



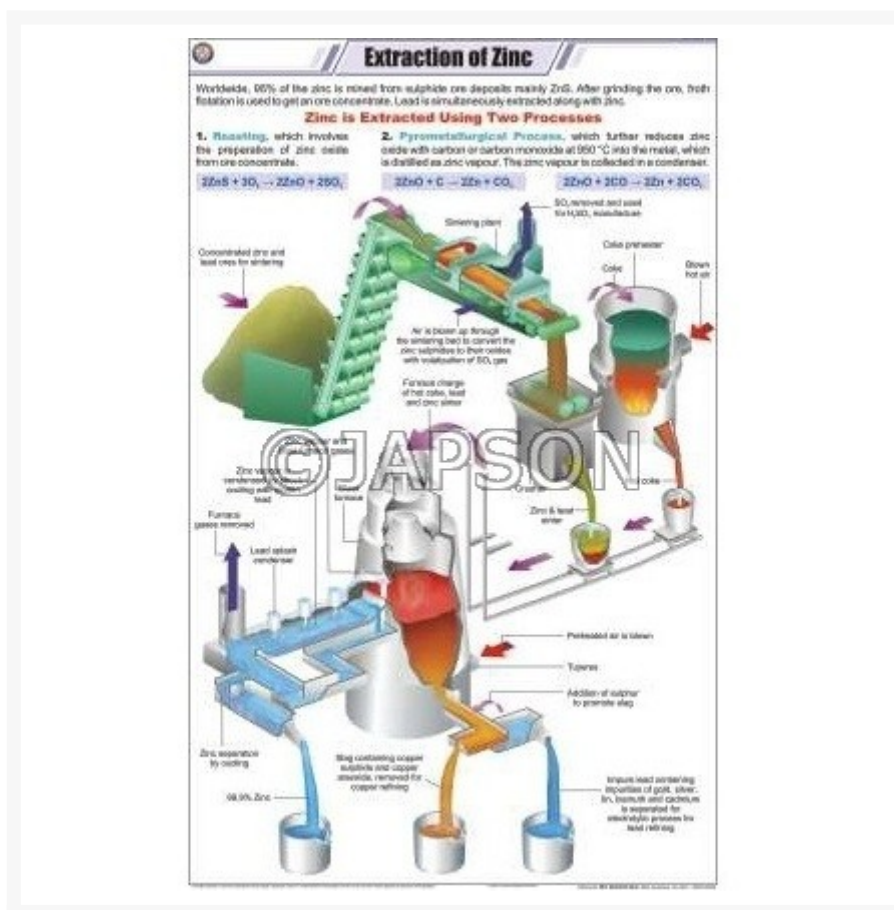
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# Chemistry (II) Charts, School Education

## Product Image



## Description

**Standard Size:** 58x90cms

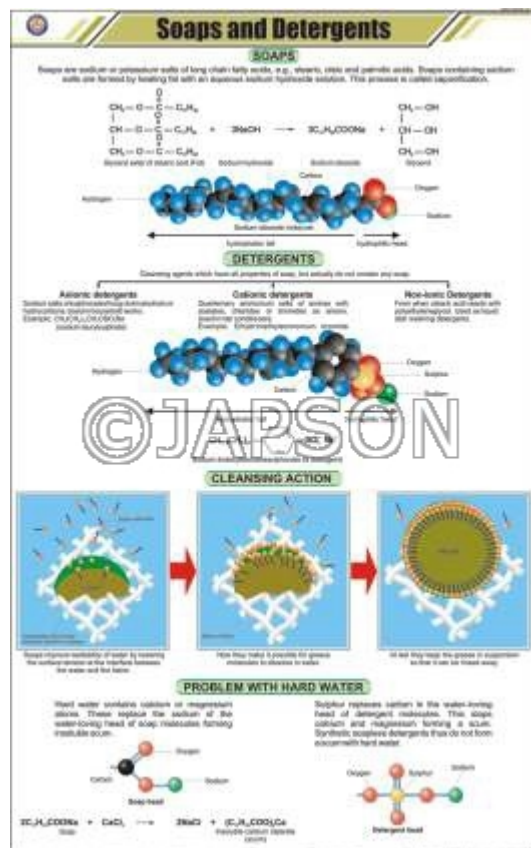
**Language:** English

Laminated Paper Charts with Plastic Rollers. These Charts have technically accurate and

