2010

Question: 1 – 30 i - x

Question: 1

What would happen if the protective tin coating over an iron bucket is broken in some places? [1]

Answer:
If the protective tin coating over an iron bucket is broken in some places iron corrodes faster than it does in the absence of Sn as oxidation potential of Fe is higher than that of Sn.

Question: 2

Write Nernst equation for the electrode reaction. M^{n+} (aq) + ne $^- \rightarrow$ M (s) . [1]

Answer.

$$E_{Mn+/M} = E^0_{Mn+/M} + \frac{2.303RT}{nF} \log \frac{[M^{n+}]}{[M]}$$

Question: 3

State any one condition under which a bimolecular reaction maybe kinetically of first order. [1]

Answer:
If one of the reactants is present in excess, than the bimolecular reaction may be kinetically of first order.

Question: 4

Of the two hydroxyl organic compounds ROH and R'OH, the first one is basic and the other is acidic in behavior. How is R different from R'? [1]

Answer:
R is an alkyl group whereas 'R' is an aryl group.

Question: 5

What is meant by the term 'peptization'? [1]

Answer:
The process of conversion of a freshly prepared precipitate into colloidal solution by adding suitable electrolyte is called peptization.

Question: 6

Arrange the following sets of compounds in order of their increasing boiling points:
Pentan – 1 – ol, butan – 1 – ol, butan – 2 – ol, ethanol, propan – 1 – ol, methanol. [1]

Answer:
Methanol, ethanol, propan-1-ol, butan-1-ol, pentan-1-ol.

Question: 7

Name one solid which shows both Frenkel and Schottky defects. [1]

Answer:
AgBr

Question: 8

How much electricity is required in coulomb for the oxidation of 1 mol of H_2O to O_2? [1]

Answer:
The electrode reaction for 1 mol of H_2O is

$$H_2O \rightarrow H_2 + \frac{1}{2}O_2$$

i.e $O_2^- \rightarrow \frac{1}{2}O_2 + 2e^-$

$\therefore$ Quantity of electricity required = 2F

= 2 x 96,500 = 1,93,000 C

Question: 9

How does BF_3 act as a catalyst in industrial processes?

Answer:
In BF_3 only six electrons are present in the valence sheet of boron. It has a great tendency to accept a pair of electrons. Thus, due to its Lewis acid character, BF_3 is used as a catalyst in Friedal Craft reaction and many industrial processes.

Question: 10

Draw a suitable labeled diagram to express the relationships for ideal solutions of A and B between vapour pressures and mole fractions of components at constant temperature. [2]

Answer:
Relationships between V.P. and mole fraction for ideal solution.

Question: 11

Estimate the minimum potential difference needed to reduce Al_2O_3 at 500°C. The free energy change for the decomposition reaction. $\frac{2}{3}Al_2O_3 \rightarrow \frac{4}{3}Al + O_2$ is ΔG = + 960 kJ, (F = 96500 $Cmol^{-}$)

[3]

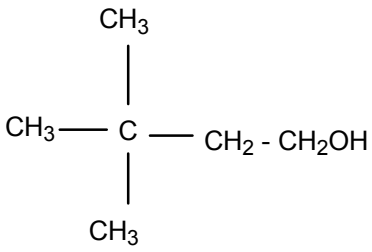
Answer:
Al_2O_3 + 6e $\rightarrow$ 2Al + $3O^{2-}$, ΔG = 960 kJ
Here, n = 6
ΔG = -nFE

$\therefore$ 9,60,000 = -6 x 96500 x E
$\therefore$ E = -1.6.58 V
$\therefore$ Minimum potential difference needed to reduce Al_2O_3 is 1.658 V.

Question: 12

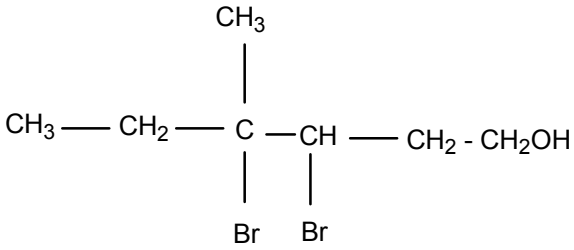
Write the IUPAC names of the following compounds: [3]

i.



Answer:
3,3 – Dimethyl – butan –1-ol

ii.



Answer:
3,4 – Dibromo – 4 – methyl hexan – 1 –ol

Question: 13

Explain giving reasons why: [2]

i. Phenol has a smaller dipole moment than methanol.

Answer:
Due to electron withdrawing effect of phenyl group, the C-O bond in phenol is less polar, where as in case of ethanol, the methyl group has electron releasing effect and hence C-O bond in its more polar. Hence dipole moment of methanol is higher than that of phenol.

ii. Haloarenes undergo electrophonic substitution reactions.

Answer:
Haloarenes undergo electrophilic substitutions more readily than that of benzene, because electron releasing OH group activates the benzene by increasing electron density on the ring and facilitates attack of electrophile.

