

hello let us continue our lecture in organic chemistry the basic principles and the fundamental aspects of organic chemistry the last lecture we were discussing the reactive intermediates in organic chemistry and the type of bond fission in organic chemistry we discussed about free radicals carbo cations carbon ions and carbenes in the last lecture now let us start this lecture with the classification of reagents that are used in organic chemistry reagents can be by and large classified as free radicals electro files and the nucleophiles the term philic essentially means affinity

So electrophilic means species that are attracted to electrons species that are inherently electron deficient which are attracted to electrons

So likewise nucleophilic means species which are inherently electron rich in nature and they are attracted to positive centers or the nucleus of the reacting species this is a very broad definition of the electrophile and nucleophile free radical is something we have already considered this is an odd electron species having only seven electrons around the carbon typically we talk about free radicals which are tertiary free radical like the tertiary butyl radical for example we have already considered the free radicals in the last lecture we will just discuss two types of reactions the free radicals can undergo free radicals can undergo addition to double and triple bonds they can also undergo hydrogen abstraction reaction if you consider a free radical $R\cdot$ and it can undergo addition reaction to a double bond they are essentially electron deficient in nature

So they tend to add to electron rich double bonds pi electron rich double bonds in doing So they form another free radical if the free radical that is formed is a more stable free radical than the free radical that is reacting then this reaction is a favorable reaction alternatively free radicals can undergo hydrogen abstraction reaction for example the tertiary hydrogens in inorganic molecules can be abstracted by free radical because that generates the tertiary radical as the product or the as the intermediate stage

So this is the hydrogen abstraction reaction the free radical essentially reacts with the c h bond removes the hydrogen in the form of a hydrogen atom and produces a radical which is a tertiary radical a very common reaction that is encountered is the triphenyl methyl radical which can be generated for example by reacting a methyl radical methyl radical can be generated by fertilizing this type of azo compounds

So in the process it produces a very stable thretyl radical or triphenyl methyl radical this is called trityl radical or triphenyl methyl radical

So these are the two types of reactions generally encountered by free radicals in organic chemistry now let us get back to the electrophiles and nucleophiles we have defined the electrophiles as electron deficient species let us start with the proton H^+ H^+ is an electrophile it can add to electron rich double bonds for example by protonation reaction for example it can react with the double bond to generate a this carbonium ion or the carbocation can be generated this is an addition reaction addition of an electrophile to the double bond to produce the corresponding electrophilic carbonium ion or the carbocation the the double bond essentially reacts with the proton because double bond is electron rich and proton is electron deficient and in the process it generates a carbocation during the course of the reaction other electrophiles are for example Br^+ Cl^+ CH_3CO^+ plus for example these are examples of electrophilic reagents in organic chemistry how can one generate this electrophilic reagent even no two plus for example is an electrophilic reagent in organic chemistry how do we generate these electrophilic reagents one can take for example bromine and treat it with ferric bromide ferric bromide is lewis acidic in nature in the process it produces the bromonium ion plus tetrabromoferate as the product you can take for example chlorine and react it with something like aluminum chloride in the process it produces chloronium tetrachloroaluminate

So essentially the lewis acidic nature of this reagent produces the corresponding electrophile by the heterolytic dissociation of the halogen halogen bond by the attachment of a halide ion onto the aluminium chloride or the ferric chloride as the reagent now if you take sulfuric acid concentrated sulfuric acid and treat it with HNO_3 for example HNO_3 is nothing but $HO-NO_2$ the HNO_2 undergoes initially a protonation because sulfuric acid is a stronger acid than nitric acid itself

So this protonation essentially results in the formation of NO_2^+ and water the water is of course will be taken up by concentrated sulfuric acid

So this is a standard way of producing the nitronium ion which is an electrophilic

reagent in organic chemistry if you are wondering how to generate the acyl cation this can also be generated by treating an acid chloride acetyl chloride for example when it is treated with aluminum chloride essentially the aluminum chloride undergoes the substitution of the chlorine by this is of course the resonance stabilized one can write the resonance structure as this structure here

So this is an acyl cation or acetyl cation is what we are referring to as the electrophile electrophiles can also be produced alkyl carbonium ions or electrophiles for example a methyl cation is an electrophile because it is electron deficient in nature and that can also be generated by means of ionization process if you take for example tertiary butyl chloride and react it with aluminum chloride you produce the corresponding carbonium ion which is an electrophile

