CBSE Board
Class XII Chemistry

Time : 3 Hrs Total Marks: 70

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1. All questions are compulsory.
2. Question nos. **1 to 8** are very short answer questions and carry 1 mark each
3. Question nos. **9 to 18** are short answer questions and carry 2 marks each. Use of calculator is not permitted.
4. Question nos. **19 to 27** are also short answer questions and carry 3 marks each
5. Question nos**. 28 to 30** are long answer questions and carry 5 marks each
6. Use log tables if necessary, use of calculators is not allowed.

Q.1 How will you prove that all the carbon atoms of glucose are in a straight chain?

Q.2 How will you prepare hexan-3-one from propan–1–ol?

Q.3 Why is thionyl chloride considered as the best reagent to convert alcohol into alkyl chlorides?

Q.4 Define the following:

i. Unit cell ii. Space lattice

Q.5 Name the most symmetrical and most unsymmetrical primitive unit cell.

Q.6 Why the slowest step is called the rate determining step?

Q.7 For the reaction

$FeCl_3 + 2SnCl_2 \rightarrow FeCl_2 + SnCl_4$

The rate law is:

$Rate = k [FeCl_3] [SnCl_2]^2$

What is the order and molecularity of the reaction?

Q.8 What happens when conc. H_2SO_4 is slowly added to cane sugar?

Q.9 Calculate the packing efficiency in the case of metal crystal for simple cubic unit cell with the assumption that atoms are touching each other.

Q.10 Ethanol and water solution show positive deviation from Raoult's law. Explain in terms of differences in the structure / polarity of the two components.

Q.11 Explain the mechanism of enzyme catalysis.

Q.12 By giving an example prove the selectivity of a catalyst.

Q.13 Why does sulphur in vapour state exhibit paramagnetic behaviour?

Or

Draw the structures of

(i) Phosphinic acid

(ii) Pyrophosphoric acid

Q.14 Write short note on

(i) Kolbe's reaction

(ii) Hydroboration

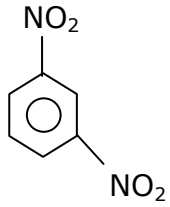
Q.15 Account for the following:

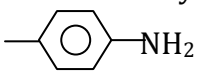
(i) Alcohols with three or less carbons are water- soluble while alcohols with five or more carbons are insoluble.

(ii) t – Butanol is more volatile than n – butanol.

Q 16. Give a chemical test to distinguish between propanamine and butan-2-amine

Q.17 Name the following compounds according to the IUPAC system:

i. 

ii. 

Q.18 Arrange the hydrides of group 16 (H_2O, H_2Se, H_2Te, H_2S) in order of increasing

a. boiling point b. acidic strength

Q.19 The rate of reaction triples when temperature changes from 20 to 50°C. Calculate the energy of activation. ($R = 8.314\ J\ mol^{-1}\ K^{-1}$).

Q.20 Conductivity of 0.00241 M acetic acid is $7.896 \times 10^{-5}\ Scm^{-1}$. Calculate its molar conductivity and if Λ^0_m for acetic acid is 390.5 $S\ cm^2mol^{-1}$. What is its dissociation constant?

Q.21 Describe a method for refining nickel.

Q.22 Give the molecular shapes of XeF_2, XeF_4, XeF_6

Q.23 Discuss the nature of bonding in the coordinate entity $[Fe(CN)_6]^{4-}$ on the basis of valence bond theory.

Q.24 Explain what do you understand by spectrum of antibiotics. Give examples.

Q.25 Bharath went to his grandfather's house in winter this year. As usual he went for fishing. His grandmother told him there will be no fishes in the lake. He noticed that it was more difficult to find fishes in winter. The fishes were deep inside the river. Whereas, in summers they were on the surface and hence he was able to catch fishes.

(a) Why are fishes on the surface in water than in the depth in summer?

(b) What value can be derived from this?

Q.26

(a) What is the difference between nucleoside and nucleotide?

(b) What is a long chain polymers of nucleotides called?

Q.27 Account for the following:

i. Chloroform is stored in dark coloured bottles.

ii. A small amount of ethanol is added to chloroform bottles.

iii. Chloroform is a compound which contains chlorine but it does not give white precipitate with silver nitrate solution.

