12th STD

PUBLIC EXAM - MARCH 2024

Part - III

Reg. No.

TIME ALLOWED : 3.00 Hours] **CHEMISTRY** (with answers) [**MAXIMUM MARKS : 70**

Instructions :

(1) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(2) Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.

Note : Draw diagrams and write equations wherever necessary.

PART - I

Note : (i) Answer **all** the questions. **15 × 1 = 15**

(ii) Choose the most appropriate answer from the given **four** alternatives and write the option code and the corresponding answer.

1. The rate constant of a reaction is 5.8×10^{-2} s^{-1}. The order of the reaction is :

(a) Second order (b) First order

(c) Third order (d) Zero order

2. Aspirin is :

(a) chlorobenzoic acid

(b) acetyl salicylic acid

(c) anthranilic acid

(d) benzoyl salicylic acid

3. In acid medium, potassium permanganate oxidizes oxalic acid to :

(a) acetate (b) oxalate

(c) acetic acid (d) carbon dioxide

4. IUPAC name of the complex $K_3[Al(C_2O_4)_3]$ is :

(a) Potassium trisoxalato aluminate (III)

(b) Potassium trioxalato aluminium (III)

(c) Potassium trioxalato aluminate (III)

(d) Potassium trioxalato aluminate (II)

5. Among the following which will not be hydrolysed?

(a) Sodium Chloride (b) Sodium Formate

(c) Ammonium Formate

(d) Ammonium Nitrate

6. Among the following cells primary cells are :

(i) Leclanche cell

(ii) Nickel-Cadmium cell

(iii) Lead Storage Battery

(iv) Mercury cell

(a) (iii) and (iv) (b) (i) and (iv)

(c) (ii) and (iii) (d) (i) and (iii)

7. In the electrolytic refining of copper, which one of the following is used as anode?

(a) Carbon rod (b) Pure copper

(c) Platinum electrode

(d) Impure copper

8. **Assertion :** Monoclinic sulphur is an example of monoclinic crystal system.

Reason : For a monoclinic system, $a \neq b \neq c$ and $\alpha = \gamma = 90°$, $\beta \neq 90°$.

(a) **Assertion** is true but **Reason** is false.

(b) Both **Assertion** and **Reason** are true and **Reason** is the correct explanation of **Assertion.**

(c) Both **Assertion** and **Reason** are false.

(d) Both **Assertion** and **Reason** are true, but **Reason** is not the correct explanation of **Assertion.**

9. The formation of cyanohydrin from acetone is an example of :

(a) electrophilic addition

(b) nucleophilic substitution

(c) nucleophilic addition

(d) electrophilic substitution

10. Which of the following is not sp^2 hybridised?

(a) Fullerene (b) Graphite

(c) Dry ice (d) Graphene

11. The oxidising agent used to stop the oxidation of primary alcohol at the aldehyde stage is :

(a) $Na_2Cr_2O_7$ (b) $KMnO_4$

(c) $K_2Cr_2O_7$ (d) PCC

12. Which of the following is the strongest acid among all?

(a) HBr (b) HI (c) HCl (d) HF

13. When aniline reacts with acetic anhydride, the product formed is :
(a) p-aminoacetophenone
(b) o-aminoacetophenone
(c) acetanilide
(d) m-aminoacetophenone

14. The pyrimidine bases present in RNA are :
(a) Cytosine and Thiamine
(b) Cytosine and Adenine
(c) Cytosine and Uracil
(d) Cytosine and Guanine

15. Activity of iron catalyst is increased by the ____ compound.
(a) CH_3COOH (b) H_2S
(c) Al_2O_3 (d) As_2O_3

PART - II

Note : Answer **any six** questions. Question No. **24** is **Compulsory.** **6 × 2 = 12**

16. What is Calcination?

17. How will you convert boric acid to boron nitride?

18. Sulphuric acid is a dehydrating agent. Justify with an example.

19. Explain common ion effect with an example.

20. Can Fe^{3+} oxidise bromide to bromine under Standard Conditions?
Given : $E^\circ_{Fe^{3+}|Fe^{2+}} = 0.771$ V
$E^\circ_{Br_2|Br^-} = 1.09$ V

21. Write Kolbe's reaction.

22. Write the structure of the following :
α – D - glucopyranose and
β – D - glucopyranose

23. What are antibiotics?

24. What is an order of a reaction?

PART - III

Note : Answer **any six** questions. Question No. **33** is **Compulsory.** **6 × 3 = 18**

25. Give the uses of helium.

26. Which is more stable Fe^{3+} or Fe^{2+} ? Why ?

27. Aluminium crystallizes in a cubic close packed structure. Its metallic radius is 125 pm. Calculate the edge length of unit cell.

