

# Sample Paper 17 Solutions

Class XII 2023-24

## Chemistry

Time: 3 Hours

Max. Marks: 70

### General Instructions:

1. There are 33 questions in this question paper with internal choice.
2. SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
3. SECTION B consists of 5 very short answer questions carrying 2 marks each.
4. SECTION C consists of 7 short answer questions carrying 3 marks each.
5. SECTION D consists of 2 case-based questions carrying 4 marks each.
6. SECTION E consists of 3 long answer questions carrying 5 marks each.
7. All questions are compulsory.
8. Use of log tables and calculators is not allowed.

## SECTION-A

**Directions (Q. Nos. 1-16) :** The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1. Sodium formate on heating yields

- (a) Oxalic acid and  $H_2$
- (b) Sodium oxalate and  $H_2$
- (c)  $CO_2$  and NaOH
- (d) Sodium oxalate

**Ans :** (b) Sodium oxalate and  $H_2$



2. Blood cells retain their normal shape in solution which are:

- (a) hypotonic to blood
- (b) isotonic to blood
- (c) hypertonic to blood
- (d) equinormal to blood

**Ans :** (b) isotonic to blood

Blood cells neither swell nor shrink in isotonic solution. As isotonic solutions have equal concentration therefore there is no flow of solvent is found and hence solvent neither enters nor flow out of the blood cells.

3. The complex ion  $[Co(NH_3)_6]^{3+}$  is formed by  $sp^3 d^2$  hybridisation. Hence the ion should posses.

- (a) Octahedral geometry
- (b) Tetrahedral geometry
- (c) Square planar geometry
- (d) Tetragonal geometry

**Ans :** (a) Octahedral geometry

According to VSEPR theory, a molecule with six bond pairs must be octahedral.

4. The activation energy for a simple chemical reaction  $A \longrightarrow B$  is  $E_a$  in forward direction. The activation energy for reverse reaction

- (a) is always double of  $E_a$
- (b) is negative of  $E_a$
- (c) is always less than  $E_a$
- (d) can be less than or more than  $E_a$

**Ans :** (d) can be less than or more than  $E_a$

The activation energy of reverse reaction will depend upon whether the forward reaction is exothermic or endothermic.

As,  $\Delta H = E_{a(\text{forward reaction})} - E_{a(\text{backward reaction})}$

For exothermic reaction,

$$\Delta H = -ve$$

Hence,  $-\Delta H = E_{a(\text{forward reaction})} - E_{a(\text{backward reaction})}$

or  $E_{a(\text{forward reaction})} = E_{a(\text{backward reaction})} - \Delta H$

Hence,  $E_{a(\text{forward reaction})} < E_{a(\text{backward reaction})}$

For endothermic reaction,

$$\Delta H = +ve$$

Hence,  $\Delta H = E_{a(\text{forward reaction})} + E_{a(\text{backward reaction})}$

or  $E_{a(\text{forward reaction})} = \Delta H + E_{a(\text{backward reaction})}$

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5. Which of the following is an insulator ?

- (a) Graphite
- (b) Aluminium
- (c) Diamond
- (d) Silicon

**Ans :** (c) diamond

Diamond is an insulator.



Both are false.  $\text{KMnO}_4$  is an oxidising agent and acetylene on treatment with alkaline  $\text{KMnO}_4$  produces oxalic acid



14. **Assertion :** The order of the reaction  $\text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O} \longrightarrow \text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH}$  is 1.

**Reason :** The molecularity of this reactions is 2.

- (a) Both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.  
 (b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.  
 (c) Assertion is correct but Reason is incorrect.  
 (d) Both the Assertion and Reason are incorrect.

**Ans :** (b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.

During hydrolysis of ester, water is always present in high concentration, thus there is very little change in its concentration and it practically remains constant. Thus, the order of reaction is 1 (pseudo first order reaction).

The molecularity reaction is 2.

15. **Assertion :** The  $[\text{Ni}(\text{en})_3]\text{Cl}_2$  ( $\text{en} =$  ethylenediamine) has lower stability than  $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$ .

**Reason :** In  $[\text{Ni}(\text{en})_3]\text{Cl}_2$  the geometry of Ni is octahedral.

- (a) Both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.  
 (b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.  
 (c) Assertion is correct but Reason is incorrect.  
 (d) Both the Assertion and Reason are incorrect.