Or

What are freons? Give some properties of freons.

Q.28 Two elements A and B form compounds having the molecular formula AB_2 and AB_4. When dissolved in 20 g of benzene, 1.0 g of AB_2 lower the freezing point by 2.3 K, whereas 1.0 g of AB_4 lowers it by 1.3 K. The molal depression constant of benzene is 5.12 K kg mol^{-1}.Calculate the atomic mass of A and B.

Or

The osmotic pressure of a urea solution is 500 mmHg at 10°C. The solution is diluted and its temperature is raised to 25°C. It is now found that the osmotic pressure of the solution is reduced to 105.3 mmHg. Determine the extent of dilution of the solution.

Q.29

(a) Compare the chemistry of lanthanoids and actinoids in terms of electronic configuration, oxidation states and radioactivity.

(b) What is the reason for the decrease in atomic/ionic size of lanthanoids along the series?

Or

(a) Explain giving reasons:

i. Transition metals and many of their compounds show paramagnetic behaviour.

ii. The enthalpies of atomization of transition metal are high.

iii. The transition metal generally form coloured compounds.

(b) What are the equivalent masses of $KMnO_4$ in:

i. neutral

ii. Acidic medium

Q.30

(a) Why is benzoic acid a stronger acid than phenol?

(b) How will you bring about the following conversions in not more than two steps?

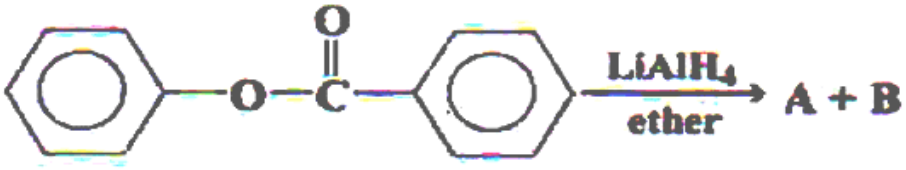
i. Benzoic acid to benzaldehyde

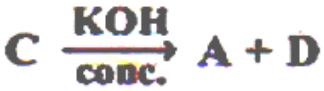
ii. Propanoic acid to prop-2-en-oic acid

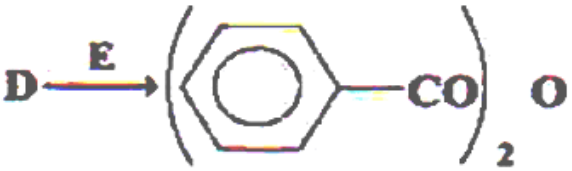
iii. Bromobenzene to 1 – phenyl ethanol

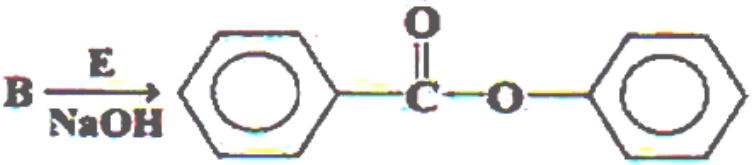
Or

Identify compounds A to E in the following reactions.









CBSE Board Class
XII Chemistry
Solution

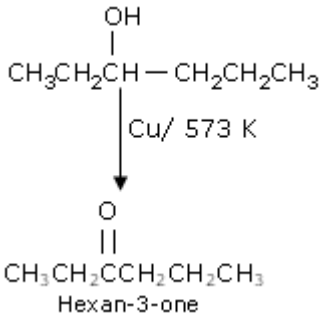
Time : 3 Hrs Total Marks: 70

Solution

Ans 1. The reaction of glucose with HI gives n – hexane and it proves that all six carbon atoms are in a straight chain.

$$HOCH_2 - (CHOH)_4 - CHO \xrightarrow[\text{Heat}]{HI} \underset{\text{n - hexane}}{H_3C - (CH_2)_4 - CH_3} \quad (1)$$

Ans 2. $CH_3CH_2CH_2OH \xrightarrow[\text{Pyridine}]{CrO_3} CH_3CH_2CHO \xrightarrow[H^+]{CH_3CH_2CH_2MgCl}$



(1)

Ans 3. Thionyl chloride is considered the best reagent to convert alcohol to alkyl halides because both the byproducts (SO_2 and HCl) are gases which escape from the reaction mixture. This makes the purification of the chloro compounds easy. (1)

Ans 4.