So generation of electrophile by treatment of a halide particularly a tertiary halide with a Lewis acid like aluminum chloride will generate the electrophilic reagent which is the tertiary butyl re cation as the electrophilic reagent now let us move on to nucleophiles nucleophiles are electron rich species

So they are essentially seeking the electro positive center or electron deficient center during the course of the reaction let us see some examples of nucleophiles water can be a nucleophile because it has two lone pairs of electron in the oxygen

So it can act as a nucleophilic reagent in many organic reaction particularly hydrolysis reactions are triggered by the nucleophilic attack of water on electron deficient center ammonia is a nucleophile for example because of the presence of lone pair of electron on the nitrogen atom

So in general amines tertiary amines secondary amines primary amines alcohols for example they are all examples of nucleophiles because of the presence of electrons one can classify them as mild nucleophiles because if it is not only electron rich if it also possesses an anionic charge then you would call them as strong electro nucleophiles some nucleophiles are for example cyanide ion hydroxide ion alkoxide ion for example phenoxide ion azide ion for example these are all typical examples of thial for example thialite anion diol is a very strong nucleophile thiolite anion is a very strong nucleophile typically halide ions for example fluoride bromide iodide they are all fairly strong nucleophilic reagents in organic chemistry they typically react with electron deficient center and undergo substitution reaction addition reaction and

So on let us see two types of reaction one is the substitution reaction using a nucleophile suppose if you take tertiary butyl chloride and react it with let us say for example sodium hydroxides the chloride can be ionized and in its place the hydroxide can be substituted

So essentially one can produce tertiary butyl alcohol as the product during the process of the substitution reaction here the carbon chlorine bond is polar under conditions of aqueous medium the carbon chlorine bond can be ionized to produce a tertiary butyl cation the OH^- can react with the tertiary butyl cation to produce the corresponding tertiary butyl alcohol

So this is an example of a nucleophilic substitution reaction nucleophilic addition reaction can be classified by the addition of a nucleophile to a double bond but the only condition is the double bond has to be electron deficient the double bond now let us consider two types of double bond let us consider ethylene double bond normally this is electron rich because the pi electron is present in the system however suppose if i attach an electron withdrawing group one or two electron withdrawing groups to the double bond for example let us add one electron withdrawing group to the double bond nitro group is an electron withdrawing group nitro ethylene for example or cyanoethylene acrylonitrile acrylic acid for example these are all examples of double bond which are attached to electron withdrawing functional group because of the nature of the electron withdrawing functional group you will have this kind of a effect resulting in a delta positive delta negative kind of a because the delta negative is stabilized by the electron withdrawing functional group

So there is a polarization of the double bond which is already present in this type of system

So the nucleophile let us say for example OH^- can essentially react with the double bond and these are double bonds which are electron deficient double bonds in comparison to ethylene itself or butane itself which are considered to be electron rich double bonds

So the electron richness or the electron deficiency is only a relative term in terms of

the relative reactivity pattern of the double bonds in this class of compounds having considered these three types of reagents now let us classify the reactions or reactions of organic chemistry into various categories and see examples of the reactions of organic molecules we have classified the reagents

So far now let us classify the types of reactions that one can anticipate or one can study in organic chemistry

So we will talk about classification of organic reactions before we go into the classification of organic reaction let me just say that in organic chemistry you typically let us say represent a reaction mechanism by means of arrow pushing mechanisms and the convention that is used in the arrow pushing is that you start the arrow from electron rich center let us say O^- which is an electron rich center push it towards the center which is electron deficient let us say for example this carbon is an electron deficient center because of the polarization of the carbon chlorine bond

So the arrow starts from the electron rich center and it is pushed towards the electron deficient center pointing towards electron deficient center and if this is a leaving group then this essentially means this chlorine leaves along with the bonding pair of electrons

So in the process you produce methyl alcohol plus a chloride ion for example So the arrow pushing mechanism essentially helps you to understand the kind of interaction between the reagent this particular case a nucleophile with the substrate in this particular case it is an electrophilic substrate because of the carbon chlorine bond and it allows you to understand the kind of interactions that will be existing in this type of a reaction mechanism

So organic reaction mechanisms are essentially an understanding of how bond is formed and bond is broken during the course of the reaction

