

good morning let us continue our discussion about valence bond theory let us see what is the nature of the bonding in ammonia molecule here ah you have to start with the nitrogen

so what is the electronic configuration hydrogen is one has two $1s^2$ two $1p^3$

so you can write $1s$ level this is $2s$ level containing 2 electrons and then there is a p orbital $2p$ orbital and then it has some one electrons here and here now it has to hybridize

so that sp^3 hybridization is obtained here

so this orbital to form three covalent bonds in addition there is a lone pair

so all of them should be accommodated in the bonding

so you need to have sp^3 hybridization how does it work

so here you have $2s$ orbital and $2p$ orbital $2s$ orbital is completely filled however $2p$ orbitals are singly occupied they can hybridize

so hybridization hybridized and can give four equivalent hybridized orbitals of this type this is sp^3 hybridized hybrid orbital you can notice that which are the orbitals hybridized it is not that if you take a carbon CH_4 you have all okay there is a promotion of electron from $2s$ orbital to $2p$ orbital that is some for carbon you have a $2s$ orbital and then you have a $2p$ orbitals

so here there is a this electronic configuration of the carbon and then one of the electron of the two s orbitals should go to this p a $2p$ orbital and then then it has two sp hybridization going on

so the hybridization occurs there between the singly occupied s and p orbitals on the other hand here the hybridization occurs between $2s$ orbital which is completely filled and two p orbitals which are singly occupied

so it is not necessary that for hybridization to occur that all the orbitals should be singly occupied okay hybridization can take place between orbitals of this type

so you have sp^3 hybridized orbital in which one of the sp^3 hybridized orbitals is occupied by a lone pair of electrons

so that means it is completely filled and then you have remaining three sp^3 hybridized orbitals available for forming bond

so you can draw the structure in this way

so you have a nitrogen and then you have a one lobe another lobe another lobe and another lobe because it is sp^3 hybridized the geometry is a tetrahedral

so you have to draw the hybridized orbital in a tetrahedral arrangement

so that these are the lobes of the sp^3 hybridized orbital which are pointed towards the corners of your tetrahedron

so this is available for forming bond

so you have one then hydrogen atom hydrogen one orbital and then another hydrogen one orbital and then you have hydrogen one orbital okay

so they form three

so three bonds and then the remaining lone pair okay you have has to be put here then then this is equal to this this structure i am redrawing that structure here that's all

so as you can see here the overlap of the atomic orbitals between the sp^3 hybridized orbital of nitrogen with hydrogen one orbital there are like that three like that

so now let us see

so the structure of them or the molecular geometry of the ammonia is is not a tetrahedral it is a trigonal bipyramidal

so trigonal pyramidal ok now let us see another molecule water H_2O ok for the central atom is oxygen

so if you look at the electronic configuration of oxygen one has two $2s^2$ two

two p four

so uh okay energy level is two s orbital containing two electron and then you have p orbital containing four electrons like this now um they can undergo

so there is no need of a promotion of electrons because there are already two orbitals containing one electron each

so what will happen is then it has under hybridization hybridized and generating four equivalent sp^3 hybridized orbitals which contains lone pairs in two of the orbitals and two orbitals contains one electron each

so it is a sp^3 hybridized orbital of the oxygen atom hybrid orbital now you can see again that hybridization takes place here this is two p orbital takes place between two s orbital which is completely filled and two pair orbital in which one of them ah for example this p x orbital is completely filled

so they hypothesized to give you four equal and sp^3 hybridized orbital in which two of them are occupied by two electrons and then you have uh two um sp^3 hybridized orbital containing one electron each which is available for forming with for forming a covalent bond with hydrogen

so you have then because it is sp^3 hybridized orbital

so the it's a tetragonal geometry you can draw the structure like this okay these are the four sp^3 hybridized orbital and then you have hydrogen okay then that hydrogen can overlap with the sp^3 hybridized orbital and then

