hello everyone in the last lecture we discussed the oxidation and rearrangement reactions of glycols with this we conclude the alcohol portion of this chapter and today we are going to continue with another topic from this module that is phenols okay so our today's topic for discussion is phenols and the general structure the chemical structure which represents phenols is given like this phenols are essentially a hydroxylated benzene ok so it is a hydroxy benzene it is also known as carbolic acid phenols are also known as carbolic acids if you look at this structure of phenol the hydroxy is attached directly to this sp2 carbon which is a part of the benzene ring if i rewrite this structure in another manner for the same phenol this is the structure of cyclo hexa two four diene one own so this essentially represents the keto form of the phenol so this can change to the enolic form which is actually the phenolic form in this case so this is the keto form and this is the enol form of this molecule and this is what we call as the keto enol tautomerism so the keto enol tautomerism exists in case of phenols and the enolic form that is the phenol in this case is the major contributor and the keto form contributes in a minor way that is why if you look at this equilibrium it is more towards the enolic form and less towards the keto form the stability of the enolic form can be understood in terms of the aromaticity acquired as a result of enolization so this aromatic ring is what is the driving force for the enolic form to predominate okay so this is the thing which exists because in this case there is only the carbonyl one carbonyl which is giving you more stability over a carbon carbon double bond right but in the case of a phenol it is the aromatization which is a driving force ok let us look at some of these examples of phenolic compounds if you have a simple phenol substituted with a methyl group at the ortho meta or para position which i can represent like this it becomes a ortho methyl a metamethyl or a para methylphenol and these methylated phenols are called crysols so the methyl substituted phenol is called chrysol and if you see this is isomeric with this molecule which is nothing but your benzyl alcohol so crysols are isomeric with benzyl alcohol but this is not a phenol a benzyl alcohol is an aromatic alcohol right this is an alcohol this is not a phenol it's an aromatic aryl ring containing alcohol but a phenol is o h is directly connected to the

benzene ring
so the two have significantly different properties ok likewise there can be other aromatic alcohols and if you have to name these aromatic alcohols
so you would take
this as the preference one two three
so you say that this is a three phenyl propanol but these are aromatic alcohols they are different from phenols the most important application of phenols
is found in the phenol formaldehyde resins ok the phenols are important precursors to
these polymers and there is where it finds its principal use let us see some of the
methods of preparation of these molecules
so the preparation of phenols can be carried
out on an industrial scale and at lab scale let us see some of the methods for
the industrial preparation of phenols
so to get the bulk amount of
phenol on the industrial level one of the methods which is used
is from the coal tar distillation
so it is a natural source the coal tar and when
we carry out the distillation of the coal tar we get different fractions from the fractional
distillation you get the light oil the middle oil and the heavy oil fractions from the cold are
distillation and it is the middle oil fraction which comprises of mixture of phenols and
naphthalene ok
so it is this middle oil which is then subjected middle oil fraction is subjected
to subsequent treatment from which pure phenol can be isolated
so this is on the industrial scale
for isolation of phenol and the boiling point of pure phenol lies in the range 180 to
182 degrees celsius another method on an industrial level for the preparation of phenols
is from chlorobenzene starting from chlorobenzene phenol is prepared by a process which is known
as douse process ok it is popularly called the douse process and in this what is done is that
chlorobenzene is treated with aqueous solution of sodium hydroxide at a high temperature and
under pressure okay
so it is treated at a high temperature and pressure and under these
conditions it results into formation of sodium phenoxide which on acidic workup gives us the
corresponding phenol
so this is called the douse process and in this the formation of the phenol is believed to occur via a benzyne mechanism
so i am sure you must have studied the benzyme
mechanism the elimination addition pathway
so that is the intermediate involved in the substitution
of the chloro group by the hydroxy group because it is kind of a nucleophilic substitution reaction