**Ans :** (d) Both the Assertion and Reason are incorrect.

$[\text{Ni}(\text{en})_3]\text{Cl}_2$  is a chelating compound and chelated complexes are more stable than similar complexes with unidentate ligands as dissociation of the complex involves breaking of two bonds rather than one.

In  $[\text{Ni}(\text{en})_3]\text{Cl}_2$ , Ni with  $d^8$  configuration shows octahedral geometry.

16. **Assertion :**  $\text{ROCOl}$ ,  $(\text{RCO})_2\text{O}$  and  $\text{RCOOR}'$  all react with Grignard reagents to form  $3^\circ$  alcohols.

**Reason :**  $\text{ROCOl}$  reacts with  $R_2\text{C'd}$  to form ketones but  $(\text{RCO})_2\text{O}$  and  $\text{RCOOR}'$  do not react at all.

- (a) Both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.  
 (b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.  
 (c) Assertion is correct but Reason is incorrect.  
 (d) Both the Assertion and Reason are incorrect.

**Ans :** (b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.

$\text{ROCOl}$ ,  $(\text{RCO})_2\text{O}$  and  $\text{RCOOR}'$  all add two molecules of Grignard reagents to give  $3^\circ$  alcohols.

## SECTION-B

**Directions (Q. Nos. 17-21) :** This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

17. Define solubility. Name the factors on which solubility of a solute in a solvent depends.

**Ans :**

The concentration of solute in a saturated solution at given temperature is called its solubility.

Solubility of a solute in a solvent depends upon

1. nature of solute and solvent.
2. temperature.
3. pressure.

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18. How are ethers named in IUPAC system ?

**Ans :**

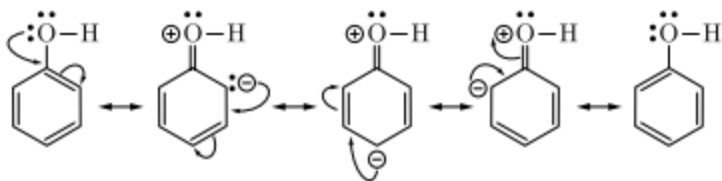
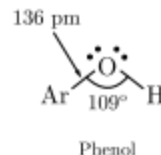
According to IUPAC system, ethers are regarded as hydrocarbon derivatives in which a hydrogen atom is replaced by an "alkoxy group" ( $-\text{OR}$ ), the larger group (R) being chosen as the parent hydrocarbon. Thus, in IUPAC system, ethers are named as "alkoxyalkane".

**or**

Explain why is  $-\text{OH}$  group in phenols more strongly held as compared too OH group in alcohols.

**Ans :**

In Phenols, the  $-\text{OH}$  group is attached to  $sp^2$  hybrid carbon of an aromatic ring. The carbon-oxygen bond length (136 pm) in phenol is slightly less than that in alcohol. This is due to partial double bond character of  $\text{C}-\text{O}$  bond on account of the conjugation of unshared electron pair of oxygen with the aromatic ring.



19. Given the standard electrode potentials  $K^+/K = -2.93$  V,  $Ag^+/Ag = 0.80$  V,  $Hg^{2+}/Hg = 0.79$  V,  $Mg^{2+}/Mg = -2.37$  V,  $Cr^{2+}/Cr = -0.74$  V. Arrange these metals in their increasing order of reducing power.

**Ans :**

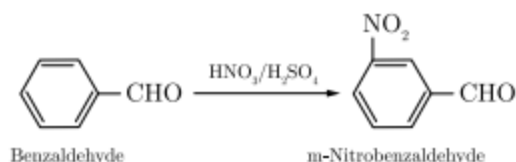
Higher the oxidation potential, more easily it is oxidised and hence greater is the reducing power. Thus, increasing order of reducing power will be.



20. Show that carbonyl group is meta directing group.

**Ans :**

Aromatic aldehydes and ketones undergo electrophilic substitution at the ring in which the carbonyl group acts as a deactivating and meta-directing group.



**or**

Why are carboxylic acids called fatty acids ?

**Ans :**

Higher members of aliphatic carboxylic acids occur in natural fat as triesters of glycerol. Therefore, these are called fatty acids.

21. Write IUPAC names of the following:

- (a)  $K_2[Ni(CN)_4]$   
(b)  $[CoCl_2(NH_3)_4]Cl$

**Ans :**

- (a) Potassium tetra cyanonickelate (II).  
(b) Tetraamminedichlorocobalt (III) chloride.

