



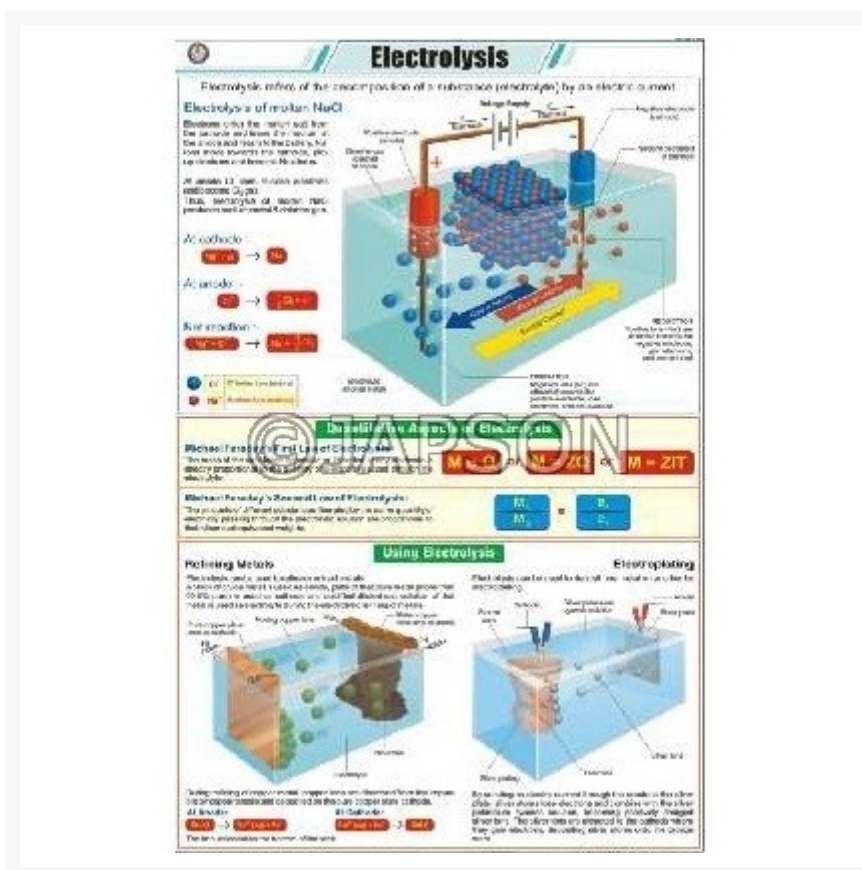
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Chemistry (III) Charts, School Education

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, Close-Packed Structure

B. Charts, Preparation of Nitrogen
& Nitric Acid

Close Packed Structures

Close packing of particles leave minimum vacant space in solids.

Close Packing in Two Dimensions

- Square Close Packing (AAA)**
Coordination number is 4.
- Hexagonal Close Packing (ABAB)**
Coordination number is 6.

Close Packing in Three Dimensions

- Three dimensional close packing from two dimensional square close packed layers
- Three dimensional close packing from two dimensional hexagonal close packed layers

Tetrahedral Voids

Octahedral Voids

Covering Tetrahedral Voids Hexagonal Close Packed Structures

Covering Octahedral Voids Cubic Close Packed Structures

Preparation of Nitrogen & Nitric Acid

LABORATORY PREPARATION OF NITROGEN

MANUFACTURE OF NITROGEN

LABORATORY PREPARATION OF NITRIC ACID

MANUFACTURE OF NITRIC ACID (OSTWALD'S PROCESS)

C. Charts, Manufacture of Phosphorus

D. Charts, Manufacture of Bleaching Powder

Manufacture of Phosphorus

Production of White Phosphorus

Phosphate rock is heated to 1200-1500°C with sand and coke to produce vaporized P₄, which is subsequently condensed into a white powder under water.

The main reactions involved are:-

$$\text{Ca}_3(\text{PO}_4)_2 + \text{SiO}_2 \xrightarrow{1200-1500^\circ\text{C}} 3\text{CaO} + \text{SiO}_2 + \text{P}_4$$

$$\text{SiO}_2 + \text{C} \xrightarrow{1200-1500^\circ\text{C}} \text{SiCO} + \text{CO}$$

$$\text{Ca}_3(\text{PO}_4)_2 + \text{C} \xrightarrow{1200-1500^\circ\text{C}} 3\text{CaO} + \text{SiO}_2 + \text{P}_4$$

Silica acts as a flux, converting CaO formed into slag: $\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$

Labels: Hopper, Phosphate rock & coke, Conveyor, Firebricks, Electrode, Carbon electrode, Electrothermal reactor, Slag.