and we know that aryl chlorides or aryl halides for that matter are not very easily susceptible
to substitution nucleophilic therefore since we find this to happen the mechanism has been
been proposed to go by a benzyne intermediate another method for the industrial
preparation of phenol is starting from cumin cumin is also known as isopropyl benzene
so we start from isopropyl benzene or cumin and treat it with air
so under oxidative
conditions it yields an intermediate which is a cumin hydro peroxide
so you get this
as the intermediate which is cumin hydro peroxide this is your starting cumin you
subject it to aerial oxidation you get this intermediate and this on
treatment with acid results in the formation of phenol along with generation of a
ketone which is nothing else but acetone
so you get the phenol and you get acetone
as the byproduct from the cumin oxidation so from in going from the hydroperoxide to
phenol we believe what is happening is that there is a migration of this phenyl group
so this reaction it involves the migration of this phenyl group to give you this intermediate
so you get this
intermediate the phenyl group migrates towards the oxygen you get this intermediate with
this carbon bearing a positive charge and then you get this intermediate in
which you have two leaving groups on an sp3 carbon
so this leaves ok and from
here this is what you get the phenol and formation of acetone
so this reaction is a
commercially successful process of making phenols ok
so this is a commercially most
successful method of making phenols starting from cumin and cumin can
be easily prepared from benzene treatment with propene
so you can easily get
cumin
so this is an acid catalyzed reaction ok you get the cumin and cumin on aerial
oxidation gives us the phenol and acetone ok these are some of the industrial
methods for the synthesis of phenols let us see what are the lab scale
preparations the lab scale preparation of phenols
so in this there are again several methods the first one i am going to discuss
is starting from sulfonic acid from sulfonic acid as the precursor this is
actually called the alkali fusion of sulfonase
so you have alkali fusion of sulfonates so
in the presence of the alkali what happens that you have your sulfonic acid
in the presence of alkali you get the sodium salt of sulfonate ok
so this
is your starting precursor your sodium aryl sulfonate and this is subjected to
fusion with the alkali

ok
so you treat it with naoh aqueous conditions at 300 degree centigrade
so this is the
fusion step where you get sodium phenoxide along with formation of na2 so3
and this then upon acidic workup gives us the phenol ok
so in
this case you get the phenol and your aryl can be anything you could have
a phenyl you could have a substituted phenyl ok a tall vial any of these
groups so
this is a method a lab scale method for preparation of phenols starting from
sulfonic
acids as the substrate the next method is by hydrolysis of dizonium
salts
so it is starting from dizonium salts and carrying out its
hydrolysis in aqueous acidic solution
so you have a diazonium salt you
subject it to acidic hydrolysis at a certain temperature
so the reaction involves
heating and you get the phenol along with the liberation of n 2 and h x and
the diazoniums we
know are easy to obtain starting from the aryl amines and the aerial amines
again you have
studied that you can always prepare starting from benzene subjecting it to
electrophilic
substitution nitration in this case you get the nitro substituted benzene
reduce it with tin
hcl you get the aerylamine and the aerial amine can be subjected to
diasotization with nano2hcl
at low temperature when you get the diazo compound which can then be subjected
to this hydrolysis
acidic hydrolysis under heat and you get the phenol and nitrogen in hcl
so this is essentially
a very straightforward method starting from the dizonium salt hydrolysis
another
method is from grignard's reagent you take the grignards reagent in the presence
of air treat them with oxygen and
this is followed by again a dilute acid hydrolysis
so what happens overall you start with the
aryl grignard reagent phenyl magnesium halide in the presence of oxygen it
forms this omgx
which upon acidic hydrolysis acidic workup gives you the phenol and this
magnesium salt
so these are some of the methods for the lab scale preparation of phenols let
us now look
at some of the physical properties of phenols
so when you see a phenol there is a hydroxyl which
is attached to this carbon which is sp2 hybridized and part of the aromatic
ring if you look at the
physical state these are usually colorless liquids or they are low melting
solids
so if you look at a phenol for that
matter simple phenol unsubstituted it is a solid with a melting point 43
degrees
centigrade it's a low melting solid but it has a high boiling point of 182