## SECTION-C

**Directions (Q. Nos. 22-28) :** This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.

22. Depict the galvanic cell in which the reaction  $2Zn(s) + 2Ag^+(aq) \rightarrow Zn^{2+}(aq) + 2Ag(s)$  takes place. Further, show
1. Which of the electrodes is negatively charged ?
  2. The carriers of the current in the cell.
  3. Individual reaction at each electrode.

**Ans :**

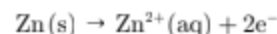
The cell will be represented as :



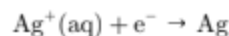
1. Anode i.e., zinc electrode will be negatively charged.
2. The current will flow from silver to Zinc in the external

circuit.

3. At anode :



At cathode :



23. Out of ethyl bromide and ethyl chloride which has higher boiling point and why ?

**Ans :**

The vander walls forces of attraction are stronger in ethyl bromide than in ethyl chloride, due to bigger size of Br than Cl. Therefore ethyl bromide has higher boiling point than ethyl chloride. (The order of boiling point is  $RI > RBr > RCl > RF$ ).

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24. Specify oxidation numbers of the metals in the following co-ordination compounds:

- (a)  $K_4[Fe(CN)_6]$   
(b)  $[PtCl_4]$

**Ans :**

- (a) Let oxidation number of metal (Fe) =  $x$ .  
Since, oxidation number of Potassium (K) and  $CN^-$  are (+)1 and (-)1 respectively.

Hence, Oxidation number of (Fe) in  $K_4[Fe(CN)_6]$  is,

$$4 + x - (6 \times 1) = 0$$

$$4 + x - 6 = 0$$

$$x = (+)2$$

- (b) Let oxidation number of Metal (Pt) =  $x$ .  
Since, Oxidation number of Chlorine (Cl) is (-1).  
Hence, Oxidation no. of Pt in  $[PtCl_4]$  is,

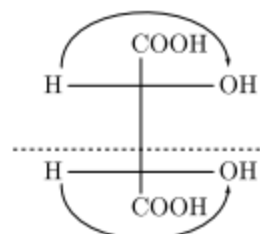
$$x - 4 = 0$$

$$x = (+)4$$

25. Does the presence of two chiral carbon atoms always make the molecule optically active? Explain giving an example.

**Ans :**

No the presence of two chiral carbon atoms not always make the molecule optically active. For example, meso tartaric acid is optically inactive because if upper half of molecule rotates the plane-polarised light towards the left, then lower half rotate it towards the right, such that net optical rotation is zero due to internal compensation.



Optically inactive meso-tartaric acid

26. Write a note on Haloform reaction.

**Ans :**

Aldehydes and Ketones containing  $\text{CH}_3\text{CO}$  - group on treatment with halogen in presence of alkali or sodium hypohalite ( $\text{NaOX}$ ) produces a haloform (chloroform, bromoform, or iodoform) In this reaction methyl group linked to the carbonyl carbon atom is converted to haloform.

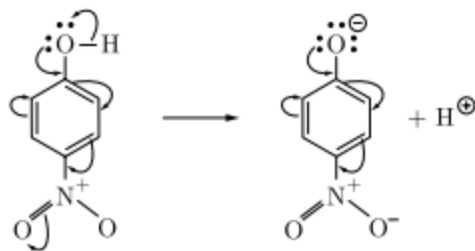


Due to the formation of yellow ppt in this reaction, it is known as iodoform test and is used for detection of compounds containing  $\text{CH}_3\text{CO}$  - group or  $\text{CH}_3\text{CH}(\text{OH})$  - group which produces  $\text{CH}_3\text{CO}$  group on oxidation.

27. *p*-Nitrophenol is more acidic than phenol explain why ?

**Ans :**

*p*-Nitrophenol is more acidic than phenol because nitro group is *e*-withdrawing group. It helps in releasing  $\text{H}^+$  ion easily as compared to phenol. After releasing  $\text{H}^+$  ion phenol forms phenoxide ion, the negative charge in oxygen atom of phenoxide ion is stabilised by the electron withdrawing  $-\text{NO}_2$  group. It helps in de-localization of negative charge of oxygen atom and makes it stable.