so this is a hydrogen oneness orbital and then you have hydrogen oneness orbital

so there are two ok covalent sigma bonds are covalent bonds are formed and these two orbital contains lone pair one each

so you have um a structure of bend structure molecule the geometry of the molecule is a bend

so that way the molecular orbital there's orange valence bond theory um gives explanation for the observed geometry its bend because of the overlap of the two um sp^3 album sp^3 hybridized orbital with two hydrogen oneness orbitals in this way

so because they are adjacent to each other each other and there is a repulsion between between the lone pairs between these two lone pairs they push these two covalent bonds together as a result the bond angle

so the angle between this hydrogen and this hydrogen is not one zero nine point five it is lesser than that because of the repulsion between the um between lone pairs lone pairs as well as a lone pair bonding electron pairs now let us see further more about um balanced bond trim valence bond method of treating bonds in other molecules for example ethe it is a you know the structure this two CH_3 groups are bonded through carbon CH groups are bonded together this is ethan now um because the carbon is connected to four atoms

so the carbon has a sp^3 hybridization similarly this carbon has um sp^3 hybridization

so then you know that from your knowledge about the CH_4 okay there are four sp^3 hybridized orbital on the carbon

so similarly in this carbon you have four sp^3 hybridized orbital three of them is used three of them are used for forming three equivalence bonds with three hydrogen atom and then the remaining one is used to form a you know form a covalent bond with another carbon atom of this of adjacent another carbon atom of this one

so there is a covalent bond bond formula between the two carbon atoms

so that can be drawn in this way carbon uh you have lobes sp^3 hybridized lobes and then there is a loop okay these three are used for forming covalent bonds with hydrogens hydrogen oneness orbital this is hydrogen oneness orbital this is hydrogen oneness orbital the remaining this hyposp hybridized orbital use used

is used to form a sigma bond with the adjacent carbon atom

so you have a carbon atom which also has the same sp^3 hybridized orbital and then you have here three more sp^3 hybridized orbital and then these are used to form um sigma bond or colon bond with the hydrogen atom

so this is a i have a sigma bond

so this is equal to ah this structure like that

so it's clear now

so the bonds are formed essentially by overlap of the atomic orbitals between hydrogen 1 orbital and carbon sp^3 sp^3 hybridized orbital and then there is a sigma bond formed between sp^3 hybridized orbital of one carbon with the sp^3 hyper hyper hybridized orbital of the another carbon

so that there is a sigma bond between them now let us see pi bonds

so far we have seen sigma bonds let us see pi bonds what is pi bonds

so you know that what is sigma bonds see sigma bonds can form ok by um overlap of the atomic orbital which are the atomic orbitals s orbital can overlap with another s orbital to give a sigma bond ok

so this is a sigma bond ss overlap this is yes yes overlap okay

so after that ah this can be written as like that this is are the center of the nucleus

so this is a intra nuclear axis and these are the nuclei of two hydrogen atoms for example

so you have here everywhere it is positive

so this ok this this is a sigma orbital sigma bond ok is a sigma bond it is a sigma bond it is this bond is symmetrically sorry cylindrically symmetrical this sigma bond is cylindrically symmetrical and then same sigma bond could could also form by the overlap of the hydrogen oneness orbital ah with p orbital or any s orbital okay this is a p orbital okay plus plus this is plus everywhere sign of the wave function should be given sorry this is minus this is minus and then they give um like this this is positive ok this is negative negative

so this is again a sigma bond formed between s orbital and p r beta similarly m ok overlap of the p orbital can also give um a sigma bond of of this type this is a pp overlap this is yes p overlap okay

so this is a ah again a sigma bond is formed by warlap at the pierpet

so pure okay we have seen how sigma bonds could form it it could form by the overlap of the two s orbital by the overlap of the s orbital the p orbital are two p orbitals now um um you know that if you take a molecule a and b then for any molecule ah one has to fix the axis okay then um we can um find out the what are the orbitals overlapping and and then the bonding pattern we can find out so if you take axis of this like this okay