So an example of that is given here this tells you there is a bond formed between the oxygen and the carbon and the bond is being broken between the carbon and chlorine because this reagent is now approaching this carbon and the chloride is leaving this carbon for example

So this is a typical way one represents organic reaction mechanism by pushing arrows and the convention is that the arrow starts from an electron rich center and the arrow head pointing at an electron deficient center when i say center i am just talking about atoms which are electron deficient and electron rich in nature this particular case the oxygen atom is the electron rich because of the anionic charge and the lone pairs of electron that are present in the system and the carbon which is the electron deficient center by virtue of having a halogen attached to it it is already polarized in nature

So having introduced the convention that is used for representing the organic reaction mechanism let us look at some examples of organic reaction one substitution reaction substitution reaction can be classified into electrophilic substitution reaction or nucleophilic substitution reaction in both of the electrophilic as well as nucleophilic you have aliphatic and aromatic type here also you have aliphatic and aromatic type of electrophilic substitution reaction

So you can have an aliphatic electrophilic substitution reaction an aromatic electrophilic substitution reaction an aliphatic nucleophilic substitution reaction and an aromatic nucleophilic substitution reaction substitution reaction is essentially substituting a hydrogen or a functional group with another functional group

So as a very general example let us say a reagent X^- is reacting with $R-H$ if the hydrogen is removed let us not worry about how it is removed for the time being you are essentially dealing with substituting a hydrogen with an X group or if you are having a X group as a leaving group and Y is the entering group this would also correspond to a substitution reaction in other words one group is substituted by another group and depending upon this reagent here this could be an electrophilic reagent or a nucleophilic reagent and that would constitute a electrophilic substitution or a nucleophilic substitution this substrate can be either aliphatic substrate on an aromatic substrate So here you can have either electrophile or nucleophile here you can have a aliphatic or aromatic substrate overall the reaction is a substitution reaction

So you can now understand and electrophilic aromatic or electrophilic aliphatic substitution reaction similarly nucleophilic aromatic or nucleophilic aliphatic substitution reaction of this kind is what is generally talked about in substitution reaction let us take a we already saw the nucleophilic substitution reaction here chloride is substituted by hydroxide

So it is a nucleophilic substitution reaction here bromide is substituted by cyanide as a nucleophile

So this is producing a carbon acetonitrile and sodium bromide if you look at both the reaction the chloride ion is displaced here and the bromide ion is displaced here and this is the reactive species or the reagent that is used here by virtue of having a δ^- or a δ^- charge these are nucleophilic reagents and this is the electrophilic carbon these are the electrophilic carbons

So it is a nucleophilic substitution because the substituting reagent is a nucleophile in this particular case

So these two examples will contribute essentially to aliphatic nucleophilic substitution reaction now let us see one example of an aliphatic electrophilic substitution reaction now let us take for example this is a special class of reaction it is a silicon substituted carbon silicon bond is what is being substituted here if you treat this with a halogen let us say for example bromine as a reagent the carbon silicon bond is broken so silicon is the leaving group here but it is leaving as a SiMe_3^- and the reacting species produce bromine bromine is the electrophile it produces two compounds trimethyl silyl bromide and the ethyl bromide reaction is essentially an aliphatic reaction the reagent is an electrophilic reagent electron deficient reagent

So it is an aliphatic electrophilic substitution reaction let us see one more example of the aliphatic electrophilic substitution reaction must be familiar with the iodoform reaction for example if you take a methyl ketone let us say for example acetone you can go all the way to tri bromo acetone or triiodo acetone if it is reacted with for example with bromine in this particular case with either acid or base as a catalyst base is not a catalyst but acid is as a catalyst

So this is an example of an electrophilic aliphatic electrophilic substitution reaction reagent is an electrophile here bromine and the carbon hydrogen bond is the hydrogen is the leaving group here

So in the process it produces HBr as the product in this particular case

So it is a sort of an auto catalytic reaction because the HBr that is produced will catalyze this reaction let us not worry too much about the reaction mechanism what is important to understand is that the reagent is an electrophilic reagent which is a halogen which is an electron deficient because of its electronegativity

So it reacts with the acetone the replacement of the CH_3 bond by bromine is what is the substitution reaction that we are talking about this under basic condition is not stable it will produce the bromoform or if it is iodine used the iodoform will be produced by means of a hydrolytic cleavage of the carbon carbon bond in this particular system