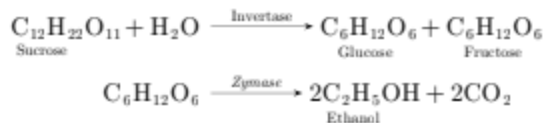


or

Define fermentation. How ethanol is formed by fermentation.

**Ans :**

Breaking down of large organic molecules into simple ones in presence of enzymes is called fermentation. Sucrose in converted to glucose and fructose in the presence of enzyme invertase. Glucose and fructose undergo fermentation in the presence of another enzyme, zymase, which is found in yeast.



Fermentation takes place in anaerobic condition (i.e., in absence of air). If air gets into fermentation mixture, the oxygen of air oxidises ethanol to ethanoic acid.

28. Explain two important uses of formalin.

**Ans :**

Aqueous solution of Formaldehyde ( $\text{H}\cdot\text{CHO}$ ). is known as formalin. It contain about 35-40% of water.

It is used as:

1. Strong disinfectant
2. Tissue hardener
3. Preservative for biological and anatomical specimens.
4. An antiseptic for sterilising the surgical instruments.

or

Give reasons for the following :

1. Ethyne is more acidic than ethane.
2. Lower members of aldehyde are more soluble in water.

**Ans :**

1. **Ethyne is more acidic than ethane :** More be the *s*-character of the hybrid orbitals of the carbon, more it will be acidic in nature. As in  $\text{CH} \equiv \text{CH}_3$ , both the carbon atoms are *sp*-hybrid, so has 50% *S*-character, while in  $\text{CH}_3 - \text{CH}_3$ , Both the carbon atoms are *sp*<sup>3</sup>-hybrid, So has 25% *S*-character. Therefore  $\text{CH} \equiv \text{CH}$  is more acidic in nature.
2. **Lower members of aldehyde are more soluble in water:** In lower aldehydes, a single small alkyl group (*R*) can not hinder the oxygen atom of  $-\text{CHO}$  group, thus It can form the intermolecular hydrogen bond with  $\text{H}_2\text{O}$  (water) molecule and is therefore soluble in water. On the other hand, longer alkyl group can hinder the oxygen atom of aldehydes, thus they can not able to form the intermolecular hydrogen bonds with water and therefore are not soluble in water.

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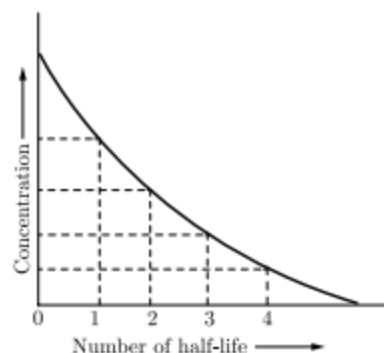
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## SECTION-D

**Directions (Q. Nos. 29-30) :** The following questions are case-based questions. Each question has an internal choice and carries 4 marks each. Read the passage carefully and answer the questions that follow.

29. The half-life of a reaction is the time required for the concentration of reactant to decrease by half, i.e.,

$$[A]_t = \frac{1}{2}[A]$$



For first order of reaction,

$$\frac{t}{\frac{1}{2}} = \frac{0.693}{k}$$

This means  $t_{1/2}$  is independent of initial concentration. Figure shows that typical variation of concentration of reactant exhibiting first order kinetics. It may be noted that though the major portion of the first order kinetics may be over in a finite time, but the reaction will never cease as the concentration of reactant will be zero only at infinite time.

Read the above passage and answer the following questions:

- (a) A first order reaction has a rate constant  $k = 3.01 \times 10^{-3} \text{ s}^{-1}$ . How long will it take to decompose half of the reactant?
- (b) Draw the plot of  $t_{1/2}$  vs initial concentration  $[A]_0$  for a first order reaction.
- (c) The rate constant for a first order reaction is  $7.0 \times 10^{-4} \text{ s}^{-1}$ . If initial concentration of reactant is 0.080 M, what is the half life of reaction?
- or**
- (d) The rate of a first order reaction is  $0.04 \text{ mol L}^{-1} \text{ s}^{-1}$  after 10 minutes and  $0.03 \text{ mol L}^{-1} \text{ s}^{-1}$  after 20 minutes of initiation. What is the half-life of reaction?