I. Unit cell: It is the smallest portion of a crystal lattice which, when repeated in different directions, generates the entire lattice. $(\frac{1}{2})$

II. Space lattice: The regular arrangement of the constituent particles of a crystalline solid in the three – dimensional space is called the 'space lattice' or crystal lattice. $(\frac{1}{2})$

Ans 5. Most symmetrical primitive unit cell is cubic unit cell. $(\frac{1}{2})$

($a = b = c$ and $\alpha = ß = \gamma = 90°$)

Most unsymmetrical primitive unit cell is triclinic unit cell. $(\frac{1}{2})$

($a \neq b \neq c$ and $\alpha \neq ß \neq \gamma \neq 90°$)

Ans 6. The slowest step is called the rate – determining step because the rate of reaction depends only on the concentration of the reactants appearing in this step. (1)

Ans 7. The rate law is:

Rate = k $[FeCl_3]$ $[SnCl_2]^2$

Order = 3 $(\frac{1}{2})$

Molecularity = 3 $(\frac{1}{2})$

Ans 8. The charring of sugar takes place. $(\frac{1}{2})$

$$C_{12}H_{22}O_{11} \xrightarrow{\text{conc. } H_2SO_4} 12C + 11H_2O \qquad (\frac{1}{2})$$

Ans 9.

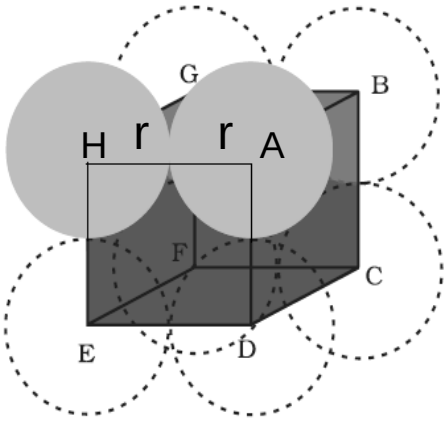
In a simple cubic,

Number of atoms per unit cell $= \frac{1}{8} \times 8 = 1$

Volume of one atom $= \frac{4}{3}\pi r^3$, where r = radius of an atom

Packing efficiency

$$= \frac{(\text{no. of atoms per unit cell}) \times (\text{volume of one atom})}{\text{volume of the unit cell}} \times 100 \qquad (\frac{1}{2})$$



In a simple cubic, atoms are in touch with each other along the edge. Therefore,

$2r = a$ $(\frac{1}{2})$

And volume of the unit cell = $a^3 = 8\ r^3$

$$= \frac{\text{Volume of one atom}}{\text{Volume of cubic unit cell}}$$

$$\text{Packing efficiency} = \frac{1 \times \frac{4}{3}\pi r^3 \times 100}{8r^3} \qquad (\frac{1}{2})$$

$$= \frac{\pi}{6} \times 100$$

$$= 52.36\% = 52.4\ \% \qquad (\frac{1}{2})$$

Ans 10. In pure water and in pure ethanol, the molecules are held together by hydrogen bonding. But the extent of hydrogen bonding is less in ethanol due to the presence of ethyl group. (1)

When ethanol is added to water, the ethanol molecules get in between the water molecules and results in the breaking of H – bonds between the water molecules. This diminishes the water – water intermolecular interactions (hydrogen bonding). As a result, the vapour pressure of such solution shows positive deviation from Raoult's law. (1)

Ans 11. In enzyme catalyzed reactions, substrate (S) and enzyme form an intermediate enzyme substrate complex $ES^{\neq}$. The steps of the enzyme catalysis are:

Step 1: Binding of an enzyme to substrate to form an activated complex:

$$E + S \rightleftharpoons ES^{\neq}$$ (1)

Step 2: Decomposition of the activated complex to form product:

$$ES^{\neq} \longrightarrow E + P$$ (1)

Ans 12. The selectivity of a catalyst is its ability to direct a particular reaction to yield a particular product. (1)

