good morning let us see um couple of structures based on vsepr theory um we have seen ah br f three molecule its valence electron you can calculate seven electron plus three into um seven um okay then it gives um 28 valence electrons and then you can arrange the electrons around the boron atom bromine atom has a central atom
so you can have fluorine fluorine fluorine fluorine
so there are six electron pairs um six electrons were used
so minus six remaining twenty two electrons then we put the electron here here here and here here okay and then and
so there are 18 electrons are gone
so you have you have four electrons that four electrons would be given as pairs on on the central atom
so there are
so you know
so if you look at the number of pairs of electrons one two three four five there are five um electron pairs
so if there are five electron pairs then the shape is the trigonal bipyramidal
so you have your boring bromine and then you have here and then you are here trigonal bipyramidal the shape of the molecule is a bend t shape because we put that because these two lone pairs repel each other
so lone pair lone pair repulsion is the highest one
so it it pushes the bonding electron pass in such a way that the angle is not 90 degree the angle between this angle is not 90 degree it slightly bend
so it is about 86 degree
so because of the ripples on strong repulsion between the two lone pairs it pushes them ok the bonding electron pass little bit down
so the shape becomes a bend t shape t shape because it looks like a shape then another molecule is there um i c l two minus for that you can calculate the valence electrons iodine valence electron is seven plus two into seven valence electron chlorine is seven plus one ah in total you have twenty two valence electrons twenty two valence electrons
so you can draw i am approximately um ah shape of the molecule i two chlorines two chlorines here there are four electrons consumed the remaining is eight electrons and then 18 electrons you can give a sparse like that like that and then minus ah 12 argon remaining 6 then you have to give here and here there
so now the total number of valence electron will be matching
so this structure has two bonding pairs and two lone pair lone pairs two lone pairs um sorry three lone pairs because one two three lone pairs two bonding with
so in total there are five um electron pairs that means the expected geometry for this molecule is the um trigonal bipyramidal and then you can put them a lone path in the equatorial plane iodine and you can have the lone pair here and here and here and then put the chlorine here and in the actual position
so that the structure is minimized and the shape of the molecule is linear the shape of the molecule is linear ok because we should not include a lone pass positions and to tell the shape of the molecule
so it's it's a it's a linear in shape called valence bond theory
so that this theory was developed by linus falling this theory is based on the levy's ideas of electron pair is used in forming a bond
so the valence bond theory is based on lewis ideas of electron pair bond ah which was developed by linus pauling
so this theory is a bond formation using valence electrons
so it is called valence bond theory why do we need this theory there are some problems with ah previous theories that we have seen for example if you look at

it look at them if you look at lewis dot structure it does not tell about the angle form or the angle between the three atoms ok you cannot find out you cannot determine what is the angle between um atoms similarly ah
so we cannot
so as a result we cannot get the shape from the leaves dot structure then we we have seen well spawn theory sorry um
so called vsepr theory under that theory we discussed shape of the molecule based on repulsion between the lone pair lone pair lone pair electron pair and the electron pair electron pair repulsions
so though based on those repulsions shape on the electron pairs are arranged and shape can be determined based on the position of the atoms
so but it doesn't give vsepr theory does not give um explanation or describing in details about the shape of the molecules
so there is another theory needed for explaining the shape of the molecule one of the theories is the valence bond theories another one is the molecular orbital theory that we will see later on uh let us see violence bond theory um
so this theory is basically um um requires overlap of the orbitals you have studied each atom has orbiters and the and with containing some electrons
so the basic idea behind this balance point theory is the sharing of electrons electrons are shared or shared by overlap of the atomic orbiters ok
so under this orbitals atomic orbitals overlapped atomic orbitals are overlapped and the electrons are shared between between atoms
so under this theory a pair of electron is required to form a one bond okay it can also if there can be more than one pair of electrons between two atoms accordingly the bond order will increase
so at least one pair of electrons are between two um two atoms needed
so this theory is based on um overlap of the atomic orbitals
so as we have as we have seen before you have a hydrogen atom ok containing oneness orbital which is one s one s one and then combining with another hydrogen atom has one s orbital containing one electron to give a hydrogen molecule hydrogen molecule okay
so that is formed by the overlap of the oneness orbital this oneness orbit this is oneness orbital okay this is oneness orbital of the another hydrogen atom okay that oneness orbital overlapped with oneness orbital or another hydrogen atom to form a hydrogen molecule now you see here the two orbitals are written in this way such that there is a overlap of the orbital this is a overlapped region of the orbital
so this ok
so this portion is called overlapping overlapped region
so because of the overlap of atomic orbitals bonds are formed
so it has one as one electron and it has one electron
so there is a there are two electrons between the two hydrogen atoms
so as as this bond formation happens um as we discussed before that you have two hydrogen atoms which are far away there are two hydrogen atom which are far away when they are like that there is no interaction between the two hydrogen atom as they get closer and closer ok they start interacting each other okay and then the energy decreases and then reaches a minimum value ok at which the energy is lowest ok and the bond is formed which is described by this potential energy diagram
so energy here it is a zero ok
so this is positive energy here is a negative energy
so you have you are starting with two hydrogen atom okay another two hydrogen atom here ok
so here there is no h a ok let us say h a this is h b ok oneness orbital

