

## - QUESTION -

Discuss in detail the soft and hard acid base (SHAB) concept with suitable examples. (10 Marks)

## - ANSWER -

### Introduction:

Soft and Hard acid base concept (SHAB) is based on the polarization ease and difficulty of the acid and base. SHAB concept was given by R.G Pearson in 1963. SHAB concept defined acids as soft and hard on the basis of size, electronegative and negative charge. Bases are also categorized as soft and hard on the basis of size, electronegativity and negative charge/oxidation state. SHAB has application as SHAB principle.

# Soft acids and bases:

Acids and bases are termed soft by Pearson due to following mentioned features

## ⇒ Size

Soft acids and bases are large in size. - The large size supports the ease of polarization of anion/cation.

## ⇒ Electronegativity

Acids and bases are soft due to low electronegativity. This makes polarization easy.

## ⇒ Oxidation state / Negative charge

Oxidation state of soft acids is low. And in case of soft bases they have high negative charge



## Examples of Soft Acids and Bases

### Soft Acids

Soft acids are cationic elements.

e.g.  $Ru^{+}$ ,  $Rh^{+}$ ,  $Cu^{+}$ ,  $Ag^{+}$

### Soft Bases

Soft bases are anionic elements

e.g.  $Br^{-}$ ,  $I^{-}$ ,  $S^{2-}$

The above elements (are elements) of periodic table from transition metals, halogens. All of them are large in size, low oxidation state and high electronegativity.

~~(Examples of)~~

## Hard acids and bases.

Acids and bases are considered hard on the basis of hard (difficulty in polarization). Pearson explained the difficult polarization of ions of alkali metals, alkaline earth metals and lighter transition metals on the basis of following:

→ Size

$(\oplus)$  } • small size of hard acid/base

The small size of acids and cat bases (cations and anions) is responsible for difficult polarization thus making them hard acids and bases.

→ Electronegativity

The small size increases the electronegativity of ions. Thus polarization becomes difficult.

→ Oxidation state / Negative charge

The oxidation state of <sup>hard</sup> soft acids is high and low negative charge of hard bases.

All above properties of ions categorize them as hard acids and bases.



## Examples of Hard Acids and Bases

### Acids

Hard acids are cationic <sup>elements</sup> <sub>elements</sub>

e.g.  $\text{Na}^+$ ,  $\text{H}^+$ ,  $\text{Li}^+$ ,  $\text{Cr}^{2+}$  etc.

### Bases

Hard bases are anionic elements

e.g.  $\text{F}^-$ ,  $\text{O}^{2-}$ ,  $\text{N}^{3-}$ ,  $\text{CH}_3\text{COO}^-$

The above elements of periodic table are from group IA (alkali metals), group IIA (alkaline earth metals) and lighter transition metals.

