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**2015**

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Question: 1 – 30

ii

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**Question: 1**

[1]

Which point defect in its crystal units alters the density of a solid?

**Answer:**

See topics on 'Frenkel types'.

**Question: 2**

[1]

Why is the froth flotation method selected for the concentration of Sulphide ores?

**Answer:**

Froth floatation method selectively prevents ZnS from coming to the froth but allows PbS to come with the froth.

**Question: 3**

[1]

Define the term 'Tyndall effect.'

**Answer:**

When a beam of light is passed through a colloidal solution and viewed perpendicular to the path of the incident light, the path of the light becomes visible. This phenomenon is called Tyndall effect.

**Question: 4**

[1]

Which is a stronger oxidizing agent Bi (v) or Sb (v)?

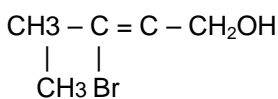
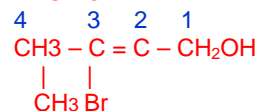
**Answer:**

Bismuth (Bi) in the pentavalent state can easily accept two electrons and gets reduced to trivalent bismuth.

**Question: 5**

[1]

Give the IUPAC name of the following compound:

**Answer:****Question: 6 (\*\*)**

[1]

Write the structure of 3 – oxopentanal.

**Question: 7**

[1]

Why is an alkyl amine more basic than ammonia?



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**Answer:**

Due to dispersal of the positive charge by the +I effect of the alkyl group; alkyl amines are stronger base than ammonia.

**Question 8**

[1]

Give an example of elastomers.

**Answer:**

Buna – S, buna- N.

**Question: 9**

[2]

A reaction is of second order with respect to a reactant. How will the rate of reaction.

- Doubled,
- Reduced to half?

**Answer:**

Since Rate =  $K [A]^2$

Let  $[A] = a$

$\therefore$  Rate =  $Ka^2$

i. If  $[A] = 2a$

$\therefore$  Rate =  $K(2a)^2 = 4 K a^2 = 4$  times

ii. If  $[A] = \frac{a}{2} \therefore$  Rate =  $K\left(\frac{a}{2}\right)^2 = \frac{1}{4} Ka^2 = \frac{1}{4}$  th

**Question: 10**

[2]

Explain the role of

(i) Cryolite in the electrolytic reduction of alumina.

**Answer:**

When an electrolyte like NaCl is added ferric oxide sol, the positively charged colloidal particles of  $Fe(OH)_3$  get coagulated by the oppositely charged  $Cl^-$  ions provided by NaCl.

(ii) Carbon monoxide in the purification of nickel.

**Answer:**

Nickel is heated in a stream of carbon monoxide forming a volatile complex, nickel tetra carbonyl which decomposed giving pure Ni metal.

**Question: 11 (\*\*)**

[2]

Draw the structures of the following molecules:

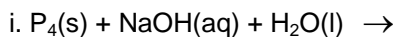
- $XeF_4$
- $BrF_3$

**Question: 12**

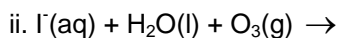
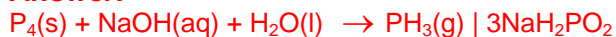
[2]

Complete the following chemical reaction equations:





**Answer:**



**Answer:**



**Question: 13**

[2]

Differentiate between molality and molarity of solution. What is the effect of change in temperature of a solution on its molality and molarity?

**Answer:**

See topics on 'Molarity (M)

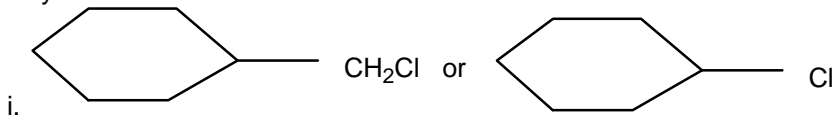
See topics on 'Molality (m)'.

Molarity decreases because volume of the solution increases with increase in temperature. But molality remains unaffected.