28. Write Arrhenius equation and explain the terms involved.

29. Explain the effect of temperature and pressure on physisorption and chemisorption.

30. Explain Knoevenagal reaction.

31. Write the reaction of primary amine with Carbon disulphide (CS_2).

32. Write a short note on peptide bond.

33. In the complex, $[Co(CN)_2 Cl_2]$ Cl, identify the following.
(i) IUPAC name
(ii) Central metal ion
(iii) Co-ordination number

PART - IV

Note : Answer **all** the questions. **5 × 5 = 25**

34. (a) (i) What are the differences between minerals and ores?
(ii) What is the role of silica in the extraction of copper?

(OR)

(b) (i) Give the uses of Boric acid.
(ii) What are silicates?

35. (a) What is Lanthanoid Contraction and what are the consequences of Lanthanoid Contraction?

(OR)

(b) (i) Write a short notes on double salts and co-ordination compounds.
(ii) Give an example of Coordination Compound used in medicine and a biologically important Coordination Compound.

36. (a) Calculate the percentage efficiency of packing in case of simple cubic crystal.

(OR)

(b) (i) Derive the integrated rate law for a Zero order reaction, A → product.
(ii) Define buffer Index.

37. (a) (i) Explain about Galvanic cell notation.
(ii) Define gold number.

(OR)

(b) Write notes on Lucas Test.

38. (a) (i) How acetic acid is prepared from Grignard reagent?

(ii) What are bio-degradable polymers? Give an example.

(OR)

(b) An organic Compound (A) of molecular formula C_2H_4O reacts with Zn-Hg / Conc. HCl to give Compound (B) which reacts with HNO_3 forming Compound (C) (as major product) and Compound (D). Compound (C) reacts with conc. HCl to give Compound (E) (Table vinegar) and hydroxylamine. Identify A, B, C, D and E with suitable reactions.

❁❁❁

ANSWER

PART - I

1. (b) First order
2. (b) acetyl salicylic acid
3. (d) carbon dioxide
4. (c) Potassium trioxalato aluminate (III)
5. (a) Sodium Chloride
6. (b) (i) and (iv)
7. (d) Impure copper
8. (b) Both **Assertion** and **Reason** are true and **Reason** is the correct explanation of **Assertion.**
9. (c) nucleophilic addition
10. (c) Dry ice
11. (d) PCC
12. (b) HI
13. (c) acetanilide
14. (c) Cytosine and Uracil
15. (c) Al_2O_3

PART - II

16. Calcination is the process in which the concentrated ore is strongly heated in the absence of air.

17. Fusion of urea with $B(OH)_3$, in an atmosphere of ammonia at 800 - 1200 K gives boron nitride.

$$B(OH)_3 + NH_3 \xrightarrow{\Delta} BN + 3H_2O$$

18. (i) Sulphuric acid is highly soluble in water.
(ii) It has strong anity towards water.
(iii) Hence it can be used as a dehydrating agent.
(iv) When dissolved in water, it forms mono ($H_2SO_4.H_2O$) and dihydrates ($H_2SO_4.2H_2O$) and the reaction is exothermic.

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2SO_4 \longrightarrow 12C + H_2SO_4.11H_2O$$

$$\underset{\text{Formic acid}}{HCOOH} + H_2SO_4 \longrightarrow CO + H_2SO_4.H_2O$$

$$\underset{\text{Oxalic acid}}{(COOH)_2} + H_2SO_4 \longrightarrow CO + CO_2 + H_2SO_4.H_2O$$

19. When a salt of a weak acid is added to the acid itself, the dissociation of the weak acid is suppressed further. For example, the addition of sodium acetate to acetic acid solution leads to the suppression in the dissociation of acetic acid which is already weakly dissociated. In this case, CH_3COOH and CH_3COONa have the common ion,CH_3COO^-

Eg : Acetic acid is a weak acid. It is not completely dissociated in aqueous solution and hence the following equilibrium exists.

$$CH_3COOH_{(aq)} \rightleftharpoons H^+_{(aq)} + CH_3COO^-_{(aq)}$$

However, the added salt, sodium acetate, completely dissociates to produce Na^+ and CH_3COO^- ion.