so let us see we have to fix the axis for this molecule let us say this is z axis this is y axis this is x axis now if you fix axis for this molecule as them um okay as as as this axis if you fix this axis as z axis then okay then the orbital then the atom a should use its its um p x p z orbital to form a sigma bond

so there is m

so um for example there is a p orbital lying along the z axis

so it is a p e x orbital

so there is similarly there is an orbital lying along the y axis this is a p x orbital these are p y orbital then there is orbital lying along the x axis and then it is a p x orbitals

so if you fix the axis of a b molecule as a z axis then the atom a and as well as atom b should use the orbital lying along the axis

so that yes sigma bond is formed then the remaining x and y orbitals p x and p y orbitals cannot be used to form a sigma bond they have to have to be used for

forming a pi bond

so pi bonds are formed by p x or p y orbitals or by both in some cases both are used but if we fix the axis of a b molecule as y axis then the a and b ok the atom a should use the orbital lying along this axis um to form a sigma bonds

so then other axis then other two axis other two orbital lying along the other on the other axis can be used for forming a pi bonds

so conventionally it is some a b axis internuclear axis is taken as a z axis

so accordingly the p x p sorry this is a p z axis or this is a p z orbital is used to form a sigma bond other two orbitals p x and p y are for forming ah pi bonds

so um

so pi bonds are formed in general by the um parallel of overlap of the atomic orbitals which is ah in contrast to the sigma bonds as you can see here a sigma bond is formed by the head on overlap these are all head on overlaps in general okay why it is called head-on overlap if you consider the p orbital head this one has a head which is overlapping with the head of the other orbital

so it is a head-on overlap for p orbital everywhere it is head because everywhere it is positive

so that's why it is called head on overlap this type of axial okay um overlap is very good for forming a bond and the overlap is more as it is as a result the bond formed out of that is stronger and shorter

so um ok

so in general sigma bonds are stronger than pi bonds because pi bonds are formed by by parallel overlap

so let us say this is a px orbital px orbital combining with another px orbital then you can have like that plus plus minus minus these are the two atoms

so here this is the inter nuclear axis

so this is the internal axis here atom a here atom b

so they overlap

so as you can see here fiber

so this is the pi bond by parallel overlapping

so in this case pi bond is formed by the parallel overlap of the suitable p orbitals here it is p x sometime p y if it is a p x

so you can also have a pi of pi bond um if you take ah p y orbital

so let us say its oriented in this way ok

so this plus this minus and then there is a p um y orbital ok

so here they can combine to form a pi bonds of this type ok

so this is a again a pi bond formed by p y orbitals this is p x orbitals here the overlap is less as a result the bond strength is lower compared to sigma bonds probably because um when they overlap there will be a interaction repulsion between the two nuclei of this here there is a nuclear there is a nuclear

so that they cannot get closer too much

so that the warlock is less compared to a head-on overlapping there is a direct head-on overlap which leads to a stronger bond but here it is only parallel

so that means these two orbitals are parallel to each other but it is perpendicular to the internuclear axis

so this is intra nuclear axis this is a inter nuclear axis this is inter nuclear axis and this is these two orbitals are parallel to each other

so so and and it is perpendicular to the internuclear axis

so as a result the okay then this can be described in ah in this way

so you have x internuclear axis two atoms are here and then they form clouds electron clouds of this type ok

so here is a positive this is negative

so this ok this internuclear axis contains the two nuclei and then on top of that

so that forms a plane there is a plane containing these two atoms then above the plane there is some electron cloud below the plane there is some electron cloud

so this these two are called one pi bonds okay these are all pi bonds which are represented in this type of an elongated dumbbell shape now let us see bonding nature in ethene or ethylene now you know that for carbon if you look at the carbon carbon is linked to three atoms two hydrogens one carbon atom