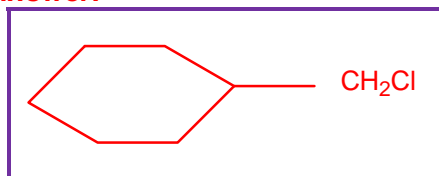
**Question: 14**

[2]

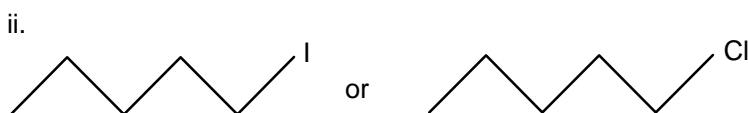
Which ones in the following Pairs of substances undergoes  $\text{S}_\text{N}2$  substitution reaction faster and why?



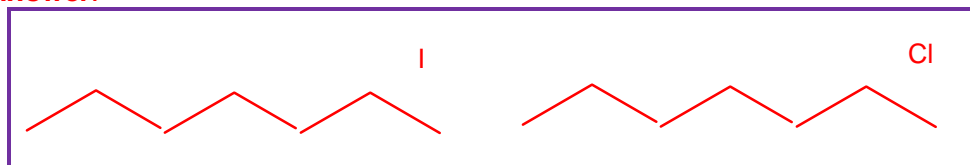
**Answer:**



It is primary halide and therefore undergoes  $\text{S}_\text{N}2$  reaction faster.



**Answer:**



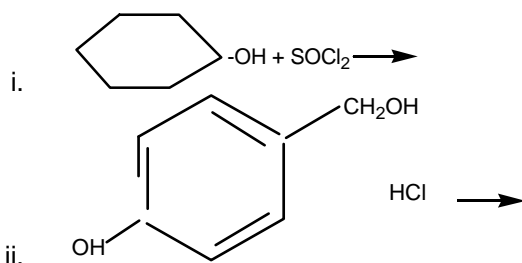
As iodine is a better leaving group because of its large size, therefore undergoes  $\text{S}_\text{N}2$  reaction faster.



**Question: 15 (\*\*)**

[2]

Complete the following reaction equations:

**Question: 16**

[2]

Explain what is meant by

i. a peptide linkage

**Answer:**

Proteins are condensation polymers of  $\alpha$ -amino acids in which the same or different  $\alpha$ -amino acids are connected by peptide bonds. Chemically, a peptide bond is an amide linkage formed between  $\text{-COOH}$  group of one  $\alpha$ -amino acids and  $\text{NH}_2$  group of the other  $\alpha$ -amino acids by loss of a molecule of water.

ii. a glycosidic linkage

**Answer:**

The two monosaccharide units are joined together through an oxide linkage formed by loss of a molecule of  $\text{H}_2\text{O}$ . Such a linkage between two monosaccharide units through oxygen atom is called glycosidic linkage.

**Question: 17**

[2]

Name two water soluble vitamins, their sources and the diseases caused due to their deficiency in diet.

**Answer:**

Examples of water soluble vitamins: B group vitamins and vitamin C.

Name of vitamins	Sources	Deficiency diseased
Vitamin B <sub>1</sub>	Yeast, milk, green vegetables and cereals.	Beriberi
Vitamin C	Citrus fruits, amla and green leafy vegetables	Scurvy (bleeding gums)

**Question: 18**

[2]

Draw the structures of the monomers of the following polymers: (\*\*)

i. Teflon

ii. Polythene

OR



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What is the repeating unit in the condensation polymer obtained by combining  $\text{HO}_2\text{CCH}_2\text{CH}_2\text{CO}_2\text{H}$  (succinic acid) and  $\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$  (ethylene diamine).

**Answer:**



**Question: 19**

[3]

Iron has a body centered cubic unit cell with a cell edge of 286.65 pm. The density of iron is 7.87 g  $\text{cm}^{-3}$ . Use this information to calculate Avogadro's number (At. Mass of Fe = 56 g  $\text{mol}^{-1}$ ).