degree centigrade
and the high boiling point you can imagine can be attributed to the hydrogen bonding property
of this molecule which we discussed earlier the other thing they possess is a typical carbolic
odor because of this hydrogen bonding ability of the phenols it is also possible to solubilize them
in water
so they are moderately soluble in water because you have two parts you have the hydroxyl
which is solubilizing it but you also have this bulky aerial group which is hydrophobic and
that is why they are moderately soluble in water and therefore they are also
soluble in organic solvents just the way the amines are highly susceptible to
oxidation the lone pair of electrons on oxygen it also makes them a good candidate to get oxidized
so the phenols get oxidized easily and if you keep them over a period of time some color develops in
these phenols ok
so these are prone to oxidation just like amines
so these are some of the
typical physical properties of phenols let us now look into some of the reactions which they
undergo and at the same time let us compare them with what we have learnt earlier with respect to
the alcohol
so i am going to divide the reactions into two categories one as we did for the alcohols
earlier one is due to the o h group and the other now in this case is going to be due to the aryl
nucleus
so unlike the alkyl part here you are dealing with the aryl
so what are the reactions
typical of the aryl nucleus and due to o h group and because of the hydroxyl again you can have two
types a those reactions which resemble alcohols
so you know that this was happening with alcohols
also and b those which do not resemble alcohols ok
so let us take each of them one by one
i start with the reactions due to o h group and in here i take those in which the
phenols have a resemblance to alcohols let us look some of those reactions
in which first a hydrogen is replaced when a hydrogen is replaced in an alcohol
the first thing if you remember we saw was the reaction with a sodium metal
so the
way alcohols were reacting with sodium metal phenols are also capable of reacting with the
sodium metal it is because of the acidity of this phenolic o h and it gives you the sodium phenoxide
along with the elimination of the hydrogen gas
so the reaction is similar to
what was seen for alcohols ok the other reaction which is similar
to alcohols is the acylation reaction
so you treat the alcohols with acid chloride acetic anhydride and you

get the corresponding esters   right
so you take acetyl chloride treat
it with phenol ok and what you get is this ester which is phenyl acetate we will discuss later that this phenyl acetate
is susceptible to a rearrangement reaction okay   which is called a phrys rearrangement
where this sl group is going to get   lost from this position and going to be a part
of the aryl ring okay
so this ester right in   the presence if this reaction is carried out
further in the presence of any levis asset   this is going to migrate to a ortho or a para
position in the benzene ring okay
so that happens   under the influence of a levis acid but otherwise
if you carry out the pyridine assisted acilation   of the phenol you end up with a phenyl ester ok so
in this case all your esters will be phenyl esters ok another reaction is benzoylation similar
to alcohols in this you treat it with benzoyl   chloride in aqueous nuh ok and this reaction
is popularly known as shorten bomban reaction
so you start with your benzoyl chloride treat
the phenol in the presence of   aqueous sodium hydroxide you just shake these
and you immediately see the formation of this ester which is phenyl benzoate
along with nacl water and this is called the
shortened bombing reaction okay phenols can also be treated with benzene sulfonyl
chloride and in this case we get what we call   as the tosylates and tosyl group is a very good
leaving group as you might have come across in the   nucleophilic substitution reactions
so to prepare
these tosylates this is what you do you start with   benzene sulfonyl chloride and you treat this with
phenol it gives you the sulfonyl ester
so you get   h5 so2 o c6 h5 and these
compounds are called tosylates it is a phenyl benzene sulfonate ok the same thing which
was happening with alcohols   it can happen with phenols also when
you treat them with alkyl halides in alkaline conditions and this reaction is what
is popularly known as the william suns synthesis okay
so the reaction involves the formation of alkyl aryl ethers
so its a very popular reaction
for making alkyl aryl ethers you start with   the phenol which under alkaline condition
exist in the form of sodium phenoxide   and you treat this with an alkyl halide ok if
you treat us with methyl chloride in aqueous nuh   it undergoes the nucleophilic substitution
reaction to give you the alkyl aryl ether which   this one is called any sole
so this is
essentially a nucleophilic substitution reaction   for the preparation of the alkyl aryl ethers

