ok welcome to this lecture this is lecture 14
on chemical kinetics again let us start from   where we ended in the last class
 so in the last
class what we were doing was we were looking at   this energy profile right of a
certain
reaction and we were taking an elementary   reaction the elementary reaction was
this
ethyl bromide reaction reacting with ah   hydroxyl ions to give ethyl alcohol
and bromide
ok and then we were trying to have ah a feeling of   what this energy profile is
trying to tell you now
before this we had looked at the meaning of this   reaction coordinate which is
horizontal axis and
the potential energy which is your vertical axis   and what these tell us about
the reaction when you
move from the reactant side to the product side ok
 so now looking at this reaction again what we can
say is remember we are looking at the molecular   level that is a molecule of c
h three c h to b
are ah interacting with ah a molecule of this ah   in hydroxyl ion or h minus
right then
what we can say is that as you know as   these come close feature as these
molecules
come close to each other then you know as   during the reaction as these
molecules
which are the reactant molecules right they come close to each other then these
interact
ok
 so these interact and as a consequence   the chemical bonds
 so these interact and
then what will happen is chemical bonds distort ok
 so what will happen is chemical bonds
distort the moment the chemical bonds distort
 so the moment the chemical bonds distort and we move on to the next page
then we can say that the potential energy increases right
 so when the reactants were just
by themselves they were not reacting
 so they were in the stable form right now the
moment they started coming close to each other   bond distortion started taking
place right and
then the potential energy started increasing now   at distances at distances
which are like typical of the chemical bond lengths chemical bond lengths the
reactant species the reactant species become partially bonded become partially
bonded together and then new chemical bonds form right
 so this is you are looking at the progress
of the reaction
 so when they are close to each   other the distance is being of the bond
lengths
then the reaction species become partially bonded   and new chemical bonds start
forming the
moment the new chemical bonds start forming   then at this point what we can
say
is at this point what we can say is   that the new chemical bonds form that is
the new chemical bonds form can say the potential energy reaches maximum ok the

potential energy reaches maximum at the point where the
potential energy reaches maximum this situation is referred to as the transition state
 so this situation now is referred to as a
transition state this transition state is often   represented by a symbol like this ok
by a symbol like this which is called a double dagger a symbol like this which is called a   double dagger
 so that means if i go back to this
ah you know the the potential energy
 so here   this transition state i will be having this double dagger
 so this is my transition state i can see   the potential energy is at the maximum right so
everything is with reference to this diagram ok   now the species the partially bonded species i am
having at the transition state
 so next i can write the molecular species present at the transition state at the transition state is referred
to as ok this is important the activated complex ok it is referred to as the activated
complex this activate complex is a transient species it is it is not please remember
this one is not an intermediate this is not an intermediate it is just a
transient species the activated complex is   that complex is that complex which is formed
at the top which means
 so the activated   complex is forming here the active complex is
forming here right i can write
 so here i have the activated complex
 so the activated complex is forming
where the activator complex is forming   at the transition state and what is the
transition state transition state is the   point where your potential energy is the maximum
in your energy profile diagram right and this   you know gaining information gaining information
about this activate complex right which pertains   to that point of the potential energy maximum this
being the transition state is of great interest   you always would like to know what your transition
state is that means what your activated complex is   in terms of structure in the transition state
this is of great fundamental interest in chemical   kinetics ok
 so now coming back
 so you look at this
what have we learnt thus far there are two axis   the horizontal axis being the reaction coordinate
the vertical axis being the potential energy   right when the reactants come close to each other
there is distortion the potential energy slowly   increases like this right then a point comes then
a point comes where the potential energy is the   maximum that means the reactants and the reactants