Question: 14 (**)

Write one chemical reaction each to illustrate the following: [2]
i. an acylation reaction
ii. a coupling reaction of a diazonium salt

Question: 15 (**)

Starting with methyl iodide, how would you prepare (i) nitromethane and (ii) methyl nitrite? Write the complete reaction involved in each case. [2]

Question: 16

Mention the direct consequences of the following factors on the chemical behavior of the transition elements:

i. They have incompletely filled d-orbitals in the ground state or in one of the oxidized states of their atoms.

Answer:
Vacant d-orbitals can accept lone pairs of electrons donated by other groups (ligands). Consequently, transition elements form a large number of complex compounds.

ii. They contribute more valence electrons per atom in the formation of metallic bonds. [2]

Answer:
Due to the large number of valence electrons per atom, the metallic bonds in transition elements are quite strong. Due to the presence of strong metallic bonds the transition metals are hard; possess high densities and high enthalpies of atomization.

Question: 17

Explain. Why? [2]
i. E° for Mn^{3+} / Mn^{2+} couple is more positive than that for Fe^{3+} / Fe^{2+}. (At. Nos. Mn = 25,
ii. Ce^{3+} can be easily oxidized to Ce^{4+}. (At. No. Ce = 58)

Answer:
See topics in 'Electro chemistry'

Question: 18 [2]

With the help of ionic equations describe what happens when
i. pH of a solution of dichromate ions is raised.

Answer:
Dichromate (orange) changes to chromate (yellow) when the pH of solution is raised.

$K_2Cr_2O_7$ (AQ) + 2KOH → $2K_2CrO_4$ (aq) + H_2O
$Cr_2O_7^{2-}$ + $2OH^-$ → $2CrO_4^{2-}$ + H_2O

ii. Potassium permanganate is electrochemically oxidized.

Answer:
K_2MnO_4 → 2K+ + MnO_4^{2-}
H_2O → H^+ + OH^-

At cathode: $2H^+ + 2e^- \rightarrow H \uparrow$
At anode: MnO42- → MnO_4^- + e^-

K+ + MnO_4- → $KmnO_4$

OR

What is energetically achieved by coupling reactions in biological systems? Explain. [2]

Answer:
See topics on 'Coupling reaction'.

Question: 19

The ionization energy of hydrogen atom is 1.312 × 106 J mol – 1. Calculate the energy required to excite the electron in a hydrogen atom from the ground state to the first excited state. (Avogadro constant = $6.022 \times 10^{23}\ mol^{-1}$) [3]

Answer:
Since ionization energy of hydrogen atom is equal to 1.312 x 106 J mol-1 state to first excited state. This is in case of 6.022 x 1023 mol-1 electrons.

So, for one electron the amount of energy required.

$$E_1 = \frac{1.312 \times 10^6\ Jmol^{-1}}{6.502 \times 10^{23}\ mol^{-1}}$$

$$E_2 = \frac{1.312 \times 10^6\ Jmol^{-1}}{6.6022 \times 10^{23}\ mol^{-1}}$$

The required amount of energy = $E_1 - E_2$

$$= \frac{1.312 \times 10^6}{6.6022 \times 10^{23}} - \frac{1.312 \times 10^6}{4 \times 6.6022 \times 10^{23}}$$

$= 1.64 \times 10^{-18}$ J

OR

Taking two examples of heterogeneous catalytic reactions, explain how a heterogeneous catalyst helps in the reaction. [3]

Answer:
Solid catalysts are used in a number of gaseous reactions. Such catalytic reactions called heterogeneous reactions. Examples of heterogeneous catalysis are:

i. Manufacture of ammonia from N_2 and H_2 by Haber's process in the presence of catalyst

$$N_2(g) + 3H_2(g) \xrightarrow{Fe(s)} 2NH_3(g)$$

ii. V_2O_5 catalyst is used in the manufacture of H_2SO_4 by contact process

$$2SO_2(g) + O_2 \xrightarrow{V_2O_5(s)} 2SO_3(g)$$

Solid catalyst helps in the following ways:

a. Simultaneous adsorption of reactants increases the concentration at the surface of the catalyst which increases the reaction rate.

b. Adsorption of reactant molecules makes the attack of other molecules pm of easier.
c. Some adsorbed molecules dissociate into atoms which are very reactive.
d. Heat of adsorption released provides activation energy for the reaction.

Question: 20 (**)

The molal freezing point depression constant of benzene (C_6H_6) is 4.90 K kg mol $^{-1}$. Selenium exists as a polymer of the type Se_x. When 3.26 g of selenium is dissolved in 226 g of benzene, the observed freezing point is 0.112°C lower than for pure benzene. Deduce the molecular formula of selenium. (At. Mass of Se = 78.8 g mol $^{-1}$)

Question: 21 (**)

The decomposition of a compound is found to follow a first – order rate law. If it takes 15 minutes for 20 per cent of original material to react, calculate: [3]

a. The specific rate constant,
b. The time at which 10 per cent of the original material remains unreacted
c. The time it takes for the next 20 per cent of the reactant left to react after the first 15 minutes.

Question: 22

Explain each of the following observations: [3]

i. Tetrahedral Ni complexes are paramagnetic but square planar Ni complexes are diamagnetic.