the interesting thing in this reaction is that when you have to prepare the alkyl aryl ether so
there can be two combinations for preparing the same alkylarill ether the question is what do we
do which alkyl halide do we start with and which phenoxide should we start with for example ok i will take one example for this
suppose we have to make this molecule which is phenyl in propyl ether there can be two routes or
two combination of reagents which can be used to arrive at this
molecule in one case you can start with this alkyl halide and the sodium phenoxide the other
could be that you start with this sodium alkoxide and treat it with you treat this with the aryl halide so
two routes are possible to arrive at this product
so the question is which is the
combination of substrates that one will choose over the other
so i put a tick here that this
reaction is feasible but this reaction is not feasible now you think why because it involves
a nucleophilic substitution
so when we have to carry out a nucleophilic substitution
on an aryl halide it is not very easy okay
so the aryl halides have a low reactivity
towards a nucleophilic substitution reaction therefore we will not choose a rhyl halide
as one of the reacting species instead we will choose the corresponding phenoxide and take
the alkyl bromide to form this alkyl aryl ether ok let us look at now few of those reactions
resembling alcohols in which the hydroxyl group is replaced
so far we were talking about cases
in which the hydrogen of the phenol was replaced when the hydroxyl is replaced there
is one example the reaction with pcl5 ok
so in this case you take the phenol
you treat it with pcl5 when we are taking the alcohol we were getting the corresponding alkyl halide in this case however the reactivity of a phenol
o h to get replaced by the chlorine is not
so facile ok why because we know that
a nucleophilic substitution on the aryl ring is very slow okay
so this will not work so
easily however if we make this substituted with electron withdrawing groups okay like a
two four di nitro phenol and then we carry out the reaction with pcl5 then in this case we
can get the corresponding chloro derivative along with the formation of these molecules
so for this we have to have a electron withdrawing substituents which activate this
carbon and make it more susceptible towards the nucleophile substitution reaction okay so
this is the similarity and the difference with respect to alcohols with which it will happen
very fast likewise reaction with ammonia so in this you take the alcohol the

phenol and
you heat it at about 250 degrees centigrade in the presence of anhydrous zinc chloride
so this is the reaction with
another nucleophile that is the ammonia and you take the phenol you have to react this with ammonia this is done
at about 250 degree centigrade in the presence of anhydrous zinc chloride to give you
these aryl amines as the product so however the o h substitution is more facile
in alcohols as compared to that in phenols ok let us look at the other category of reactions
in which phenols do not resemble alcohols let us see those reactions in which the phenols do
not resemble alcohols and the first in this list is the reaction with ferric chloride solution so
the action of ferric chloride solution
so this reaction is actually taken as a test for
identification of phenol
so it is a qualitative color test for identification of phenols this
tells us if the o h group is attached to the aryl core ok
so the reactions in which phenols
do not resemble alcohols is by virtue of the fact that o h group is attached to the aryl core and
this is what makes them different from alcohol so the action of ferric chloride solution on alcohol
on the phenol gives you a violet green purple red color
so there is an appearance of all
these different types of colors depending upon the type of phenol you are using
and this happens due to the formation of ferric complexes of ferric chloride with phenol
so the ferric
chloride solution gives a positive test or it gives a color change a ferric chloride
solution is orange in color yellowish orange
so it will change to all these different colors
if it sees any of these enols or phenols and enols and phenols give a positive ferric
chloride test
so this is what is not given by alcohol
so you can distinguish that the
hydroxyl containing compound is an alcohol or a phenol another reaction in which they are
different is the reaction with zinc dust you heat the phenol with zinc dust
ok you heat it and what you get is the reduced form of the phenol you get arenese as the product ok
so the phenols on treatment with zinc dust are reduced to adenes okay another difference between them is based upon the
acidic nature of phenols ok
so the acidic nature of phenols the acidity of phenols is not the
same as that of alcohol
so if i have to draw a comparison a carboxylic acid being most acidic
and an alcohol being least acidic in between comes the phenol ok

