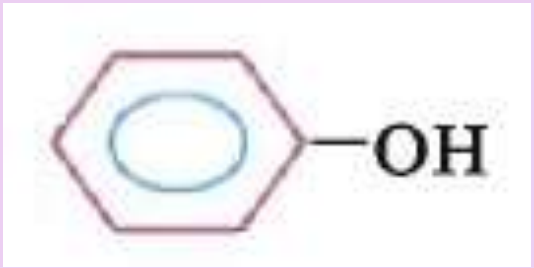
Acidity of Alcohols and Phenols

CH_3OH



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INTRODUCTION

- **Alcohols are the organic compounds that contain alkane hydrocarbon chain in which one hydrogen is replaced with hydroxyl group.**
- **If in alkane chain one, two, three hydroxyl group is present then the alcohol is termed as monohydric, dihydric, trihydric alcohol respectively. And if more than three hydroxyl groups are present than it will be known as polyhydric alcohol.**

CLASSIFICATION

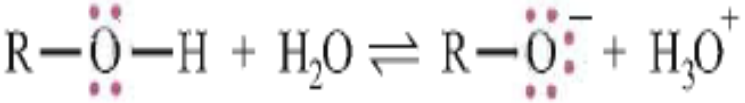
The classification of alcohols is carried out in three types depending on the carbon which has been attached to the hydroxyl group in structure of alcohol, viz (1) Primary (1^0) alcohol, (2) Secondary (2^0) alcohol and (3) Tertiary (3^0) alcohol.

(1) Primary (1^0) alcohol : Alcohol, in which the hydroxyl group is attached to primary carbon is called primary (1^0) alcohol.

(2) Secondary (2^0) alcohol : Alcohol, in which the hydroxyl group is attached to secondary carbon is called secondary (2^0) alcohol.

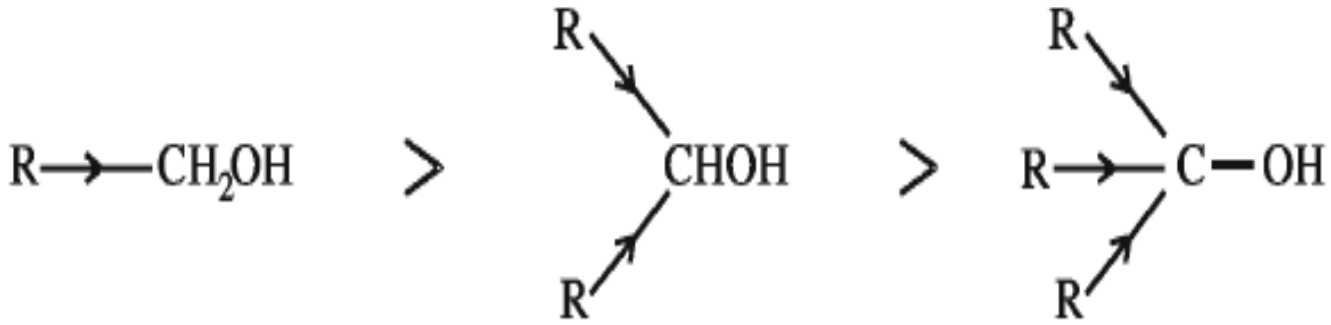
(3) Tertiary (3^0) alcohol : Alcohol, in which the hydroxyl group is attached to tertiary carbon is called tertiary (3^0) alcohol.

Acidity of Alcohols : Aqueous solution of alcohols possess slight acidic property due to polar O–H bond present in them. Alcohols have acidic property similar to that of water. Most of alcohols (except methanol) are less acidic than water.



Alcohol Alkoxide ion

In alcohol compounds, an electron releasing group–R(–CH_3, –C_2H_5) increases the electron density of O–H bond, so results in decrease of the polarity of O–H bond. As a result the acidic property decreases. Thus, the order of acidic strength of alcohol compounds is,



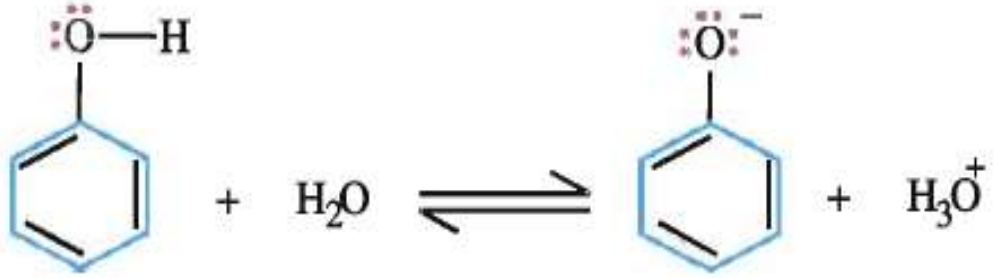
Primary alcohol Secondary alcohol Tertiary alcohol

Phenols

Phenols are the substances that contain hydroxyl group directly attached to the phenyl ring.