For example:

$$CO(g) + 3H_2(g) \xrightarrow{Ni} CH_4(g) + H_2O(g)$$

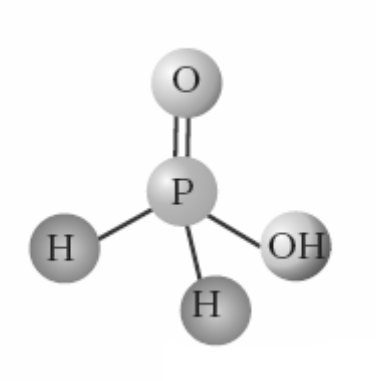
$$CO(g) + 2H_2(g) \xrightarrow{Cu/ZnO/Cr_2O_3} \underset{\text{(methanol)}}{CH_3OH(g)}$$

$$CO(g) + H_2(g) \xrightarrow{Cu} \underset{\text{(formaldehyde)}}{HCHO(g)}$$ (1)

Ans 13. In vapour state sulphur partly exists as S_2 molecule and S_2 molecule has two unpaired electrons in the antibonding π^* orbitals. Hence, in vapour state sulphur exhibits paramagnetism. (2)

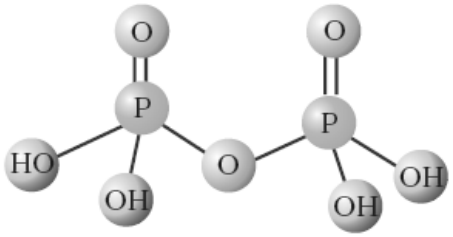
Or

(i) Phosphinic acid(H_3PO_2)



(1)

(ii) Pyrophosphoric acid ($H_4P_2O_7$)

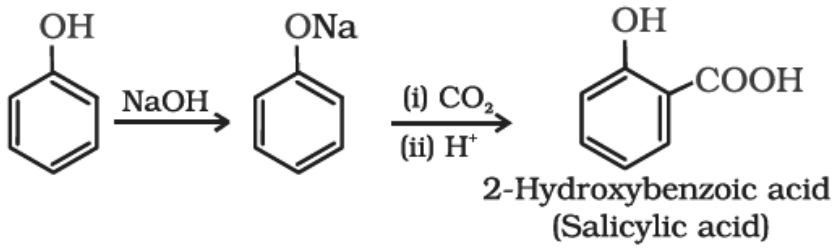


(1)

Ans 14.

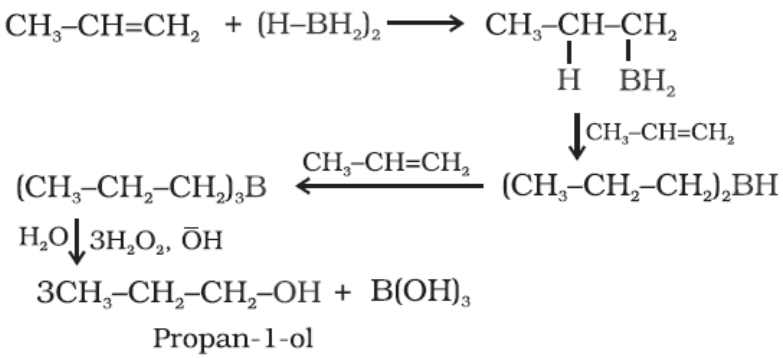
(i) Kolbe's reaction

In this reaction, phenol is reacted with sodium hydroxide to form sodium phenoxide. Sodium phenoxide formed is reacted with carbon dioxide to form ortho hydroxy benzoic acid as the main product.



(1)

(ii) Hydroboration: In this method, alkene reacts with diborane, B_2H_6 (an elctrophile) to form alkyl boranes which on oxidation with alkaline hydrogen peroxide yield alcohol.



(1)

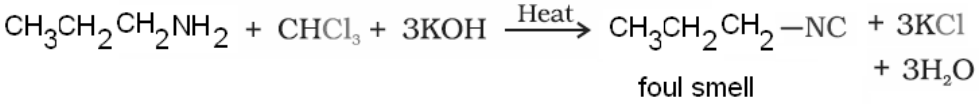
Ans 15.