so carbon is sp^2 hybridized orbitals now if you take electronic configuration of the carbon this is a $2s$ orbital containing two electrons and then you have a two p orbitals containing two electrons then it has to undergo sp^2 hybridization sp^2 hybridization then it has to undergo first promotion of electron to here and then it has to undergo sp^2 hybridization then you will have

so promotion of electron and hybridization then that will lead to three equivalent sp^2 hybrid orbitals containing one electron each and there is one more p orbital which is not hybridized containing one electron ok this orbital can be p_x or p_y orbital

so electron is promoted to this level and then it undergoes hybridization to give three sp^2 hybridized orbitals containing one electron and they are equal in energy and there is one more orbital which is not hybridized which lies there which is higher in energy which lies there that is a pure p orbital it can be a pure p orbital one of the p orbitals p_x or p_y orbital now carbon could use these three sp^2 hybridized orbitals to form three bonds ok

so you have a carbon

so when it is sp^2 hybridization it is a trigonal planar geometry

so you have a trigonal planar geometry this is sp^2 hybridized orbital and then each one two of them forms a sigma bond with hydrogen one sp^2 orbital hydrogen one sp^2 orbital yes sigma bond is formed between carbon and hydrogen this is hydrogen this is hydrogen and then another sp^2 hybridized orbital is used to form a sigma bond with another adjacent CH_2 group which also contains sp^2 hybridized orbitals sp^2 hybridized orbital

so this is a sigma bond by sp^2 sp^2 overlap here sp^2 hydrogen one sp^2 orbital here again sp^2 hydrogen one sp^2 orbital

so this is how it is carbon here carbon and then you have hydrogen and we have hydrogen and you have hydrogen okay but

so what we have seen

so far is the formation of sigma bonds but if you in the structure there is another bond okay because carbon has a four valence only three are written one more valence is not satisfied

so you have to know that there is a p orbital lying on each carbon atom

so there is a p orbital here there is a p orbital here it can be p_x or p_y or p_z which can overlap with the same p_x p_y orbital lying on the other adjacent carbon atom ok

so they can interact and they can interact ok then there is a pi bond formation this is pi bond okay that pi bond is above the plane formed by the four CH_2 sigma bonded CH_2

so these two hydrogen and carbon and this carbon two hydrogens are in a plane above that plane there is a cloud of electrons and below the plane there is a cloud of electrons that cloud of electrons is called pi bonds a pi bond is formed by the overlap of the p_x or p_y orbital of the one carbon atom with the p_x p_y orbital of the other carbon atom and it also contains sigma bond

so in ethylene um there is a one sigma bond and and there is one pi bond between two carbon atoms

so let us see the bonding nature in with ethanes or acetyl or acetylene what is hydrogen c triple bond carbon hydrogen now you can see that the carbon is linked to two atoms here is one atom here is another atom

so it is sp hybridized orbitals and there is no lone pair on the carbon atom

so it is all sigma bond okay it is all bonded there is no um lone pass

so it is sp hybridized orbit that means sp hybridization means diagonally um high product hybrid orbitals

so carbon um has two s orbital and in two electrons two s orbital and there is a two p orbital like that then it has to undergo um promotion of electron and hybridization hybridized then um okay then you will have hybridized orbital two fiber iso orbitals okay containing one electrons here and here and then there are two more unhybridized orbital containing one electrons like that okay

so number of electron valence electron is four here is a four here also four after uh hybridization promotion of electron hybridization number of valence electron is not changed it remains the same but okay the energy levels are um changed

so two of them okay two of the sp hybridized orbital this is sp hybridized orbitals sp hybridized orbital here is the pure pr beta it can be px and py orbitals which are not hypervisor now

so you have a carbon containing sp hybridized orbital which are pointed in opposite directions

so you have carbon here similarly you have another carbon here okay which also contains same type of sp hybridized orbital that can overlap with this carbon sp orbital okay and then this orbital can overlap with the hydrogen oneness orbital ok similarly this com sp orbital can overlap with the hydrogen oneness orbital