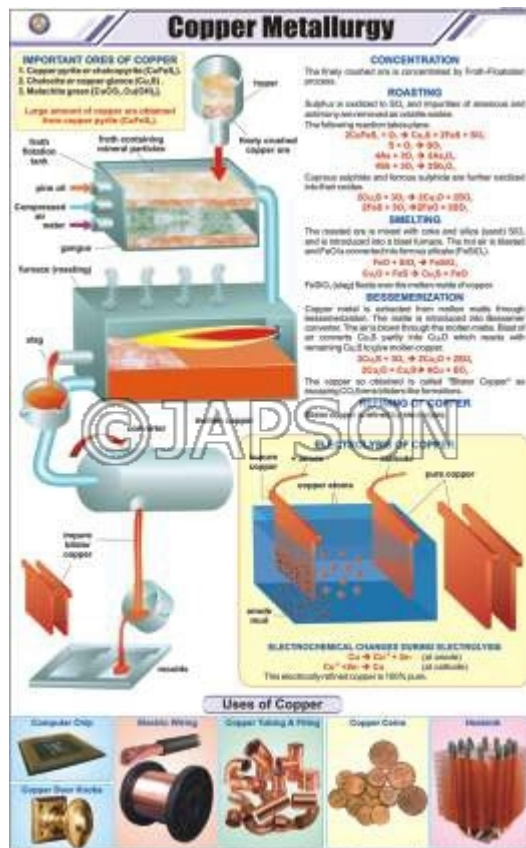
detailed description in vivid colours.

**Note:** Based on minimum order quantity conditions, Charts can be customized to your requirements in terms of CONTENT, LANGUAGE, SIZE, etc. Please write back to us for discussion.

## A. Charts, Soaps and Detergents



## B. Charts, Copper Metallurgy



## C. Charts, Cement and Concrete

## D. Charts, Extraction of Zinc

## Cement and Concrete

### Preparing Portland Cement

The limestone (provides calcium oxide) and Clay (provides silica, alumina and ferric oxide) are ground, mixed with water and carbonated. Next the material is burned in a large rotary kiln at 2500°F. The clinker so formed is then cooled and ground to a fine powder in a ball mill. Gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ) is added during the grinding process to delay setting time of cement. Finally the powdered cement is packed in water proof bags.

**Composition of Cement**

|                         |          |
|-------------------------|----------|
| $\text{CaO}$            | 55 - 75% |
| $\text{SiO}_2$          | 20 - 25% |
| $\text{Al}_2\text{O}_3$ | 5 - 10%  |
| $\text{Fe}_2\text{O}_3$ | 2 - 3%   |

### Concrete

Concrete is a heterogeneous material composed of coarse sand, gravel, crushed stones and water.

#### Hydrating Concrete with Water

When water is mixed into cement, hydration occurs. The hydrated cement surrounds the aggregate particles and binds them to provide maximum strength.

#### Types of Reinforced Concrete Foundations

#### Applications of Cement & Concrete

## Extraction of Zinc

Worldwide, 80% of the zinc is mined from sulphide ore deposits mainly  $\text{ZnS}$ . After grinding the ore, froth flotation is used to get an ore concentrate. Lead is simultaneously extracted along with zinc.