are partially bonded to each other within allowed chemical bond distances and the point where
the potential is the maximum this point is or this situation or this point is referred to
as the transition state because transition state because once you have reached the maximum then you
go a little bit to the other side you fall back to the product
 so that is what your transition state
is your transitioning your transition state means your transitioning that means you are changing
transition means change you are changing from the reactants to the products through this point which
is the maximum and your potential energy diagram and the complex the complex that is forming
between your reactants is called the activated complex which is formed at the transition
state this activated complex remember is not intermediate it is only having a very transient
very very transient very very short lived lifetime that means it is very short lived there for a very
very small amount of time and its barely barely observable it is not an intermediate intermediates
can be observed activated complex no hence this is a big difference between activated complex
and intermediate
 so the accurate complex is necessarily the one which is formed at your
transition state okay now having said this having looked at this increase in potential energy then
when we move to the other side of the transition state you start going over to the product
side ok you realize that we are going through a change in the potential energy right but before
doing that just lets take another quick example
 so that you know this diagram is made a little
more clear say for example consider this following reaction a two plus b two going to two a b now let this be an elementary reaction
element reaction means the way it is written thats how it is taking place in one step right
so then what i can write is i can say right you know this is just an example just a hypothesis its not necessary that it has to take place
this way i can say i have a a right plus b b then it goes through something like
this let me write it as a a b b ok then then it goes over to the product side ok then it goes over to 2 a b
 so how is it 2 a b you get 1 a b from here and 1 a b from here isn't it
 so that means this i can write as a b a b
 so what are the distortions you are
looking at
 so when this a two reacts with b two to give two a b what is going to happen the
a a bond has to break the b b bond has to break right then the a b bond has form this a
b bond also has to form this this species which is looking like a

square this species is your activated complex right
 so remember now this activated
complex is a present at the transition state
 so this activated complex is present at your
transition state what has happened at the   activated complex or what you know what is so
this is hypothesis again just for example
 so the   activate complex is such you see as i move from
a two and b two to two a b what am i going to do   i am going to break the a bond i am going to
break the b b bond but i am going to form also   two a b bonds this is exactly what is happening
out here what it is telling you is that   this one is partially broken between a a
the bond between b b is partially broken   then one a and one b one atom of a one and a b is
being involved in partial bond formation again the   other atom of a n other atom of b is involved in
partial bond formation ok
 so you have progressed   in terms of the breakage you have also
progressed in terms of bond formation   and that is why this is called an activated
complex where you have a little bit of bond   breaking taking place or whatever bond breaking
taking place and also bond formation taking place   when we move on to the other side we get these
two a b molecules thats why its called two a b   and thats why this one is referred to as
your activated complex now think about   now think about this from here to here and
think about your potential energy diagram so   what is happening your reactants were for this
your reactants were a two plus b two right so   these were your reactants then what happened was
when this reactor started coming close together   the a a bond started breaking and the b b bond
also started breaking hence the potential energy   started moving up then you came to a maximum
what happened at the maximum at the maximum what   had happened was you had the partial breakage of
the a bond the partial breakage of the b e bond   not only that you also had the partial formation
of a b bond and the partial formation of a bond   then a slight push that means a
slight move in the other direction   in the other direction what happens is now
the a b bond forms every bond forms and the a   and b bond they snap that means they break and
that is why and that is how you would read your   energy profile in terms of this ah example right
and this being the activate complex and i again   i hope that this discussion gives you an idea of
what this energy profile is trying to tell you ok one more thing you have to realize what
happens is that as you go from the reactor   to the product side you go through

an energy
barrier
 so so let this be the energy barrier that means you move up in terms of energy
 so this   is your activation energy right remember
this is activation energy which is say ea this is activation energy right once
you have
activated them enough they have moved to the   top then they can go over to the
product side
ok you know let me ah try to remind you about   that energy distribution that
the kinetic energy
distribution huh that only those molecules which   will have at least this
amount of energy remember
the shaded portions at least this amount of energy   and more would go over to
the product side
this is what you are saying that means if the   reactants have to go over to the
product side i
need to move up to the top and to move to the top   of the cell or the potential
energy i need this
amount of energy this is called the activation   energy right now the question
is the question
which you ah you know ask yourself now is   how does it gain this energy
 so let
us again talk about this reaction c h three c h two b r plus o h minus how
would it how would these reactants how   would these reactants move like this
to
the top of the energy
 so what happens is this energy which is e a this e a it is attained through
collisions between the reactants
 so they collide collide collide
 so once
on collision what happens is they gain energy   right once they gain energy
those collisions
which will give rise to sufficient energy   that is e a and they move to the top
they would
be having a very good chance of moving over to the   product side
 so this is how at a certain
temperature collisions in the reaction system   that is the collisions in the
reaction system giving rise to the kinetic energy right because of collisions
will bring about
this attainment of the activation energy   right once the activation energy is
retained then
there is every chance that the reactor molecules   will go over to the product
side and that is
typically how it happens
 so now you understand   when i raise the temperature what is going
to happen when i raise the temperature the   collisions would be happening more
vigorously
because i have increased the thermal energy right   its more moving larger
velocity right more speed
more ah collisions happening with greater vigor   and because collisions happen
with greater
vigor then the reaction rate will also   increase with increase in temperature
right
and that's typically how the thing happens   because remember the activation