so this is the sp hybridized

so this is esp this is again sp

so sp this hydrogen bonus orbital

so which is equal to hydrogen carbon sigma bonded carbon and then hydrogen and then you know that there is a two there are two more few p orbitals are there on each carbon atoms

so there is a p orbital lying along the x axis and then there is another p y orbital lying along the y axis

so it is a p y orbital this is px orbital

so this is a plus minus this is my plus this minus similarly you have here p here p x orbital and then p y orbital and then

so there can be overlap between this p x p p x p x orbital and then between and then uh here is a positive

so here and then there is a overlap between p y and p y orbitals okay

so that will give two pi bonds carbon a sigma bond and then hydrogen here and hydrogen here and there is a two pi bonds which are perpendicular to each other

so if you say this is a positive negative then is negative this is positive

so because px and py orbitals are orthogonal to each other the pi bonds formed formed by them are also orthogonal to each other they are perpendicular to each other or perpendicular to the um internal axis

so ethylene or acetylene contains two ah types of bonds between two carbon atom one is the one okay a sigma bond and then there are two pi bonds two pi bonds okay

so um

so far we have seen hybridization of um orbitals what are the those orbital between hybridization between s and p orbital it is also possible to have um hybridization between um s p and d orbitals ok you have s orbital p orbital and

then d orbital you have f i o f orbital we are not going to see this one ok um then but um because that is higher in energy but d orbital is accessible um by energy

so if you go to um third row elements for example pass press or sulfur these are third row main group elements they have accessible d orbitals

so it is possible if you look at the energy levels of the d orbital present in phosphorous and sulfur ok compared to energy levels of energy levels of s and p orbital they are comparable

so it is like that

so if you take a phosphorous phosphorus atom you have a 3s orbital um first is the 3s orbital you have 3s orbital and then 3p orbital on top of that there is a 3d orbitals then above that 4s orbital is there and then 4 p orbital is there now these energy levels are comparable

so if you say this is the energy level of the 3d orbital and then um okay

so it's three p okay three p orbital energy level is there then three s orbital is like that right and then on top of that you have 4s orbital and then on top of that 4 prb terms

so energy level of the 3d orbital is comparable with the with the energy levels of s and p orbitals similarly it is comparable with 4s and 4p orbitals as a result there is a possibility for hybridization of 3s 3p orbital with 3d orbital as well as hybridization of 4s4p orbital with 3d orbitals

so you can have $sp^3 d$ using this

so using this one $sp^3 d$ as well as $sp^3 sp^3 d_2$ similarly it is also possible here it is a $d_2 sp^3$ hybridizations are possible let us see some examples now $sp^3 d$ hybridization possible and then because there are um ok five hybridized orbitals here four another one is a phi if it is a phi ah hybridized orbital then geometry is a trigonal bipyramidal trigonal pi parameter the examples are p f phi p c l phi you can also have hybridization $sp^3 d_2$ the geometry is a square pyramidal okay square pyramidal you know the shape of that this is a square pyramidal okay there is no bond between this for example this is a um for example bromine bromine square pyramidal okay and then there is a lone pair here okay

so this is a br f5 here is a fluorine here is the fluorine here is a fluorine here is the fluorine and there is no bond between two plural atom but to show the shape of the square pyramidal i drawn the line i drawn a line between each pairs and there is a lone pair here okay

so but there is a bond here and here there is a bond there is a bond and there is a bond

so the shape of the molecule is a square pyramidal another molecule or another another hybridization is the $sp^3 d_2$ here when

so there are four orbital another two more

so six you know orbitals are there hybridized orbitals

so geometry is octahedral examples are s f 6 c r f 6 3 minus you can also have um $d_2 sp^3$ hybridization for them its geometry is octahedral examples are ammonia hexamine three plus like that you can also have $d s s p^2$