oneness orbital between two hydrogen atoms there is no interactions potential energy is zero
so as they get closer the energy decreases ok
so the reaches minimum and then increases ok
so as they get closer in ok they attract each other that's why energy is decreasing becoming negative negative and then reaches the minimum ok
so this is a this is inter nuclear distance ok inter nuclear internuclear distance okay
so this is increases
so from here this is 0 to um some positive value increases
so it reaches minimum at which this is the energy of the molecule this is the distance between the two hydrogen atom
so at that at this distance at this distance a bond is formed and energy is released
so how much energy released the difference between this and this is released
so at this stage energy is higher here the energy is lower because a bond is formed when bond is formed it becomes more stable and then some that much from here to here ok from the difference between this level and this level energy level um energy is released as a result a stable ah molecule is formed ok
so in this way a bond formation is explained in valence bond theory now um
so you have not only you have oneness orbital oneness orbital you also have p orbitals and then you have d orbital of orbitals we are not going to consider overlap of the d orbital f orbital we are going to conserve only s and p orbitals
so which are the orbitals can overlap what are the types of overlap which can lead to a bonding
so for that you should be familiar with um orbitals what is orbital okay
so you have a oneness okay for hydrogen it has oneness orbital and there is one electron here okay this is center of the nucleus okay and you have one electrons okay
so this is a oneness orbital ah for hydrogen atom the oneness orbital is spherical actually what is orbital orbital is a region around the nucleus where finding the electron is very high the probability of finding the electron in that region is very high that is called orbitals
so you take a orbital orbital means finding the electron probability of finding the electron in that region is greatest okay
so then that orbital is overlapping or mixing with another orbital okay then there is a bond formation for bond formation electrons are needed ok
so that nucleus nuclei are attracting them
so this is a oneness orbital shape if you take a shape of the one or spherical shape if you take a p orbital there are three types of p orbital
so if you say this is a ok ok this is x this is y this is z there is some orbital along the x axis there is orbital along the y axis there is orbital along the z axis
so there are three p orbitals that is p x orbital p y orbital p z orbitals are there all of them can be used for bond formations
so which orbital can overlap with which orbitals that is what we have to look at it
so when you look at that um we can also tell um from the nature of the overlap whether there is there can be a bonding or not
so that is why there is a another concept called the overlap another concept called the overlap criterion of bond strength overlap criteria bond strength
so there is that means there is a relationship between the nature of the overlap and the bond strength okay

so um because overlap is important to have a stronger bond the higher the overlap the stronger the bond that means you have a oneness orbital for example plus oneness orbital can give a overlapped bonding orbital suppose this is this much this much is the overlap suppose if you have a overlap it is also possible to have overlap this much