energy is
independent of temperature that is what was one of   the assumptions we had taken when we were talking
about the temperature dependence of reaction rates   thus higher the temperature more vigorous are the
collisions and hence it is easier to attain this e   a the activation energy that means go to the top
of the hill and thus the reaction rate increases   because more and more reactant molecules
can easily go over to the product side as   compared to a lower temperature now you can ask
a question
 so the question is let us go back to the other reaction c six h five c h two
c l plus o h minus giving c six h five
c h two o h plus c l minus right here we are two steps c six h five c h two c l the
first elementary step giving c six h five c   h two plus plus c l minus the next one was c
six h five c h two plus plus o h minus giving   c six h five c h two o h
 so these were reactions
three and four right
 so this was three this was   these are reactions three and four now   the question that might come to your mind is
ok if i am talking about collisions between the   reactants i have two reactant species out here
they are colliding right they are getting this   through the kinetic energy of collisions they are
getting this activation energy and then they move   over to the product side but if i look at this
composite reaction and if i look at my first step   the first elementary step the first element
is step is only one reactant species right the   first envision is only one reactant species then
how can collisions happen you might be thinking   like this right because for this reactant or for
this reaction i had two reactant species they were   colliding no problem to understand but what about
this c c expression c l the reaction number three how can this happen remember for any any reaction
to happen i will always have to cross an energy   barrier right as an energy
 so i am talking about
those reactions where an energy barrier exists   and these reactions are such that there will
be energy barrier and for them to go over to   the product side
 so for example for c c x 5 c h
2 c l to go to this cation plus c l minus a c c   l bond has to be broken that means i have to go
over a potential energy maximum but how can i do   that because i have only one reactant species
so this anomaly
 so is this an anomaly at all would you think it is an anomaly can we explain that its actually very easily explained
 so for reactions involving single reactant species like this
a single reactant a single reactant there is no other species right so

it rules out collisions ok but here i need reactant which is c 6 h 5 c h 2 c l
energy is needed to break the c l sorry c c l bond but there is no other
reactant right there is no other
reactant
 so there is no other reactant
 so do we say will collision be ruled out ok i do not have any other reactant
species   the only thing that i have is c c g so
c social which has to break a c c l bond   to go in order to go over to this
cation
plus c l minus there is no other reactant   does that mean that there is no
collision
happening at all thats not true
 so what happens is now what happens is the following the c6h5 ch2cl collides
with its sorry its own molecules
 so there are many molecules in the
reaction system though these molecules c c x   s socl can collide with each
other right that
means the reactants collide with each other and also if it is if it is being
done in a
solvent the c six h five c h two c l can also collide with the solvent molecules
 so what is it colliding with
then i need i do not need another reactant   i have
 so many c c h social molecules out
there that all these molecules can collide   and through this kinetic energy i
gain that
activation energy to which it goes over to the   top or you can also collide
with the solvent
molecules which are out there and do the same   thing right hence i do not need
another reactant
so you should not be thinking in like that way so   its not that i will i can
only have collisions
if i need if i have two reactants in the system   because when you are talking
about a system
you are not talking about one molecule you   are talking about many many
molecules
 so if it
is a mole of reactants which is you are talking   about avogadro number of
molecules right there are
so many other c c h five cho cell molecules that   means all then what happens
is that all the other
molecules will be colliding amongst each other   depending upon the temperature
of the reaction
and hence it will attain the activation energy   alternatively or along with
this or parallelly
or simultaneously together with this   if you have taken this in a solvent
which
is say a water then there are many water   molecules the c c
 so cs2 cell molecules
will also collide with the water molecules   and then also gain activation
energy just go over
to the top of the potato energy and then move   on to the product side and hence
i get the top
reaction c c h five c h two plus going to or ah   plus c n minus right
 so this is how you