Phenols are more acidic than alcohol due to the resonance that stabilize the phenoxide ion.

Acidity of phenol : Aqueous solution of phenol changes blue litmus paper into red. Moreover it is neutralised with solution of sodium hydroxide, but not with a solution of sodium carbonate. It indicates that phenol possesses weak acidic nature. Polar O–H bond present in phenol is responsible for acidity.

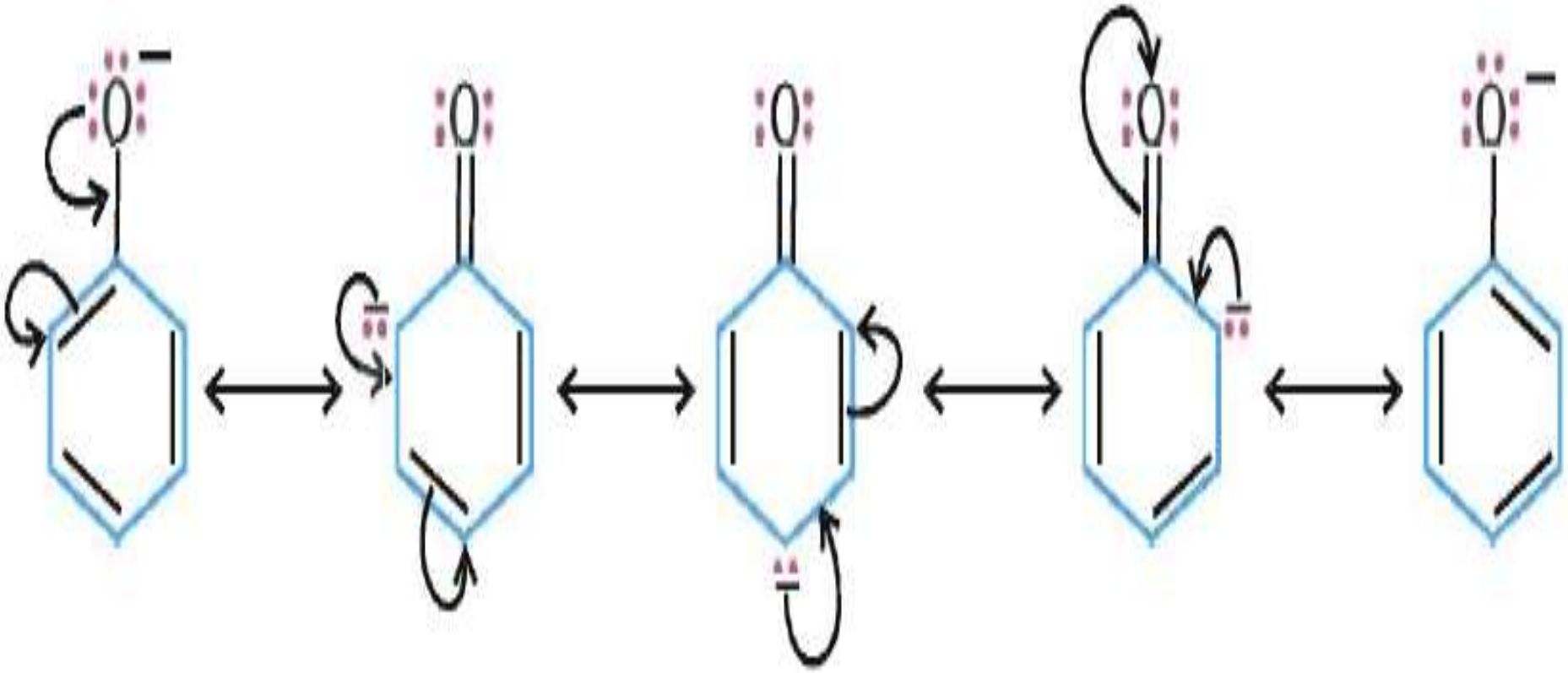


Phenol Phenoxide ion

Here naturally a question will arise that which of the two from alcohol and phenol will have more acidity ? We will think about this. As we discussed previously the alkoxide ion is formed from alcohol.

Alcohol Alkoxide ion

In alkoxide the negative charge is localised on oxygen atom, that is its resonance forms are not possible. In phenoxide ion the negative charge on an oxygen atom becomes delocalised. Due to this more than one resonance forms of phenoxide ion are possible. Therefore stability of phenoxide ion is higher than that of alkoxide ion.



Due to higher stability of phenoxide ion, its reaction with H_3O^+ to form phenol means reverse reaction is less easy as compared to alkoxide ion. So, concentration of H_3O^+ is higher in aqueous solution of phenol than in aqueous solution of alcohol. Therefore **aqueous soultion of phenol is more acidic than alcohol.**