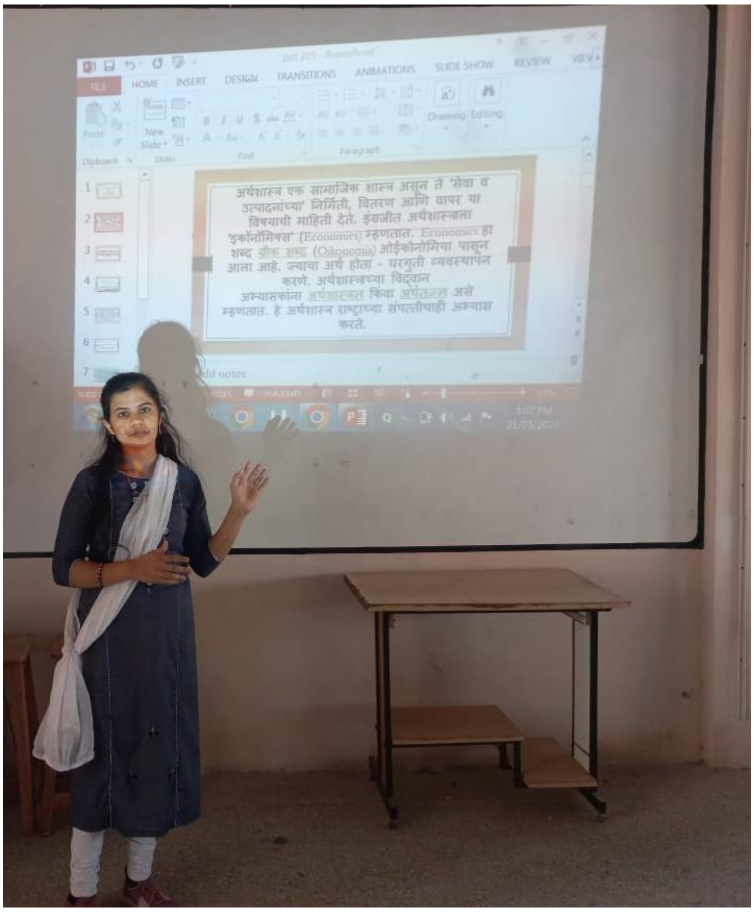
Criterion 2.3.2 Teachers use ICT-enabled tools for effective teaching-learning process.

The college has an optimum number of facilities for inculcating ICT-enabled tools in the teaching-learning process regularly such as well-developed computer laboratories, Wi-Fi-enabled premises, classrooms/ laboratories equipped with LCD projectors, and virtual classrooms for effective teaching-learning processes and optimised delivery of education. Faculty members used online learning resources, social networking sites, and blended learning platforms. For teaching, ICT-based learning tools such as PowerPoint presentations, and audio-visual aids were used which help teachers to allocate more time for facilitation. Blended learning platforms such as Google Classrooms and Virtual Labs (IIT Bombay) were also created to facilitate students to learn at their own pace. WhatsApp was used to share important announcements and study materials with students, disseminate other information and address queries. Teachers use various updated software such as Maxima, Python, and La Tex. E-books and e-journals are shared with students by faculty members. The college organized an international e-conference. Departments also organized various webinars via online platforms such as ZOOM and Google Meet for students. The college has its own YouTube channel where the video lectures of teachers have been made available for revision purposes. College library uses various software such as Libraria and Inflibnet facilities like N-list for providing hardcopy books and e-books respectively. The college used Rayat ERP software for the continuous internal evaluation process. The college also has a dynamic website that provides instant access to students, E-content, and academic information.

Department of Arts




Prof. Wayal P.A. teaches their syllabus of economics to students

Prof. Otari V.A. demonstrates a movie regarding their subject knowledge to students

Department Of Commerce


Prof. Dolas R.D taking a lecture on class T.Y.B.Com and also guiding Prof. Auti S.S. and Prof. Argade P.P


Prof. Dolas R.D. Teaches to students through PPT

Department Of Science


Prof. Morde A.B. teaching Plant tissue culture to S.Y.B.sc students




Prof. Vikhe R.B and Prof Morde A.B demonstrating the instruments in lab

# भीमाशंकर शिक्षणसंस्था संचालित, दत्तात्रय गोविंदराव वळसे पाटील महाविद्यालय

2023-24

CLASS-F.Y.B.A.

SUB:Indian Economic Development

Prof:Bombale.D.A

# पर्यटन

प्रस्तावना-

व्याख्या -एका व्यक्तीने किव्वा व्यक्ती समूहाने एका ठिकाणाहून

दुसरया ठिकाणी मनोरंजनासाठी ,अभ्यासासाठी ,कामासाठी केलेला

प्रवास म्हणजे पर्यटन होय .

## ❖ भारतातील पर्यटन क्षेत्रासमोरील आव्हाने-

- पायाभूत सुविधांत वाढ
- नवीन मुक्कामाच्या ठिकाणांचा विकास

- सुविधा
- मनुष्यबळाची उपलब्धता
- माहिती व संप्रेषण

- सुरक्षा आणि सुरक्षितता
- सुरक्षित online व्यवहार
- योग्य कर आकारणी

- पर्यटन स्थलांना व संबंधित बाबींना प्रसिद्धी
- बँक आणि ए टी एम सुविधा सुधारणा

- पर्यावरणीय प्रदूषण  नियंत्रण

- समारोप

# Introduction

**Marginal Cost**

- Marginal Cost is defined as, ‘ the change in aggregate costs due to change in the volume of production by one unit.’

- Marginal cost is the additional cost incurred in the production of one more unit of a good or service.

- It is derived from the **variable cost** of production, given that fixed costs do not change as output changes, hence no additional fixed cost is incurred in producing another unit of a good or service once production has already started.

# Bhimashankar shikshan Sanstha's
# Dattatray Govindrao Walse Patil Mahavidyalaya
## paragon tarfe awasari bk.

Prof . Auti S.S.

Department of Commerce

2023-24

# Marginal cost

| Particular | Rs. |
|---|---|
| Direct Material | XX |
| Direct labour | XX |
| Direct Expenses | XX |
| **Prime Cost** | **XX** |
| (+) Total Variable overhead | XX |
| **Marginal cost per unit** | **XXX** |

# Marginal Costing

- Marginal Costing is a costing technique wherein the marginal cost, i.e. variable cost is charged to units of cost, while the fixed cost for the period is completely written off against the contribution.
- Ascertainment of cost and measuring the impact on profits of the change in the volume of output or type of output.
- Marginal costing is a very useful technique of costing for decision-making.
- In marginal costing, costs are segregated into fixed and variable

# Features of Marginal Costing

- It is a technique of costing which is used to ascertain the marginal cost and to know the impact of variable cost on the volume of output.
- Selling price is based on marginal cost plus the contribution.
- Profit is calculated by deducting marginal cost and fixed cost from sales.
- The profitability of product or department is based on contribution made available by each product or department.
- Cost Volume Profit (or Break Even) Analysis is one of the integral parts of marginal costing.
- Valuation of stock of work in progress and finished goods is done on the basis of marginal cost.