should think and finally and finally the difference in potential energy between
between the products and reactants that means what i
take is the difference is what   potential energy of products
minus potential energy of reactance and this is equal to the enthalpy change is
equal to the enthalpy change right now let us go back to the our diagram
the energy profile that we had drawn before
 so here if you look at the energy profile now
so this is the production range of reaction this   is a portion of your product
the potential is
your product is less than the potential energy   of reactant
 so that means the delta h in this
case is negative
 so if i write this one is ok so   if i write lets see if i use a different
color um
yeah
 so if i use a different color
 so for example this is delta h right
 so what is delta h
delta h is the potential in your products   minus the potential of your
reactants now for
this one you can see the product is at a lower   potential energy than that of
the reactants which
means the reaction is exothermic
 so here i can   write the delta h is for this profile the delta h
is negative why because as defined as defined what   is delta h it is the
potential of your product
minus the potential range of reactants and you   can see out here the potential
your products is
this which is lower than the potential range of   reactance
 so when i take this one and subtract
from here i should be getting a negative number   because this is higher than
this and is the delta
h is negative and i can say that the way this energy profile has been drawn the
reaction
is exothermic in nature you should now draw   a reaction profile where this
delta h is positive
right based on this discussion you should be able   to draw
 so delta h positive means the potential
of your products is higher than the potential   reactance
 so it will just reverse that means the
the products will move up reactants moving down
 so products would be having a higher potential
energy than the reactants in that case the delta   h would be positive that is
the reaction is
endothermic in nature
 so then in a nutshell   what we have discussed is the very essential
features of an energy profile again to end this   part what is this energy
profile telling you the
energy profile tells you many important things a   let us talk about the axis
the reaction coordinate
it tells you the path the reaction is taking now   as the reaction is taking
that path the vertical
axis which is the potential energy is telling you   how the potential energy is
changing as

the reaction path is being traversed or that means as we are going along the path of the reactants to the products ok number three when i go from the reactants
to the products right based on this profile i go through a potential energy maximum because
from here to here the bond distortion takes place as the bond distortion start taking place the
production increases and then i come to a point for an elementary reaction then i come to a point
where i reach the maximum of the potential energy right
so that maximum scenario is called the
transition state and the complex the complex which forms at the maximum the complex which forms
of the maximum is called the activated complex the moment the active complex is formed then we
move on to the other side this this being at the top of the energy barrier the energy can now only
decrease and it goes over to the products right how do i get this energy or how do the molecules
get in this energy
so if its a two reactant system a plus b then a will collide with b if its a one reactant system a go into products then there are
so many molecules of a they can collide
the a molecules can also collide with the solvent molecules to get this energy move to the top of
the energy barrier and then go over to the product side and finally the difference in potential
energy between the products and the reactants will define your change in enthalpy
so if this
delta h is negative it is exothermic if the delta h is positive it is endothermic in nature ok and
delta h being defined by this equation right now see when i had you know ah plotted
this or drawn this energy profile i said that this is for the reaction between
c h two c h two b and o h minus right again a question can come to mind the question is ok if i have done all these things for the molecule or for the reaction the two step
reaction the composite reaction this ah mixture of two elementary steps can i draw a possible
energy profile for this reaction is it possible
so let's see whether we can do it remember that
c 6 h 5 c h 2 plus is an intermediate
so if this is an intermediate if this is an intermediate and
based on this the energy profile can be drawn like ok
so these are my reactants these are my products right and this
is how my energy probably look like because this is how my energy profile
looks like right and remember i had potential energy out here and this is my
reaction coordinate ok this i out here is my intermediate this i out here is my intermediate
so for this for this reaction for
this reaction the intermediate is c c h five c h two plus
so i can write