$$CH_3COONa_{(aq)} \longrightarrow Na^+_{(aq)} + CH_3COO^-_{(aq)}$$

20. Required half cell reaction

$2Br^- \longrightarrow Br_2 + 2e^-$ $\quad (E^\circ_{ox}) = -1.09V$

$2Fe^{3+} + 2e^- \longrightarrow 2Fe^{2+}$ $\quad (E^\circ_{red}) = +0.771V$

$2Fe^{3+} + 2Br^- \longrightarrow 2Fe^{2+} + Br_2$ $\quad (E^\circ_{cell}) = ?$

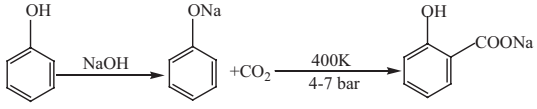
$E^\circ_{Cell} = (E^\circ_{ox}) + (E^\circ_{red})$

$= -1.09 + 0.771$

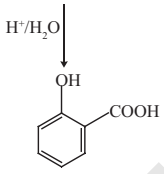
$= -0.319$ V.

E°_{Cell} is – ve; ΔG is +ve and the cell reaction is non-spontaneous. Hence Fe^{3+} cannot oxidises Br^- to Br_2.

21. In this reaction, phenol is first converted into sodium phenoxide which is more reactive than phenol towards electrophilic substitution reaction with CO_2. Treatment of sodium phenoxide with CO_2 at 400K, 4-7 bar pressure followed by acid hydrolysis gives salicylic acid.

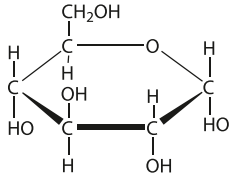


phenol sodium phenoxide sodium salicylate

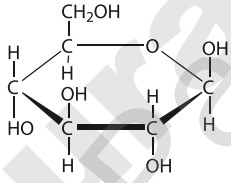


Salicyclic acid

22.



α -D-glucose
(α–D-Glucopyranose)



β -D-glucose
(β–D-Glucopyranose)

23. The medicines that have the ability to kill the pathogenic bacteria are grouped as antibiotics.

Examples : Amoxicillin, ampicillin,cefixime, cefpodoxime, erythromycin, tetracycline etc..

24. Order is the sum of the powers of concentration terms involved in the experimentally determined rate law. It can be zero (or) fractional (or) integer.

PART - III

25. (i) Helium and oxygen mixture is used by divers in place of air oxygen mixture. This prevents the painful dangerous condition called bends.

(ii) Helium is used to provide inert atmosphere in electric arc welding of metals.

(iii) Helium has lowest boiling point hence used in cryogenics (low temperature science).

(iv) It is much less denser than air and hence used for filling air balloons.

26. (i) Electronic configuration of Fe^{3+} is $[Ar]3d^5 4s^\circ$.

(ii) It consists of 5 unpaired electrons.

(iii) Half-filled and stable.

(iv) Electronic configuration of Fe^{2+} is $[Ar]3d^6$.

(v) It consists of 4 unpaired electrons.

(vi) Partially filled d-subshell is less stable.

(vii) Hence, Fe^{3+} is more stable than Fe^{2+}.

27. For the cubic close packed structure, let 'a' be the edge of the cube and 'r' be the radius of atom.

Given : $r = 125$ pm

$a = 2\sqrt{2} \times r$

Plug the value of r we get

$= 2 \times 1.414 \times 125$ pm $= 353.5$ pm.

28. The exact dependence of the rate of a chemical reaction on temperature is given by Arrhenius equation.

(i) $K = Ae^{-E_a/RT}$

(ii) Where,

(iii) A = Arrhenius factor or the frequency factor

(iv) T = Temperature

(v) R = Gas constant

(vi) E_a = Activation energy

29. Effect of temperature :

When temperature is raised chemisorption first increases and then decreases. Whereas physisorption decreases with increase in temperature.

Effect of pressure :

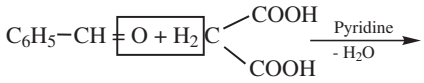
Chemical adsorption is fast with increase in pressure, it can not alter the amount of adsorption. In Physisorption the extent of adsorption increases with increase in pressure.

30. Knoevenagal Reaction:

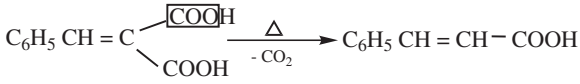
(i) Benzaldehyde condenses with malonic acid in the presence of pyridine forming cinnamic acid

(ii) Pyridine act as the basic catalyst.