Phosphorus vapor & CO is condensed here where white phosphorus is distilled by condensing with water.

Converting White Phosphorus into Red Phosphorus

Red phosphorus is formed by heating white phosphorus to 250°C.

Labels: Alcohol lamp, Valve, Mercury and Water, Metal bath, Sand bath, Furnace, Porcelain vessel containing white phosphorus, Thermometer.

Manufacture of Bleaching Powder

Bleaching powder is a dirty white amorphous solid with a pungent smell of chlorine.

CHEMICAL COMPOSITION

Bleaching powder is actually a mixture of Calcium Hypochlorite, Calcium Chloride, Water and some Slaked Lime.

$$\text{Ca}(\text{OCl})_2 \cdot \text{CaCl}_2 \cdot \text{Ca}(\text{OH})_2 \cdot 2\text{H}_2\text{O}$$

INDUSTRIAL PRODUCTION

On industrial scale, it is manufactured in Hasenclever Plant or in Bachmann's Plant.

Raw Materials

- Slaked Lime
- Chlorine Gas

Reactions Involved

$$2\text{Ca}(\text{OH})_2 + 2\text{Cl}_2 \rightarrow \text{Ca}(\text{OCl})_2 + \text{CaCl}_2 + 2\text{H}_2\text{O}$$

Slaked Lime + Chlorine → Calcium Hypochlorite + Calcium Chloride + Water

Manufacture of Bleaching Powder - HASENCLEVER PLANT

The plant consists of a number of horizontal systems, provided with rotating shafts with blades. Slaked lime is dropped into the longest cylinder. The cylinder rotates on the downward movement of slaked lime. Chlorine gas is introduced at the bottom. The contact currents allow a thorough mixing of the raw materials and complete conversion into bleaching powder.

Manufacture of Bleaching Powder - BACHMANN'S PLANT

Bachmann's plant consists of vertical tower made of cast iron. The tower is provided with a hopper at the top, two tanks near the base (one for chlorine and other for hot air) and an exit for waste gases near the top.

- The tower is fitted with eight shelves at different heights each equipped with rotating plates.
- The slaked lime is introduced through the hopper.
- Slaked lime comes in contact with chlorine.
- Bleaching powder is collected in a barrel at the base.

E. Charts, Acids, Bases and Salts

F. Charts, Electrolysis

Acids, Bases and Salts

ACIDS

Acids are the substances that are sour in taste, change blue litmus to red and give H⁺ (hydrogen ion) when dissolved in water. Acids have a pH less than 7.

Acids are sour. They react with metals, carbonates, etc.

BASES

Bases are substances that are bitter in taste, change red litmus to blue, and liberate hydroxide ions (OH⁻) when dissolved in water. Bases have a pH greater than 7.

Bases are bitter in taste. Bases react with acids to form salts. All metals react with acids to form salts.

SALTS

Salt is produced because of neutralization.

Salt is neutral in taste. Salt is produced because of neutralization.

Neutralization in Every Day Life:

- Antacid medicine to relieve indigestion.
- Soil treatment to improve soil fertility.
- Neutralization of acid rain.
- Neutralization of waste water.

Electrolysis

Electrolysis refers to the decomposition of a substance (electrolyte) by an electric current.

Electrolysis of molten NaCl

Electrolysis of molten NaCl is carried out in a cell. The cell is divided into two half-cells by a porous diaphragm. The cathode is connected to the negative terminal of the battery and the anode to the positive terminal.

At cathode: $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$

At anode: $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$

Net reaction: $2\text{NaCl} \rightarrow 2\text{Na} + \text{Cl}_2$

Disadvantages of Electrolysis

The process of electrolysis is slow and costly. It requires a large amount of electricity. It is not suitable for the production of large quantities of products.

Using Electrolysis

Electrolysis is used to produce pure metals, to coat metals, and to produce gases.

Electroplating: The process of depositing a thin layer of a metal on the surface of another metal by electrolysis.

Electrorefining: The process of purifying a metal by electrolysis.