so the overlap here is very less you can also have a situation ah like this little bit higher than this ok higher than this

so you can have

so among these three which overlap will give the higher bond energy will which will give strong bond i would say it is found that this type of overlap because the overlap is higher the mixing of the orbital is higher that will give the stronger bond compared to other two where the overlap is less

so how that is why the higher the overlap the stronger the bond that means when there is a higher overlap when there is a more overlap there is a buildup of electrons between the two nuclei okay as a result when there is a buildup of nuclei electrons between the two nucleus ok between two there is one nucleus there is another nucleus and you build up electron between them

so as okay electrons are shielding the two nucleus okay

so there is a ah less repulsion repulsion is avoided between two nuclei at the same time attraction between electron and nucleus is increased when there is a buildup of electron electrons between the two nucleus

so that will happen if there is a very good overlap

so overlap is related to the bond strength higher the overlap higher the bond strength

so that is a that is

so one can tell um from the nature of the overlap whether there is a bond or not

so let us see what are the ways in which orbitals can overlap okay which will lead to a bonding which will lead to a bonding that means there is a buildup of electron density between the two nuclei and there are some overlaps which will lead to um the reduction in electron density between two nuclei and as a result overlap integral or overlap is negative okay and then and there are overlaps where the overlap is zero let us see what are they ok

so let us see this is the z axis and you have m p z orbital this is positive this is negative whenever you draw a orbital whenever you draw a orbital the sine of the wave function should be given

so this is positive this is positive ok positive this is positive ok this is the past the sign ok this the negative or positive a symbol refer to the sign of the wave function ok

so negative r positive refer to refer to the sign of the wave function what is wave function that we are not going to see now here you will be studying in higher classes

so for time being you keep it ok

so this is a wave function which is used a wave function is a mathematical equation let me simply describe them mathematical function used to describe the orbitals

so orbitals were actually in fact a graph okay

so this is a this is not the picture of the pc orbital remember okay

so it has a shape like that but it is a plot of mathematical function orbitals are plot of mathematical functions as you plot x y okay here also the orbitals this type of shape was obtained by plotting wave function wave functions

so you could you could this um okay describe orbital using wave functions

so when you are whenever you are drawing orbital it is important to give the sign of the wave function there so if you take a p orbital p z orbital let us say this is a positive this is negative now it it could overlap with s orbital for example s orbital is this plus ok this is a sine of the wave function of the s orbital is everywhere oneness orbital is positive everywhere

so it is spherical symmetry okay spherical in shape

so everywhere it is positive

so it can overlap with this orbital in any direction because everywhere it is positive but on the other hand if you take a pg orbital it has m ok positive wave function here here it is a negative

so to have a bonding situation ok or to have a overlap which will lead to a bonding then it has to overlap in this way only

so this is one atom containing for example hydrogen oneness orbital okay and then there is another atom having a pc orbital they approach each other to form a bond to form a bond it is very important to understand that ok

so you have atom a you have atom b then there is a axis ok there is a these two atoms should come in the same line should car in the same axis okay if they want to use its own orbital which is lying in this axis okay to have a maximum overlap these two orbital atoms should should come should be collinear with the orbitals ok for example um atom this is atom a ok this is atom a uses its p z orbital then the s orbital ok can overlap anyway because it is more symmetrical should come in the z axis only to have a maximum overlap another atom should come in the same axis otherwise the overlap will be very less ok

so it should come in the same line

so you can see that

so this atom is approaching this atom or both of them approaching each other to form a bond and ok that can happen if the overlap is good

so what overlap is good which overlap is good if you have this a p z orbital negative positive and then you have a oneness orbital ok it is everywhere it is positive this is p z minus okay oneness orbital oneness orbital of the hydrogen atom now there is a positive overlap now you can see that i put i one okay put two orbitals together where the sine of the both orbitals is positive

so sine of the this orbital is positive sine of this slope of the p c orbital is positive but this slope sign is negative ok