(i) The solubility of alcohol in water is due to the presence of intermolecular hydrogen bonding.
As the size of alcohol molecule increases, alkyl group becomes larger and prevents the formation of hydrogen bonds with water molecules and hence solubility goes on decreasing with increases in length of carbon chain.

(ii) t – Butanol and n – butanol have the same molecular mass but t – butanol is more branched. As branching increases, van der Waals forces decrease due to decrease in surface area. Thus, t - butanol has a lower boiling point than n – butanol. (1)

Ans 16. Carbylamine test can be used to distinguish between propanamine and butan-2-amine. (1)

Propanamine is a primary aliphatic amine and therefore will give a foul smell of isocyanide when heated with chloroform and potassium hydroxide. Butan-2-amine is a secondary aliphatic amine and will not give this test.



(1)

Ans 17.

(i) 1, 3 – Dinitrobenzene (1)

(ii) 4 – Aminotoluene (1)

Ans 18.

(a) The correct order is

$H_2S < H_2Se < H_2Te < H_2O$ $(\frac{1}{2})$

Down the group, molecular mass increases, so surface area increases and hence the van der Waals' forces also increase. Therefore, the boiling point increases down the group. H_2O has abnormally high boiling point due to strong intermolecular hydrogen bonding. $(\frac{1}{2})$

(b) The correct order is

$H_2O < H_2S < H_2Se < H_2Te$ $(\frac{1}{2})$

As we move down the group, size increases and hence the strength of M—H bond decreases. So, the tendency of release hydrogen ion in water increases. Hence the acidic strength increases down the group. $(\frac{1}{2})$

Ans 19. Let $T_1 = 20°C = 293\ K$

$T_2 = 50°C = 323\ K$

$k_2 = 3k_1$ (given)

Or

$$\left(\frac{k_2}{K_1}\right) = 3$$

We know that

$$\log\left(\frac{k_2}{k_1}\right) = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right] \quad (1)$$

$$E_a = \frac{2.303 \times 8.314 \times 293 \times 323}{30} \log(3)$$

$$E_a = \frac{2.303 \times 8.314 \times 293 \times 323 \times 0.477}{30}$$

$$E_a = 28811.85\ J\ mol^{-1} \quad (1)$$

(1 mark for calculations)

Ans 20.

$\Lambda^\circ_m\ (CH_3COOH) = 390.5\,S\ cm^2\ mol^{-1}$

$\kappa = 7.896 \times 10^{-5}\ Scm^{-1}$

$M = 0.00241\,M$

$\Lambda_m = \frac{\kappa \times 1000}{M}$ $(\frac{1}{2})$

$= \frac{7.896 \times 10^{-5} \times 1000}{0.00241}$

$= 32.76\,S\ cm^2\ mol^{-1}$ $(\frac{1}{2})$

$\alpha = \frac{\Lambda_m}{\Lambda^\circ_m}$ $(\frac{1}{2})$

$= \frac{32.76}{390.5}$

$= 0.0839$ $(\frac{1}{2})$

$K = \frac{C\alpha^2}{1 - \alpha}$ $(\frac{1}{2})$

$= \frac{0.00241 \times (0.0839)^2}{(1 - 0.0839)}$

$= 1.85 \times 10^{-5}$ $(\frac{1}{2})$

Ans 21.

Mond's process is used for the refining of nickel. (1)

Nickel when heated in a stream of CO, forms volatile nickel tetracarbonyl, $Ni(CO)_4$. The carbonyl vapour when subjected to still higher temperature undergoes thermal decomposition giving pure metal. (1)

$Ni + 4\,CO \xrightarrow{330\text{-}350\,K} Ni(CO)_4$ $(\frac{1}{2})$

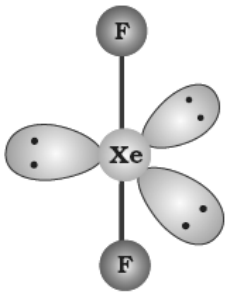
Impure

$Ni(CO)_4 \xrightarrow{450\text{-}470\,K} Ni + 4\,CO$ $(\frac{1}{2})$

Pure

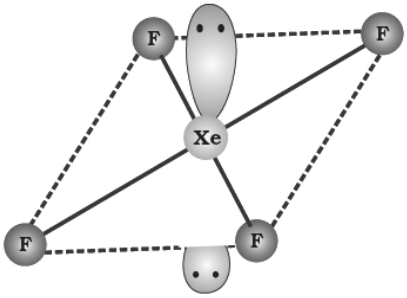
Ans 22.