# Advantages

- It is simple to understand and easy to operate.
- It helps in evaluation of performance of different departments, divisions, products, salesmen etc.
- It helps in cost control by concentrating on variable cost as the fixed cost is non-controllable in the short period.
- It provides the management with useful techniques like break even analysis, P/V ratio etc.
- It is a very useful tool of profit planning. It guides the management about the profitability at various levels of production and sales.

# Limitations

- The classification of total costs into fixed and variable cost is difficult.
- In this technique fixed costs are totally eliminated for the valuation of inventory of finished and semi-finished goods. Such elimination affects the profitability adversely.
- In marginal costing historical data is used while management decisions are related to future events.
- It does not provide any standard for the evaluation of performance.
- Selling price fixed on the basis of marginal cost will be useful only for short period of time.
- Assessment of profitability on the marginal cost base can be used only in the short period of time.

**Income Statement Under Marginal Costing**

**XYZ LTD. Product P**

| Particulars | Amount Rs. | Amount Rs. |
|---|---|---|
| Sales | | |
| Less: Variable Costs | | |
| Contribution | | |
| Less: Fixed Costs | | |
| Profit | | |

| PARTICULARS | AMT (Rs.) | COST PER UNIT |
|---|---|---|
| SALES | 1000 | 10 |
| - VARIABLE COST | - 400 | 4 |
| CONTRIBUTION | 600 | 6 |
| - FIXED COST | 300 | 3 |
| PROFIT | 300 | 3 |

# Some concepts/Terms of Marginal Costing

- Fixed Cost
- Variable cost
- Contribution
- Profit Volume Ratio
- Break Even point
- Margin of Safety
- Cost Volume Profit Analysis

# Fixed Cost

- Known as **“Period Cost” or “Time Cost”.**
- Does not depend on volume of production and sales.
- Fixed cost remain constant
- Fixed cost are fixed in unite.

- Examples:-

  **Salary, rent, manager’s Salary etc. known as fixed overheads.**

# Variable Cost

- Increase and Decrease in proportion to sales and output.
- Called as **“Product Cost” or “Marginal Cost”**
- Vary in direct proportion to output
- Variable cost vary in total but they remain constant per unit.
- Example:-

  **Direct Material, Direct Wages etc.**

# Contribution

- Contribution is the difference between sales and variable cost.
- Contribution is also known as “Contribution Margin” or “Gross Margin”.
- **Formulas :-**
  - Contribution = Sales – Variable Cost
  - Contribution = Fixed Expenses + Profit
  - Contribution – Fixed cost = Profit
  - Contribution + Variable Cost = Sales
  - Sales – Variable cost = Fixed Cost $\pm$ Profit/ Loss

# Profit Volume Ratio/ Contribution to Sales

- **Profit-volume ratio** indicates the relationship between contribution and sales and is usually expressed in percentage.

- High P/V ratio indicate high profitability

- Low P/V ratio indicate low profitability

# Formulas of P/V ratio

$$\text{P/V Ratio} = \frac{\text{Contribution}}{\text{Sales}} \times 100 \quad \text{(or)}$$

$$= \frac{\text{Sales} - \text{Variable Cost}}{\text{Sales}} \times 100 \quad \text{(or)}$$

$$= \frac{\text{Fixed Expenses} + \text{Profit}}{\text{Sales}} \times 100 \quad \text{(or)}$$

$$= \frac{\text{Change in Profits or Contribution}}{\text{Change in Sales}} \times 100$$

# Break Even Point

- The break-even point can be defined as a point where total costs (expenses) and total sales (revenue) are equal.

- Break-even point can be described as a point where there is **no net profit or loss.**

- Total Sales Revenue = Total Cost incurred

# Formulas for BEP

- $$\text{Break Even Points (Units)} = \frac{\text{Fixed Cost}}{\text{Contribution per unit}}$$

$$\text{Break Even Points( Rs.)} = \frac{\text{Fixed Costs}}{\text{C/S Ratio}}$$

$$= \text{BEP Unit} * \text{Selling price}$$

# Margin of Safety

- Margin of Safety (MOS) measures the distance between budgeted sales and breakeven sales

- Margin Of Safety = Actual Sales – Breakeven sales

  $$\text{Margin Of Safety} = \frac{\text{Profit}}{\text{P/V Ratio}}$$

# Cost-volume-profit

- Cost-volume-profit analysis, or CVP, is something companies use to figure out how changes in costs and volume affect their operating expenses and net income.

- CVP works by comparing different relationships, such as the cost of operating and producing goods, the amount of goods sold, and profits generated from the sale of those goods.

- CVP analysis gives companies strong insight into the profitability of their products or services.

- Cost-volume-price analysis is a way to find out how changes in variable and fixed costs affect a firm's profit.

- Companies can use the formula result to see how many units they need to sell to break even (cover all costs) or reach a certain minimum profit margin.

# Cost-Volume-Profit Analysis Formula

- The CVP formula can be used to calculate the sales volume needed to cover costs and break even, in the CVP breakeven sales volume formula, as follows:

$$\text{Breakeven Sales Volume} = \frac{FC}{CM}$$

**where:**

$FC = \text{Fixed costs}$

$CM = \text{Contribution margin} = \text{Sales} - \text{Variable Costs}$

To use the above formula to find a company's target sales volume, simply add a target profit amount per unit to the fixed-cost component of the formula. This allows you to solve for the target volume based on the assumptions used in the model.

# Uses of CVP analysis

- Many companies and accounting professionals use cost-volume-profit analysis to make informed **decisions about the products or services they sell**.

- CVP analysis plays a larger role in managerial accounting than in financing accounting.
  - Managerial accounting focuses on helping managers or those tasked with running businesses , make smart, cost-effective moves.
  - Financial accounting, by contrast, focuses more on painting an economic picture of a company so that outside parties, such as banks or investors, can determine how financially healthy it is.

# Elements of CVP analysis

- The three elements involved in CVP analysis are:
  - **Cost,** which means the expenses involved in producing or selling a product or service.
  - **Volume,** which means the number of units produced in the case of a physical product, or the amount of service sold.
  - **Profit**, which means the difference between the selling price of a product or service minus the cost to produce or provide it.

# Assumptions when using CVP analysis

- When managers use CVP analysis to make business decisions, the following assumptions are made:
  - All costs, including manufacturing, administrative, and overhead costs, can be accurately identified as either fixed or variable.
  - The selling price per unit is constant
  - Changes in activity are the only factors that affect costs.
  - All units produced are sold.

Thank You…

*Bhimashankar shikshan sanstha*

**Dattatray Govindrao Walse Patil Mahavidyalaya**

*Pargaon,tarfe awasari bk.*

# Inorganic Polymer

T.Y.BSC -2023-24

ASST. PROF. ASWARE A.D
DEPARTMENT OF CHEMISTRY
D.G.W.P.MAHAVIDYALAYA

# INORGANIC POLYMER

**PRESENTED BY**

ASST. PROF. ASWARE A.D.

