

# CHART - 1 > Preparations of Gases - Hydrogen

## HYDROGEN

### • NATURE

Neutral gas, which is colourless, odourless, tasteless & non-toxic.

### • DENSITY

1000 ml. of gas at S.T.P. weighs 0.09 g. Hydrogen is the lightest gas known.

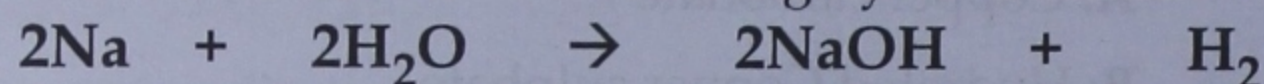
### • SOLUBILITY

100 vols. of water dissolves about 2 vols. at S.T.P. Hydrogen is slightly soluble in water.

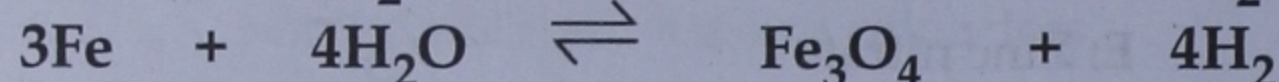
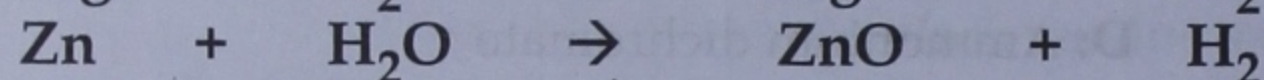
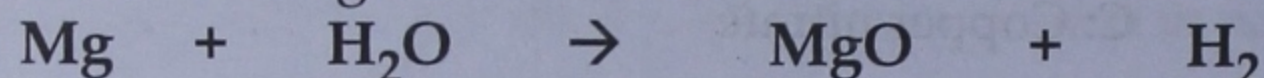
### • PREPARATION - General methods & Laboratory preparation

#### - General methods from - water

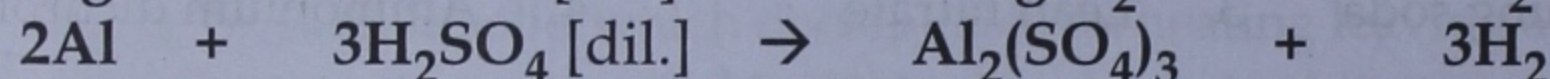
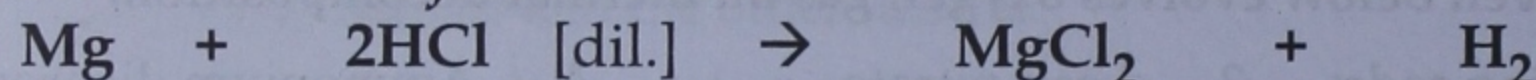
- From cold water - reaction highly exothermic.



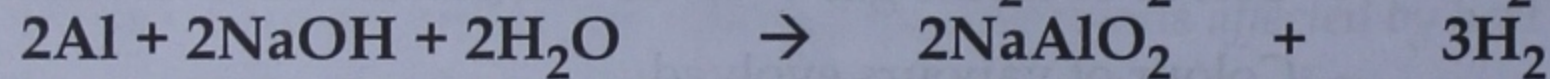
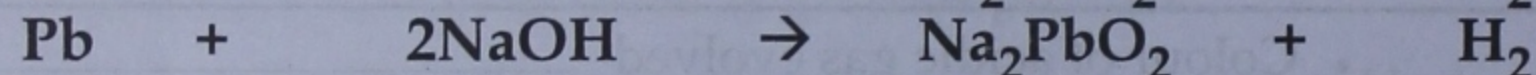
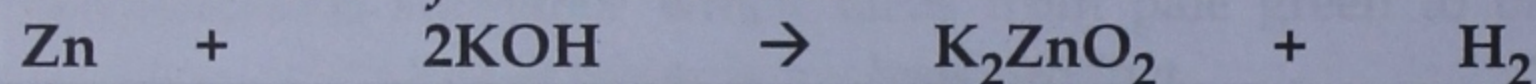
- From boiling water or steam



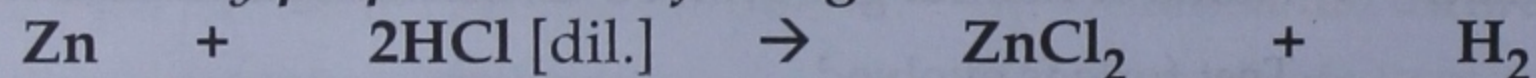
#### - General methods from - acids



#### - General methods from - alkalies



#### - Laboratory preparation - from granulated zinc and dil. HCl

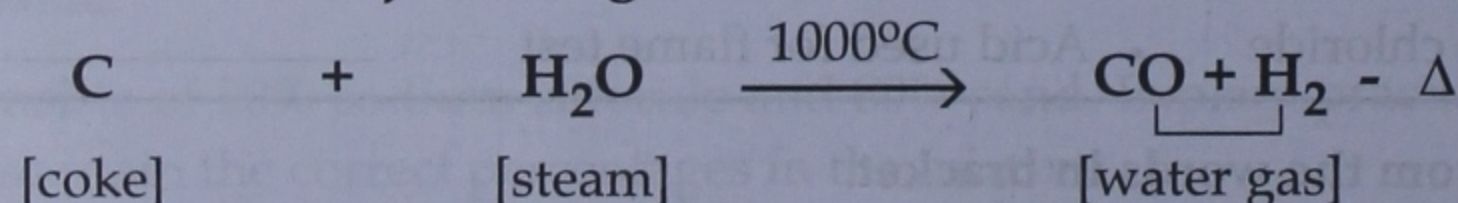


**Removal of impurities** - Impurities obtained are removed by passage through - washer bottles containing  $\text{AgNO}_3$ ,  $\text{Pb}(\text{NO}_3)_2$  &  $\text{KOH}$  solutions to remove - arsine, hydrogen sulphide &  $\text{NO}_2$ ,  $\text{CO}_2$ ,  $\text{SO}_2$  impurities respectively.