1. XeF_2 is linear in shape.



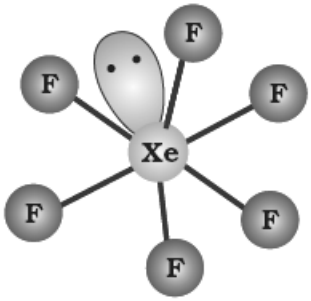
(1)

2. XeF_4 is square planar.



(1)

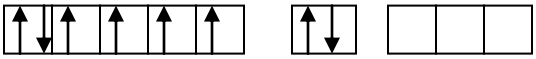
3. XeF_6 has distorted octahedral structure in which all the six positions are occupied byfluorine atoms and the lone pair is present at the centre of one of the triangular faces.

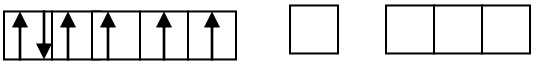


(1)

Ans 23. $[Fe(CN)_6]^{4-}$

Oxidation state of Fe is +2

$Fe \rightarrow 3d^6 4s^2$ 

Fe^{2+} $3d^6 4s^0$ 

(1)

As 6 CN^- ligands approaches, pairing of the unpaired electron in d- orbitals takes place because CN^- is a strong field ligand.

The Fe^{2+} ion undergoes d^2sp^3 hybridisation.

$[Fe(CN)_6]^{4-}$ 

6 pairs of electrons from 6 CN^- groups

(1)

As there is no unpaired electron, the complex is diamagnetic in nature. $(\frac{1}{2})$

The geometry is octahedral. $(\frac{1}{2})$

Ans 24. The full range of microorganisms attacked by an antibiotic is called its spectrum. (1)

Antibiotics can be divided into two types:

Narrow spectrum antibiotics: These are effective against very few types of microorganisms. $(\frac{1}{2})$

Example: Penicillin $(\frac{1}{2})$

Broad spectrum antibiotics: These are effective against several different types of microorganisms. $(\frac{1}{2})$

Example: Chloroamphenicol $(\frac{1}{2})$

Ans 25.

a) According to Henry's law at low temperature gases are more soluble and hence as more oxygen gets dissolved in water fishes survive better even in depth of the river. In summer as the oxygen is less in water the fishes come to the surface. (2)

b) The value that I derive from this is wisdom is superior to knowledge. (1)

Ans 26.

(a)

Nucleoside	Nucleotide
A unit formed by the attachment of a base to 1' position of sugar moiety is known as nucleoside. (1)	When a nucleoside is linked to phosphoric acid at 5' position of sugar moiety, we get a nucleotide. (1)

(b) Nucleic acids are long chain polymers of nucleotides. (1)

Ans 27.

(i) Chloroform in the presence of air gives a poisonous phosgene gas. The reaction is catalysed by light. To slow down this reaction, we store the $CHCl_3$ in dark coloured bottles. $(\frac{1}{2})$

$$CHCl_3 + \frac{1}{2}O_2 \xrightarrow{\text{light}} COCl_2 + HCl \qquad (\frac{1}{2})$$

(ii) A small amount of ethanol is added to convert poisonous $COCl_2$, if any, into a non – poisonous diethyl carbonate. $(\frac{1}{2})$

$$COCl_2 + 2\ C_2H_5OH \longrightarrow (C_2H_5)_2\ CO_3 + 2\ HCl \qquad (\frac{1}{2})$$

(iii) $CHCl_3$ being a covalent compound does not ionize to give free chloride ions. Therefore, no precipitate is formed with $AgNO_3$. (1)

Or

The chlorofluoro compounds of methane and ethane are collectively known as Freons. (1)

Properties of freons are: (2)

i. They are extremely stable
ii. They are unreactive
iii. They are non- toxic
iv. They are non- corrosive