**Answer:**

$$\text{Here } a = 286.65 \text{ pm} = 286.65 \times 10^{-10} \text{ cm}$$

$$D = 7.87 \text{ g cm}^{-3}$$

$$M = 56$$

$$Z = 2,$$

Now calculate,  $N_A$

Using the following formula.

$$d = \frac{Z.M}{a^3 N_A} \Rightarrow \frac{Z.M}{a^3 .d}$$

$$\therefore \therefore N_A = \frac{2 \times 56}{(286.65 \times 10^{-10})^3 \times 7.87}$$

$$N_A = \frac{112}{(2.87 \times 10^{-8})^3}$$

$$= \frac{112}{23.63} \times 7.87 \times 10^{-24}$$

$$= \frac{112}{185.97} \times 10^{-24}$$

$$= 0.6022 \times 10^{24}$$

$$= 6.022 \times 10^{23}$$

**Question: 20**

[3]

100 mg of a protein is dissolved in just enough water to make 10.0 mL of solution. If this solution has an osmotic pressure of 13.3 mm Hg at 25°C, what is the molar mass of the protein?

( $R = 0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}$  and 760 mm Hg = 1 atm.)

**Answer:**

Here,

$$w = 100 \text{ mg} = 0.100 = 0.1 \text{ g}$$

$$V = 10.0 \text{ ml} = 0.01 \text{ L}$$

$$\pi = 13.3 \text{ mm Hg} = 133 / 760 \text{ atm}$$

$$T = 25^\circ\text{C} = 25 + 273 = 298 \text{ K}$$

$$R = 0.082 \text{ L atm mol}^{-1} \text{ K}^{-1}$$

$$M = ?$$



$$\begin{aligned}\therefore \text{Molar mass } M &= \frac{wRT}{\pi V} \\ &= \frac{0.1 \times 0.0821 \times 298}{13.3 / 760 \times 0.01} \\ &= \frac{0.1 \times 0.0821 \times 298 \times 760}{13.3 \times 0.01} \\ &= \frac{1859.4008}{0.133}\end{aligned}$$

[3]

A first order reaction has a rate constant of  $0.0051 \text{ min}^{-1}$ . If we begin with  $0.10 \text{ M}$  concentration of the reactant, what concentration of the reactant will be left after 3 hours?

Here,

$[R]_0 = 0.10 \text{ M}, [R] = ?$

$T = 3 \text{ hours} = 3 \times 60 = 180 \text{ min}$

$$K = 0.051 \text{ min}^{-1}$$

Using the formula,

$$K = \frac{\frac{2.303}{t \log [R]_0}}{[R]} \cdot \frac{wRT}{\pi V}$$

$$= \frac{0.1 \times 0.0821 \times 298}{13.3 / 760 \times 0.01}$$

$$= \frac{0.1 \times 0.0821 \times 298 \times 760}{13.3 \times 0.01}$$

$$= \frac{1859.4008}{0.133}$$

$$0.0051 = \frac{2.303}{180 \log 0.10} [\text{R}]$$

$$\frac{\log 0.10}{[R]} = \frac{0.0051 \times 180}{2.303}$$

$$\therefore \frac{0.10}{[R]} = \text{anti-log } (0.3986)$$

$$\frac{0.10}{[R]} = 2.503 \Rightarrow \frac{0.10}{2.503} = 0.039M$$

[3]

How the following colloids are different from each other in respect of dispersion medium and dispersed phase: give one example of each type.



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i. An aerosol

**Answer:**

it is a colloidal dispersion of a liquid in a gas. Example: fog.

ii. A hydrosol

**Answer:**

It is a colloidal solution of a solid in water as the dispersion medium. Example: starch solution.

iii. An emulsion

**Answer:**

It is a colloidal system when both the dispersed phase and the dispersion medium are in the liquid state. Example: oil in water.

**Question: 23**

[3]

Account for the following:

i.  $\text{NH}_3$  is a stronger base than  $\text{PH}_3$ .

**Answer:**

Due to the presence of lone pair of electrons on the central atom both  $\text{NH}_3$  and  $\text{PH}_3$  are Lewis Bases. When  $\text{NH}_3$  or  $\text{PH}_3$  accepts a proton, an additional N-H or P-H bond is formed.

ii. Sulphur has a greater tendency for catenation than oxygen.