so positive positive when you have a two lobes um having sign of same sign having the same sign then when they overlap that type of overlap will give you bonding

so the here the overlap is here the overlap is positive the warlock is okay is greater than 0 which is greater than

so that is

so that means there can be a bond formation there can be a bond portion formation between this atom and this atom because the overlap is greater than zero okay suppose if you draw the same one in this way in this way ok you have positive this is negative i put negative this is positive and then you have another atom which is oneness orbital this is p z orbital ok they approach each other to each other as a result when they overlap assume that they are overlapping then what will happen if you draw the diagram in this way okay this is a negative this is positive this is positive

so this is a p z minus oneness orbital here the overlapping is the overlap is less than zero this is negative it is overlap is less than zero it is negative

so this is a positive overlap this is positive overlap this is negative overlap which overlap will give you bonding for only positive overlap will give you bonding okay will give you a bond formation between two atoms negative overlap will give ah will give you a situation where there is a reduction in electron density between the two nuclei

so as a result nucleus nucleus repulsion will be there and there is there will be no bond formation in this case because overlap integral or overlap is less than zero why it is less than zero the sign is opposite okay okay
so these two orbitals are not having the same sign of the wave function here the sign of the wave function negative here the sign of the wave function is positive when you put them together they cannot lead to a bonding ok
so the the bonding overlap is less than it becomes negative
so those positive negative can be calculated by quantum mechanics without looking at calculations one can tell from the sign of the wave functions ok which are overlapped um you can tell which overlap is bonding for is for bonding which warlock is for um will will lead to a ah overlap of nega negative
so only positive overlap will give a bonding situation this will not give you a um bonding situation
so so far we have seen overlap of them s orbital p z orbitals now let us see overlap of the p orbitals ah this is a z axis you have here one p z orbital this is positive this is positive i am sorry this is negative positive negative because sine of the wave function changes after the ah this node nodal plane as you studied before now you can have another orbital overlapped with this one ok this is positive this is negative now this sign of the wave function for this orbital positive this is also positive here the overlap is is okay positive overlap is greater than zero if you draw this diagram in this way its this negative this is positive this is negative this opposite is a positive
so the here the overlapping is a negative less than zero it is a less than zero because ok
so this region ok is a positive negative overlaps
so the positive lope of this orbital is overlapping with the negative loop of this orbital
so as a result overlap is less than zero here both are positive such a overlap will give a bonding situation okay
so that
so overlap is greater than zero now p orbital can also combine can also overlap in this way ok this is a x axis this is y z axis this is p x this is another p x p x orbital or ah you can have r r you can also have p y orbital
so this is a positive positive negative negative there is
so here the overlap is positive ok overlap is greater than
so it is a positive overlap ok if you draw the same in this diagram in this way positive negative negative positive see that here the overlap is is less than zero
so negative
so negative ok
so this is not for bonding this is for bonding
so p z orbital combining with another p z orbital because they are coming in the same axis similarly p x or beta or p y orbital can combine with the p x p y orbital of the another atom to give a bonding um overlap it can give overlap of negative overlap now you can also describe which
so now we have seen overlap integral or overlap of greater than zero less than zero and which are the situations are for zero overlap if you take s orbital this is a b is a ok one axis and then you draw a x ok s orbital which is combining with the um ok p x or p y orbital here this is a oneness orbital or s orbital now here ok now here overlap equal to 0 now because say this is the positive of the positive this is negative for s orbital it is positive everywhere
so here positive here positive
so there is a overlap overlap is greater than zero if you come here here is a