### Zinc is Extracted Using Two Processes

- 1. Roasting**, which involves the preparation of zinc oxide from ore concentrates.
 
$$\text{ZnS} + 3\text{O}_2 \rightarrow \text{ZnSO}_4 + 2\text{SO}_2$$
- 2. Pyrometallurgical Process**, which further reduces zinc oxide with carbon or carbon monoxide at 950 °C into the metal, which is distilled as zinc vapour. The zinc vapour is collected in a condenser.
 
$$\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$$

$$\text{ZnO} + 3\text{CO} \rightarrow \text{Zn} + 3\text{CO}_2$$

E. Charts, Alkynes

F. Charts, Alkenes

## Alkynes

Alkynes are unsaturated hydrocarbons containing at least one triple bond.

**Functional Group**  $\text{—C}\equiv\text{C—}$

**General Formula**  $\text{C}_n\text{H}_{2n-2}$

**3-D Structure of Simplest Alkyne Ethyne (Acetylene)**

**NOMENCLATURE:** In common system, alkynes are named as derivatives of acetylene. In IUPAC system they are named as derivatives of corresponding alkenes replacing 'ene' by suffix 'yne'. The position of the triple bond is indicated by the first triply bonded carbon.

| Value of n | Mol. Formula           | Structure   | Common Name     | IUPAC Name |
|------------|------------------------|---|-----------------|------------|
| 2          | $\text{C}_2\text{H}_2$ | $\text{H—C}\equiv\text{C—H}$                      | Acetylene       | Ethyne     |
| 3          | $\text{C}_3\text{H}_4$ | $\text{CH}_3\text{—C}\equiv\text{CH}$             | Methylacetylene | Propyne    |
| 4          | $\text{C}_4\text{H}_6$ | $\text{CH}_3\text{—CH}_2\text{—C}\equiv\text{CH}$ | Ethylacetylene  | But-1-yne  |

### Preparation

- 1. From Calcium Carbide**  
Ethyne is prepared by treating calcium carbide with water:  
$$\text{CaC}_2 + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{C}_2\text{H}_2$$
- 2. From Vicinal Dihalides**  
Ethyne is prepared by the double dehydrohalogenation of vicinal dihalides:  
$$\text{H}_2\text{C—CH}_2 + \text{KOH} \xrightarrow{\text{Alkaline}} \text{H}_2\text{C=CH}_2 + \text{H}_2\text{O}$$
  
$$\text{H}_2\text{C=CH}_2 + \text{Br}_2 \xrightarrow{\text{Alkaline}} \text{HC}\equiv\text{CH} + 2\text{H}_2\text{O}$$

### Applications of Alkynes

- Use-1:** Alkynes are used as a starting material for drugs and dyes.
- Use-2:** Acetylene is used in welding of steel and metal.
- Use-3:** Used as starting material for manufacturing large number of organic compounds such as chloroalkenes, vinyl chloride and acrylic polymers.

## Alkenes

Alkenes are unsaturated hydrocarbons containing at least one double bond. They are also known as olefins (oil forming).

**General Formula**  $\text{C}_n\text{H}_{2n} \text{ (n} \geq 2\text{)}$

**Functional group**  $\text{>C=C<}$

**Ethene is the simplest alkene commonly known as ethylene.**

| Molecular Formula         | Structure   | IUPAC Name         |
|---------------------------|---|--------------------|
| $\text{C}_2\text{H}_4$    | $\text{CH}_2 = \text{CH}_2$                                       | Ethene             |
| $\text{C}_3\text{H}_6$    | $\text{CH}_2 = \text{CH} - \text{CH}_3$                           | Propene            |
| $\text{C}_4\text{H}_8$    | $\text{CH}_3 - \text{CH}_2 - \text{CH} = \text{CH}_2$             | But-1-ene          |
| $\text{C}_4\text{H}_8$    | $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_3$               | But-2-ene          |
| $\text{C}_5\text{H}_{10}$ | $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_2 - \text{CH}_3$ | Pent-2-ene         |
| $\text{C}_6\text{H}_{12}$ | $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH} = \text{CH}_2$   | Hexa-1,3-diene     |
| $\text{C}_4\text{H}_8$    | $\text{CH}_3 - \text{C}(\text{CH}_3) = \text{CH}_2$               | 2-Methylprop-1-ene |