Light and elegant luagage made of polymer



*Plastics chairs to add colour and comfort*

Telephones made of bakelite-first synthetic polymer


Armour shield made of polycarbonate combines the transparency of glass and strenghth of steel

# introduction

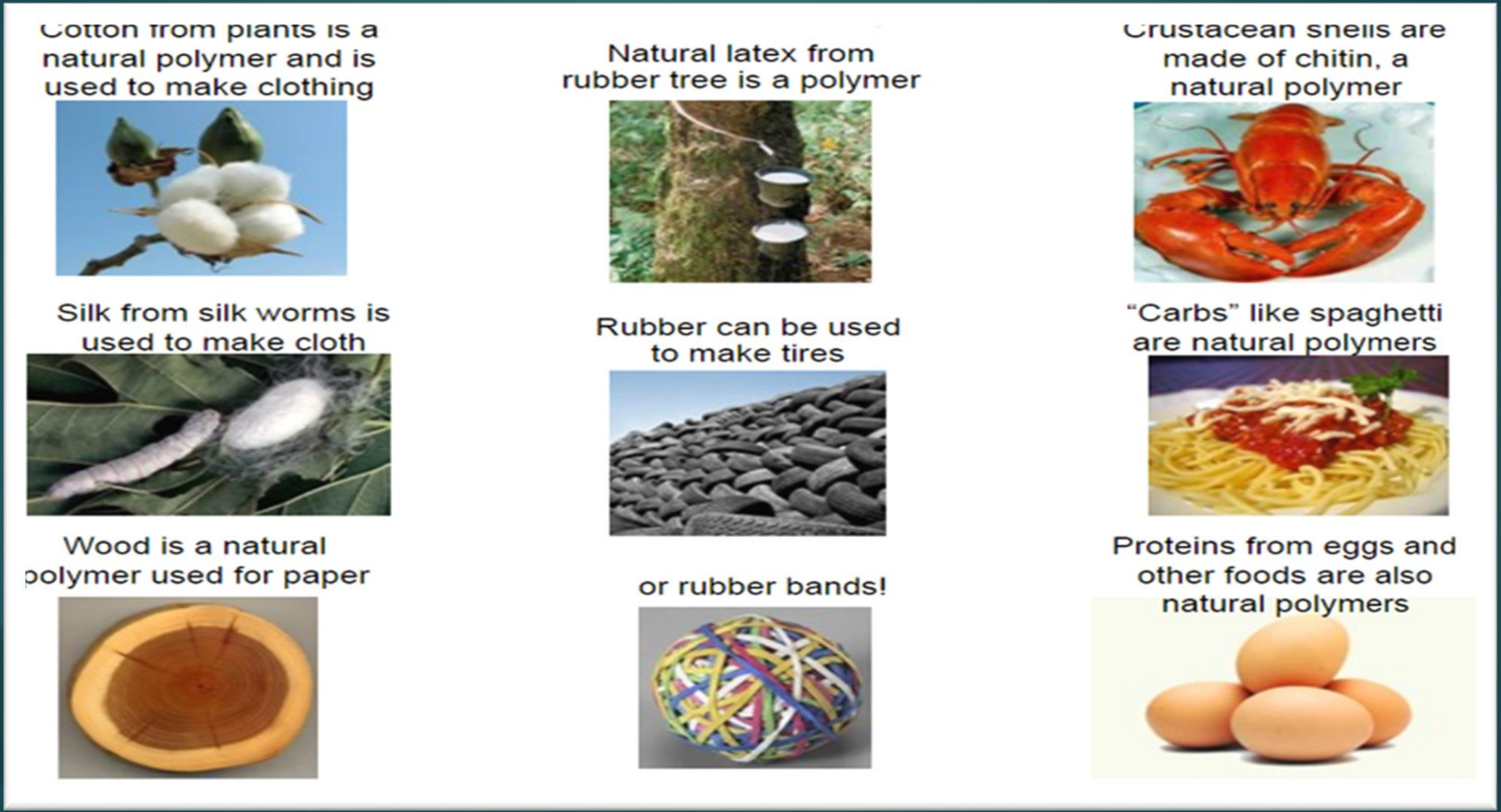
HERMAN MARK-Austrian American chemist who although not the world's first polymer chemist, was known as the father of polymer science.

HERMAN STAUDINGER-In the early 1920s formulated the macromolecular theory of polymer for which he later received the Nobel prize in chemistry and was also known as the father of polymer chemistry.

The first synthetic polymer was invented in 1869 by JOHN WESLEY HYATT.

In 1907 LEO BAKELAND invented the first polymer made independent of the product of organisms, thermosetting phenol-formalde

# What are polymer?



# WHAT ARE POLYMERS?

**Polymer**: It is a macromolecule made up of small, similar though not necessarily identical repeating chemical units joined by covalent bonds.

e.g. Butadiene + butadiene + …….. → polybutadiene

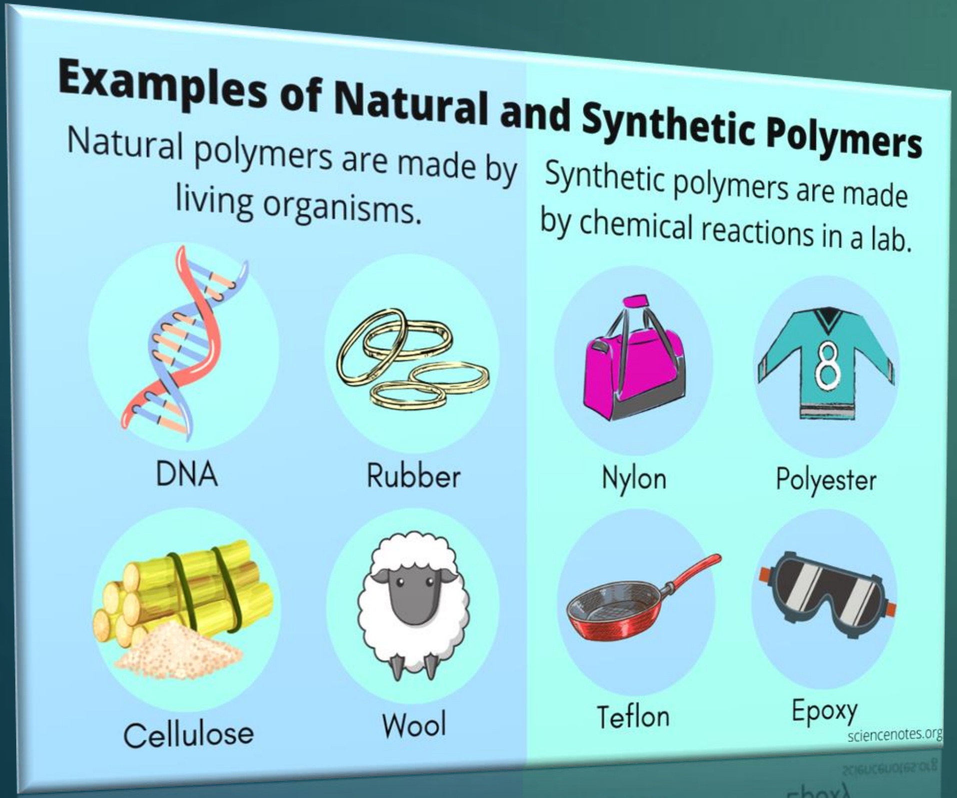
**Monomer**: It is the smallest repeating unit that is joined to other similar repeating units by covalent bonds to form a macromolecule.