**Ans :**

- (a) For a first order reaction :

$$t_{1/2} = \frac{0.693}{k},$$

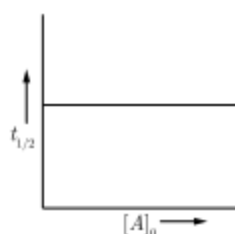
$$k = 3.01 \times 10^{-3} \text{ s}^{-1}$$

$$t_{1/2} = \frac{0.693}{3.01 \times 10^{-3}} = 230.3 \text{ s}$$

- (b) For a first order reactions,

$$t_{1/2} = k[A]_0^0 = k$$

Thus  $t_{1/2}$  is independent of initial concentration. Hence plot of  $t_{1/2}$  vs  $[A]_0$  will be a horizontal line.



- (c) Half life ( $t_{1/2}$ ) of a first order reaction is given is :

$$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{7.0 \times 10^{-4}} = 990 \text{ s}$$

**or**

- (d) Let the concentrations of the reactant after 10 min and 20 min be  $C_1$ , and  $C_2$ , respectively.

$$\text{Rate after 10 min} = k C_1 = 0.04 \times 60 \text{ mol L}^{-1} \text{ min}^{-1}$$

$$\text{and rate after 20 min} = k C_2 = 0.03 \times 60 \text{ mol L}^{-1} \text{ min}^{-1}$$

$$\frac{C_1}{C_2} = \frac{4}{3}$$

Let the reaction starts after 10 minutes.

$$k = \frac{2.303}{10} \log \frac{C_1}{C_2}$$

$$= \frac{2.303}{10} \log \frac{4}{3} = 0.02878$$

$$t_{1/2} = \frac{0.6932}{k} = \frac{0.6932}{0.02878}$$

$$= 24.086 \text{ min}$$

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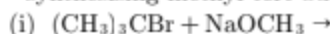
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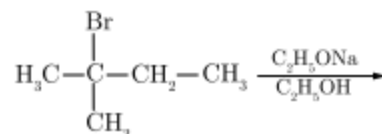
30. When haloalkanes with ( $\beta$ -hydrogen atom are boiled with alcoholic solution of KOH, they undergo elimination of hydrogen halide resulting in the formation of alkenes. These reactions are called  $\beta$ -elimination reactions or dehydrohalogenation reactions. These reactions follow Saytzeff's rule. Substitution and elimination reactions often compete with each other. Mostly bases behave as nucleophiles and therefore can engage in substitution or elimination reactions depending upon the alkyl halide and the reaction conditions.

Answer the following questions :

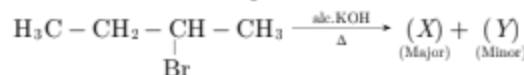
- (a) Which of the following is the correct method for synthesising methyl tert-butyl ether and why?



- (b) What will be the major product in the following reaction?



- (c) Consider the following reaction:



Identify (x) and (y)

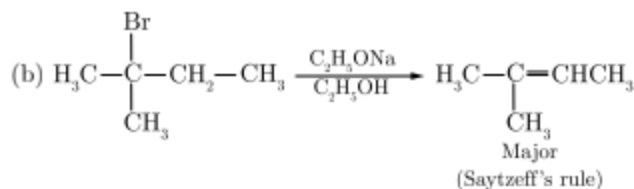
**or**

- (d) Predict all the alkenes that would be formed by dehydrohalogenation of 2,2,3-trimethyl-3-bromopentane with sodium ethoxide in ethanol ?

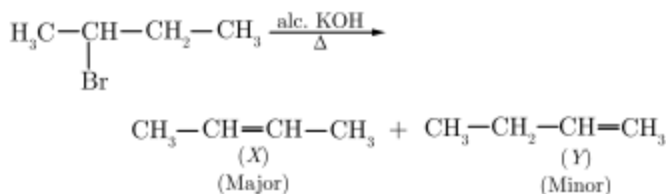
**Ans :**

- (a) Substitution and elimination reactions are always competitive reactions. Since tertiary ( $3^\circ$ ) alkyl halides preferentially undergo elimination and primary ( $1^\circ$ )

alkyl halides preferentially undergo substitution, therefore, reaction (a) will undergo elimination reaction to give iso-butylene and the reaction (b) will undergo substitution reaction to give methyl tert-butyl ether.