### Preparation

- 1. From alkyl halide reaction of alkyl halide**  
$$\text{CH}_3\text{—CH}_2\text{—X} + \text{Na} \rightarrow \text{CH}_2 = \text{CH}_2 + \text{NaX}$$
  
Ethyne: Ethene
- 2. Dehydrohalogenation**  
$$\text{CH}_3\text{—CH}_2\text{—X} \xrightarrow{\text{KOH}} \text{CH}_2 = \text{CH}_2 + \text{HX}$$
  
(X = Cl, Br, I)
- 3. Dehydration of alcohols**  
$$\text{CH}_3\text{—CH}_2\text{—OH} \xrightarrow{\text{H}_2\text{SO}_4} \text{CH}_2 = \text{CH}_2 + \text{H}_2\text{O}$$
  
Ethanol: Ethene + Water
- 4. Dehalogenation of vicinal dihalides**  
$$\text{CH}_2\text{Br—CH}_2\text{Br} + 2\text{Zn} \rightarrow \text{CH}_2 = \text{CH}_2 + 2\text{ZnBr}_2$$

### Application of Alkenes

G. Charts, Alcohols

H. Charts, Alkanes



## Alcohols

**Alcohols** are organic compounds in which a **hydroxyl group (-OH)** is bound to a carbon atom of an alkyl or substituted alkyl group.  
In common terms alcohol refers to ethanol found in alcoholic beverages.

**General Formula:**  $C_nH_{2n+1}OH$

**Nomenclature:** Alcohols are named by substituting 'ol' of alkane with the suffix 'ol'. Position of substituents is indicated by numerals.

### Common and IUPAC Names of Some Alcohols

| Formula  | Common Name        | IUPAC Name          |
|--|--------------------|---------------------|
| $CH_3 - OH$  | Methyl alcohol     | Methanol            |
| $CH_3 - CH_2 - CH_2 - OH$  | n-Propyl alcohol   | Propan-1-ol         |
| $\begin{array}{c} CH_3 \\   \\ CH_3 - CH - CH_2 - OH \end{array}$      | Isopropyl alcohol  | Propan-2-ol         |
| $CH_3 - CH_2 - CH_2 - CH_2 - OH$                                       | n-Butyl alcohol    | Butan-1-ol          |
| $\begin{array}{c} CH_3 \\   \\ CH_3 - C - OH \\   \\ CH_3 \end{array}$ | tert-Butyl alcohol | 2-Methylpropan-2-ol |

### PREPARATION

**1. From Alkyl Halides:** Reaction of alkyl halides with aqueous sodium hydroxide and in alcohols.

$$CH_3X + NaOH \rightarrow CH_3OH + NaX$$

**2. Reduction of Aldehydes and Ketones:**

$$RCHO + H_2 \xrightarrow{Ni} RCH_2OH$$

$$RCOR' + H_2 \xrightarrow{Ni} R-CH(OH)-R'$$

**3. Reduction of Carboxylic Acids:**

$$RCOOH \xrightarrow{LiAlH_4, H_2O} RCH_2OH$$

### USES OF ALCOHOL (ETHANOL)

- In Alcoholic Beverages (Wine, Beer, Spirits)
- In Digestive Syrups
- In Cough Syrups
- In Antiseptic Lotions

## Alkanes

**ALKANES** are the chemical compounds that consist only of the elements carbon (C) and hydrogen (H). They are also called saturated hydrocarbons because the carbon atoms in them are linked by single bonds.

