2010

Question: 1 – 30

Question: 1

State the type of hybrid orbitals associated with (i) P in PCl_5 and (ii) S in SF_6.   [1]

Answer:
i. sp^3d of P in PCl_5
ii. $sp^3 d^2$ of S in SF_6.

Question: 2

State any one reasons for alkaline metals in general having a greater tendency to from complex than alkali metals.   [1]

Answer:
It is due to small size and higher charge on alkali earth metal cations as compared to corresponding alkali metal cations.

Question: 3

Name a drug used in case of mental depression.   [1]

Answer:
Equanil

Question: 4

Write the IUPAC name for any of the isomers with the molecular formula $[Pt(NH_3)_2 Cl_2] Cl_2$.   [1]

Answer:
Diamine dichloro platinum(IV) chloride.

Question: 5

Carefully examine the diagram and name the process involved: [1]

Answer:
The process involved is reverse osmosis because the solvent molecules move from higher concentration to lower concentration.

Question: 6

In the transition series, with an increase in atomic number the atomic radius does not change very much. Why is it so?

Answer:
As one proceeds along a transition series, the nuclear charge increases which tend to decrease the size but the addition of electrons in the d-subshell increases the screening effect which counter balances the effect of increased nuclear charge.

Question: 7

If the close packed cations in an AB type solid have a radius of 75 pm. What would be the maximum and minimum sizes of the anions filling the voids?   [2]

Answer:
For closed packed AB type solid,

$$0.414 \le \frac{r^+}{r^-} \le 0.732$$

$$0.414 \le \frac{75pm}{r^-} \le 0.732$$

or $\dfrac{1}{0.414} \ge r^- \ge \dfrac{75pm}{0.732}$

or $181.15pm \ge r^- \ge 102.46pm$

Thus size of the anion lies between 102.46 pm and 181.15 pm

Question: 8

For the equilibrium $2H_2(g) + O_2(g) \rightleftharpoons 2H_2O(l)$ at 25°C. $\Delta G°$ is – 474.78 kJ mol^{-1}. Calculate log K for it. (R = 8.314 jK^{-1} mol^{-1}). [2]

Answer:
$\Delta G^0 = -2.303\ RT \log K$

$\therefore \log K = \dfrac{VG^0}{2.303RT} = \dfrac{474.78}{2.303 \times 8.314 \times (273+25)}$

$= -83.2$

Question: 9

Give an example of a fuel cell and write the anode and cathode reactions for it. [2]

Answer:
$H_2 - O_2$ is an example of fuel cell. The electrode reactions in this cell are

$\underline{\text{At anode}: 2H_2(g) + 4OH^-(aq) \rightarrow 4H_2O(l) + 4e^-}$

$\text{At cathode}: O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$

Question: 10

Molar conductance of a 1.5 M solution of an electrolyte is found to be 138.9 seimen cm^2. What would be the specific conductance of this solution? [2]

Answer:
Specific conductance = Molar concentration x Molar conductance
$= 1.5 \times 10^{-3}$ mol cm^{-3} x 138.9 S cm^2
$= 0.208$ S cm^{-1}

Question: 11 (**) [2]

a. Draw a schematic graph showing how the rate of a first order reaction changes with change in concentration of the reactant.

b. Rate of a reaction is given by the equation: Rate = k [A]^2 [B]
What are the units for the rate and the rate constant for this reaction?

Question: 12

Rate constant k of a reaction varies with temperature according to the equation:

$\log k = constant - \dfrac{E_a}{2.303R} \cdot \dfrac{1}{T}$, Where E_a is the energy of activation for the reaction. When a graph is plotted for log K versus $\dfrac{1}{T}$, a straight line with a slope – 6670 K obtained? Calculate energy of activation for this reaction. State the units. (R = 8.314 JK^{-1} mol^{-1}) [2]

Answer:

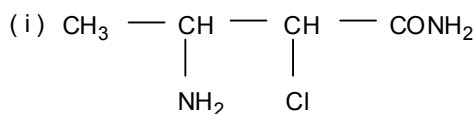Slope of line = - $\dfrac{E}{2.303R}$ = - 6670 K

Ea = 2.303 R x 6670
= 2.303 x 8.314 x 6670
= 127711.43 J mol^{-1}

Question: 12 [2]

Write the IUPAC names for:

(i) CH$_3$ — CH — CH — CONH$_2$
$\qquad\qquad$ |$\qquad$ |
$\qquad\qquad$ NH$_2$$\quad$ Cl