for this reaction it is c six h five   c h two plus
 so that is my intermediate
right ok
 so what are these see there are   two hums why are there two humps there are
two steps right the first step taking me from the reactants to the intermediate
right and this
i can say is what i will say here
 so this is my transition state which is often abbreviated
as ts you have an average s t s for step one ok
 so this is step one which is
essentially the reaction three and then   you understand
 so this point would be
my t s that is transition state for step two and as defined before this would be
my delta h
 so here you can see that yes i can indeed draw an
energy profile for a composite reaction provided   i know the composite reaction
very well in
terms of the intermediates that are coming   out this reaction is very well
studied and this
carbocation intermediate is proposed to be there   right and hence what i have
done is you can see
this is the transition state for step one i go   from here to here i form the
intermediate then the
next step is the intimidator reacts with o h minus   to form this
 so what are my reactions here for
the first one my reactants are c 6 h 5 c h 2 c l   going to this plus and then
what i have is this one   reacts with o h minus reacts with o h minus to
give me the products
 so i forgot to write here ok here you will be having the here you will
be having the activated complex for step one   activate complex for step two but
see this
is the intermediate i do not say this is the   activator complex this is
intermediate
this is of lower energy than these two   ok
 so so hence this is extremely important for
you to understand that this intermediate and these   two are completely
different the species i
have at the top is my activator complex and   the species which is lying at the
lower energy
lower potential energy is my intermediate ok
 so yes even for a composite reaction i can draw an
energy profile but i have to make sure that i know   the reaction mechanism very
well which will allow
me to draw the energy profile okay other things   remaining the same right
 so um you know i think
we have spent enough time on you know these energy   profiles talking about
these and what they try
to ah tell you now lets move on and ah lets talk   about ah something which is
also very significant
for an elementary reaction its called molecularity   called molecularity as i
had referred
ah to it before too
 so a common method   of classifying elementary reactions is based
on its molecularity now how do i say that so   what i say is

so ah suppose i have an elementary
reaction which goes from a to b suppose i have   another linear direction it
goes like a plus b
going to p
 so all these reactions are elementary   right all these reactions being
elementary
what i say this is a unimolecular reaction this is a bi molecular reaction this
is a bi molecular reaction now suppose
i have something like you know say two a   plus b going to b for example if this
is also an
elementary reaction then i will say that this is a ter molecular reaction ok
 so the
definition of molecularity is like this   there is one molecule of a going
to p hence its called unimolecular   one molecule of a and one molecule of b
makes
it two molecules hence its called bimolecular   two molecules of a reactive
molecular v total
of three molecules is called tur or tri molecule   thats what the molecularity
is now for an
elementary reaction for an elementary reaction   what happens is based on this
based on this
i can write down the rate loss because i know   what the molecular it is
 so like say for a going
to p
 so for a go into p my rate law would be   r is equal to k times concentration
of a
for this reaction a go into b now for the   next one a plus b go into p remember
all
these elementary reactions r is equal to k a b then for the other one the time
molecule
of the term molecular reaction i can write r is equal to k a squared b now you
can see the
exponents on the top are the powers on the top   a raised to the power one hence
it its called
unimolecular then a raised to the power one b   raised to the power one total
one plus one is two
its called biomolecular then two a plus b going to   p
 so its tri molecular term molecular we say
ok a square b
 so two plus one is equal to three   ok
 so then what is the significance of this
elementary reaction and molecularity what it   tells you is that for an
elementary reaction for
an elementary reaction
 so let me ok right here for an elementary reaction molecularity and order are
the same
 so for an elementary
reaction molecularity and order   are the same
 so this one was unimolecular remember this is a new molecular
 so i can
straight away write the right equation   as k times concentration of a the
order
is one because it is unimolecular then
 so when i say order outer means overall