positive here is a negative
so here the overlap is negative
so positive overlap negative overlap they cancel each other
so that overlap equal to zero in this
so this way can um atoms cannot form a bond okay
so this is the internal okay new center of the nucleus of one atom this is the center of the nucleus of another atom they approach each other to form a bond
so if their orbitals are oriented in this way for s orbital everywhere same for p x orbital if it is oriented in this way then it will lead to an overlap of zero value ok then you can also have another situation
so this is a um x this is a z axis
so this is this orbital is for example this is positive negative negative positive
so this this one is the y axis
so z axis y axis x axis
so we are trying to combine um px and and px orbital of one atom p y orbital of another atom you know that um p x p y p z orbital orthogonal to each other
so the angle is 90 degrees
so that is orthogonal
so this is in on y x axis this orbital on the y axis when they want to when when you put them together ok to form ah then you will have like this type of situation this situation here the overlap is ok is g equal to 0 ok
so these are the ah types of overlap what we have seen
so far is the types of overlap for bonding um okay and for for bonding and when the overlap is less than zero ah that is negative there is no bonding on the overlap can be zero
so overlap can be zero it can be positive negative and then the magnitude you have to remember that how much it can overlap that depends on the nature of the orbital and internuclear distance as the internuclear distance between two atoms decreases the overlap will be more at the same time when it approaches when they approach each other too much closer there is a repulsion
so also the shape of the size of the orbital when for example ah you take a smaller atom you take a larger atom larger atom means it has um ok larger orbitals smaller atoms small orbital when they overlap what will happen is the overlap cannot be effective it will lead to a negative overlap because suppose you have for example you have a oneness orbiter okay this is the center of the nucleus of one one atom a and then you are up um up bringing another atom as a p orbital p c orbital for example and then suppose if it is overlap too much ok suppose this is ok this is a positive positive this is good suppose if you overlap in this way ok in this way positive
so there is a positive this is negative
so it will lead to a negative overlap
so it should not be
so the overlap magnitude of the overlap depends on the internuclear distance and shape of the orbit also shape of the orbitals those details we are not worrying much right now what we wanted to emphasize here is the overlap of the arbiter what are the types of overlap types of overlaps of orbitals ah for bonding now with this knowledge this knowledge of overlap is important to understand the bonding um in under the balance bond theory ok now we are going to a very important concept that how the bonds are formed under um valence bond theory for example if you take a hydrogen atom as one electron combining with the chlorine um it has here one unpaired electron can give okay
so hydrogen cl like that okay
so a pair of electron is between hydrogen atom and chlorinator you have single

bond is formed that is called a covalent bond or sigma bond okay similarly ah if you take a nitrogen three unpaired electrons are there
so one lone pair can combine with another nitrogen atom having a three unpaired electrons to give three bonds between the two nitrogen atom three net
so there is this is equal to which is equal to three like this like
so three bonds are formed three covalent bonds are formed between two nitrogen atom okay now
so um because
so the bonds are formed because each atom contains one unpaired electrons ok
so the that many number of bonds are formed here there is no problem here um similarly if you take ok
so hydrochloride that i explained here now now if you take a carbon the ok for example methane ok methane there are four bonds are formed but if you look at the electronic configuration of carbon is one has two um two s two two p two ok
so its energy level i can draw ah in this way the valence electron this is the valence electron
so this is a two s orbital containing two electron and then you have here um
so this is the energy okay this is a 2p orbital contain ah two unpaired electron here and here one of the p orbital on orbitals is free now um if you look at that that way as you have seen here it has one unpaired electron it has one unpaired electron combined to form a covalent bond same way if you um look at the electronic configuration of carbon atom it has two unpaired electrons
so that means it can combine with two hydrogen atom ok ah ok let us say this way itself two
so combined with two hydrogen atom ah ok each which has some one electrons ah and you can have carbon ok like this ok you can form but it is not the case this is its not forming in this way
so you will have carbon forming ch2 only which will be more stable if you if you go by this way in reality this is very unstable molecule however it exists with different r groups he replace hydrogen by r group you can stabilize that that we are not studying here
so this is not the actual situation what we have here ch4 okay four hydrogens atoms are bonded to one carbon atom how is it possible why i am asking is that carbon contains only two unpaired electrons how it can go to a state um containing four unpaired electrons
so that four bonds are formed why we need four why we need to have four unpaired electron because because there is okay a pair of electron is needed to form a bond
so one atom gives one electron another atom gives another electron
so a pair is formed between that hydrogen between two atoms a bond is formed
so carbon has to have four unpaired electrons to have a four bonds how is it possible
so um you have to do or introduce a concept another concept that concept is called called hybridization concept hybridization or mixing of orbitals of atomic orbital hybridization of atomic orbitals
so let us see how to do a hybridization as i said before
so here you have m um oneness orbital for carbon oneness orbital containing two electrons and then you have two p orbital containing two unpaired electrons then you have to promote one of the electrons from here to here
so promotion electron why do we need to promote electrons to have unpaired electron maximum unpaired electrons here is the um okay
so one electron because one of them is gone here okay
so you can have like this state when you promote oneness or sorry this is a 2s orbital 2s orbital electron to the 2p orbital because it has one vacant orbital