Answer:
3-amino –2-chloro butanamide

(ii) ON — ⬡ — N(CH$_3$)$_2$

Answer:
p-Nitroso-N, N-dimethylaniline

$\qquad\qquad\qquad$ CH$_3$
$\qquad\qquad\qquad$ |
(iii)$\quad$ CH$_3$ — C — Cl
$\qquad\qquad\qquad$ |
$\qquad\qquad\qquad$ CH$_3$

Answer:
2-chloro – 2 - methylpropane

Question: 13 *(**)*

Before reacting aniline with HNO$_3$ for nitration, it is converted to acetanilide. Why is this done and how is nitro – aniline obtained subsequently? [3]

Question: 14

Why are inter – halogen compounds more reactive than the related elemental halogens? [3]

Answer:
This is because the bond between two dissimilar halogen atoms is weaker than the bond between two similar halogen atoms. The overlapping between orbitals of dissimilar atoms is less effective than that between similar atoms.

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OR

Identify the type of inter – molecular forces that exist between the following pairs: [2]

i. Na^+ ion and water molecules

Answer:
Ion-dipole attraction

ii. Ag^+ ion and I^- ion

Answer:
Ion-induced dipole attraction

iii.   Argon and Argon

Answer:
Dispersion forces

iv.   HF and H_2O

Answer:
H-bonding

Question: 15 (**)

Using the values bond approach predict the shape and magnetic character of $[Co(NH_3)_6]^{3+}$.
(Atomic number of Co is 27)   [3]

Question: 16

State the significance of numbers in the polymer names nylon – 6 and nylon – 66. Write the monomers used for making nylon – 66.   [3]

Answer:
In nylon-6, the repeat unit contains 6 carbon atoms in its molecule. In nylon- 66, these are two repeat units each containing 6 carbon atoms. Nylon-66 is made from hexamethylene diamine and adipic acid.

Question: 17

State the significance of primary and secondary structures of proteins.   [3]

Answer:
Primary structure
The sequence in which various amino acids are arranged in a protein is called primary structure. The amino acid sequence of a protein determines its function and is critical of its biological activity.

Secondary structure
Secondary structure determines the coiling of the polypeptide chain into helical structure. The secondary structure arises due to regular folding of various polypeptide chains and due to inter-molecular hydrogen bonding between carboxyl and amino acids. It is of two types: α-helix and β-pleated sheet configuration.

Question: 18

What are multi molecular and macromolecular colloids? Give one example of each type. How are associated colloids different from them?   [3]

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Answer:
Multimolecular colloids
These are formed when several atoms or molecules are forced to aggregate in dispersion medium e.g. gold sol. These are lyophobic in nature.

Macromolecular colloids
These formed when macromolecules of colloidal size are dispersed in dispersion medium e.g. protein in water. These are lyophilic in nature.

Associated colloids
Some colloids behave as normal strong electrolytes at low concentration but exhibit colloidal properties at higher concentrations due to the formation of aggregated particles.

These aggregated particles are known as micelles and such substances are known as associated colloids. They behave as true solutions at low concentrations.
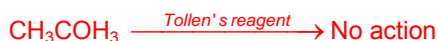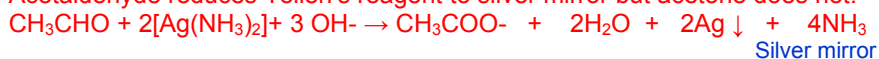
Question: 19 (**)

State one chemical method each to distinguish between the following pairs of organic compounds
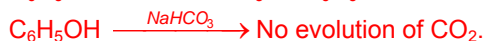[3]

i. Acetaldehyde and acetone

Answer:
Acetaldehyde reduces Tollen's reagent to silver mirror but acetone does not.
$CH_3CHO + 2[Ag(NH_3)_2]+ 3\ OH- \rightarrow CH_3COO- + 2H_2O + 2Ag \downarrow + 4NH_3$
Silver mirror

$CH_3COH_3 \xrightarrow{Tollen's\ reagent}$ No action

ii. Phenol and benzoic acid

Answer:
Benzoic acid being a stronger acid than phenol, it decomposes $NaHCO_3$ to evolve CO_2 but phenol does not.

$C_6H_5COOH + NaHCO_3 \rightarrow C_6H_5\ COONa + H_2O + CO_2 \uparrow$
$C_6H_5OH \xrightarrow{NaHCO_3}$ No evolution of CO_2.

iii. Propanone and ethanol

Answer:
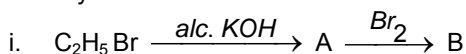Treat the compound with Lucas reagent (Concentrated HCl + anhydrous ZnCl2) Ethanol gives cloudiness on heating.