(iii) Carbanion formed from malonic acid.

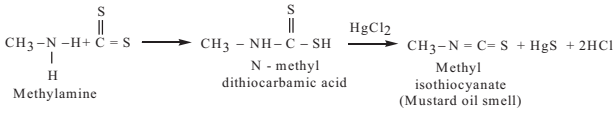


Benzaldehyde Malonic acid



Cinnamic acid

31. When primary amines are treated with carbon disulphide (CS_2), N - alkyldithio carbonic acid is formed which on subsequent treatment with $HgCl_2$, gives an alkyl isothiocyanate.



Methylamine — N - methyl dithiocarbamic acid — Methyl isothiocyanate (Mustard oil smell)

32. (i) The amino acids are linked covalently by peptide bonds.

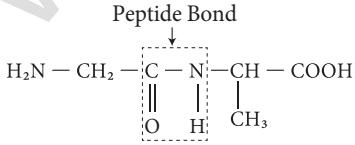
(ii) The carboxyl group of the first amino acid react with the amino group of the second amino acid to give an amide linkage between these amino acids.

(iii) This amide linkage is called peptide bond. The resulting compound is called a dipeptide.

(iv) If the number of amino acids are less it is called as a polypeptide, if it has large number of amino acids then it is called a protein.

Glycine Alanine

Peptide Bond



Glycyl alanine - Dipeptide

33. (i) **IUPAC Name :**
Dichloridodicyanidocobalt (v) chloride

(ii) **Central metal ion :** Co(v).

(iii) **Co-ordination number :** 4

PART - IV

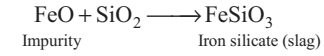
34. (a) (i)

Minerals	Ores
A naturally occurring substance obtained by mining which contains the metal in free state or in the form of compounds.	Ore contains a high percentage of metal, from which it can be extracted conveniently and economically.
All minerals are not ores	All ores are Minerals
It contains a low percentage of metal.	It contains a high percentage of metals
Ex : Mineral of Al is bauxite and china clay	**Ex :** Ore of Al is bauxite

(ii) Role of silica in the extraction of copper :

(1) Copper is extracted form copper matte which contains iron as impurity.

(2) Silica is added to remove this impurity as iron silicate in the form of **Fusible slag**.



Impurity — Iron silicate (slag)

(OR)

(b) (i) Uses of Boric acid :

(1) Boric acid is used in the manufacture of pottery glases, enamels and pigments.

(2) It is used as an antiseptic and as an eye lotion.

(3) It is also used as a food preservative.

(ii) Silicates : The mineral which contains silicon and oxygen in tetrahedral $[SiO_4]^{4-}$ units linked together in different patterns are called silicates.

35. (a) As we move across 4f series, the atomic and ionic radii of lanthanoids show gradual decrease with increase in atomic number. This decrease in ionic size is called lanthanoid contraction.

Consequences of lanthanoid contraction:

1. Basic nature :

As we from Ce^{3+} to Lu^{3+} , the basic character of Ln^{3+} ions decrease. Due to the decrease in the size of Ln^{3+} ions, the

ionic character of Ln –OH bond decreases (covalent character increases) which results in the decrease in the basic nature.

2. **Similarities among lanthanoids:**
In the complete f-series only 10 pm decrease in atomic radii and 20pm decrease in ionic radii is observed. Because of this very small change in radii of lanthanoids, their chemical properties are quite similar.

3. The elements of the second and third transitition series resemble each other more closely than the elements of the first and second transition series.

(OR)

(b) (i) Double salts and co-ordination compounds:

(1) When two or more stable compounds in solution are mixed together and allowed to evaporate, in certain cases there is a possibility for the formation of double salts or coordination compounds.

(2) For example when an equimolar solution of ferrous sulphate and ammonium sulphate are mixed and allowed to crystallise, a double salt namely Mohr's salt (Ferrous ammonium sulphate, $FeSO_4.(NH_4)_2SO_4.6H_2O$) is formed.

(ii) Coordination compounds used in medicine Cis-platin is used as antitumour drug in cancer treatement.

Examples of biologically important coordination compounds.

(1) A red blood corpuscles (RBC) is composed of heme group, which is Fe^{2+} - Porphyrin complex. It plays an important role in carrying oxygen from lungs to tissues and carbon dioxide from tissues to lungs.

(2) Chlorophyll, a green pigment present in green plants and algae, is a coordination complex containing Mg^{2+} as central metal ion surrounded by a modified Porphyrin ligand called corrin ring. It plays an important role in photosynthesis, by which plants converts CO_2 and water into carbohydrates and oxygen.