So these are examples of substitution reaction involving aliphatic reagents in the case of aromatic substitution reaction the most common reaction is the aromatic electrophilic substitution reaction because aromatic rings are typically electron rich in nature for example if you take benzene it's said to be electron rich because of the extent of electrons that are present in the π orbitals of benzene

So let us take the example of substituting this hydrogen of benzene which is same as every other hydrogen in benzene because it is a symmetrical molecule the reagent is say essentially an NO_2^+ is the reagent produced by reaction of sulfuric acid with nitric acid the combination of these two will essentially produce the NO_2^+ So the two reagents that are reacting here are the NO_2^+ and the hydrogen is released as a proton

So you can see here the hydrogen is substituted by an electrophile

So this is an electrophilic substitution reaction because it is carried out on an aromatic substrate it is an aromatic electrophilic substitution reaction suppose if you want to do a nucleophilic aromatic substitution reaction the nucleophile is electron rich

So the aromatic ring has to be electron deficient in nature how do we make an aromatic ring as an electron deficient ring by putting a large number of electron withdrawing functional group like for example all the nitro groups in this molecule make it electron deficient in comparison to for example benzene or in comparison to nitrobenzene and you have a good leaving group in the form of a fluoride ion

So if you treat this with let us say OH^- CN^- thiolate S^- for example these are all nucleophiles

So that constitute essentially a nucleophilic substitution reaction because it is carried out on an aromatic ring it could correspond to an aromatic nucleophilic substitution reaction

So the fluoride ion is being replaced by the OH substituted by the OH and this molecule is what is known as picric acid trinitrophenol is picric acid highly bitter in nature if you ever get the picric acid in your fingers the finger will be bitter for several days it gets absorbed under the skin and the bitterness lasts for a very long period of time in the second example a cyanide is produced for example with the loss of fluoride ion in the last example a sulfide is produced now you can ask the question why not just to take chlorobenzene and do this kind of reaction fluorobenzene is not sufficiently electron deficient in nature to act as a substrate for the nucleophilic substitution reaction nevertheless chlorobenzene under very harsh conditions can be made to react with sodium hydroxide to give phenol this is more than 300 degrees centigrade it can undergo phenol and sodium chloride

So under very harsh conditions one can push the reaction and make it undergo this reaction

So these examples I hope sufficiently illustrate the electrophilic substitution reaction as well as nucleophilic substitution reaction this particular case so three is the electrophile producing a sulfonic acid derivative for example if you use ferric chloride and acetyl chloride the electrophile that is generated is the CO^+

So this will undergo electrophilic substitution reaction to produce acetophenone as the product in all of these cases proton is released during the course of the reaction

So there are several examples of the substitution reaction that we have discussed during the course of the last 15 minutes or

So let us move on to the second type of organic reaction namely addition reaction addition reaction is essentially very simple by definition addition of two reagents across a double bond or a triple bond is known as the addition reaction here also one can classify this into electrophilic addition reaction nucleophilic addition reaction normally aromatic compounds do not undergo addition reaction they undergo substitution reaction because the double bonds are not typical double bonds they are delocalized double bonds in the aromatic system

So they cannot be considered like ethylene as an unsaturated compound

So normally we are always talking about in the aliphatic compounds only this class of addition reactions in organic chemistry now take the simple example of addition of hydrogen in the presence of a metal catalyst like nickel for example this will produce ethane as the reagent now this is an example of an addition reaction this is essentially a neutral H_2 adding across a carbon carbon double bond this could be even a carbon carbon triple bond for example let us take this example here platinum or palladium or even nickel can be used for addition of the hydrogen

So when it adds hydrogen initially it produces an alkene rather difficult to stop it at this alkene stage essentially goes to the alkane which is this particular alkane in the phenyl propane is produced during the course of this reaction

So these are simple addition reactions its hard to classify them as electrophilic or nucleophilic because the neutral hydrogen is what is adding in this type of a situation on the other hand if one adds bromine for example bromine water decolorization of bromine water by ethylene is a very well known qualitative test in organic chemistry now you are reacting with a electrophilic reagent