so the acidity of phenol
lies between the carboxylic acid and the alcohol but a phenol is about 1 million times more
acidic than alcohols ok it is one million times more acidic than alcohols
but still it is a weak acid
so because of the acidic nature
of phenols what are the different things it does which are not given by an alcohol one it turns a blue litmus red ok second it dissolves in alkali it dissolves
in alkali completely because you get the corresponding sodium phenoxide
so it dissolves
in alkali the other thing is which is similar to an alcohol but different from a carboxylic
acid is that it does not give no effervescence with sodium bicarbonate solution okay
it is not acidic enough to release carbon dioxide on treatment with sodium bicarbonate
so if we look at the acidity of phenol in aqueous solution it is weakly acidic and can give you this
phenoxide ion ok
so this is a weak acid and this is a strong base and this is a very stable base
at the same time
so if you look at the structure of the phenol and the
phenoxide ion
so we know that a phenol can exist in all these residence stabilized structures
with the charge accumulating at the ortho and para positions ok and
if you look at the phenoxide ion in this case the charge is in
fact much more concentrated ok and the phenoxide ion is stabilized again by resonance
so it is
stable because it is stabilized by all these resonating structures
it is stabilized by resonance and that is why it has this ability to lose
the proton because the corresponding phenoxide anion which is produced is resonant stabilized
so the pka of the phenols in water at 25 degrees centigrade a simple phenol it is eight nine ok let us compare some of the p k values of the differently substituted phenols
so as to get an idea of how the acidity varies according to
the electronic influence
so if you have phenol or two methoxy or two methylphenol
which we say is a orthochrysol or a three methyl phenol or a four methylphenol
so i am talking about orthochrosol metacrysol and paracrisol okay
if you have a two chlorophenol a three chlorophenol a four
chlorophenol or two nitrophenol a three nitrophenol or four nitrophenol or if you have di substituted a two four dinitro phenol or a tri substituted two four six nitro phenol
which has the common name picric acid
so the acidity is comparable to an acid
so it gets
the name picric acid and compare it to cyclo hexanol
so the p k values of these different
phenols and cyclohexanol is of the order nine point eight nine with two methyl

phenol
it increases ok
so a lower p k shows it is more acidic here it is increasing because the
methyl group it increases the electron density on the ring and therefore the
acidity of the
o h bond decreases with a three methyl
so when you change the substitution from two to three
so at the meta position it is less influencing and the p k is therefore lower
little lower
than the ortho substituted isomer
so it is ten point zero one with para it is similar to ortho
10.
17 with the two chlorophenol now the chloro applying its minus i effect ok
the
inductive effect the acidity increases and the pka reduces to eight point one
with
three three chloro the inductive is lower little less because it is away and
therefore
it is and there is the mesomeric effect okay as well which is operating in
case of this chloro
it is eight point eight zero with four chloro ok the pka is further low it is
nine point two zero two nitrophenol very strong electron withdrawing it is the
minus
m effect which makes it most acidic more than that of the simple phenol and
the p pk becomes
7.
17 with 3 nitro the minus m is not operative it is a minus i you have 8.
28 with the 4 nitro
derivative it is similar to the ortho 7.
15 with dinitro substitution it becomes more acidic
3.
96 and that is why we saw that in this case the substitution was happening
with pcl5 with
the 246 nitro it becomes 0.
38 and compare it to a cyclic alcohol the cyclohexanol which is 18.