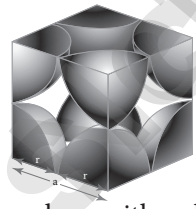
36. (a) Percentage efficiency of Packing of simple cubic crystal :

$$\left\{\begin{matrix}\text{Packing fraction}\\ \text{(or) efficiency}\end{matrix}\right\} = \frac{\left\{\begin{matrix}\text{Total volume occupied by}\\ \text{spheres in a unit cell}\end{matrix}\right\}}{\text{Volume of the unit cell}} \times 100$$

Let us consider a cube with an edge length 'a' as shown in fig. Volume of the cube with edge length a is = a × a × a = a^3

Let 'r' is the radius of the sphere. From the figure,

$a = 2r \Rightarrow r = \frac{a}{2}$



∴ Volume of the sphere with radius 'r'

$$= \frac{4}{3}\pi r^3 = \frac{4}{3}\pi\left(\frac{a}{2}\right)^3$$

$$= \frac{4}{3}\pi\left(\frac{a^3}{8}\right) = \frac{\pi a^3}{6} \quad \text{.....(1)}$$

In a simple cubic arrangement, number of spheres belongs to a unit cell is equal to one

∴ Total volume occupied by the spheres in sc unit cell $= 1\times\left(\frac{\pi a^3}{6}\right)$ .....(2)

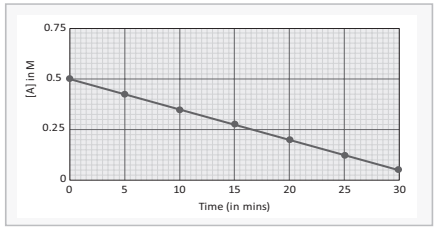
Dividing (2) by (3)

Packing fraction $= \frac{\left(\frac{\pi a^3}{6}\right)}{(a^3)} \times 100 = \frac{100\,\pi}{6}$

$= 52.38\%$

(OR)

(b) (i) Zero order reaction: A reaction in which the rate is independent of the concentration of the reactant over a wide range of concentration is called as zero order reaction. Let us consider the following by hypothetical zero order reaction.



A plot of [A] Vs time for a zero order reaction A ⟶ product with initial concentration of [A] = 0.5 M and k = 1.5 × 10^{-2} $mol^{-1}L^{-1}$ min^{-1}

The rate law can be written as

$$\text{Rate} = k[A]^0 \quad ...(1)$$

$$\frac{-d[A]}{dt} = k(1) \quad \therefore ([A]^0 = 1)$$

$$\Rightarrow -d[A] = kdt$$

Integrate the above equation between the limits of $[A_0]$ at zero time and [A] at some later time 't',

$$-\int_{[A_0]}^{[A]} d[A] = k\int_0^t dt$$

$$-([A])_{[A_0]}^{[A]} = k(t)_0^t$$

$$[A_0]-[A] = kt \quad ...(2)$$

$$k = \frac{[A_0]-[A]}{t}$$

Equation (2) is in the form of a straight line

$$y = mx + c$$

ie., $[A] = -kt + [A_0]$

$$\Rightarrow y = c + mx$$

A plot of [A] vs time gives a straight line with a slope of $-k$ and y - intercept of $[A_0]$.

(ii) Buffer Index : Buffer index is defined as the number of gram equivalents of acid or base added to 1 litre of the buffer solution to change its pH by unity.

$$\beta = \frac{dB}{d(pH)}$$

Here,

dB = number of gram equivalents of acid / base added to one litre of buffer solution.

37. (a) (i) Galvanic Cell notation :

(1) The galvanic cell is represented by a cell diagram, for example, Daniel cell is represented as

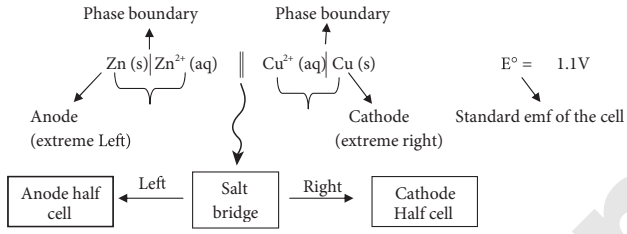
$$Zn(s)|Zn^{2+}(aq)||Cu^{2+}(aq)|Cu(s)$$

(2) In the above notation, a single vertical bar (|) represents a phase boundary and the double vertical bar (||) represents the salt bridge.