okay
so we need to put one electron here that is promoting electron from 2s level to a 2p level
so that the carbon will have 4 unpaired electron why we need four anal electron to explain the ch four to explain ch4
so it is like that okay
so there are four covalent bonds around the carbon atom
so that means the carbon should have four unpaired electrons
so that is why um we imagine that one of the electrons went to the two p orbital and forming four and pad electrons ok then the carbon can form a four bonds but you remember that this is one ok two s orbital this is a two p orbital two p orbital
so let us say this is a p x orbital this is um um p y orbital this is as p z orbital now let us draw a diagram this this is let us say this is x this is y this is z axis okay this is a carbon okay a hydrogen atom
so you have a three p orbital one um s orbital okay
so that means these three p orbital can combine with three hydrogen atoms each having one electrons
so you put a hydrogen atom here this is hydrogen atom for example one hydrogen atom you put another hydrogen atom here we put another hydrogen atom here okay
so three bonds three covalent bonds are formed using three pc orbitals
so this is a carbon um okay 2p y orbital plus okay hydrogen oneness orbital
so okay a bond is formed a bond is formed similarly this bond is formed this bond between this carbon and the hydrogen is formed using carbon two ah p x orbital plus hydrogen oneness orbital similarly this bond is formed using carbon um two p z orbital plus hydrogen oneness orbital okay
so three bonds are formed the fourth bond could form ok ah using two s orbital present on the carbon atom
so which which ok which could be here which would be here ok this is a hydrogen atom
so this is a carbon two s orbital combining with the hydrogen oneness orbital now see that three bonds are formed using three p orbitals another bond is formed using okay carbon 2s orbital okay now you know that it is a geometry or shape of the molecule is a tetrahedral angle between these two hydrogen atom angle angle is here here this angle is 109.
5 degree okay but if you look at the angle here the angle between these two axis is 90 degree or here it is 90 degree but here it is around um 125 degree
so in this in reality in methane molecule the angle is 109 109.
5 everywhere any angle you take it will be the same value but in this in this way okay if you go um in this way of some bond formation you would end up with the molecule having certain angles 90 degree certain angle 120 degree which is not the case okay in addition the bond okay the bond formed between the carbon p x orbital and oneness orbital is different from the bond formed between the carbon two s orbital and hydrogen oneness orbital ok but if you look at that then the bond energy or energy of each bond here is the same but the energy of each bond is not same it is different
so this is not the way um by which the bond is formed um in for ch4 then what is happening these okay then what okay then what to do then we have to introduce a concept called hybridization hybridization means mixing of atomic orbital this p orbital mixes with the s orbital ok that is why ok it
so once this is formed this state is not ready for bond formation this state is not this state ok this state is not is not ready for bond formation ok then it undergoes process called hybridization then
so you have yeah um s orbital two s orbital one electron and then two p orbital

okay containing one electron two p orbital then it undoes hybridization hybridized and giving three four equal equivalent hyper hybridized orbitals containing one electron each okay this is called sp3 hybrid hybrid orbitals sp3 because s orbital mixed with p orbital how many p orbital p a three p orbital that's why sp3 hybridized orbital sp3 hybrids hybrid orbitals