So that produces dibromo ethylene in this particular instance suppose if one adds water in the presence of an acid when you say water in the presence of an acid it is a hydronium ion that is being reactive species this is also an electrophilic addition reaction this will essentially initially produce this particular compound you can see here the elements of water is being added across the carbon carbon double bond in a sort of a regio specific manner the water molecule is given a specific color here H_2O is added and this is an enol form it does not exist in the enolic form it goes to a ketone which is this particular ketone

So essentially you have added a molecule of water across a carbon carbon triple bond to produce a ketone this is also an electrophilic addition reaction the reaction is triggered by the addition of a proton to the triple bond followed by attack of water onto the double bond protonated double bond for example

So the reactive species essentially is proton in the absence of proton water will not react with this reagent or with this substrate for example this is electron rich triple bond

So it has to be initially protonated to make a carbonium ion which reacts with water to produce the enol enol undergoes tautomerism to give the ketone as the product in this

particular case

So these are examples of aliphatic electrophilic addition reaction now if you want to add a nucleophile to a double bond as I mentioned earlier the nucleophile has to add only to an electron deficient double bond

So how do we make a double bond and electron deficient double bond in comparison to ethylene if you take this particular compound will be electron deficient methyl vinyl ketone for the simple reason you have a resonance structure which is withdrawing the electron makes this carbon center as an electrophilic center now nucleophile can add across this

So if you react it with sodium hydroxide for example it will essentially produce or if you add sodium cyanide for example in the presence of an aqueous acid it will produce the cyanide will add across the carbon carbon double bond to produce the corresponding addition product

So what you have done here is essentially taken a nucleophile either the hydroxide or the cyanide here this is also addition of water across a double bond but then the reactive species is a hydroxy anion hydroxide anion is a reactive species

So it is a nucleophile and nucleophile is what is adding across the carbon carbon bond because of the electron deficient nature of the carbon carbon bond here it undergoes the addition reaction in this particular manner to give the addition products which are nucleophilic addition across a carbon carbon double bond there are also some addition reactions which are fairly advanced organic chemistry reactions which will be neutral in nature I will give you one example of an addition reaction these are also called cycloaddition reactions because they form cyclic compound during the course of the addition reaction let us take the example of ethylene if ethylene undergoes photolysis in the UV region in other words if you shine light UV light on the ethylene molecule two ethylene molecules undergo addition reaction to give cyclobutane as the product what has happened is you write one more ethylene molecule beneath the other ethylene molecule and essentially both of them are neutral compounds there is no electrophilic or nucleophilic reagent involved here the reaction proceeds through an excited state of the ethylene one of the ethylene is excited to the higher electronically excited state and the excited state of ethylene reacts with the ground state ethylene for example to produce a cyclobutene

So this is an example of a photochemical cycloaddition reaction what is the emphasis here that this is an addition reaction addition across carbon carbon double bond where the adding partner is also a carbon carbon double bond for example leading to the formation So if you want to show it by means of a mechanism this is how it is shown this bond is essentially cleaved and the new carbon carbon bond is formed here another new carbon carbon bond is formed here

So these are the newly formed carbon carbon bond you can see here this ethylene is added to the other ethylene one more example we will see and then proceed further if you take butadiene and react it with for example acrylic acid this reaction is also an addition reaction look at this reaction carefully a carbon carbon bond is formed between these two carbons the pi electron is shifted over here this pi electron is involved in forming a carbon carbon carbon bond across this

So this will essentially produce a cyclohexal hexane derivative this four carbon unit is a diene and this is a dienophile and they undergo an addition cycloaddition reaction to produce a cyclic compound since there are four carbons and two carbons involved it is a four plus two cycloaddition reaction

So it is four plus two is six

So that is why a six membered ring is being formed in this particular instance

So these are considered as neutral cycloaddition reaction because there are no electrophilic or nucleophilic reagents involved in any of this reaction

So we are done with the addition reaction we will move on to the next class of reaction namely elimination reaction elimination reaction is just the opposite of addition

reaction if you can eliminate two units of functional group from an aliphatic compound then you will end up with an unsaturated compound and the fragments of elimination this is easily illustrated by taking this example here if it is treated with strong alkali under heating condition the delta essentially means heat what happens is this already has a delta plus because of the inductive effect of the bromine

So that makes this hydrogen acidic makes the adjacent hydrogen also acidic and as a result of that an elimination reaction can happen under these conditions the hydroxide

ion is the base that is abstracting a proton

So from the electron rich center you go to an electron deficient center and this is essentially breaking a carbon hydrogen bond here forming a double bond and the bromine is lost as a bromide ion