Ans 28. For compound AB_2:

$w_A = 20$ g

$w_B = 1.0$ g

$\Delta T_f = 2.3$ K

$K_f = 5.12$ K kg mol^{-1}

$M_{AB_2} = A + 2B$

$\Delta T_f = K_f . m$

$$\Delta T_f = K_f . \frac{w_B \times 1000}{M_B \times w_A} \qquad (1)$$

$$2.3 = 5.12 \times \frac{1.0 \times 1000}{(A + 2B) \times 20} \qquad (\frac{1}{2})$$

$$(A + 2B) = 111 \qquad .....(1) \qquad (\frac{1}{2})$$

For compound AB_4:

$w_A = 20$ g

$w_B = 1.0$ g

$\Delta T_f = 1.3$ K

$K_f = 5.12$ K kg mol^{-1}

$M_{AB_4} = A + 4B$

$\Delta T_f = K_f . m$

$$\Delta T_f = K_f . \frac{w_B \times 1000}{M_B \times w_A}$$

$$1.3 = 5.12 \times \frac{1.0 \times 1000}{(A + 4B) \times 20} \qquad (\frac{1}{2})$$

$$(A + 4B) = 197 \qquad .....(2) \qquad (\frac{1}{2})$$

Solving equation (1) and (2),

$A = 25$ g mol^{-1} (1)

$B = 43$ g mol^{-1} (1)

Or

$\pi_1 = 500$ mmHg $\qquad\qquad$ $\pi_2 = 105.3$ mmHg

$= \frac{500}{760}$ atm $\qquad\qquad$ $= \frac{105.3}{760}$ atm

$T_1 = 283$ K $\qquad\qquad$ $T_2 = 298$ K

$\pi V = nRT$

At 283 K,

$\pi_1 V_1 = nRT_1$ (1)

$V_1 = \frac{n \times R \times 283 \times 760}{500}$ ...(1) (1)

At 298 K,

$\pi_2 V_2 = nRT_2$

$V_2 = \frac{n \times R \times 298 \times 760}{105.3}$ ....(2) (1)

Dividing Eq.(2) by (1) gives

$\frac{V_2}{V_1} = \frac{n \times R \times 298 \times 760}{105.3} \times \frac{500}{n \times R \times 283 \times 760}$ (1)

$\frac{V_2}{V_1} = 5.0$ (1)

i.e. the solution has been diluted five times.

Ans 29.

(a) (3)

Lanthanoids	Actinoids
Electronic configuration: $4f^{1-14}\ 5d^{0-1}\ 6s^2$	Electronic configuration: $5f^{1-14}\ 6d^{0-1}\ 7s^2$
Oxidation states: They all show + 3 common oxidation state except in a few cases where it is + 2 and + 4.	Oxidation states: They show along with + 3, higher oxidation states such as + 4, + 5, +6 and + 7.
Except promethium, lanthanoids are not radioactive.	All actinoids are radioactive.

(b) The contraction or decrease in the size is due to the poor shielding of one electron by another in the same 4f sub – shell and this shielding is less in comparison to one d-electron by another. (2)

OR

(a)

(i) Elements show paramagnetic behaviour when their atoms have at least one unpaired electron. Transition metals usually have one or more unpaired electrons which make them paramagnetic. (1)

(ii) Transition metals have one or more unpaired electrons per atom which makes them have strong interatomic interaction. Thus transition metals have higher enthalpies of atomization. (1)

(iii) Due to the presence of unpaired electrons and d-d transitions, the transition metals are generally coloured.

b. The equivalent mass of $KMnO_4$ depends upon the number of electron it accepts in a particular medium.