so one d orbital hybridized with one s r button two p r b terms

so geometry is a square planar examples are transition metal common complexes now we are not going to discuss about uh structure of transit metal complexes platinum nickel gobot we are going to see only the structure of main group compounds let us see the structure of $pc l_5$ or $pc l_5$ for example or pf_5 $pc l_5$ okay

so if you look at the electronic configuration the phosphorous atom uh the valence orbital is the 3s orbital containing two electrons on top of that you have here three p orbital of this there is a one electron everywhere and there is a empty d orbital one two three four five there are five d arbiter

so this is three d orbital this is three p orbital now to form a five bonds you have only uh three p orbitals containing one electron each

so there must be um two more um hybridized orbital or arbiters available with phosphorus

so that it can form five bonds

so um

so the process is promotion of electron from these orbital three three s orbital to the three d orbital

so promotion of electron electron gives energy level of this type three this is three s orbital containing one electron because one of the electron is gone to three d orbital that i will show you now here and then there is a one two three four five three five

so here it's gone now you can see that electron is promoted from 3s orbital to 3d orbital now these orbitals after promotion orbiter should undergo hybridization hybridized and giving five equivalent hybridized orbitals one two three four three four

so you can have one two three four five and then there is a okay

so it is a um sp three d hybridized orbital and there are unhybridized d orbital remaining is four d orbitals because one of the d orbital one of the d orbital is used for um hybridization with the sp orbitals this

so this is a three p orbital this is three d orbitals

so okay

so hybridization between three s three 3p and 3d one of the orbital is used we will see which which is that orbital

so after that you have sp³d hybridized orbital phi sp³ there are five sp³ hybridized orbital which are equivalent energy which are not equivalent energy and i will show you unlike um carbon you have sp³ hybridizer here this here are two types of um hybridized orbitals here is the empty drb terms

so the geometry for the password pcl phi is the trigonal bipyramidal geometry

so the phosphorous phosphorus and then you have here sp³d hyperdisorbitals like this and then you can bring the chlorine um towards the phosphorous atom which is having a sp³ d hybridized orbital ready for forming bond

so you have a head on overlap between the um chlorine um singly filled p orbitals

so that is a positive this is a negative ok

so this is a chlorine and then similarly you can have a overlap with another chlorine atom you can also have overlap with ah p orbital of the another chlorine atom these are the chlorine atom p orbitals okay

so you have there is a p orbital chlorine atom and then you have um okay chlorine atom p r b terms

so phi sigma bonds are this is equal to p c c l c l c l c l c l

so trigonal by pyramidal

so here in this molecule there are two types of bonds okay

so this is a plane okay

so this plane is called equatorial plane equatorial plane the orbitals used to form um ok from bonds with these three chlorine atoms is called equatorial orbitals

so the bond these bonds are also called equatorial bonds okay and these two are axial bonds these two are axial axial bonds okay these three one two three these are called equatorial bonds equatorial bonds they are different now which is orbitals used for which performing which are which type of bonds

so you have here um uh okay

so carbon the pass plus has a okay there are three p orbitals

so let's say this is x orbital p x orbital this is p y orbital p z orbital and

then three s orbital and then here

so to form a axial bond phosphorus usage uses its p z orbital p c orbital and ok d z square orbital for forming axial bonds ok because they are oriented these two orbitals are oriented along the z axis okay

so along the z axis which are used to form an axial bond then the remaining orbitals are s orbital and then p x and p y orbital for forming for equatorial equatorial bonds equatorial bonds are useful

so it becomes clear that there are two sets of hybridized orbitals one is one set is the pc and dc square orbital which are used for forming axial bond these are the axial bonds also

so which is okay that is slightly different in energy compared to the energy of the three equatorial bonds these are the equivalent one two three these are the equatorial bonds formed by another set of hybridized orbital which is s p x p py hybridized orbitals as a result they are different um in terms of bond energy in other words bond strength