**Homopolymer**: A polymer made up of identical chemical units joined by covalent bonds is called a homopolymer.

**Copolymer:** A polymer made up of different chemical units joined by covalent bonds is called a copolymer.

**Degree of Polymerisation (D.P.):** The number of repeating chemical units in a polymer is called the degree of polymerisation. When the degree of polymerisation is 2,3,4 the polymer is called a dimer, trimer, and tetramer respectively. When the degree of polymerisation is of

# Classification of polymer




- **(A) Natural & (B) Synthetic polymer :**

*(1)Those isolated from natural materials are called natural polymers.*

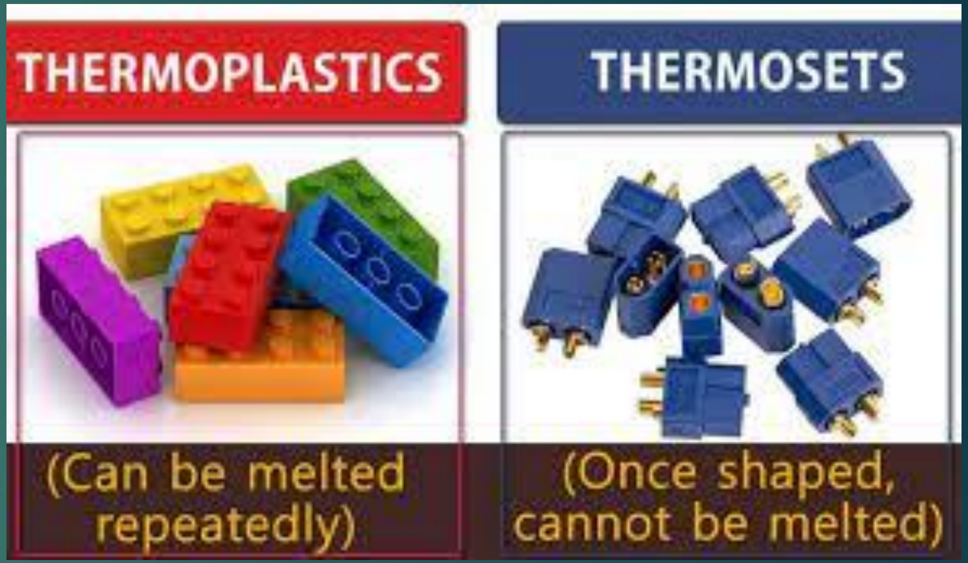
*e.g. cotton, silk, wool, rubber cellophane, cellulose rayon, leather &so on are chemical modifications of natural polymer*

*(3) Polymers synthesised from low molecular weight compounds are called synthetic polymers.*

*e.g. polyethylene, pvc, nylon, epoxy resins, silicones &terylene.*

# © Thermoplastic & (D)Thermosetting polymer:

- *(i)The polymer that softens on heating & stiffens on cooling is termed a thermoplastic polymer.*
- *e.g. polyethylene, PVC, nylon sealing wax oxides and amines.*
- *(ii)some polymers, on the other hand, undergo some chemical change on heating & convert themselves into an infusible mass. such polymers that become an infusible & insoluble mass on heating called thermosetting polymer.*
- *When heated they become rigid and hard.*



# (E) ELASTOMERS & FIBRES :

- ***Elastomers:*** *They are elastic like natural rubber. They have high tensile strength. They are cross-linked molecules. They include butadiene copolymers, polyisoprene, silicones, polyurethanes etc.*
- ***Fibres:*** *They are thread-forming solids with high tensile strength. They are usually organic compounds like polyamides, derivatives etc.*

# (B) Organic & Inorganic polymer

| Organic Polymer | Inorganic Polymer |
|---|---|
| 1)They contain a skelecton of CCl) atoms, sometimes with N and O atoms attached with them. | 1)They contain a skeleton of C-C as well as other atoms, with different atoms attached to them. |
| 2) They show a tendency to form linear chain structures. | 2)They show a tendency to form structures with four-six-eight-membered rings. |
| 3) At high temperature, they do not show a tendency to depolymerise | 3)At high temperature, they show tendency to depolymerise to cyclic monomers |
| 4) At high temperature, they change their three-dimensional structure | 4)At high temperature and even in molten state, they retain their regularity in three dimensional structure. |
| 5) The degree of polymerization is usually high e g. starch, proteins. | 5)The degree of polymerization is not high eg $(PNF_2)_7$ |
| 6) They are stable in air generally upto 300°C | 6)They are thermally highly stable. |
| 7) They are easily attacked by acids, alkalies and solvents. | 7) They show much resistance to attack by acids, alkalies and solvents |

