Enzyme catalysis.

(1) Enzymes are complex nitrogenous substances secreted by low forms of vegetable animal organism.

(2) Enzymes are actually protein molecules of higher molecular mass.

(3) Enzymes form colloidal solutions in water and are very effective catalysts. They catalyze numerous reactions, especially those connected with natural processes.

(4) Numerous reactions occur in the bodies of animals and plants to maintain the life process. These reactions are catalyzed by enzymes. The enzymes are thus, termed as **bio-chemical catalysts** and the phenomenon is known as **bio-chemical catalysis**.

(5) **Nitrogenase** an enzyme present in bacteria on the root nodules of leguminous plants such as peas and beans, catalysis the conversion of atmospheric N_2 to NH_3.

(6) In the human body, the enzyme carbonic anhydrase catalysis the reaction of CO_2 with H_2O,

$$CO_2(aq) + H_2O(l) \rightleftharpoons H^+(aq.) + HCO_3^-(aq.)$$

The forward reaction occurs when the blood takes up CO_2 in the tissues, and the reverse reaction occurs when the blood releases CO_2 in lungs.

Catalysts in industry

Process	Catalyst
Haber's process for the manufacture ammonia. $N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$	Finely divided iron. Molybdenum as promoter and 200 atmospheric pressure and 450-500°C temperature.
Ostwald's process for the manufacture of nitric acid. $4NH_3(g)+5O_2(g) \rightarrow 4NO(g)+6H_2O(g)$ $2NO(g)+O_2(g) \rightarrow 2NO_2(g)$ $4NO_2(g)+2H_2O(l)+O_2(g) \rightarrow 4HNO_3(l)$	Platinized asbestos and temperature 300° C.
Lead chamber process for the manufacture of	Nitric oxide

sulphuric acid. $2SO_2(g) + O_2(g) \square 2SO_3(g)$ $SO_3(g) + H_2O(l) \rightarrow H_2SO_4(l)$	
Contact process for the manufacture of sulphuric acid. $2SO_2(g) + O_2(g) \square 2SO_3(g)$ $SO_3(g) + H_2SO_4(l) \rightarrow \underset{\text{oleum}}{H_2S_2O_7(l)}$ $H_2S_2O_7(l) + H_2O(l) \rightarrow 2H_2SO_4(l)$	Platinized asbestos or vanadium pentoxide (V_2O_5). Temperature 400-450^0 C.
Deacon's process for the manufacture of chlorine. $4HCl(g) + O_2(g) \rightarrow 2H_2O(l) + 2Cl_2(g)$	Cupric chloride $(CuCl_2)$. Temperature 500° C.
Bosch's process for the manufacture of hydrogen. $\underbrace{CO + H_2}_{water\ gas} + H_2O(g) \rightarrow CO_2(g) + H_2O(g)$	Ferric oxide (Fe_2O_3) + chromic oxide as a promoter. Temperature 400-600° C.
Synthesis of methanol. $CO(g) + 2H_2(g) \rightarrow CH_3OH(l)$	Zinc oxide (ZnO) +chromic oxide as promoter. Pressure 200 atmospheres and temperature 250° C.
Hydrogenation of vegetable oils. $\text{Oil}(l) + \text{H}_2(\text{g}) \rightarrow \text{Vanaspati ghee (s)}$	Nickel (finely divide). Temperature 150-200°C. High pressure.
Manufacture of ethyl alcohol by fermentation of molasses (sugar solution). $C_{12}H_{22}O_{11}(l) + H_2O(l) \xrightarrow{\text{Invertase}}$ $\underset{\text{glucose}}{C_6H_{12}O_6(l)} + \underset{\text{fructose}}{C_6H_{12}O_6(l)}$ $C_6H_{12}O_6(l) \xrightarrow{\text{Zymase}} 2C_2H_5OH(l) + 2CO_2(l)$	Invertase enzyme and zymase (yeast) enzyme. Temperature 25-30° C. Conversion occurs in 2 or 3 days.
Manufacture of ethyl alcohol from starch. (a) $\text{Starch}\ (l) \xrightarrow{\text{Diastase}} \text{Maltose}\ (l)$ (b) $\text{Maltose} \xrightarrow{\text{Maltase}} \text{Glucose} \xrightarrow{\text{Zyamase}} \text{Alcohol}$	Germinated barley (diastase enzyme). Temperature 50- 60° C. Yeast (maltase and zyamase enzymes). Temperature 25-30^0 C.
Manufacture of acetic acid from ethyl alcohol $C_2H_5OH(l) + O_2(g) \longrightarrow CH_3COOH\ (l) + H_2O(l)$	Mycoderma aceti. Temperature 25-30° C.
Bergius process for the synthesis of petrol from coal. $\text{Coal} + H_2(g) \rightarrow \text{Mixture of hydrocarbo ns}$	Ferric oxide (Fe_2O_3). Temperature 475°C and pressure 200 atmosphere.