G. Charts, Prep. of Chlorine and Hydrochloric Acid

H. Charts, Atoms and Molecules

Preparation of H₂ and CO₂

HYDROGEN

Laboratory Preparation

Laboratory preparation involves reaction

Metal + Acid → Salt + Hydrogen

$$\text{Zn(s)} + 2\text{HCl(aq)} \rightarrow \text{ZnCl}_2\text{(aq)} + \text{H}_2\text{(g)}$$

Commercial Manufacture

Steam Re-forming of Natural Gas

Methane in natural gas is reacted with steam in a reversible reaction to produce hydrogen.

$$\text{CH}_4\text{(g)} + \text{H}_2\text{O(g)} \xrightarrow[\text{CO(g)}]{\text{Ni catalyst, 800°C}}$$

CO produced is used to reduce unreacted steam to produce more hydrogen.

$$\text{CO(g)} + \text{H}_2\text{O(g)} \rightarrow \text{H}_2\text{(g)} + \text{CO}_2\text{(g)}$$

CARBON DIOXIDE

Commercial Manufacture

CO₂ is produced as a by-product in a lime kiln where limestone (calcium carbonate) is decomposed to produce lime.

$$\text{CaCO}_3\text{(s)} \rightarrow \text{CaO(s)} + \text{CO}_2\text{(g)}$$

Laboratory Preparation

In the laboratory it is conveniently prepared by the

$$\text{CaCO}_3\text{(s)} + 2\text{HCl(aq)} \rightarrow \text{CaCl}_2\text{(aq)} + \text{CO}_2\text{(g)} + \text{H}_2\text{O(l)}$$

Sodium Chloride Crystal

Formation of sodium chloride involves transfer of electron from chlorine atom to sodium atom. Chloride anions and Sodium cations thus formed are arranged in a regular lattice occupying all the octahedral holes. Each ion is surrounded by six ions of the other kind. This arrangement is known as cubic close packed (ccp).

Crystal Fracture: Pushing one layer against another in an ionic crystal brings ions of the same charge next to each other. The repulsions force the layers apart.

FCC Arrangement: Each face-centered lattice point gives exactly one half contribution, in addition to the corner lattice points, giving a total of 4 atoms per unit cell (8 × 1/8 + 6 × 1/2 = 4).

NaCl Statistics	
Formula	NaCl
Crystal System	Cubic
Lattice Type	Face-Centered
Space Group	Fm-3m, No. 225
Cell Parameters	a = b = c = 0.357 nm, z = 4
Atomic Positions	Cl: 4a, 4b Na: 4c, 4d, 8e
Density	2.167 g cm ⁻³
Melting Point	801°C
Alloyable Elements	Al, Ag, Au, Bi, Cd, Co, Cr, Cu, Fe, Ni, Pb, Pt, Sn, Zn
Interstitial Compounds	H, N, O, S, C, I, K, Rb, Tl

M. Charts, Preparation of Sodium Hydroxide (NaOH)

N. Charts, Preparation of Ammonia & Haber Process

Preparation of Sodium Hydroxide (NaOH)

Preparation of NaOH in Castner Kellner Cell

NaOH is commercially prepared by the electrolysis of sodium chloride in Castner Kellner Cell which has mercury as cathode and carbon as anode. A sodium amalgam is formed which is treated with water to give sodium hydroxide and hydrogen gas.

$$2\text{Na-Amalgam} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + 2\text{H}_2 + \text{H}_2$$

At cathode:
 $\text{Na}^+ + e^- \rightarrow \text{Na-amalgam}$

At anode:
 $\text{Cl}^- \rightarrow \frac{1}{2} \text{Cl}_2 + e^-$

Preparation of Sodium Carbonate (Ammonia Soda or Solvay Process)

Solvay process produces soda ash (Na₂CO₃) from brine and limestone. Calcium chloride is its major by product.

Principal Reactions:

- $\text{NH}_3 + \text{H}_2\text{O} + \text{CO}_2 \rightarrow \text{NH}_4\text{HCO}_3$
- $\text{NH}_4\text{HCO}_3 + \text{NaCl} \rightarrow \text{NaHCO}_3 + \text{NH}_4\text{Cl}$
- $\text{NaHCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{CO}_2 + \text{H}_2\text{O}$
- $\text{NH}_4\text{Cl} + \text{CaCl}_2 \rightarrow 2\text{NH}_3 + 2\text{CaCl}_2 + \text{H}_2$

Preparation of Ammonia & Haber Process

Natural Occurrence

Ammonia (NH₃) is produced by the natural decomposition of animal and plant matter in nature. It also occurs in the soil in the form of ammonium salts.

