Zeolite (shape selective catalysis).

(1) Zeolite are alumino–silicates of the general formula, $\boxed{M_{x/n}[AlO_2]_x.(SiO_2)_y.mH_2O}$, where, M may be simple cation like Na^+, K^+ or Ca^{2+}, n is the charge on the simple cation, m is the number of molecules of water of crystallization.

(2) Some well-known zeolites are as follows,

Erionite $\longrightarrow Na_2K_2CaMg(AlO_2)_2(SiO_2)_2.6H_2O$

Gemelinite $\longrightarrow Na_2Ca(AlO_2)_2(SiO_2)_4.6H_2O$

Faujasite (natural) $\longrightarrow Na_{56}(AlO_2)_{56}(SiO_2)_{136}.250\,H_2O$

ZSM-5 $\longrightarrow H_x[(AlO_2)_x(SiO_2)_{96-x}].16\,H_2O$

Linde-A (synthetic) $\longrightarrow [Na_{12}(AlO_2)_{12}(SiO_2)_{12}.27\,H_2O]_8$

(3) The characteristic feature of zeolites is the openness of the structure, which permits cavities of different sizes.

(4) The open structure is provided by silica in which aluminum occupies x/(x+y) fraction of the telrahedral sites.

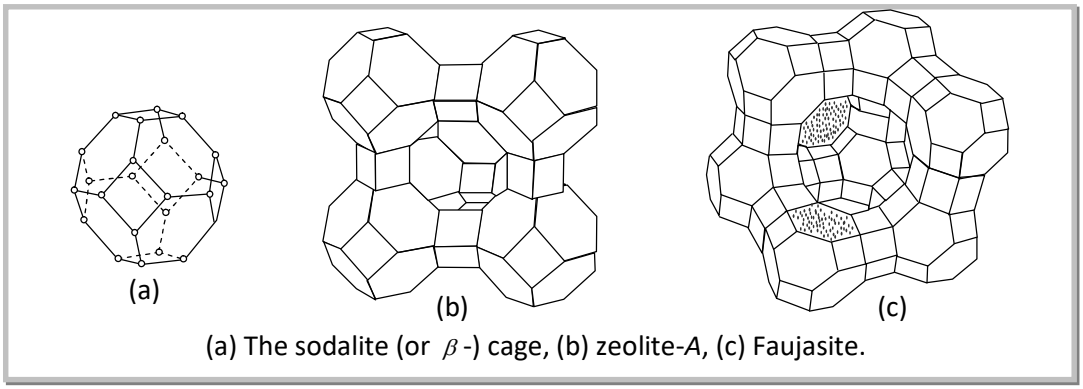
(5) The negative charge of the aluminosilicate framework is neutralized by the replaceable cations.

(6) The void space forms more than 50% of the total volume, which is occupied by water molecules.

(7) The reaction- selectivity of zeolites depends upon the size of cavities (cages), pores (apertures) and the distribution of pores in the structure. The pore size in zeolites generally varies from 260 pm to 740 pm.

(8) The building block of zeolites is a truncated octahedron. This is also called the sodalite cage (or β - cage).

(9) Tetrahedral atom denoted by open circles in fig (a) are present at the corners of polygons with the oxygen atoms approximately half way between them.



(a) The sodalite (or β-) cage, (b) zeolite-*A*, (c) Faujasite.

(10) Zeolite have high porosity due to the presence of one, two, or three dimensional networks of interconnected channels and cavities of molecular dimensions.

(11) Accordingly zeolite - A is formed by linking sodalite cages through double four-membered rings, Faujasite (Zeolite X and Y) is formed by linking the sodalite cages through double six-membred rings.

(12) Many Zeolites occur in nature and they can be readily prepared in laboratories.

(13) There is a new class of highly siliceous zeolites with an optimal pore diameter of 550pm. ZSM-5 is one such zeolite having the formula. $[H_x(AlO_2)_x.(SiO_2)_{96-x}].16H_2O$

(14) The zeolite catalyst ZSM-5 converts alcohols to gasoline (petrol) by dehydrating the alcohol and producing a mixture of wide variety of hydrocarbons. The shape selectivity of this catalyst is demonstrated by data given in table.

	Input stock			**Input stock**	
Product (in %)	**methanol**	**n-heptyl alcohol**	**Product (in %)**	**methanol**	**n-heptyl alcohol**
Methane	1.0	0.0	i- Pentane	7.8	8.7
Ethane	0.6	0.3	Benzene	1.7	3.7

i-butane	18.7	19.3	Toluene	10.5	14.3
n-butane	5.6	11.3	Xylenes	17.2	11.6