Answer:
In the complex $[NiCl4]^{2-}$, nickel undergoes sp^3 hybridization and the complex has tetrahedral geometry, in the presence of weak ligand field Cl^-, the unpaired electrons of nickel do not paired up. So the complex is paramagnetic.

In complex like, $[NiCl4]^{2-}$, the unpaired electrons of 3d orbitals are forced to pair in the presence of strong ligand field of CN^-, Ni^{2+} ion undergoes dsp^2 hybridization resulting in square planar geometry. As there are no unpaired electrons, the complex is diamagnetic.

ii. Only transition metals are known to from π - complexes.

Answer:
π – complex is the compounds of transition metals with alkenes, alkynes, benzene and other ring system. In such compounds, the metal-carbon bonds arise from covalent interaction between the π –electron of unsaturated hydrocarbon and the vacant of filled d-orbitals which are present in transition metals.

Question: 23

State difference between the following pairs: [3]

(i) α-helix and β-pleaded sheet structure

***Answer**:*
α-helix-In this type of structure the long peptide chain undergo formation of H-bonding between the  bonds of different peptide groups within the same chain. As a result the polypeptide chain gets coiled up to form a right handed helix.

β-pleaded sheet structure – In this structure the long peptide chains lie side by side to form a flat sheet. Each chain is held to the two neighboring chains by H-bonds (N-H…O = C)

(ii) Primary and Secondary structure of a protein (**)
(iii) Enzymes and coenzymes [3]

***Answer**:*
Enzymes are biological catalysts which catalyze the various biochemical reactions in the body. Chemically all enzymes are globular proteins.

***Question: 24** (**)*

Write short notes on:
i. Riemer-Tiemann Reaction
ii. Friedel Craft Acylation Reaction
iii. Aldol Condensation Reaction.

Question: 25

Explain the following terms with suitable examples:

i. Schottky defect

***Answer**:*
See topics in 'Schottky types'

ii. F – center [3]

***Answer**:*
a. F-centers are sites from where anions are missing and the vacant sites are occupied by free electrons.
b. F-centers cause color to the crystals.
c. They are normally produced by heating a crystal of alkali metal halides in the presence of vapors of that alkali metal and allowing it to cool.

Question: 26

Draw the structures of monomers for the following polymers. Also draw the structures of the polymer and uses. (**) [3]
i. Polythene
ii. Polystyrene
iii. PVC

Question: 27

Describe the following giving one example each: (**) [1/2 + 1/2]

a. Mechanism of heterogeneous catalysts
b. Hardy Schulze Rule

Question: 28

i. Describe the contact process for the manufacture of sulphuric acid.

Answer:
See topics in 'Industrial production'.

ii. Give its uses [5]

Answer:
See topics in 'Uses'.

OR

Consider the following data for the reaction: A + B $\rightarrow$ Products **

Run	Initial concentration (A)	Initial concentration (B)	Initial rate (mol s^{-1})
1	0.10 M	1.0 M	2.1×10^{-3}
2	0.20 M	1.0M	8.4×10^{-3}
3	0.20 M	2.0 M	8.4×10^{-3}

Determine the order of reaction with respect to A and with respect to B, and the overall order of the reaction. [5]

Question: 29

Give appropriate reasons for each of the following observations: [5]
i. Sulphur vapor exhibits some paramagnetic behavior.

Answer:
At elevated temperatures, sulphur vapors exist, as S_2 molecules which are paramagnetic like O_2.

ii. Silicon has no allotropic form analogous to graphite.

Answer:
This is due to reluctance of silicon to form pπ- pπ multiple bonds because of large size of silicon atom. Hence, silicon exists only in diamond structure.

iii. Of the noble gases only xenon is known to form real chemical compounds.

Answer:
Xe has relatively lower ionization energy among inert gases and thus the outermost shell electrons of Xe are excited to d-subshell and thereby showing unpaired electronic structure.

iv. Nitrogen shows only a little tendency for catenation, whereas phosphorus shows a clear tendency for catenation.

Answer:
Nitrogen shows a little tendency for catenation, due to weakness of N - N single bond whereas phosphorous shows a clear tendency for catenation due to its unexpectedly high bond energy.

OR

A solution containing 12.5 g of non – electrolyte substance in 175 g of water gave a boiling point elevation of 0.70 K. Calculate the molar of the substance. (Elevation constant for water is K_b = 0.52 K kg mol $^{-1}$). (**)

Question: 30 (**)

a. How will you convert [5]

i. Benzoyl chloride to benzaldehyde
ii. Propanone to 2 – propanol
iii. Benzoic acid to m – nitrobenzoic acid

OR

Write the reaction and state the reaction conditions in each case.

b. Write the names and structures of the products formed in the following reactions: [5]

i. Reaction of semicarbazide ($NH_2CONHNH_2$) with formaldehyde
ii. Oxidation of ethyl benzene with alkaline $KMnO_4$.

OR

A sweet smelling organic compound 'A' is slowly by air in the presence of fight to a highly poisonous gas. On warming with silver powder, it forms a gaseous substance 'B' which is also produced by the action of carbide on water. Identify 'A' and 'B' and write the equation of the reactions involved. (**) [5]

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