# INORGANIC POLYMER

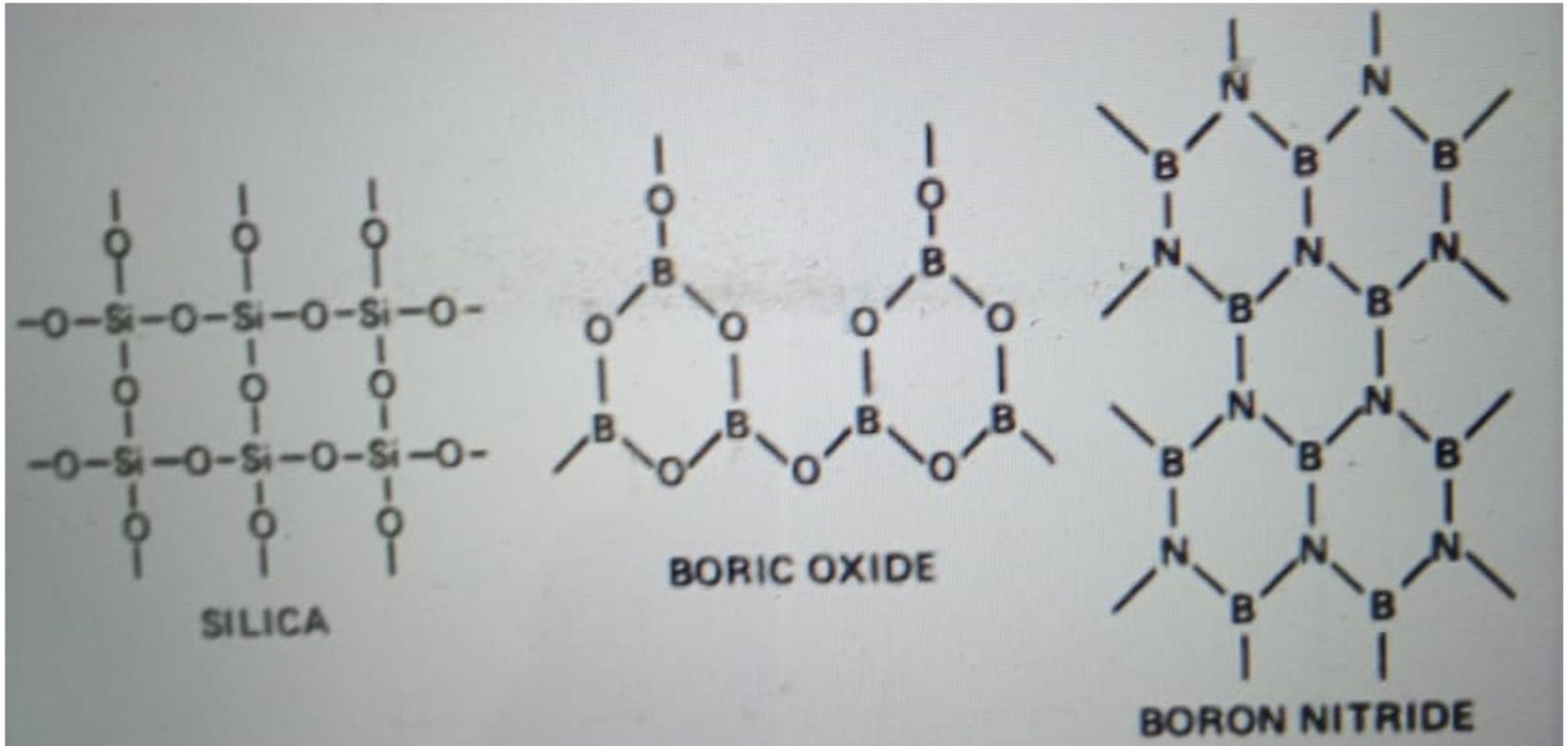



Figure 1.– *Some inorganic polymers.*

# Classification of Inorganic polymer

## Mayer's Classification:

This classification is based on the structures of the polymers.

According to this classification, the polymers have either linear sheet-like or three-dimensional structures, in a solid state.

This classification suffers from a drawback that it does not include some common structures like cyclic or branched structures.

## Korshak and Mozyora's Classification:

According to this classification, inorganic polymers can be divided into two groups,

i) those with a skeleton of atoms of the same type (homoatomic) and ii)those with a skeleton of atoms of a different type (heteroatomic).

## Classification based on method of preparation:

Inorganic Polymers can be classified according to their method of preparation as

(a) condensation polymers

(b) addition polymers

(c) co-ordination polymers.

# SYNTHESIS, STRUCTURAL ASPECTS AND APPLICATIONS OF INORGANIC POLYMERS

# (1) Silicones:

- **Introduction:** The organosilicon polymers containing Si-O-Si- linkages are called silicones.
- The Si-O bond is more stable than the C- O bond by about 22 Kcal per mole.
- Silicon is $sp^3$ hybridized.
- terminal oxygens silicones contain oxygen moieties (e.g. $CH_3$, $C_6H_5$) attached to silicon and hence they contain Si-C bonds. On account of this, they are also called organosilicon polymers.
- based on physical state such polymers are generally classified as - (a) Linear silicones (silicone oils), (b) Silicone elastomers, and(c) Silicone resins. Some are also called silicone greases.

- **Synthesis:**
- **Step I: Preparation of alkyl/ aryl-substituted chlorosilanes.**

(i) $SiCl_4 + CH_3MgCl \rightarrow$ **$CH_3SiCl_3 + MgCl_2$**

On further alkylation, it gives,

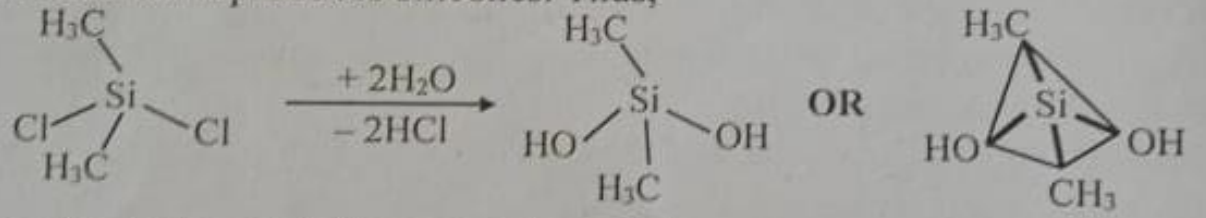
$$CH_3SiCl_3 + CH_3MgCl \longrightarrow (CH_3)_2SiCl_2 + MgCl_2$$

$$(CH_3)_2SiCl_2 + CH_3MgCl \longrightarrow (CH_3)_3SiCl + MgCl_2$$

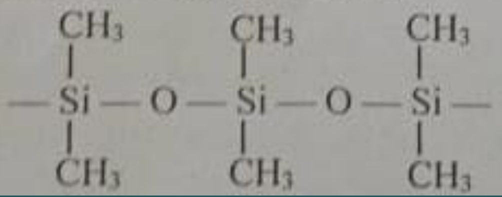
ii) Industrially, the organo silanes are prepared by direct reaction of alkyl or aryl halides with Si,

$$2CH_3Cl + Si \xrightarrow[300°C]{\text{Cu powder}} (CH_3)_2SiCl_2$$

**Step II :** The substituted halosilanes undergo hydrolysis to give related substituted silanols. Then on condensation it produces silicones. Thus,




The structure of polydimethylsiloxane is shown below.



- **Properties:**
- (i) They show low thermal conductivity.
- (ii) Their toxicity is low
- (iii) They form watertight seals.
- (iv) All silicones are - (i) water repellent (ii) thermally and electrically insulating (iii) chemically inert. (iv) antistick (v) antifoam (vi) flame resistance.
- **Application:**
- **i) Silicone oils:** They are used: a) As dielectric insulating media, e.g. in transformer oils. b) As hydraulic oils (Fluids)c) As compressible fluids for liquid springs. d) As antifoaming agents in sewage disposal plants, textile dyeing, cooking oil etc. (in ppm).e) As an additive in cosmetics (lipsticks, sun tan lotion, hair oil etc.)