$CH_3\ CH_2\ OH + HCl \xrightarrow{ZnCl_2} CH_3\ CH_2\ Cl + H_2O$
Ethanol   Ethyl chloride

Propanone does not give Lucas test.

Question: 20 (**)

Identify the substance A and B in each of the following sequence of reactions:
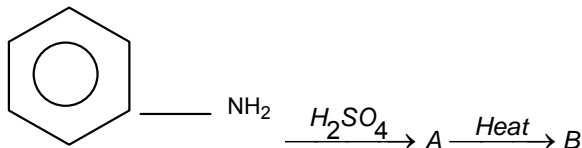i. $C_2H_5\ Br \xrightarrow{alc.\ KOH} A \xrightarrow{Br_2} B$
ii.

_____

iii.

Question: 20 (**)

i.   Give the structural formula of DDT
ii. How DDT is prepared.
iii. Give its any two use   [3]

Question: 21 (**)

Calculate the mole fraction of ethylene glycol ($C_2H_6O_2$) in a solution containing 20% of $C_2H_6O_2$ by mass.

Answer:
Let total mass of solution = 100g

∴ mass of ethylene glycol W2 = 20g
and mass of Solvent (water) W_1 = 80g

Molar mass of [$C_2H_6O_2$]

M_1 = 12 x 2 + 1 x 6 + 16 x 2
M_1 = 24 + 6 + 32 = 62 g mol^{-1}

Molar mass of water (H2O) M2 = 1 x 2 + 16 = 18 g mol-1

Moles of water n1 = $\dfrac{W_1}{M_1} = \dfrac{80}{18} = 4.444$ mol

Moles of $C_2H_6O_2$, n_2 = $\dfrac{W_2}{M_2} = \dfrac{20}{62} = 0.322$ mol

Question: 22 (**)

Represent the cell in which the following reaction takes place.
Mg (s) + 2 Ag$^+$ (0.0001 M) → Mg^{2+} (0.130 M) + 2 Ag (s).

Calculate its E cell if E$^\theta$ $_{cell}$ = 3.17 V.   [3]

Question: 23

What are anomers? How many anomers of glucose are known? Name them.   [3]

Answer:
The pair of diastereoisomers of aldoses which differ in configuration about C_1 carbon atom are called anomers. These are two anomers of glucose which are:

i.   α – D-glucose
ii. β – D-glucose

Question: 24

Outline the principles of refining of metals by the following methods:

i.   Zone refining   [2]

Answer:
This method is based on the principles that the impurities are more soluble in the melt than in the solid state of the metal.

A circular mobile heater is fixed at one end of the rod of the impure metal. The molten zone moves along with the heater which is moved forward. As the heater moves forward, the pure metal crystalizes out of melt and the impurities pass on into the adjacent molten zone.

This process is repeated several times and the heater is moved in the same direction. At one end, impurities get concentrated.

This method is very useful for producing semiconductor and other metals of very high purity like germanium, silicon, boron etc.

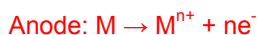ii. Electrolytic refining   [2]

Answer:
In this method, the impure metal is made to act as anode. A strip of the same metal in pure form is used as Cathode. They are put in a suitable electrolyte both containing soluble salt of the same metal. The more basic metal remains in the solution and the less basic ones mud.

The reactions are,

Anode: $M \rightarrow M^{n+} + ne^-$
Cathode: $M^{n+} + ne^- \rightarrow M$

Copper and zinc are refined by this method.

iii. Distillation   [1]

Answer:
In this method, the impure metal is evaporated to obtain the pure metal as distillate. This method is very useful for low boiling metals like zinc and mercury.

OR

The following rate data were obtained at 300 K for the reaction $2A + B \rightarrow C + D$:

Experiment No.	[A] mol L^{-1}	[B] mol L^{-1}	Rate of formation of D mol L^{-1}min^{-1}
1.	0.1	0.1	6.0×10^{-3}
2.	0.3	0.2	7.2×10^{-2}
3.	0.3	0.4	2.88×10^{-1}
4.	0.4	0.1	2.4×10^{-2}

Calculate the rate of formation of D when [A] = 0.5 mol L^{-1} and [B] = 0.2 mol L^{-1}. (**)   [5]

Question: 25

Define the terms molarity and molality for a solution. How does a rise in room temperature change the molarity and molality values of the solution?