so those orbitals what is the difference between this orbital and this orbital

so you can see the number of atomic orbital which are hybridized equal to the number of hybridized orbitals same four orbit atomic orbital combine to give four hybridized atomic orbitals okay now when you look as after hybridization energy of these orbitals are same they have the same value of energy and then when they hybridize they look like this a carbon okay you have carbon and you have a lobe okay and then there is a small loop and then there is a large rope opposite there is a small loop okay there is a big lobe and then there is some there is another big lobe there is a small loop this sign is positive this is negative ok similarly this is positive this is negative this is a positive this is negative this is positive this is negative

so atomic orbitals were combined to give a hybridized orbitals okay after hybridization you can see that a lobe of them hybridized orbitals are larger compared to the atomic orbitals okay

so when the lobe is larger okay

so you have a lobe of this beak ok compared to atomic orbital up like this ok

so orbitals having this much lobe is good for overlap this is good for bond formation because the lope is greater here the grow when the lope of the orbital is bigger it can overlap much better way or the overlap will be much positive more positive compared to our atomic orbital having overlap of this size

so that's why hybridization hybridized orbitals are better for overlapping and and hence better for bond formations

so once after formation of sp

so this these are the sp3 hybridized orbital

so what is that there are four atomic orbitals combined to four hybridize orbital and they have equal energy ok sp three hybridized orbital high flights equal energy they have equal energy each contains one electrons and their lobes are oriented ok lobes are oriented along towards particular directions that determines the shape of the molecule in this case for carbon these lobes ok lobes are pointed toward corners of a tetrahedron

so when they combine with the hydrogen a tetragonal molecule is formed

so you can draw here a hydrogen atom ok combining with this is hydrogen atom the another hydrogen atom you put hydrogen atom here and put another hydrogen atom here you put another hydrogen atom here okay

so hydrogen atom here hydrogen atom here is a positive okay here the sign of the wave function is positive everywhere for hydrogen atom for hydrogen oneness orbital

so that will give um a carbon like this tetragonal shape that is the reason it has okay the angle of one zero point degree and the bond strength is same okay four bonds are formed by using by four hybridized sp3 orbitals and ok those orbitals are equal energy and contains one electron each and ok when bonds are formed ok they give particular shape to the molecules in case of carbon the shape of the molecule is a tetrahedral

so that is how bonds are formed under the valence bond theory method basically what we have seen is the overlap of the atomic orbitals okay been okay

so on on top of that we have seen promotion of electrons to the higher energy lying orbital and then hypothesization between the orbitals giving a hybridized orbital ok and then bond formation leading ok leading to a shape of the molecule ok

so now let us see a simple case of bond formation between s orbital ok a simple molecule such as um beryllium cl2 or beryllium um ah for example ah c l two r b r two r beryllium dimethyl ok
so now you know what is the electronic configuration of beryllium its one s two two s two one s two two s two ok
so this is the electronic configuration of carbon atom and as you know that
so this is a two s orbital of the um beryllium and contains no unpaired electrons but how does it possible for beryllium to form um two bonds with two chlorine atoms okay
so that means that we can understand that we can explain in this way ok you have a empty p r beta lying higher in energy ok there is two p orbital
so first job is promotion of electron promotion of electron ok that leads to a situation like this this is a two p orbital this two s orbital now you have two orbitals containing one electrons each now it has to undergo hybridization to give two equivalent okay hybridized orbital containing one electron each
so this is called a sp hybridized orbital hyper hybridized orbital or diagonal orbitals diagonal hybridized orbitals how do they look like we can draw that in this way yes z axis okay here the 2p orbital is a ah z lying along the z axis
so this is a z axis this is a p z axis positive this is negative combining with um s orbital oneness uh ok combining with the two s orbital of the same um atom
so you have a two 2s orbital this is a 2 pz orbital 2 pc orbital this is a 2s orbital ok this is positive sign it has positive sign everywhere and can give 2 hybridized orbital of this type plus this is the center of the nucleus another one of this type see a large lobe and small lobe this one is positive this is negative
so which we can write together a beryllium atom and there is a large lobe and there is another large loop ok there is a small loop here there is small loop here positive
so beryllium atoms ready for for bond formation
so then the two chlorine atoms can come closer to this one they have one unpaired one unpaired electron and can form a bond between between them ok
so the p orbital of the chlorine atom can overlap here ok
so for example in this way ok
so this is a z axis
so this is z axis
so z axis
so this is a z axis there is another
so because this is z axis
so this is a beryllium two chlorines like this
so when
so because these are the sp hybridized orbital okay sp hybridized orbital which their lobes are opposite each other
so this is the center of the atom and you have a large rope here and then there is another loop ok in the opposite direction
so angle between them is 180 it is 180 angle between the two orbitals
so the here the angle is 180 degree and they are okay projected opposite each other
so and contains one electron there is one electron here which is ready for bond formation with another atom having another one unpaired electrons
so you have your this one is the pz orbital off okay of chlorine which which contains one electrons which can combine with this isp hybridized orbital to form a covalent bond a sigma a sigma bond or covalent bond between beryllium atom and chlorine atom similarly in the on this in this direction also
so this is called a sp hybridization