so this is a rough estimate of the pka values and the effect of different
electronic
substituents at different positions on the aerial ring of the phenol and the
relative influence it
has on the acidity behavior of these molecules ok all right
so this was about the reactions
with respect to the hydroxyl group now we move on to the second aspect of the
phenol reactions that is the reactions of the nucleus what happens from the
nucleus perspective
so in this the first example i am taking is hydrogenation reaction
hydrogenation is
you are reacting the phenol with hydrogen in the presence of a catalyst a
nickel
catalyst in this case and you heat it right and you get the reduced
product and the reduction of the aromatic core is what is taking
place and you get cycloalkanols this is what you get
so you start with the phenol treat it with hydrogen three moles of
hydrogen will be required for complete reduction of all the three

bonds of the aromatic ring in the presence of nickel as the catalyst and
you get the reduced product your cyclohexanol the more important reactions of the nucleus
are the electrophilic substitution reactions the electrophilic substitution reactions are the
reactions in which the electrophile comes and attacks onto the benzene ring or the arene
ring and this you must have studied when you do did the aromatic hydrocarbons the reactions
on a benzene ring ok
so the different types of electrophilic substitutions you know are
halogenation nitration sulfonation friedel crafts reaction all these are also possible on
a phenol but they have a different reactivity pattern which follows for the phenols so
what happens is that your hydroxyl group it activates the benzene ring and
because it activates the benzene ring the relative reactivity of the phenolic aryl
core towards the electrophilic substitution is much more as compared to the unsubstituted
one which is a simple benzene
so let us see one by one what happens with in with the different
electrophilic substitution reactions halogenation as the first one
so one thing which we know that because of the
hydroxyl group our ring is activated okay
so the o h is an activating group and as we just
saw it activates the ortho and para position
so the ortho and para positions are electron rich
right because of the hydroxyl group activation there is a more charge at the ortho and para
position the negative charge by virtue of which the electrophile will prefer to attack
at these sites
so in halogenation reaction you start with a phenol and let us take examples of a bromination
reaction you treat it with bromine ok now i take two conditions
you treat it with bromine water is the one condition if you do
so you get not a mono substituted or a disubstituted but
you get a tri-substituted tri bromo substituted phenol ok you get a tri bromo substituted
phenol if you treat it with bromine water if you treat this with bromine in a non
polar solvent like a cs2 or acetic acid at low temperature at 0 degrees
centigrade you are able to control the reactivity the
electrophilicity of bromine
so the electrophilic reactivity of bromine is reduced when
we carry this out in a non polar solvent and at low temperature and under such conditions
we end up with a mixture of mono substituted ortho and para products with the para
bromophenol being the major product
so this is the major when we carry out
the bromination at 0 degree centigrade with carbon disulphide as the solvent
so as is

expected because the nucleus is highly activated   because of the hydroxyl group which has given
its electrons at the ortho and para position   the reaction yields a mixture of the ortho
and para substituted products and this bromine   reagent what we are using source of bromine
generation we call this a bromate bromide method
 so your bromine water   okay what you are using comes from a mixture
of we can use a mixture of potassium bromate plus potassium bromide
 so it
is a bromate bromide method all right another example of electrophilic
substitution is sulfonation what is happening   in sulfonation reaction compare it to the
sulfonation of benzene ok ok one more thing i   would like to point out in bromination is you just
notice that under the conditions of bromination   the levis acid has not been used is not required
for bromination
 so you remember that with benzene   ring we were making use of levis acids to activate
the conditions and helps in the generation   of the electrophile ok
 so it increases the
reactivity of the electrophilic substitution but   with phenols this is not required ok
sulfonation you start with the phenol you treat it with concentrated
h2so4 the temperature   is ranging in the range 15 to 25 degree
centigrade the product which you get is the ortho sulfonated phenol ok you get the ortho
substituted phenol and if the same reaction   with concentrated h2so4 is carried out at
100 degrees centigrade we get the product   which is a para substituted phenol
 so in this case we get the   paraisomer and if you heat the ortho
isomer at 100 degree centigrade   it gets converted to the paraisomer and if you
carry out this reaction with concentrated h2so4 at any temperature in the range 3200 degree
centigrade you end up with a mixture of ortho and   pera
 so this three different conditions tell
us that what is happening is that when the   reaction is carried out at low temperature we
are getting one product the ortho substituted   which is a kinetic product
 so we are talking
about the kinetic versus thermodynamic stability   of substitution in this case when we carry it
out at higher temperature we are getting the   more stable the thermodynamically more stable
product
 so we say it is a thermodynamically   controlled reaction
 so we get a thermodynamic
product and if we heat it ok at high temperature
 so sulfonic acid is a very bulky group it is
a bulky group and it will not like to stay   at the ortho position next to hydroxy and