Laboratory Preparation of Ammonia

From Ammonium Chloride

Ammonia gas is usually prepared in the laboratory by gently heating ammonium chloride (NH₄Cl) and slaked lime [Ca(OH)₂]

$$2\text{NH}_4\text{Cl(s)} + \text{Ca(OH)}_2\text{(s)} \xrightarrow{\text{heat}} \text{CaCl}_2\text{(s)} + 2\text{NH}_3\text{(g)} + 2\text{H}_2\text{O(g)}$$

Manufacture of Ammonia by Haber Process

STEPS IN THE HABER PROCESS

- Hydrogen is obtained from methane and steam.
- Nitrogen is obtained from air.
- The two gases (N₂ & H₂) are mixed in ratio 1:3.
- Mixture is compressed to about 200 bar and heated to high temperature.
- Mixture is then goes to reactor containing beds of hot iron. The iron catalyzes the reaction:
 $\text{N}_2\text{(g)} + 3\text{H}_2\text{(g)} \rightleftharpoons 2\text{NH}_3\text{(g)}$
- The two gases (N₂, H₂ & NH₃) are mixed in ratio 1:3.
- Mixture of N₂, H₂ & NH₃ leaves the converter. It is cooled to condense ammonia. The N₂ and H₂ are pumped back to the converter.
- Ammonia is stored as liquid under pressure.

O. Charts, Prep. of Sulphur Dioxide & Sulphuric Acid

P. Charts, Preparation of O₂ and Liquefaction of Air

Prep. of Sulphur Dioxide & Sulphuric Acid

PREP. OF SULPHUR DIOXIDE

IN LABORATORY
SO₂ is readily generated by treating a sulphite with dil. sulphuric acid.
 $SO_3^{2-}(aq) + 2H^+(aq) \rightarrow H_2O(l) + SO_2(g)$

INDUSTRIAL PRODUCTION
Industrially it is produced as a by-product of the roasting of sulphide ores. The gas so produced is dried, liquefied under pressure and stored in steel cylinders.
 $4FeS_2(s) + 11O_2(g) \rightarrow 2Fe_2O_3(s) + 8SO_2(g)$

USES OF SULPHUR DIOXIDE

- Used to bleach wood, silk and wool pulp.
- Used as a food preservative and disinfectant.
- Used in the manufacture of sulphuric acid.
- Liquid SO₂ is used as a solvent to dissolve chemicals.

STEPS IN THE CONTACT PROCESS

Sulphur

- Burned in air to form SO₂.

Sulphur dioxide, SO₂
 $S(s) + O_2(g) \rightarrow SO_2(g)$

- Mixed with more air.
- Passed over four separate beds of catalyst (V₂O₅) at 450°C.

Sulphur trioxide, SO₃
 $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

- Absorption of SO₃ in concentrated sulphuric acid to form oleum.

Thick fuming liquid called oleum (H₂S₂O₇)
 $SO_3(g) + H_2SO_4(l) \rightarrow H_2S_2O_7(l)$

- Mixed carefully with water to get concentrated sulphuric acid, H₂SO₄ (aq).

PRODUCTION OF SULPHURIC ACID

Manufacture of Fertiliser

Automobile Applications

Tanning Leather

Paints and Pigments

Preparation of O₂ and Liquefaction of Air

Laboratory Preparation of Oxygen

BY HEATING COMPOUNDS CONTAINING OXYGEN

$2KClO_3 \rightarrow 2KCl + 3O_2$

BY ELECTROLYSIS OF WATER

$2H_2O \rightarrow 2H_2 + O_2$

Manufacture of Oxygen by Liquefaction of Air

MAJOR STEPS IN THE PROCESS

- Air is filtered to remove dust.
- Moisture & CO₂ are removed.
- Air is compressed at about 200 atmospheres.
- Compressed air is cooled & passed into coils contained in a chamber.
- Compressed air is allowed to expand in the chamber cooling the coils.
- Expanded gas is returned to the compressor with multiple cooling and expansion and compression steps resulting finally in liquefaction of the compressed air at a temperature of -196°C.
- Liquid air is allowed to warm to distil first the light hydrogens, then the nitrogen, leaving liquid oxygen.
- Multiple fractionators will produce 99.5 percent pure oxygen.

Disclaimer

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