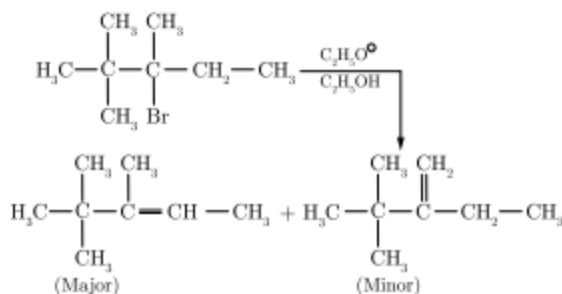
(c)



According to Saytzeff's rule, the more substituted product is more stable and is formed as major product. Hence (X) is the major product (80%) and (Y) is the minor (20%) and less stable product.

or

(d)



## SECTION-E

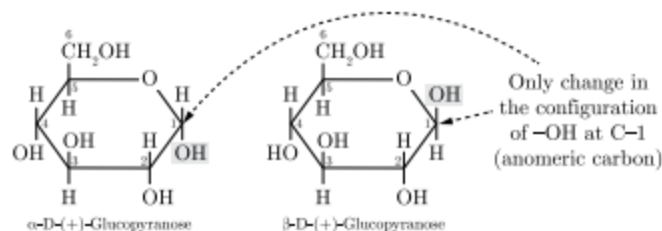
**Directions (Q. Nos. 31-33) :** The following questions are long answer type and carry 5 marks each. Two questions have an internal choice.

31. Draw the structures of  $\alpha$ -D-glucose and  $\beta$ -D-glucose.

**Ans :**

This six membered cyclic structure of glucose is termed pyranose structure in analogy with pyran. To write Pyranose structure,

- (i) Draw a hexagon with its oxygen atom at the upper right hand corner.
- (ii) Place  $-\text{CH}_2\text{OH}$  group at C-5 above the plane of the hexagon ring (in D-series).
- (iii) In Fischer projection, if  $-\text{OH}$  group is present on the right hand side, place it below the plane of the ring.



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32. Define rate constant of a reaction. Derive an expression for the rate constant of 1st order reaction

**Ans :**

According to this law at a given temperature the rate of a chemical reaction is directly proportional to the product of the molar concentration of the reactants.

The molar concentration of the reactant is also called active mass. Let us consider a simple reaction of the type.



According to law of mass action, rate of the reaction may be written as :

$$\text{Rate} = k[A][B]$$

where  $[A]$  and  $[B]$  are the molar concentrations of reactants,  $k$  is constant of proportionality and is called rate constant. The rate constant is also called velocity constant and is a measure of rate of the reaction.

Now, if concentration of each of the reactants involved in the reaction is unity i.e.,  $[A] = [B] = 1$ , then substituting these values in above expression, we get

$$\text{Rate of reaction} = k \times 1 \times 1 = k$$

Thus, the rate constant of a reaction at a given temperature may be defined as rate of the reaction when the molar concentration of each of the reactants is unity.

That is why the rate constant is also called specific reaction rate.

Example : Consider the general first order reaction



Let  $[R]$  is the concentration of the reaction  $R$  and  $k$  is the rate constant for the first order reaction. For the first order reaction, the rate of the reaction is directly proportional to the concentration of the reactant  $R$ . Thus,

$$\text{Rate} = -\frac{d[R]}{dt} = k[R] \quad \dots(1)$$

This form of rate law is known as differential rate equation. Integrated form of rate law can be written as follow:

$$K = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$$

where  $[R]_0$  = initial concentration.

$[R]$  = concentration at time ' $t$ '

or

1. Define zero order reaction.
2. Derive integrated rate equation for zero order reaction.
3. Derive an expression for half life period of a zero order reaction.

**Ans :**

1. Zero order reaction— The reaction for which the rate of reaction does not depend upon concentration of reactant is called a zero order reaction. For such a reaction :

$$\text{Rate} = K[R]^0 = K$$

2. Integrated rate equation for a zero order reaction – Consider the reaction  $R \longrightarrow P$

$$\text{Rate} = -\frac{d[R]}{dt} = K[R]^0$$

As any quantity raised to power zero is unity.

$$\text{Rate} = -\frac{d[R]}{dt} = K \times 1$$

$$d[R] = -K dt$$

Integrating both sides

$$[R] = -Kt + I \quad \dots(i)$$

Where,  $I$  is the constant of integration At  $t=0$ , the concentration of the reactant  $R = [R]_0$ . Where  $[R]_0$  is initial concentration of the reactant.