**General Formula:**  $C_nH_{2n+2}$

**Methane:** is the simplest alkane. It has a tetrahedral structure with all H-C-H bond angles of  $109.5^\circ$ .

**Methane Molecule**

**NOMENCLATURE**  
Names of alkane series of hydrocarbons end in 'ane'. The prefix tells the number of carbon atoms in the chain.

### Details of Early Members of Alkane Series

| Name    | Molecular Formula | No. of Carbon Atoms | Boiling Point ( $^\circ C$ ) | Physical State at Room Temp. |
|---------|-------------------|---------------------|------------------------------|------------------------------|
| Methane | $CH_4$            | 1                   | -164                         | gas                          |
| Ethane  | $C_2H_6$          | 2                   | -87                          | gas                          |
| Propane | $C_3H_8$          | 3                   | -42                          | gas                          |
| Butane  | $C_4H_{10}$       | 4                   | -0.5                         | gas                          |
| Pentane | $C_5H_{12}$       | 5                   | 36                           | liquid                       |

### Applications of Alkanes

- Petroleum Refinery
- Petrol Pump
- Vehicle Run on Petrol
- LPG
- CNG-Station
- CNG Bus
- Cooking Gas

## I. Charts, Electroplating and Corrosion

## Electroplating and Corrosion

Electroplating is the coating of an electrically conductive object with a layer of metal using electrical current. The result is a thin, smooth, even coat of metal on the object. The layer of deposited metal is usually from  $5 \times 10^{-4}$  cm to  $1 \times 10^{-2}$  cm thick.

**Basic rules for electroplating an object with metal M:**

- The object must be made the cathode.
- The electrolyte must be a solution of a salt of metal M.
- The anode is made of a strip of metal M.

### Gold Plating Cell

Reaction at cathode:  $Au^{3+} + 3e^- \rightarrow Au$   
Reaction at anode:  $Au \rightarrow Au^{3+} + 3e^-$

### Silver Electroplating

Reaction at cathode:  $Ag^+ + e^- \rightarrow Ag$   
Reaction at anode:  $Ag \rightarrow Ag^+ + e^-$

### EXAMPLES OF CORROSION

The breaking down of essential substances in a material due to chemical reactions with its surroundings is called corrosion.

- Rusting of iron
- Silver articles become black when exposed to air
- Green coating on copper vessels

### Mechanism of Rusting

Due to forced oxidation, Fe is oxidized by oxygen in the air to form rust ( $Fe_2O_3 \cdot xH_2O$ ). The reaction is as follows:

$$4Fe + 3O_2 + 2xH_2O \rightarrow 2Fe_2O_3 \cdot xH_2O$$

### Factors Involved in Rusting

In 1907, Sir H. N. McCoy, in his book 'The Rusting of Iron', showed that rust is formed in the order: Fe > FeO > Fe(OH) > Fe<sub>2</sub>O<sub>3</sub> > Fe<sub>2</sub>SO<sub>4</sub>. The rusting of iron is a complex process involving several factors.

## Aluminium Metallurgy

Aluminium extraction is done in two phases: **Bayer's process** of refining bauxite ore to obtain alumina & **Hall-Heroult process** of smelting the alumina to get pure aluminium.

### BAYER'S PROCESS

- CRUSHING:** Bauxite ore is mechanically crushed.
- LEACHING:** The ore is heated in  $CO_2$  at  $125^\circ C$ . The oxides and silicates of iron and aluminium hydroxide impurities do not dissolve in the hydrochloric solution.
- PRECIPITATION:** Solid impurities of iron hydroxide are added to the solution. The dissolved aluminium hydroxide precipitates out as white fluffy solid.
- CLARIFICATION:** The full solution aluminium solution is separated out from the solution.
- CRYSTALLIZATION:** When heated to  $200^\circ C$ , the dissolved aluminium hydroxide decomposes to alumina.

### HALL-HEROULT PROCESS

- Purified  $Al_2O_3$  is mixed with  $Na_2CO_3$  (Cryolite) and  $CaF_2$  to lower the melting point.
- The molten mixture of  $Al_2O_3$  and  $Na_2CO_3$  is electrolyzed in an electrolytic cell.