How much urea (moral mass = 60 g mol $^{-1}$) should be dissolved in 50g of water so that its vapor pressure at room temperature is reduced by 25 %. Calculate molality of the solution obtained. [5]

OR

Explain why transition metals are:

a. Paramagnetic
b. Good catalysts.

Answer:
Molarity of a solution is the number of moles of solute dissolved in one liter of the solution. Molarity of a solution changes with temperature due to change in volume with temperature.

Molality of a solution is the number of moles of solute dissolved in one kilogram of the solvent. It does not change with temperature.

$$\frac{P_A^0 - P_A}{P_A^0} = \chi B \cong \frac{W_B / M_B}{W_A / M_A} = \frac{W_B}{M_B} \times \frac{M_A}{W_A}$$

or, $\dfrac{25}{100} = \dfrac{W_B}{60} \times \dfrac{18}{50}$

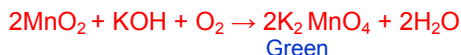$W_B = \dfrac{25 \times 60 \times 100}{100 \times 18} = 41.667g$

Question: 25

Describe how potassium permanganate is made from pyrolusite. Write the chemical equations for the involved reactions.
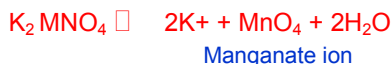
Describe with an example each the oxidizing actions of permanganate ion in alkyl – line and acidic media. What acid and alkali are usually used?   [5]
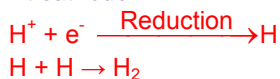
Answer:
Finely powdered pyrolusite is fused with KOH in the presence of air to give green colored potassium magnate.

$2MnO_2 + KOH + O_2 \rightarrow 2K_2MnO_4 + 2H_2O$
                    Green

Potassium manganate is electrolyzed in a tank having nickel anode and iron cathode. Manganate ion is oxidized into permanganate ion.

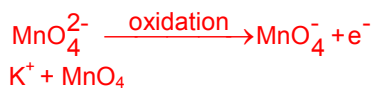$K_2MnO_4 \square \quad 2K+ + MnO_4 + 2H_2O$
                    Manganate ion
$HOH \square \quad H^+ + OH-$

At cathode:
$H^+ + e^- \xrightarrow{\text{Reduction}} H$
$H + H \rightarrow H_2$

At anode:

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$$MnO_4^{2-} \xrightarrow{\text{oxidation}} MnO_4^- + e^-$$

$K^+ + MnO_4$

In acidic medium:
KMNO4 oxidizes ferrous sulphate into ferric sulphate in the presence of dil H_2SO_4.

$2\ KmnO_4 + 3H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 3H_2O + 5\ [O]$
$2FeSO_4 + H_2SO_4 + [O] \rightarrow Fe_2(SO_4)_3 + H_2O \times 5$
$2KMnO_4 + 8H_2SO_4 + 10\ FeSO_4 \rightarrow K_2SO_4 + 2\ MnSO_4 + 3H_2O + 5\ Fe_2\ (SO_4)_3$

Alkaline medium:
In the presence of conc. KOH, potassium iodide is oxidized potassium iodate.

$2KMnO_4 + 2KOH \rightarrow 2K_2\ MnO_4 + H_2O + [O] \times 3$
$KI + 3\ [O] \rightarrow KIO_3$
$6KmnO_4 + 6KOH + KI \rightarrow 6K_2\ MnO_4 + 3H_2O + KIO_3$

OR

Write the structures of the reagents / organic compounds A to F in the following sequence of reactions: (**)

$$A \xrightarrow[H_2O]{NaOH\ /\ Br_2} B \xrightarrow[0^\circ C]{NaNO_2\ /\ HCl} C \xrightarrow{D} E \xrightarrow[heat]{Cl_2\ /\ Fe} F \xrightarrow{H_2\ /\ Pt} \text{(benzene with } CH_2NH_2\text{)}$$
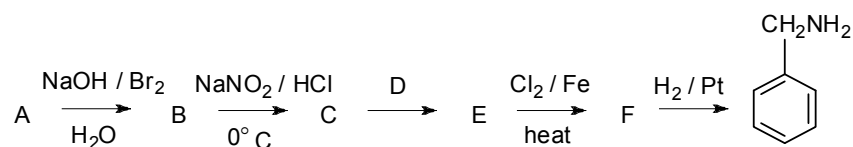
A. Benzamide
B. Aniline
C. Benzene diazonium chloride
D. Pot. CyanideE. Benzonitirle
E. m – chloro cyanobenzene

(**) Currently out of syllabus. Answer can be provided up on request

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