Substituting in equation (i)

$$[R]_0 = -K \times 0 + I$$

$$[R]_0 = I$$

Substituting the value of  $I$  in the equation (i)

$$[R] = -Kt + [R]_0 \quad \dots(2)$$

$$Kt = [R]_0 - [R]$$

$$K = \frac{[R]_0 - [R]}{t} \quad \dots(3)$$

Comparing (ii) with equation of a straight line,  $y = mx + c$ , if we plot  $[R]$  against  $t$ , we get a straight line with slope  $= -K$  and intercept equal to  $[R]_0$

3. Half life period of a zero order reaction— The half life period of a reaction is that in which the concentration of a reactant is reduced to one half of its initial concentration.

It is represented as  $t_{1/2}$ .

$$t = t_{1/2}; R = \frac{[R]_0}{2}$$

Here  $[R]_0 =$  Initial concentration

$$t_{1/2} = \frac{1}{K} \left[ [R]_0 - \frac{[R]_0}{2} \right] = \frac{[R]_0}{2K}$$

Thus half life  $t_{1/2}$  of a zero order reaction is directly proportional to be initial concentration of the reactants and inversely proportional to the rate constant.

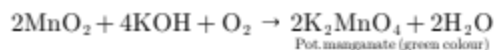
33. Describe the preparation of potassium permanganate from pyrolusite ore by electrochemical method. Discuss its important properties and uses.

**Ans :**

1. Preparation of potassium permanganate.

$KMnO_4$  is prepared from pyrolusite  $MnO_2$  in two steps:

- (i) **Conversion of  $MnO_2$  into potassium manganate :** In this step pyrolusite ore is fused with  $KOH$  in the presence of air, potassium manganate is formed.

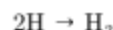


- (ii) **Oxidation of  $K_2MnO_4$  to  $KMnO_4$  :** It can be done by two methods

- (a) **Chemically :** By bubbling  $Cl_2$  gas through the solution of potassium manganate.



- (b) **Electrochemically :** Potassium manganate solution is electrolysed between iron electrodes.



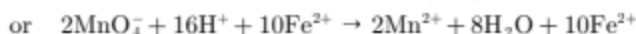
**Properties :**  $KMnO_4$  is a dark violet crystalline solid having a metallic lustre, slightly soluble in water and on heating 513 K decompose to given oxygen.



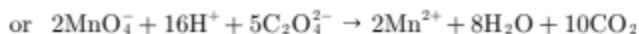
2. Potassium permanganate is a powerful oxidising agent in neutral, alkaline or acidic solution because it liberates nascent oxygen.



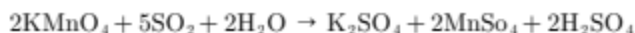
- (i) It oxidises ferrous salt to ferric salt



- (ii) It oxidises oxalic acid to  $CO_2$



- (iii) It oxidises sulphur dioxide to sulphuric acid.

**Uses of  $KMnO_4$** 

1. It is used in volumetric analysis.
2. Used as disinfectant, germicide and deodorant.
3. Used for purification of water.
4. Used for the bleaching of wool, cotton, silk etc.

or

What is lanthanoid contraction? Give its cause. What are the consequences of lanthanoid contraction?

**Ans :**

Lanthanoid contraction is the regular decrease (contraction) in the atomic and ionic radii of Lanthanoids from lanthanum of leutecium.

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**Cause of lanthanoid contraction :** As we move from left to right in the series nuclear charge increases by one unit with that an additional electron enters into 4f orbital. But electrons do not effectively screen the nucleus (because of the shape of f orbital), due to this poor shielding by 4f electrons, the effective nuclear charge increases and size decreases.

**Consequences of lanthanoid contraction**

1. **Difficulty in separation of lanthanoids :** Due to very small difference in ionic radii of lanthanoids their chemical properties are similar, therefore the separation of the lanthanoids in the pure state is difficult.
2. **Similarity in the size of elements of second and third transition series :** The size of the atom of any element of the third transition series is almost same as that of the atom of the element lying in the same group of the second transition series, the similarity in size is due to the effect of lanthanoid contraction.
3. **Effect of the basic strength of hydroxides :** With decrease in size of lanthanoid ions from  $\text{La}^{3+}$  to  $\text{Lu}^{3+}$ , the covalent character of the hydroxide increase and hence the basic strength decreases.  
 $\text{La}(\text{OH})_3$  is most basic and  $\text{Lu}(\text{OH})_3$  is least basic.

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