i. In a neutral medium

$$MnO_4^- + 2H_2O + 3e^- \rightarrow MnO_2 + 4OH^- \quad (\frac{1}{2})$$

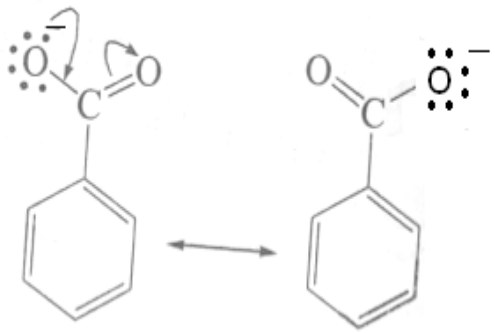
As $KMnO_4$ accepts the electrons in a neutral medium, its equivalent mass will be M/3. (M = mol. mass of $KMnO_4$). $(\frac{1}{2})$

ii. In an acidic medium

$$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O \quad (\frac{1}{2})$$

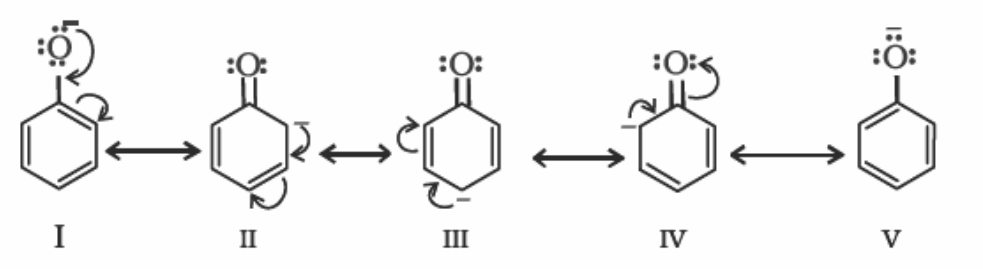
As $KMnO_4$ accepts five electrons in acidic medium, its equivalent mass will be M/5 (M = mol. mass of $KMnO_4$). $(\frac{1}{2})$

Ans 30. a. Benzoic acid is a stronger acid than phenol because benzoate ion is stabilized by two equivalent resonance structures in which the negative charge is present at the more electronegative oxygen atom. $(\frac{1}{2})$



$(\frac{1}{2})$

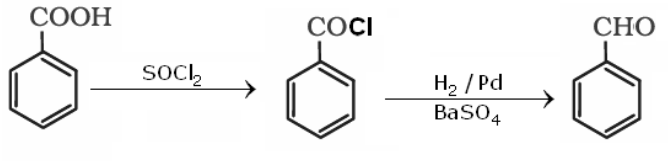
The conjugate base of phenol, phenoxide, ion has resonance structures in which the negative charge is at the less electronegative carbon atom. $(\frac{1}{2})$



$(\frac{1}{2})$

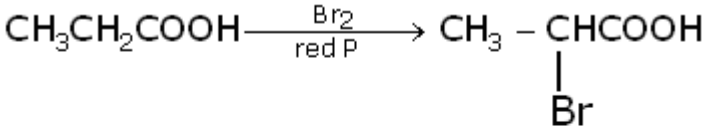
Thus, the benzoate ion is more stable than phenoxide ion. Hence, benzoic acid is a stronger acid than phenol.

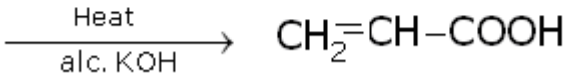
b. i.



(1)

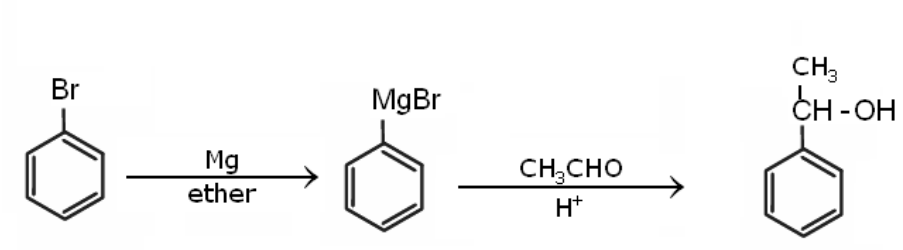
ii.





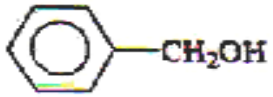
(1)

iii.



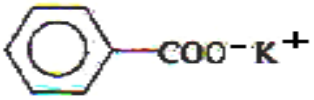
(1)

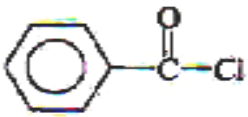
Or

A → 

B → 

C → 

D → 

E → 

(5)