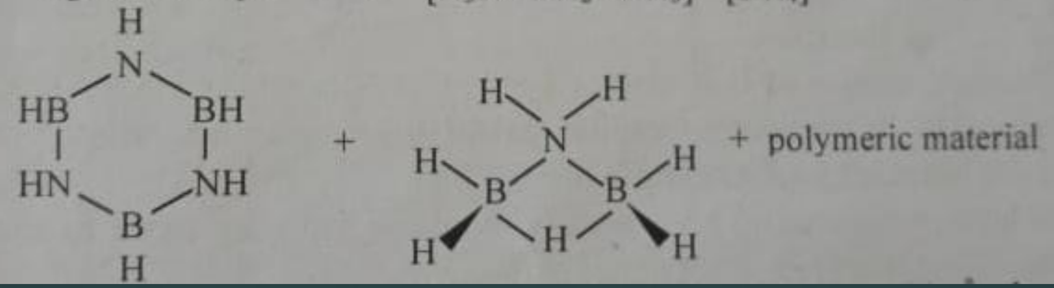
- ii) Silicone greases: They are used: for use in heavy-duty steel gears and shafts. For this, methyl. phenyl silicone oils are thickened by Li-soaps.
- iii) Silicone rubber: They is used in making :(a) Cable insulation (b) Static and rotary seals (c) Gaskets (d) Diaphragms (e) Electric tape insulation (f) Industrial sealants and adhesives (g) Heart valves (h) Space suits(i) Accurate impressions for dentures (j) Masks in cinema.
- v) Silicone resins: They are used in making :(a) Insulations in electrical equipment and (b) Laminates in electrical equipment. (c) High-temperature paints and coatings on cooking utensils.

# (2) Borazines (Borazole):

- Borazine (also called borazole) and its derivatives constitute a class of compounds with B-N bonds, contributing to the stability of the backbone structure.
- The cyclic compounds (RBNR') are called borazines or borazoles. They are isoelectronic with benzenoid hydrocarbons. Therefore, they might be expected to show some aromatic character.
- **Synthesis:**

As stated earlier borazine was first made by Stock and Pohland in 1926, by heating diborane with ammonia at 125°C.

$$B_2H_6 + 2NH_3 \xrightarrow{125^\circ} [H_3N \cdot BH_2 \cdot NH_3]^+ \ [BH_4]^- \xrightarrow{200^\circ}$$



various substituents.

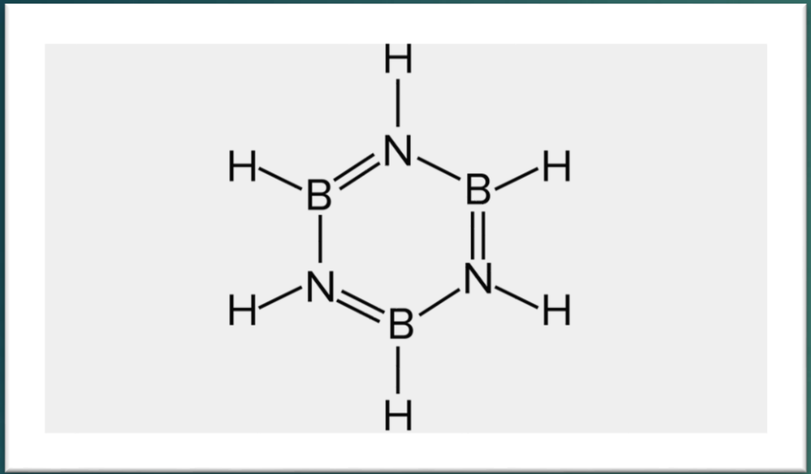
2) Borazine is more conveniently prepared by heating ammonium chloride and $BCl_3$ to give B–trichloro borazole which is then reduced with $LiAlH_4$ or $NaBH_4$ in ether solution.

$$3NH_4Cl + 3BCl_3 \xrightarrow{\text{ether}} Cl_3B_3N_3H_3 + 9HCl$$

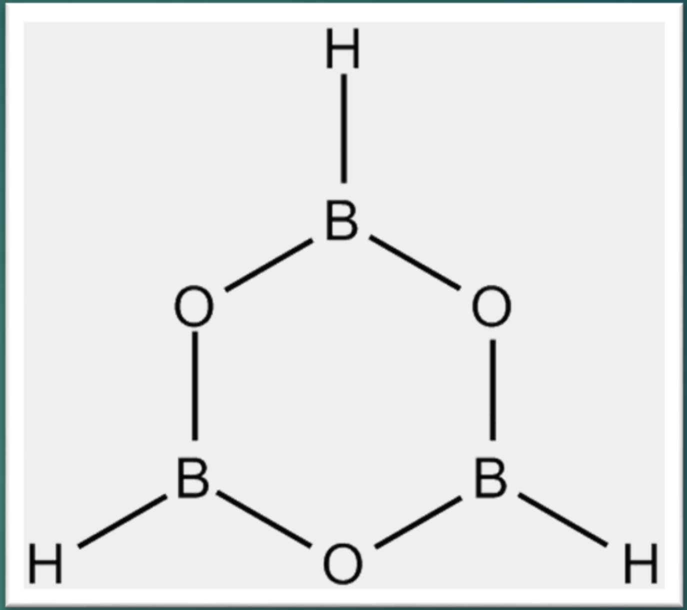
$$Cl_3B_3N_3H_3 + 3NaB_4 \longrightarrow B_3N_3H_3 + \frac{3}{2} B_2H_6 + 3NaCl$$

The molecule is planar with a B-N bond distance of 1.44 A throughout the ring compared with a C-C distance of 1.42 A in benzene. The N-N and B-N distances are 1.02 Å and 1.20 Å respectively. The B-N distance is less than that expected for a single bond (1.60 Å). This is attributed to the delocalized pπ-pπ bonding.

- **Structure, Physical and Chemical Properties:**




Borazine




Boraxine

- **The chemical properties of borazines differ from those of benzenoid compounds.**
- **Borazines are usually easily hydrolysed. But the rate of hydrolysis is slightly lower. This is attributed to presence of bulky alkyl or aryl substituents.**

- Uses:
- Borazines are starting materials for other potential ceramics such as boron carbonitrides.
- Borazine can also be used as a precursor to grow hexagonal boron nitride (h - BN) thin films and single layers on catalytic surfaces such as copper, platinum, nickel, iron and many more with chemical vapour deposition (CVD)

# 3) Phosphazenes

- Term was used to show phosphorus, nitrogen (= azo) and P=N double bond.
- These are generally present in phosponitrilic polymers.
- They are thus ‘unsaturated in compounds containing phosphorus and nitrogen. The phosphorus is mostly in a 5+ oxidation state.
- They show water-repellent, solvent-resistant and flame-resistant properties.
- Phosphazenes are generally classified on the basis of a number of phosphazen unies that are present in the structure.

