t}$$

$$\frac{1}{10} = e^{-60t}$$

Taking log on both sides.

$\log 10 = 60t \log e$

$$60t = \frac{\log 10}{\log e}$$

$60t = 2.3 \log 10$

$60t = 2.3$

$$t = \frac{2.3}{60} \text{ seconds.}$$

$= \boxed{0.038 \text{ seconds.}}$

Ans.- Concentration is reduced to one tenth of its value in 0.038 seconds.

$$\frac{2.3}{60}$$

$$\frac{23}{600}$$

$6\overline{)23}$ = 3.83
−18
50
−48
20
18
2

$$\frac{3.83}{100} = 0.038$$

22 . Bond Order - Half of the difference between the number of electrons present in bonding molecular orbitals and anti-bonding orbitals is called the bond order.

Bond Order = $\frac{1}{2}$ (Bonding electrons - Antibonding electrons).

O_2 molecule - has 16 electrons.

Electronic Configuration -

$\sigma_{1s}^2 \ {}^*\sigma_{1s}^2 \ \sigma_{2s}^2 \ {}^*\sigma_{2s}^2 \ \sigma_{2p_z}^2 \ \pi_{2px}^2 \ \pi_{2py}^2 \ {}^*\pi_{2px}^1 \ {}^*\pi_{2py}^1$

Bond Order = $\frac{1}{2}(10-6) = 2$

Molecular oxygen is paramagnetic because it consists of unpaired electrons in ${}^*\pi_{2px}$ and ${}^*\pi_{2py}$ orbitals.

23.

i) Phosphorus is a pentavalent atom while silicon is a tetravalent atom. When ~~pho~~ silicon is doped with phosphorus, it replaces some silicon atoms and forms four bonds with the surrounding silicon atoms. The fifth electron is free and can conduct electricity. Thus the conduction of the silicon increases as compared to pure silicon and it behaves as n-type (free electrons - negative charge) semiconductors.

ii) In schottky defects ~~a~~ pairs of anions and cations are absent from the lattice. A vacancy is created at their lattice points. The mass of the lattice decreases but volume is the same. Therefore, the density of the solid decreases.

iii) Normal transparent glass is silica in its amorphous form. The property of amorphous solids is same everywhere. It ~~has~~ is a disordered

arrangement. On keeping for a long time and under continuous exposure of heat and pressure, some silica molecules in some places can arrange themselves in order and convert to crystalline form.
This crystalline form is not transparent.
Therefore old glass objects appear milky.

24. $\Delta T_f = K_f \times m$

where, K_f is molal freezing constant.
m is molality of solute.

$(273.15 - 271) = K_f \times 0.1539$ ①

Molality of glucose solution -

5g glucose - 100g solution
5g glucose - 95g solvent
$\frac{5}{180}$ moles - $\frac{95}{1000}$kg solvent.

$$m = \frac{5}{180} \times \frac{1000}{95} = \frac{100}{18 \times 19}\ m.$$

$$(273.15 - T) = K_f \frac{100}{18 \times 19} \quad (2)$$

$(2) \div (1)$

$$\frac{(273.15 - T)}{(273.15 - 271)} = \frac{100}{18 \times 19} \times \frac{1}{0.1539}.$$

$$273.15 - T = \frac{100 \times 2.15}{18 \times 19 \times 0.1539}.$$

$$273.15 - T = 4.07$$

$$T = 273.15 - 4.07$$

$$= \boxed{269.08\ K} \text{ (approx.)}$$

$$\frac{215}{18 \times 19 \times 0.154}$$

$$\frac{215000}{18 \times 19 \times 154}$$

1392.20

25.

i) The carbohydrates which contain free aldehydic or ketonic groups, which can reduce Tollen's and Fehling's reagent are called reducing sugars.

eg. Glucose.

ii) When a protein is subjected to physical or chemical changes, there is change or degradation in higher (secondary, tertiary) structures of the protein without affecting its primary structure. This is called denaturation of protein. The protein loses its biological activity.

iii) Oxygen is replenished in our atmosphere during the process of photosynthesis.