### Uses of Aluminium

- Packaging
- Aircraft Industry
- Construction
- Utensils

## K. Charts, Plastics

## L. Charts, Synthetic Fibres



## Plastics

### Thermoplastics

Arrangement of molecular units is linear or slightly branched.

#### PVC (Polyvinyl chloride)

Prepared by polymerization of vinyl chloride

$$n \text{ CH}_2=\text{CHCl} \rightarrow \text{---}[\text{CH}_2-\text{CHCl}]_n\text{---}$$

**Applications:** Pipes, window frames, floor tiles, etc.

#### Polythene

**LDPE** (Low Density Polyethylene)

$$n \text{ CH}_2=\text{CH}_2 \rightarrow \text{---}[\text{CH}_2-\text{CH}_2]_n\text{---}$$

**Applications:** Plastic bottles, plastic bags, etc.

**HDPE** (High Density Polyethylene)

$$n \text{ CH}_2=\text{CH}_2 \rightarrow \text{---}[\text{CH}_2-\text{CH}_2]_n\text{---}$$

**Applications:** Plastic bottles, plastic pipes, etc.

### Thermosetting plastics

Arrangement of molecular units is cross-linked or heavily branched.

#### Bakelite

Prepared by condensation polymerization of phenol and formaldehyde

$$n \text{ C}_6\text{H}_5\text{OH} + n \text{ HCHO} \rightarrow \text{Bakelite} + n \text{ H}_2\text{O}$$

**Applications:** Electrical switches, handles of kitchen utensils, etc.

#### Melamine

Prepared by condensation polymerization of melamine and formaldehyde

$$n \text{ C}_3\text{H}_3\text{N}_3 + n \text{ HCHO} \rightarrow \text{Melamine resin} + n \text{ H}_2\text{O}$$

**Applications:** Fireproof materials, electrical insulators, etc.

## Synthetic Fibres

Synthetic fibre is a chain of molecules known as monomers which form polymers.

### Characteristics

1. Dry up quickly
2. Durable
3. Less expensive
4. Easy to maintain

### Nylon

Strong, elastic, light, lustrous and easy to wash.

**Nylon 6,6**

Prepared by condensation polymerization of hexamethylenediamine with adipic acid under high pressure & temperature.

$$n \text{ H}_2\text{N}(\text{CH}_2)_6\text{NH}_2 + n \text{ HOOC}(\text{CH}_2)_4\text{COOH} \rightarrow \text{Nylon 6,6} + n \text{ H}_2\text{O}$$

**Applications:** Socks, raincoats, etc.

### Rayon

Obtained by chemical treatment of wood pulp. Similar to that of silk (also called artificial silk).

When mixed with cotton, it is used to make bed sheets.

When mixed with wool, it is used to make carpets.

### Polyester

**Polyester Fabrics**

- (a) do not get wrinkled easily
- (b) are cheap
- (c) are easy to wash

**Example: Terylene**

Prepared by heating a mixture of ethylene glycol and terephthalic acid at 420 to 480 K in presence of zinc acetate as catalyst.

$$n \text{ HOCH}_2\text{CH}_2\text{OH} + n \text{ HOOC}-\text{C}_6\text{H}_4-\text{COOH} \rightarrow \text{Terylene} + n \text{ H}_2\text{O}$$

**Applications:** T-shirts, dresses, etc.

### Acrylic

Resembles natural wool.

**Example: Polyacrylonitrile**

Prepared by addition polymerisation of acrylonitrile in presence of peroxide catalyst.

$$n \text{ CH}_2=\text{CHCN} \rightarrow \text{Polyacrylonitrile}$$

**Applications:** Carpets, etc.

## M. Charts, Organic Acids

## N. Charts, Esters

## Organic Acids

Organic acids are organic compounds with acidic properties. Most common organic acids are carboxylic acids having  $\text{COOH}$  group.