# Classification of Phosphazenes

- **1)Monophosphazene:**
- **They are of the type $X_3P = NR$ (where X and R = Cl, OR, $NR_3$ etc.)**

They can be prepared as follows :

a) By reacting an azide ($R - N_3$) with $PR_3$ (R = Ar, OR, $Cl_3$ $NR_2$),

Thus,

$$P(C_6H_5)_3 + C_6H_5 - N_3 \xrightarrow{-N_2} (C_6H_5)_3 P = N - C_6H_5$$

b) By reacting dihalotriphenylphosphenes with aromatic amines :

thus,

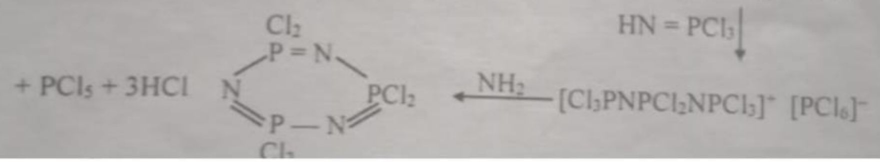
$$(C_6H_5)_3 PCl_2 + C_6H_5 - NH_2 \xrightarrow{-2HCl} (C_6H_5)_3 - P = N - C_6H_5$$

- 2)diphosphazenes:
- They contain two P = N - groups. The P = N and the P - N bonds are equivalent.
- The diphosphazenes are generally prepared by

$$PCl_5 + NH_4Cl \xrightarrow[\text{carbon solvents}]{\text{Chlorohydro}} [Cl_3P = N - PCl_2 = N\ PCl_3]^+\ Cl^-$$

The mechanism of this reaction is rather complicated. It is believed that $NH_4\ [PCl_6]$ is first formed and loses HCl to give the unstable species $HN = PCl_3$, which then reacts as follows in the formation of the trimer :

$$[PCl_4]^+\ [PCl_6]^- + HN = PCl_3 \longrightarrow [Cl_3P = N = PCl_3]^+\ [PCl_6]^- + HCl$$



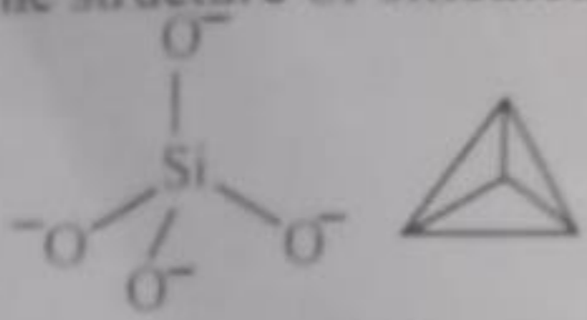
- Uses:
- These are used for making:
- i) rigid plastics, plastic films, expanded foams,
- Ii) fuel hoses, gaskets.
- Iii) o-ring seals for use in extremely cold climates (eg. in high-flying aircraft or vehicles for Arctic-type climates.)
- v) composite materials together with asbestos, glass or ordinary phenolic resins.

# (3) Silicates:

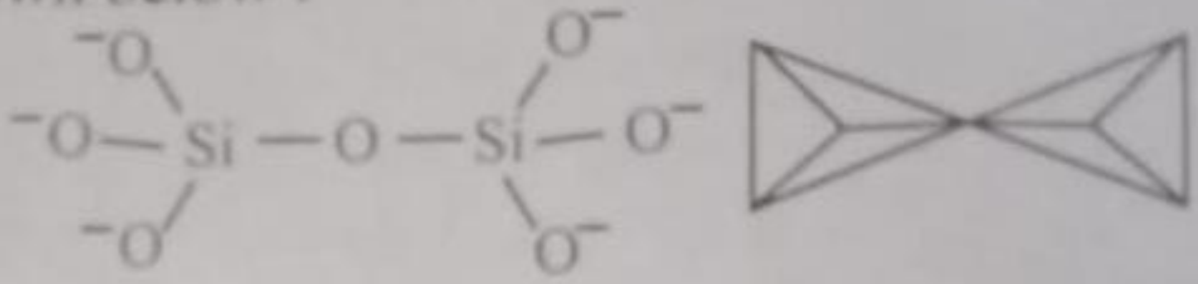
- Silicates are obtained by heating metal oxide, sulphate and carbonate at high temperatures.
- These may be soluble (sodium silicate) or insoluble (eg. most of the naturally occurring silicates) in water.
- silicates containing the $SiO_4$ tetrahedran joined through Si-O-Si bonds.
- **Classification**: based on their structures.
- a) Orthosilicates: The formal orthosilicate ion $SiO4^{4-}$ is the simplest silicate anion. It is present in some minerals and synthetic $Be_2SiO_4$, $Mg_2SiO_4$, and $ZrSiO_4$. They may be arranged tetrahedrally, octahedrally or in a cubic lattice.
- b)Disilicates: Two $SiO_4$, units may share one oxygen atom and form disilicate $(O_3SiOSiO_3)^{6-}$ or $Si_2O_7^{6-}$ ion, e.g. thortiveitite $Sc_2Si_2O_7$, and hemimorphite $Zn_4$ (OH) $Si_2O_7$.

ed.

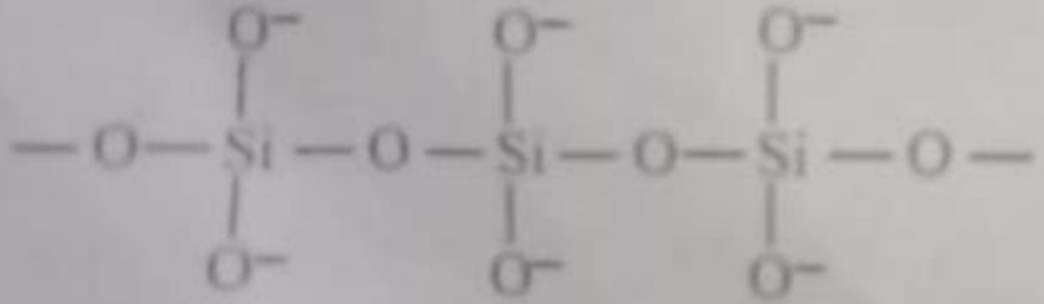
The structure of silicates is shown below :