Green Plants take the energy from the Sun and convert water and carbon dioxide into energy and

273.15
− 4.07
269.08

22500
− 1140
21360

4.07
18 | 73.27
− 72
127

380
3
1140

18
6
108

18
7
126

oxygen.

$$6CO_2 + 6H_2O + E \longrightarrow C_6H_{12}O_6 + 6O_2$$

b) Enzymes are a type of proteins which act as biocatalyst in the biological reactions. Enzyme can also be non-protein. Generally, enzyme consist of a non-protein part called the prosthetic part which is covalently bonded to the protein and is called cofactor.
An substance which attaches itself to the enzyme at the time of reaction is called co-enzeme.

26. Entropy of a substance is defined as

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

when the process is carried out reversibly and isothermally. Entropy is a measure of degree of randomness or disorder in the substance.

ii) A spontaneous reaction is that which occurs without any external stimulus like heat or energy.
For a spontaneous reaction the total change in entropy (system + surroundings) is positive and the change in Gibbs function is negative.

b) Reduction of Aluminium -

$2Al_2O_3 \longrightarrow 3O_2 + 4Al$ ① $\Delta_r G^\circ = 22500$ kJ/mol.

1. If carbon changes to carbon monoxide.

$2C + O_2 \rightleftharpoons 2CO$ $\Delta_r G^\circ = -500$ kJ/mol

$6C + 3O_2 \rightleftharpoons 6CO$ ② $\Delta_r G^\circ = -1500$ kJ/mol

① + ②

$2Al_2O_3 + 6C \longrightarrow 4Al + 6CO$ $\Delta_r G^\circ = 21000$ kJ/mol

As ΔG is positive reaction is not feasible.

2. If carbon changes to CO_2.

$C + O_2 \longrightarrow CO_2$ $\Delta_r G° = -380$ kJ/mol

$3C + 3O_2 \longrightarrow 3CO_2$ ③ $\Delta_r G° = -1140$ kJ/mol.

① + ③

$2Al_2O_3 + 3C \longrightarrow 4Al + 3CO_2$ $\Delta_r G° = 21360$ kJ/mol

As $\Delta_r G°$ is positive, the reaction is not feasible.

Therefore, ~~carbon~~ aluminium can't be reduced by carbon at 1773K.

27.

i) The strength of acid ∝ stability of conjugate base.

The conjugate base formed - $X^{\ominus}$

As the size of halogen increases, the negative charge is dispersed over a larger area and formed anion is more stable.

~~Thef~~ Therefore stability of conjugate base -

$I^- > Br^- > Cl^- > F^-$

Thus, order of strength of acid.

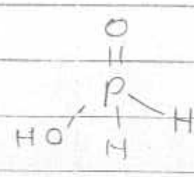
$HI > HBr > HCl > HF$

ii) The lower oxidation state becomes more stable with increasing atomic number in group-13 because of

Inert Pair Effect.

As the size of atoms increases on going down the group the bond energy released on the formation of bond decreases. This energy is not enough to unpair the electrons of s-orbital. Thus, s-orbital electrons don't participate in bonding.

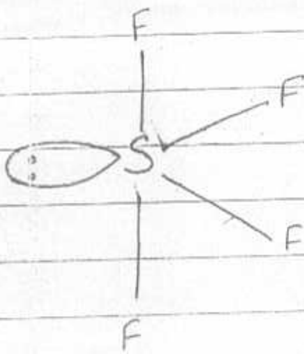
iii) H_3PO_2 -



The two P-H bonds are not polar. Thus, the hydrogen attached

directly to Phosphorus is not acidic.
The -OH group attached to Phosphorus is acidic. As there is only one such group, H_3PO_2 is a monoprotic acid.

b) i) $:SF_4$ -



ii) $:\ddot{X}e F_2$ -