### NOMENCLATURE

(i) Common names end with the suffix **-ic acid** and have been derived from Latin or Greek names of their natural sources. Example: Formic acid, Lactic acid, Acetic acid, Citric acid and Oxalic acid.

(ii) In IUPAC system, aliphatic carboxylic acids are named by **replacing the ending -e** in the name of the corresponding alkane with **-oic acid**.

### NAMES AND STRUCTURE OF SOME CARBOXYLIC ACIDS

| Structure  | Molecular Formula                 | Common Name             | IUPAC Name     |
|--|-----------------------------------|-------------------------|----------------|
| $\text{H}-\text{C}(=\text{O})-\text{OH}$                         | $\text{CH}_3\text{COOH}$          | Formic Acid             | Methanoic Acid |
| $\text{H}-\text{C}(=\text{O})-\text{CH}_2-\text{OH}$             | $\text{CH}_3\text{COOH}$          | Acetic Acid             | Ethanoic Acid  |
| $\text{H}-\text{C}(=\text{O})-\text{CH}_2-\text{CH}_2-\text{OH}$ | $\text{C}_3\text{H}_7\text{COOH}$ | Propionic Acid          | Propanoic Acid |
| $\text{C}_6\text{H}_5-\text{COOH}$                               | $\text{C}_6\text{H}_5\text{COOH}$ | Benzene carboxylic Acid | Benzoic Acid   |

### STRUCTURE OF CARBOXYL GROUP

$\text{R}-\text{C}(=\text{O})-\text{OH}$

### Applications of Organic Acids

- Organic acids are used in the manufacture of dyes and pigments.
- Organic acids are used in the manufacture of plastics.
- Organic acids are used in the manufacture of medicines.

## Esters

Esters are sweet smelling chemical compounds derived from an acid (one containing an  $\text{O}=\text{C}$  group) and a hydroxyl compound such as an alcohol or phenol. Most common carboxylic acids used to derive esters are carboxylic acids ( $\text{R}-\text{C}(=\text{O})-\text{OH}$ ).

### GENERAL FORMULA

$$\text{R}-\text{C}(=\text{O})-\text{OR}'$$

(R and R' are any alkyl or aryl group)

### NOMENCLATURE

1. Name the alkyl from the alcohol - **yl**.
2. Name the acid with the  $\text{C}=\text{O}$  with -ate.

Example:  $\text{CH}_3-\text{C}(=\text{O})-\text{O}-\text{CH}_3$  (Methyl ethanoate)

### SOME COMMON ESTERS

| NAME             | FORMULA  | ODOR        |
|------------------|--|-------------|
| Ethyl methanoate | $\text{HCOOC}_2\text{H}_5$                                 | Raspberries |
| Ethyl propanoate | $\text{C}_2\text{H}_5\text{CH}_2\text{COOC}_2\text{H}_5$   | Pineapple   |
| Ethyl butanoate  | $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOC}_2\text{H}_5$ | Pineapple   |
| Ethyl pentanoate | $\text{C}_4\text{H}_9\text{CH}_2\text{COOC}_2\text{H}_5$   | Cinnamon    |
| Octyl ethanoate  | $\text{CH}_3\text{COOC}_8\text{H}_{17}$                    | Orange      |

### PREPARATION

**Fischer esterification:** Carboxylic acid + Alcohol in presence of few drops of concentrated sulphuric acid as catalyst.

$$\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \rightarrow \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$$

ethanoic acid + ethanol → ethyl ethanoate + water

### Applications of Esters

- Esters are used for making perfumes.
- Esters are used in ice-creams and cold drinks.
- Esters give flowers and fruits their pleasant fragrances and flavours.
- Esters are used in the manufacture of plastics.

## O. Charts, Blast Furnace

## P. Charts, Manufacture of Glass

[illegible]

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