**Answer:**

Sulphur has a stronger tendency for catenation than oxygen because of stronger S-S bonds as compared to O-O bonds.

iii. Bond dissociation energy of  $\text{F}_2$  is less than that of  $\text{Cl}_2$ .

**Answer:**

Due to smaller size, the lone pairs of electrons on the F-atom repel the bond pair of the F-F bond as compared to the larger size of Cl atoms, the lone pairs of Cl do not repel the bond pair of Cl-Cl bond. Hence F-F bond energy is lower than that of Cl-Cl bond energy.

OR

Explain the following situations:

(i) In the structure of  $\text{HNO}_3$  molecule, the N-O bond (121 pm) is shorter than N=OH bond (140 pm)

**Answer:**

Due to smaller size of N-O, than N-OH, the N-O bond length of  $\text{HNO}_3$  is smaller than N-H bond length.

(ii)  $\text{SF}_4$  is easily hydrolyzed whereas  $\text{SF}_6$  is not easily hydrolyzed.

**Answer:**





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In  $\text{SF}_4$ , S is not sterically hindered since it is surrounded by only four F atoms, so attack of  $\text{H}_2\text{O}$  molecules can take place easily and hence hydrolysis takes place.

On the other hand, S is sterically protected by six F atoms in  $\text{SF}_6$  and does not allow  $\text{H}_2\text{O}$  molecules to attack the S atoms. Thus  $\text{SF}_6$  does not undergo hydrolysis.

(iii)  $\text{XeF}_2$  has a straight linear structure and not a bent angular structure.

**Answer:**

As  $\text{XeF}_2$  has 5 pairs (100 electrons around Xe forming a  $\text{sp}^3\text{d}$  hybridization. Therefore, its geometry is linear.

**Question: 24**

[3]

For the complex  $[\text{Fe}(\text{en})_2\text{Cl}_2]\text{Cl}$ , (en = ethylene diamine), identify

i. The oxidation number of iron,

**Answer:**

Given complex is  $[\text{Fe}(\text{en})_2\text{Cl}_2]\text{Cl}$

$x + 90$

$0 + 2 \times 9 - 10 + 9 - 10 = 0 \Rightarrow x - 3 = 0$

$\therefore$  Oxidation number of Fe = 3

ii. The hybrid orbitals and the shape of the complex,

**Answer:**

Hybridization:  $\text{d}^2\text{sp}^3$

Shape of complex: octahedral

iii. The magnetic behavior of the complex,

**Answer:**

Paramagnetic

iv. The number of geometrical isomers,

**Answer:**

Two

v. Whether there is an optical isomer also, and

**Answer:**

No

vi. Name of the complex, (At. no. of Fe = 26)

**Answer:**

Dichloridobis (ethane-1, 2-diamine) Iron (III) chloride

**Question: 25 (\*\*)**

[3]

Explain the mechanism of the following reactions:



- Addition of Grignard's reagent to the carbonyl group of a compound forming an adduct followed by hydrolysis.
- Acid catalyzed dehydration of an alcohol forming an alkene.
- Acid catalyzed hydration of an alkene forming an alcohol.

**Question: 26 (\*\*)**

[3]

Giving an example for each describes the following reactions:

- Hofmann's bromide reaction
- Gatterman reaction
- A coupling reaction

**Question: 27 \*\***

Explain the following types of substances with one suitable example, for each case:

- Cationic detergents
- Food preservatives.
- Analgesics.

**Question: 28 (\*\*)**

[3]

Define molar conductivity of a substance and describe how for weak and strong electrolytes, molar conductivity changes with concentration of solute. How is such change explained?