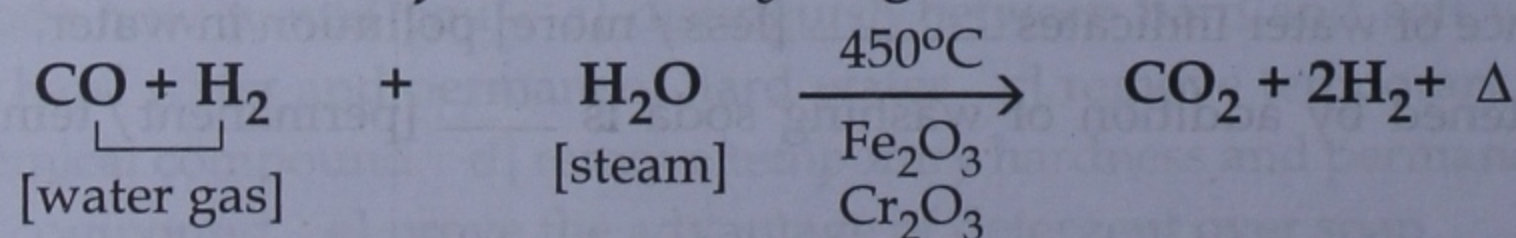
**Collection of gas** - Downward displacement of water.

### • PREPARATION - Industrial method - Bosch Process

#### - STEP I - Production of water gas



#### - STEP II - Reduction of steam to hydrogen



#### - STEP III - Recovery of hydrogen from the above mixture

- Removal of  $\text{CO}_2$  - By dissolving above mixture in water under pressure or in caustic potash soln.

- Removal of  $\text{CO}$  - By dissolving in ammoniacal cuprous chloride.

# Reference Chart - Preparations of Gases [Contd.]

GASES	NATURE	DENSITY [V. D. of air = 14.4]	SOLUBILITY [in water]	LABORATORY PREPARATION
1. NITROGEN	Neutral Colourless Odourless Tasteless Non-toxic	V. D. = 14 - Almost as heavy as air.	100 vols. of water dissolves about 2.3 vols. at 30°C. - Slightly soluble.	<ul style="list-style-type: none"> <li><math>\text{NH}_4\text{Cl} + \text{NaNO}_2 \rightarrow \text{NH}_4\text{NO}_2 + \text{NaCl}</math> Sodium nitrite</li> <li><math>\text{NH}_4\text{NO}_2 \rightarrow 2\text{H}_2\text{O} + \text{N}_2</math></li> </ul> <p>Collection of gas - Downward displacement of water</p>
2. OXYGEN	Neutral Colourless Odourless Tasteless Non-toxic	V. D. = 16 - 1.1 times denser than air.	100 vols. of water dissolves about 4 vols. at S.T.P. - Slightly soluble.	<ul style="list-style-type: none"> <li><math>2\text{H}_2\text{O}_2 \xrightarrow{\text{MnO}_2} 2\text{H}_2\text{O} + \text{O}_2</math> Hydrogen peroxide</li> <li><math>2\text{KClO}_3 \xrightarrow[\text{MnO}_2]{\Delta} 2\text{KCl} + 3\text{O}_2</math> Potassium chlorate</li> <li><math>2\text{Na}_2\text{O}_2 + 2\text{H}_2\text{O} \rightarrow 4\text{NaOH} + \text{O}_2</math> Sodium peroxide</li> </ul> <p>Collection of gas - Downward displacement of water</p>
3. CHLORINE	Acidic Greenish yellow Choking odour Sour Taste Poisonous	V. D. = 35.5 - 2.5 times heavier than air.	1 vol. of water dissolves about 2.7 vols. at 15°C. - Fairly soluble.	<ul style="list-style-type: none"> <li><math>\text{MnO}_2 + 4\text{HCl} \xrightarrow{\Delta} \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2</math> [conc.]</li> </ul> <p>Collection of gas - Upward displacement of air</p>
4. CARBON MONOXIDE	Neutral Colourless Odourless Tasteless Poisonous	V. D. = 14 - Almost as heavy as air.	100 vols. of water dissolves about 3.5 vols. at 0°C. - Slightly soluble.	<ul style="list-style-type: none"> <li><math>\text{H.COOH} \xrightarrow[\text{conc.}]{\text{H}_2\text{SO}_4} \text{CO} + \text{H}_2\text{O}</math> Formic acid</li> <li><math>\text{COOH} \xrightarrow[\text{conc.}]{\text{H}_2\text{SO}_4} \text{CO} + \text{CO}_2 + \text{H}_2\text{O}</math>   COOH [H<sub>2</sub>C<sub>2</sub>O<sub>4</sub>] oxalic acid</li> </ul> <p>Collection of gas - Downward displacement of water</p>
5. CARBON DIOXIDE	Slightly acidic Colourless Odourless Slight sour taste Non-poisonous	V. D. = 22 - 1.5 times heavier than air.	1 vol. of water dissolves about 1 vol. of gas. - Fairly soluble.	<ul style="list-style-type: none"> <li><math>\text{CaCO}_3 + 2\text{HCl} \xrightarrow{\Delta} \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2</math> [dil.]</li> </ul> <p>Collection of gas - Upward displacement of air</p>