(3) The anode half cell is written on the left side of the salt bridge and the cathode half cell on the right side.

(4) The anode and cathode are written on the extreme left and extreme right, respectively.

(5) The emf of the cell is written on the right side after cell diagram.



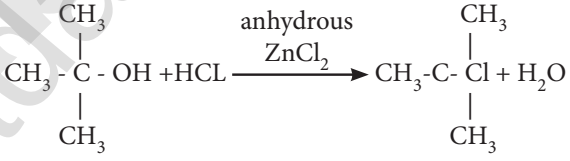
(ii) (1) 'Gold number' is a measure of protecting power of a colloid.

(2) Gold number is defined as the number of milligrams of hydrophilic colloid that will just prevent the precipitation of 10ml of gold sol on the addition of 1ml of 10% NaCl solution.

(3) Smaller the gold number greater the protective power.

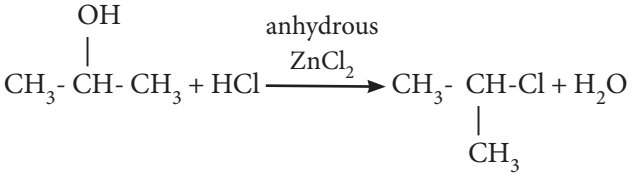
(OR)

(b) Lucas Test: When alcohols are treated with Lucas agent (a mixture of concentrated HCl and anhydrous $ZnCl_2$) at room temperature, tertiary alcohols react immediately to form a turbidity due to the formation of alkyl chloride which is insoluble in the medium.

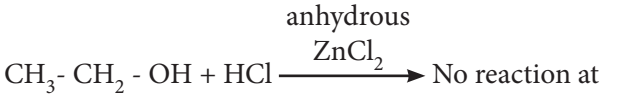


2-methylpropan-2-ol — 2-chloro-2-methylpropane (immediate appearance of turbidity)

Secondary alcohols react within 10 minutes to form a turbidity of alkyl chloride where primary alcohols do not react at room temperature.

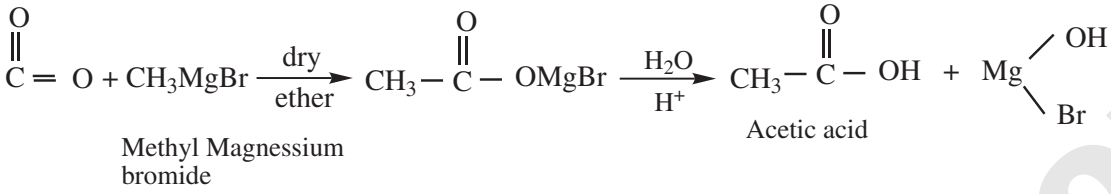


propan-2-ol — 2-chloropropane (slow appearance of turbidity)



ethanol — (Turbidity appears only on heating)

38. (a) (i) From Grignard reagent : Grignard reagent reacts with carbon di oxide (dry ice) to form salts of carboxylic acid which in turn give corresponding carboxylic acid after acidification with mineral acid.



(ii) Bio-degradable polymers :

(1) The materials that are readily decomposed by microorganisms in the environment are called biodegradable.

Examples:

Polyhydroxy butyrate (PHB)

Poly-3-hydroxy butyrate-co-3-hydroxyl valerate (PHBV)

(2) Biodegradable polymers are used in medical eld such as surgical sutures, plasma substitute etc… these polymers are decomposed by enzyme action and are either metabolized or excreted from the body.

(OR)

(b)

$$CH_3 - CHO(A) \xrightarrow[\text{conc.HCl}]{Zn/Hg} \underset{\text{ethane}}{CH_3 - CH_3(B)}$$

$$CH_3 - CH_3 \xrightarrow[675K]{HNO_3} \underset{\substack{73\% \\ \text{nitroethane (C)}}}{CH_3 - CH_2 - NO_2} + \underset{\substack{27\% \\ \text{nitromethane (D)}}}{CH_3NO_2}$$

$$CH_3 - CH_2 - NO_2 \xrightarrow[H_2O]{HCl} \underset{(E)}{CH_3COOH} + NH_2OH$$

Compound	Molecular Formula	Name
A	$CH_3 - CHO$	Acetaldehyde
B	$CH_3 - CH_3$	Ethane
C	$CH_3 - CH_2 - NO_2$	Nitroethane
D	$CH_3 - NO_2$	Nitromethane
E	CH_3 - COOH	Acetic acid

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