So you can see here an element of hydrogen bromide is being lost here this will essentially produce ethylene this is one of the ways of making ethylene in the laboratory So the overall reaction is ethylene is produced sodium bromide is generated because you start with sodium hydroxide here and water is the other product that is being produced and this is an example of a elimination reaction another elimination reaction we will see if we take tertiary butyl alcohol and treat it with sulfuric acid or H^+ plus what will happen if you treat it with H^+ there are lone pairs of electron on the oxygen

So the oxygen is going to be protonated with the simultaneous loss of a hydrogen from here

So you eliminate water in other words you do a dehydration reaction produce the corresponding alkene these are examples of elimination reaction one can have a this is what is known as beta elimination is beta elimination because this is a functional group which is being eliminated this is alpha carbon and this is a beta carbon in other words an element from the alpha carbon and another element from the beta carbon is eliminated So it is called beta elimination or one two elimination there are examples of alpha elimination known if you take the chloroform and treat it with sodium hydroxide chloroform because of the presence of the three halogen on this carbon this is a fairly acidic hydrogen

So this hydrogen can be removed

So the OH^- essentially removes this hydrogen in the process the electrons get pushed in this particular manner producing a species known as dichloro carbene this is a general way of making dichloro carbene for example using this

So this is alpha elimination because both the groups are eliminated from the alpha position itself let us take one more example this is methylene bromide methylene bromide has a structure which is this structure when you react it with the zinc for example methylene bromide and methylene iodide can be reacted with zinc the zinc essentially gobbles up the two bromine atoms producing zinc bromide in the process and produces a carbene as a reactive intermediate the reaction proceeds essentially by initially zinc reacting with to produce an organo zinc reagent like this this will undergo elimination of the this is also an example of an alpha elimination process produces carbene directly by removal of two of the bromines by zinc zinc is an electro positive element

So it reduces the carbon bromine bond to produce the zinc bromide derivative here this can eliminate zinc bromide as it is to give the carbon as the product in this particular instance

So these are some examples of elimination reactions that we can appreciate in organic chemistry there are also one four eliminations known let us not concern ourselves with the one four elimination for the time being the last class of reaction is the rearrangement reaction this would be the fourth type if you look at the volatile synthesis of urea that is an excellent example of a rearrangement reaction isocyanate is essentially on heating undergoes rearrangement to give urea as the product this is the probably the ever first rearrangement reaction that is known initially you have a ammonium cyanide which is the ionic substance undergoing rearrangement to give a organic substrate which is a neutral substrate for example neutral compound which is urea this is an example of a rearrangement reaction in rearrangement reaction atoms migrate from one position to another position that is the most important thing here for example the hydrogens have migrated from the ammonium ion to the other nitrogen and in fact the cyanide ion is this particular ion

So somewhere along the line the carbon nitrogen bond is broken and the carbon oxygen bond is formed during the course of the reaction

So rearrangement reaction essentially involve migration of atoms from one's carbon to another carbon let us quickly take a look at the rearrangement reaction here there is a rearrangement of the if you treat it with an acid essentially it will undergo rearrangement to give a more substituted olefin here there is a migration of a double bond from the this is one butane whereas this is two butane

So migration of the double bond is also considered to be a rearrangement process this can also be called as isomerization reaction process carbonium ions are very prone to undergo

rearrangement reaction last example we will look at here is that you take this as alcohol which is a neopentyl alcohol if you treat it with an acid it produces neopentyl carbonium ion which is a primary carbonium ion the positive charges on the carbon
So you protonate the oxygen remove a water molecule is a dehydration reaction is what we are talking this is not a stable compound because this is a primary carbonium ion
So there is a migration of the methyl group to the adjacent position because that will produce a tertiary carbonium ion carbocation this is a molecular rearrangement you started with a highly branched tetra tri-methyl methyl derivative now you have a dimethyl ethyl derivative because there is a skeletal rearrangement that has taken place
So these are some examples of organic classification of organic reaction
So what we saw in this particular lecture is essentially the various types of attacking reagents namely electrophiles and nucleophiles and free radicals various types of organic reactions under the classification of substitution addition elimination and rearrangement kind of reaction thank you very much for your kind attention
So foreign