so the hybridized orbital after hybridization it is important to understand that what is the what is the percentage of s orbital in the hypotenuse orbital what is the percentage of p orbital in this hybridized orbital they are equal ok because two orbital combined to give two hybridized orbital ok then its character is divided

so because two orbitals involved

so it has a fifty percent s orbital a s r s character ok ok 50 percent yes and then 50 p orbitals okay because two atomic orbitals are combined

so you have um 50 each on the other hand on the other hand we have seen sp3 hybridization for methane what is the um percentage of s character for this hybridized orbital it is one third

so this hybridized orbital for carbon ok ok

so is positive everywhere ok it has some ok 25 percent ok or some ok it has a 25 percent of s and then 75 percent of p character or one okay one fourth of s character and three fourths of a p character for each hypothesis orbitals and that's why they are having um equal energy

so that way bonds are formed

so you could understand here very clearly that bonds are formed by overlap of the atomic orbitals if if there is no um suitable atomic orbitals available then atomic orbital combine to give hybridized orbital to give high required number of hybridized orbital and then bond formation takes place now another molecule which we can see is the um third group elements boron ok it can form um boron trifluoride of this type ok

so boron electronic configuration is um you can write that 1 s 2 ah 2 p 2 s 2 sorry 2 s 2 then 2 p 1 1 s 2 2 s 2 2 p 1

so and then

so you have to

so you have two s orbital and then two p orbital ok and it has two electron and it has one electrons then promotion of electron promotion can give of this state ok

so there are two unpaired electrons

so this is some after promotion of electron and then they combine and then hybridize hybridized to give three equivalent orbitals okay containing one electron each

so it is called a s p two hybridized orbital sp two hybridized orbital because one s orbital that is s orbital this is a two p orbital two p orbital two s orbital

so one s orbital combining the two p orbitals

so it is called s p two orbitals

so there are two p orbitals are involved that's why it is a s p two orbital they look like this there is small loop there is another small lobe other this is positive this positive this is positive ok

so this is some for example x okay this is if you say this is ah z axis this y axis ok

so this can accept

so it contains one electron here one electron here you one electron here which can combine with another atom having one electrons

so for example ah fluorine ok fluorine electronic configuration one has two two s two um two p five two p five it has a one unpaired electron in the p c orbital ok

so there are

so this is a p z orbital contain one another unpaired electron that can combine with the hypothesis orbital of the boron atom and form a bond like this positive negative this is positive negative this is positive negative so this is a um boron like this trigonal ok is a planar geometry ok equilateral triangle ok the geometry shape of the molecule is equilateral triangle that's how a bond formations happen

so now ok they have equal energy this orbital hypothesis are equal energy containing one electron and the character is shared by s and p orbital

so this is gassiev one third it is a two third of the p orbital one third of p s orbital and two third two thirds of the p rb terms thank you you