therefore it will migrate it will prefer to stay at the para position at a high temperature because that is not the most thermodynamically favorable position for the stay of the sulphuric acid it is a bulky group so that is why a parasubstituted product is thermodynamically favorable and the ortho one forms as a kinetic product at low temperature ok another reaction in this is the nitration reaction you start with phenol you treat it with dilute nitric acid 25 percent nitric acid temperature is 25 degree centigrade you get ortho nitro phenol ok and you get paranitrophenol so you get a mixture of ortho and para isomers with the ortho being the major and para being minor the same thing if you carry out instead of dilute nitric acid you use concentrated nitric acid you get not a mono substituted but a tri nitro substituted phenol which is called picric acid but the thing is the yield in this case is still not good so you saw that the yield here also the percentage conversion it's a 30 to 40 percent yield and a 10 percent yield so yields are poor in case of nitration ok so nitration results in poor yield of products and this happens because of oxidation of the starting material as a side reaction so the starting phenol gets oxidized as i told you it is quite prone to oxidation so under the in the presence of nitric acid it undergoes oxidation and it gives you more of the oxidative side products and less of the desired nitro derivative so a better method to execute this reaction and get the nitro derivative is that you first sulfonate it you treat it with sulphuric acid and we just saw that when you do this in any of these temperature ranges you end up with a mixture of ortho and para sulfonic acid but the yield in this case is good okay it is not at least getting oxidized the core is not getting oxidized so when you get the mixture of this ortho and pera now you subject it to nitration ok you treat this with concentrated hno3 and when you subject it to nitration here you get 246 trinitrophenol that is the picric acid so here you get this in good yield so you first converted into the sulfonic acid derivative and the sulfonic acid its a good leaving group ok so it facilitates the reaction ok and the second thing is that because it is present it deactivates the benzene prevents it from oxidation ok it deactivates the benzene nucleus and prevents its oxidation which was happening because of this o h group right

so it prevents the oxidation by deactivating the benzene nucleus of the phenol
and then it is easily replaced by no2
so this method for making picric acid is better in terms
of the yield as compared to a direct nitration ok another reaction which involves
an electrophilic substitution is the friedel crafts reaction it's a friedel crafts
alkylation which i am going to discuss today which involves the treatment
of the phenol with alkyl halide in the presence of a level
acid to give alkyl phenols
so you take the phenol okay treat it
with alkyl halide in the presence of the levis acid you end up with a mixture of
ortho and para alkylated phenols if you start with the phenol and treat it with a bulky
alkyl halide like a tertiary butyl chloride this is a case which selectively
gives only the para substituted product
so in this case the alkylation happens
only at the para position unlike the other case it is by virtue of this you say virtue or it is
because of the steric hindrance of offered by the tertiary butyl group ok another reaction i am
going to take in this electrophilic substitutions is the nitro station reaction
so in the nitro
session what is happening you replace the h by n o ok
so your electrophile is no plus and
you know that no plus is a weak electrophile yet it undergoes a reaction onto phenol so
your reaction involves treatment of the phenol with nitrous acid
so you take the phenol
treated with nitrous acid at low temperature and it undergoes a nitro station
so the ortho position
is blocked here it undergoes nitro station at the para position and the nitrous acid can be
generated we know from the corresponding nitrite salt in the presence of the acid
so this is how
you generate nitrous acid and this nitrous acid is capable of carrying out the nitrosation of the
phenol and this is one of the examples where an electrophile like a nitrosyl ion can be added it
can be sub the phenol can give us the nitrosylated phenols okay
so i stop here with the electrophilic
substitution reactions there are still many more reactions of phenols which we have to discuss
but i will stop here and next class will take up another very important reaction of phenols
that is the riemertemon reaction but till then you can just go through all this and revise
and gear up for the next class thank you you