$SiO_4^{4-}$



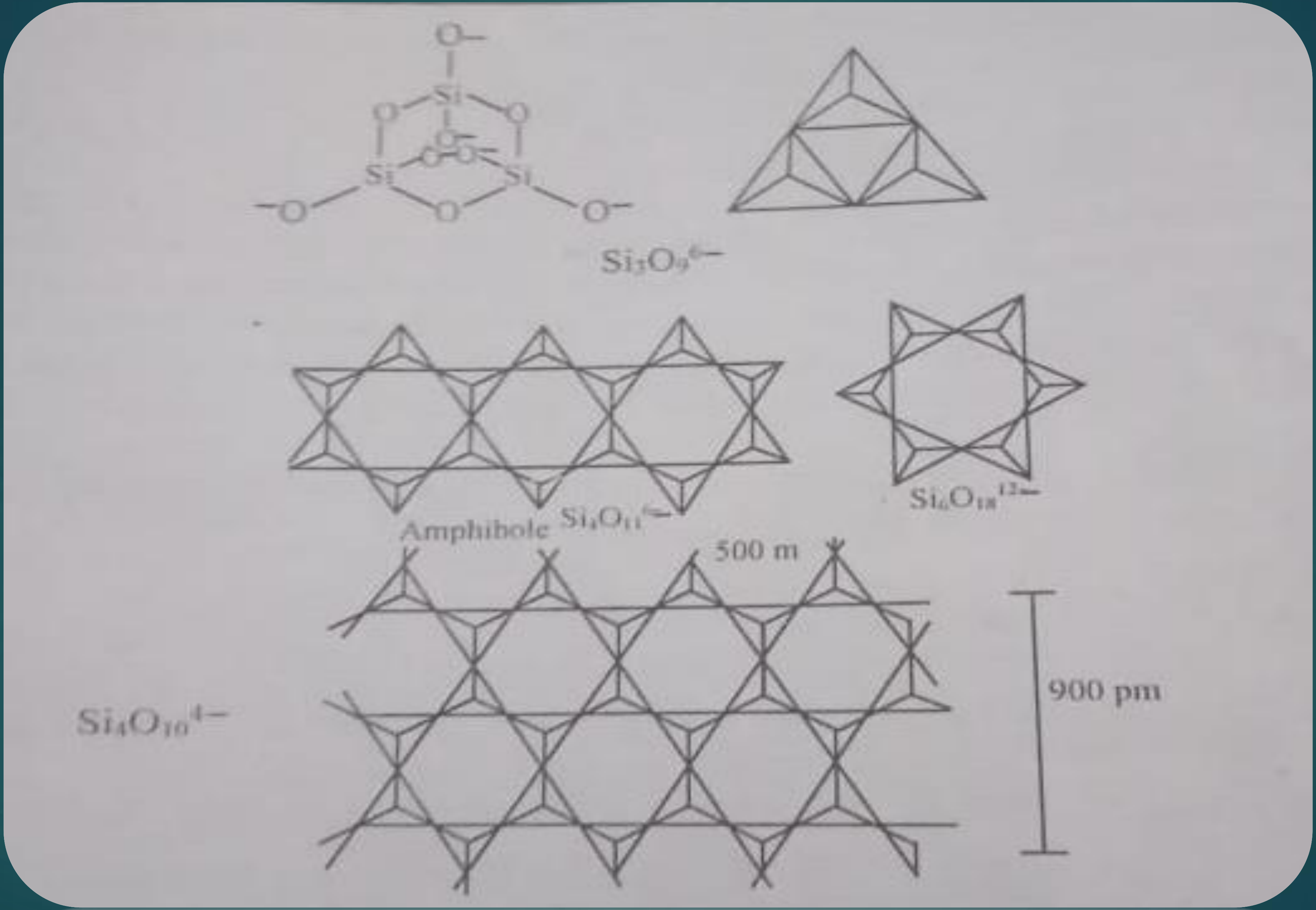
$Si_2O_7^{6-}$



Pyroxene

$(SiO_3)_n^{2n-}$

- C) Chain Silicates:
- The $SiO_4$ tetrahedra may share two O atoms to form infinite chains.
- These chains may be of two types - (i) In pyroxenes, linear chains exist, e.g. $Na_2SiO_3$, $Li_2SiO_3$ diopside, $CaSiO_3$ etc. (ii) In amphiboles, six $SiO_4$ units share two oxygen atoms each giving a ring of $Si_6O_6$ atoms.
- These $Si_6$, units can form chains by extending in one direction giving the composition $Si_40_{11}^{6-}$
- d) Cyelic silicates: The most important cyclic silicates are the tri and hexasilicates $Si_3O_9$ and $Si_6O_{18}^{12-}$ examples are, beninotite $BaTiSi_3O_9$, dioptase $Cu_6Si_6O_{18}.6H_2O$.
- e)Layer silicates: Layer structures are formed when $SiO_4$, units share three O atoms The infinite sheet corresponds to $Si_4O_{10}^{4-}$. It is present in kaolin $Al_2(OH)_4Si_2O_5$, micas and talc $Mg_2(Si_2O_5)_2.Mg(OH)_2$. These are soft, easily hydrated minerals in which the sheets are held together by hydrogen bonds.



$Si_3O_9^{6-}$
Amphibole $Si_4O_{11}^{6-}$
$Si_6O_{18}^{12-}$
500 m
900 pm
$Si_4O_{10}^{4-}$

- Silicate-Applications (uses):
- Mary sillicates are used as a direct result of their physical properties. For example clay minerals are used for absorbing chemicals, micas are used for electrical insulation, asbestos is used for thermal insulation agate and flint are used as hard or sharp surfaces and variety of gemstones are used for ornaments and jewellery.
- Some important technological applications are given below:
- alkali silicates: These are used mainly as glue
- Cement: Both Portland and high alumina cement are used for construction purposes.
- Ceramics: They are mainly used for making bricks, tiles and pottery. Frequently silicates are used in industry. It is also used in soaps and detergents.

# (4)Siloxanes:

- A siloxane is a functional group in organosilicon chemistry.
- It contains Si-O-Si linkage. The parent siloxane includes the oligomeric as well as polymeric groups.
- Siloxanes also include branched compounds, the main feature of this is that each pair of silicon centres is separated by one oxygen atom.
- Siloxane is a functional group $R_3SiO$ - (where the three $R_3$ may be different, whereas silicone is a substance containing the Si-O-Si linkage.)
- The siloxane compounds can be either straight-chain compounds or branched compounds. Polymers of siloxane are called silicones.

- **Structure**: Siloxanes usually adopt tetrahedral structures containing $sp^3$ hybridization. The Si-O bond is 1.64 A and the Si-O-Si angle is rather open at 142.5°.
- **Synthesis:**

**Synthesis of Siloxanes**

The hydrolysis of silicon chloride gives a siloxane, thus,

$$2R_3Si-Cl + H_2O \longrightarrow R_3Si-O-SiR_3 + 2HCl$$

The reaction proceeds through the initial formation of silanols ($R_3Si-OH$), thus,

$$R_3SiCl + H_2O \longrightarrow R_3Si-OH + HCl$$

The siloxane bond can then form through a silanol + Chlorosilance pathway, thus,

$$2R_3SiOH \longrightarrow R_3SiO-SiR_3 + H_2O$$

$$R_3Si-OH + R_3SiCl \longrightarrow R_3Si-O-SiR_3 + HCl$$

Hydrolysis of silyldichloride can give linear or cyclic products.

Linear products are terminated with silanol groups as,

$$nR_2Si(OH)_2 \longrightarrow H(R_2SiO)_n + (n-1)H_2O$$

The liner products have great commercial values.

On the other hand cyclic products have no silanol end as,

$$nR_2Si(OH)_2 \longrightarrow (R_2SiO)_n + nH_2O$$

- **Uses:**
- Siloxanes are silicone-based compounds, hence they are generally used for their softening, smoothening and moistening action.
- Siloxanes have high electrical insulating properties, they possess chemical stability and due to the wide temperature range, they retain resiliency. Silicone rubbers are mainly used for heat resistance, seals, gaskets, and electrical insulators.