A voltaic cell is set up at 25°C with the following half cells:

$\text{Ag}^+$  (0.001 M) | Ag and  $\text{Cu}^{2+}$  (p.10 M) | Cu  
What would be the voltage of this cell? ( $E^0_{\text{cell}} = 0.46 \text{ V}$ )

OR

- State the relationship amongst cell constant of a cell, resistance of the solution in the cell and conductivity of the solution. How is molar conductivity of a solute related to conductivity of its solution?
- A voltaic cell is set up at 25°C with the following half cells:

Al |  $\text{Al}^{3+}$  (0.001 M) | Ni and Ni |  $\text{Ni}^{2+}$  (0.50 M)  
Calculate the cell voltage [ $E^0_{\text{Ni}^{2+} | \text{Ni}} = -0.25 \text{ V}$ ,  $E^0_{\text{Al}^{3+} | \text{Al}} = -1.66 \text{ V}$ ]

**Question: 29 (\*\*)**

- Complete the following chemical reaction equations:

- $\text{MnO}_4^-(\text{aq}) + \text{C}_2\text{O}_4^{2-}(\text{aq}) + \text{H}^+(\text{aq}) \rightarrow$
- $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{Fe}^{2+}(\text{aq}) + \text{H}^+(\text{aq}) \rightarrow$

- Explain the following observations about the transition / inner transition elements:

- There is in general an increase in density of element from titanium (Z = 22) to copper (Z : 29).



- ii. There occurs much more frequent metal-metal bonding in compounds of heavy transition elements (3<sup>rd</sup> series).
- iii. The members in the actinide series exhibit a larger number of oxidation states than the corresponding members in the lanthanide series.

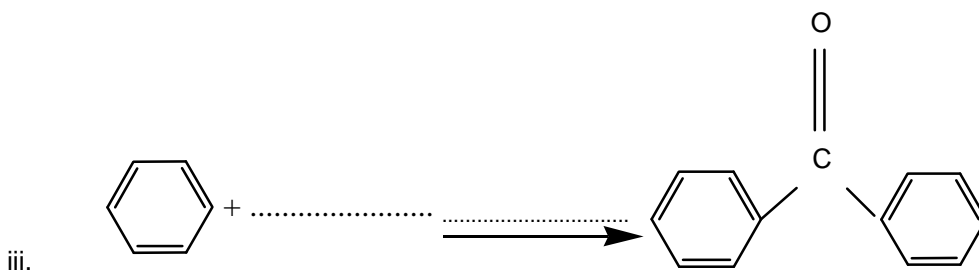
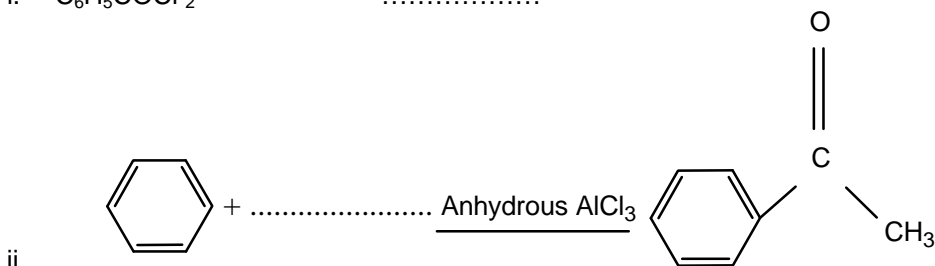
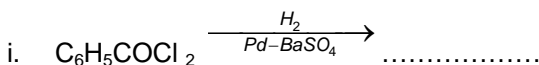
**Question: 30 (\*\*)**

[5]

- a. Illustrate the following name reactions by giving example:
  - i. Cannizzaro's reaction
  - ii. Clemmensen reduction
- b. An organic compound A contains 69.77% carbon, 11.63% hydrogen and rest oxygen. The molecular mass of the compound is 86. It does not reduce Tollen's reagent but forms addition compound with sodium hydrogen sulphite and gives positive iodoform test. On vigorous oxidation is ethanoic and propanoic acids. Derive the possible structure of compound A.

OR

- a. How are the following obtained?
  - i. Benzoic acid from ethyl benzene.
  - ii. Benzaldehyde from toluene.
- b. Complete each synthesis by giving the missing material, reagent or products:



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

