CHAPTER - 1

INTRODUCTION

Valency is the combining capacity of an element or a radical. Some may be monovalent, some divalent and some trivalent etc. A list of these is given below :

Monovalent (one valency)

–H	hydrogen	–Na	-	sodium
–OH	hydroxyl	–K	-	potassium
–Cl	chloride	–Hg	-	mercurous
–Br	bromide	–Ag	-	silver
–I	iodide			
$-NO_3$	nitrate	$-CH_3^-$	-	methyl (alkyl-symbol R)
$-HCO_3$	bicarbonate	$-C_6H_5^-$	-	phenyl (aryl)
$-NH_4$	ammonium	$-C_6H_5CH_2^-$	-	benzyl (aralkyl)

Divalent (two valencies)

SO_4	<	sulphate	Hg	=	mercuric
CO_3	<	carbonate	Ba	=	barium
O	=	oxygen	Zn	=	zinc
Mn	=	magnanese	Pb	=	lead
Mg	=	magnesium	Fe	=	ferrous
Ca	=	calcium			

Trivalent (three valencies)

N	(either 3 or 5)	nitrogen	Cr	chromic
Sb	"	antimony	Fe	ferric
As	"	arsenic	Al	aluminium
P	"	phosphorus		

Tetravalent (four valencies)

C. carbon

A monovalent element or radical, since its valency is one, will combine with only one equivalent of another monovalent element or radical.

Example : NaCl

Likewise a divalent element or radical, which has two valencies, will combine with one equivalent of another divalent element or radical.

Example :- $CaCO_3$. Like this for trivalent elements etc.

Two equivalents of a monovalent element or radical will combine with one equivalent of a divalent element or radical.

Eg :- Na_2CO_3

Similarly three equivalents of a monovalent element or radical will combine with one equivalent of a trivalent element of radical, eg: - $FeCl_3$ (ferric chloride). Likewise four equivalents of a monovalent element will combine with one equivalent of a tetravalent element.

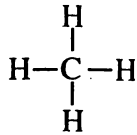
Eg : - CH_4 (Methane).

Therefore to understand the structure of any substance a knowledge of the valencies of the components involved is necessary.

In the structure of organic compounds, the elements or radicals are linked by covalent bonds which is indicated by a line drawn between the components.

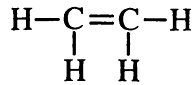
Eg : - CH_4.

Structural formula



In this structure, the four valencies of carbon are fully satisfied by four monovalent hydrogen atoms. However when the valencies are not fully satisfied like this, a double bond or a triple bond may form part of the structure.

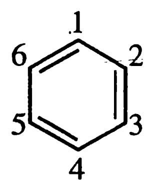
Eg : - Ethylene



Here two hydrogen atoms satisfy two valencies of each of the two carbon atoms. The other two valencies are satisfied by setting up another link between the carbon atoms themselves. Therefore a double bond comes into existence. In the same way acetylene $CH \equiv CH$ has one valency of each carbon satisfied by one hydrogen and the other three valencies by the carbon atoms between themselves by establishing a triple bond.

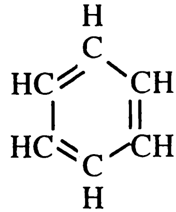
Benzene is a ring compound with the formula.

C_6H_6 or



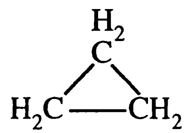
There are three double bonds in the structure. Benzene has 6 carbon atoms to each of which is attached a single hydrogen atom. If each carbon atom is attached to two carbon atoms, one on either side, even then including the hydrogen atom only three valencies are satisfied. Therefore a double bond comes into being on one side of the carbon atom so that each carbon atom may have all the four valencies accounted for.

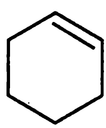
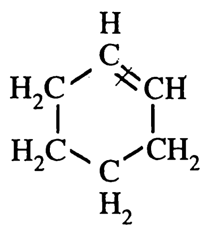
So benzene can also be depicted as below :

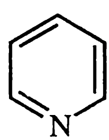
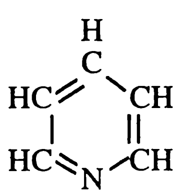


Usually the hydrogen atoms are not indicated in the structures. Therefore it is better to calculate the number of other atoms or radicals and if any valencies are still left unsatisfied, it may be safely assumed that in the absence of a double or triple bond, the valencies are satisfied by the required number of hydrogen atoms. Even if there is a double bond, there is scope for the presence of hydrogen atoms also subject to the condition that the number of valencies satisfied does not exceed the valency number of the element.

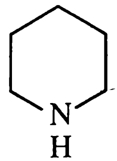
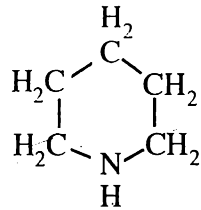
Examples :

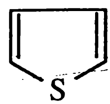
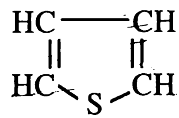
(1) Cyclopropane  or 

(2) Cyclohexene  or 

(3) Pyridine  or 

In this structure please note the trivalent nitrogen atom whose three valencies are satisfied by a single bond with one carbon atom on one side and by a double bond with another carbon atom on the other side.

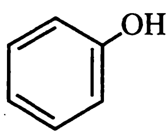
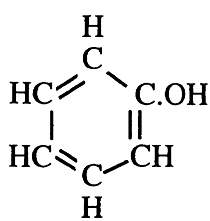
(4) Piperidine  or 

(5) Thiophen  or 

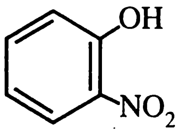
Piperidine is prepared by reduction of pyridine. Note that there are no double bonds now. The carbon atoms and the nitrogen atom have each acquired one hydrogne atom more. Since all the valencies are satisfied now, there is no need for double bonds.

Another point to be noted is that the atoms and radicals are substituents, that is they come in place of another atom or radical.

Consider the structure of phenol.

 or 

In this structure the -OH group has come in place of a hydrogen atom. It has replaced a hydrogen atom. The structural formula can also be written as C_6H_5OH. If another substituent such as a nitro group is introduced into the nucleus, it will take the place of a hydrogen atom at another position.



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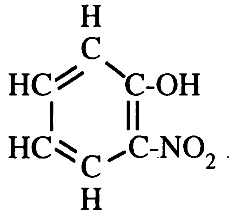

or $C_6H_4(OH)NO_2$