so uh actually sp² hybridized orbitals are good for forming stronger bonds

so they are shorter compared to p c b d c square orbitals they are longer

so these bonds are the axial bonds are longer relatives little bit longer okay these bonds are shorter okay because the overlap of sp² hybridized orbital with the carbon or with the chlorine p p orbital is greater compared to the overlap formed between um chlorine p orbital and the p z and dc square orbitals this can also be explained as a result these two bonds are longer compared to the phosphorous chlorine bond of the equatorial bonds

so this could also be the difference in bond length or bond strength could also be explained um explained by invoking the repulsion between the bonding electron pairs

so this chlorine atom is rippled by ok or this bonding electron is rippled by three bonding electron present in the equatorial plane

so one bonding pair there is another bonding pair there is another bonding all of them ripple the bonding pair um between the this chlorine atom and phosphorus atom

so as a result they they get away from each other

so the bond length is increase bond length is increase for axial bonds yes you have 6 here again 3s orbital you have 3 s orbital connecting 2 electron and then you have three p orbital ok like this okay

so the same ah what is that called um doubly field orbital on top of that you have a d orbital okay which is empty 3d or beta

so promotion of electron followed by hybridization gives six equivalent highway sp³ d² orbitals one two three four five

so one electron here one three four five six and then you are left with three unused and hybridized three 3d orbitals which is empty here this one is the sp three and then d² okay

so three one one sr by tall orbital and then three p orbital

so sp³ and then two d orbitals were used

so you have d²

so sp³ d² hypo hybridized orbitals which are ready for forming a bond with ah fluorines the structure is like that you have a middle uh sulphur and then arrange the

so because there are six orbitals are there the expected geometry is octahedral you can draw the structure like this okay

so these are the loops of the sp³ d² hybridized orbital which are projected um towards the corners of the octahedron geometry

so ok

so here this orbital could overlap with the p orbital of the fluorines this is

fluorine p orbital which is singly filled p orbital of the fluorine fluorine fluorine chlorine

so this is equal to sulfur like that

so octagonal geometry it has a octagonal geometry

so um sigma bonds or bonds are formed by overlap of the atomic orbitals

so let me summarize them if you have sp hybridized orbital sp hybridization the expected geometry is linear the geometry is linear then that means it has two sigma bonds the angle are 180 if you have sp² hybridization the geometry is a trigonal planar geometry trigonal planar which contains three sigma bonds three sigma bonds ok it can also give bend geometry but it has only two sigma bonds big ass there is a another okay there is a another um ok another ok the sp another sp² hybridized orbital is occupied by a lone pair

so ah you have ah only two sigma bonds ok

so you have a middle atom and then there are two like water

so it is a bend structure you have only two sigma bonds ok if there is a three sigma bonds it is a trigonal planar if it is only two sigma bonds then it is a bend for sp² hybridization now let us see sp³ if it is same you can you are familiar with the tetrahedron tetrahedral geometry which contains four sigma bonds it can also have trigonal pyramidal and it contains three sigma bonds ok only three sigma bonds and then it can also be a bend geometry it has two sigma bonds

so the angles are here 109.

5 in case of um sp² hybridization angle is 120 degree

so if you have sp³ hybridization on the familiar geometry is a tetrahedral that means there is a four sigma bonds okay it can also give trigonal pyramidal that means only it has three sigma bonds because there is because one of the sp³ hybridized orbital is occurred by lone pair similarly two of the sp³ hybridized orbital occupied by two lone pairs then you are left with only two sigma bonds in that case the geometry is bent okay

so then you have sp^{3d} hybridization then you have a trigonal pipe pyramidal geometry that means it has a five sigma bonds ok

so five sigma bonds then you can also have c sub structure then it has only four sigma bonds there is only four sigma you can also have ah t shape geometry in that case only three sigma bonds are there because there are two more two lone pairs are there it has only once um one lone pair it has two lone pairs but it contains three sigma bonds

so the geometry is a t shape it can also be linear

so in that case only two sigma bonds only two sigma bonds are there remainings are are for lone pairs the angles are here 90 degree 120 degree and then 180 degree thank you you