order
 so for this one it is bimolecular by molecule this is a raised to the power
one b raised to the power one one plus one   two by molecular
 so the overall order is true
hence its biomolecular right by uni
 so this is three molecules say term molecular three molecules two
plus one three i straight away write the   rate expression without even thinking
about it
because for a limited reaction i can straight away   write there are expressions
because molecular
and order are exactly the same and when i   talk about r i mean the overall
order ok so
then i can write this again as the following the experimental the experimental
overall order of of an elementary reaction of an elementary reaction is the same
as molecularity is the same as
molecularity ok
 so this is again extremely important where the
overall order and molecularity for   an elementary reaction are the same
allowing us
to straight away write the rate expression right   please keep this in mind that
molecularity molecularity is a theoretical concept it is a theoretical
concept why because by looking at   by looking at this by looking at this
knowing
that these are elementary i am writing or   knowing that there is one molecule
out here
one molecule of a one other b i write down the   molecularity molecular means
the total number of
molecules involved in the reaction however order is an experimental quantity
 so this further reinforces the significance
of an elementary reaction where we say that   theoretically what we say based on
the
balanced chemical equation is exactly   the same as is observed using
experiments
so the order which is an external quantity   is the same as molecularity which
is a theoretical
quantity which we look at or which we write   by looking at the balanced
chemical equation
these are the same for an elementary reaction   then finally i can write down
for an
elementary reaction having done all these three very important points
it is has to be a single step reaction number two must proceed through only one
transition state ok must process only one transition state it
cannot have multiple transition states because   the moment you have multiple
transition
states you are talking about multiple   elementary steps that means a composite
reaction number three molecularity is equal to overall order keeping in mind
that this is a
theoretical quantity and this is obtained through   experiments right this is
where the significance
of the elementary reaction rise and these are the   characteristics of an
elementary reaction that
one should keep in mind whenever you come across   a reaction or whenever you
come across a word in
a book which says that this reaction is elementary   nature and immediately

these three features or
characteristics of the elementary reaction should   you know come to your mind that ok whenever i am
talking about elementary reaction i am talking   about these three things a single step reaction
a reaction which has to process by through only   one transition state and for that elementary
reaction because it is elementary in nature   the molecularity is equal to the over order that
means the balanced chemical equation tells me   or allows me to write down the rate expression
that is k times a times b or k times a   or consideration of a or k times something else
based on what the molecularity of the reaction   is and this is extremely important for us to
keep in mind ok
 so this was ah you know all about   elementary reactions and the molecularity too
let us look at our typical you know example   right see for let us let uh let us look
at ah say this following example ok
 so the following example goes like this i have
two bromine atoms combining to give me the   bromine molecule this example one ok
 so here if
i spread it up i can write b r plus b r giving me   b r two and this being an elementary reaction
i can straight ever write that r is equal to k b r p r and these being the same k p r squared
ok this was an elementary reaction
 so i could   write it like this let us take another example
 so let this be example number two
 so another example is say ok let us consider this i two breaking up into i plus i here
the rate is equal to k times i two i know there is an elementary reaction
so i can straight away write this point   because i know that it is an elementary
reaction having you know gone through this   or you know what you are doing right now we can
also ask ourselves a question
 so the question is suppose i have a first order reaction suppose i have a first order direction you
are given a first order reaction right then what can be said about its molecularity again read the question
it is a first order reaction   and being a first order reaction you are asking can anything be said about its molecularity now
think about your answer what will your answer   be your answer should be no it cannot be said
why because though it is a first order reaction it is not told or no information
is provided whether in the first order reaction whether the first order reaction is elementary or not if it is not said or if it is
not told to you whether its elementary or not   then we cannot say or talk about

its molecularity
because the molecularity remember molecularity molecularity is only applicable
for an elementary reaction it is only applicable for an elementary reaction
only applicable
for eliminator reaction which means molecularity has no existence for a complex
or composite reaction it does not
exist why because there is some
 so a composite or complex direction is
made up of a series of elementary steps each elementary steps would be having
its molecularity
 so how can you talk about molecular anyway out there hence please
remember that this would only be applicable for an elementary reaction and this
is this
like i you know i should say this has this has no existence that means
we cannot use the word molecularity for a composite direction no we
cannot use it right
 so this was ah molecularity being discussed with reference
to an elementary reaction right ok now how would you realize whether
reaction is complex or not complex or composite reactions how would you realize
whether reaction is
composite or not right the first thing is detection of reaction intermediates
remember the bessel cation c c x y c h two
plus that is how we realized that it has an intermediate hence it is a
composite reaction but
do understand that in many cases it is difficult it is difficult it is difficult
to identify intermediates identify or isolate intermediates hence maybe
this is not the best way of figuring out whether it is a composite reaction or
not then what is the
other thing i will just mention it will carry on in the next class the other
thing is
to look at the form of experimental rate equation
 so you look at this you look at the
form of the exponential equation which i mean
 so i will quickly write this one down suppose
i have this following reaction c l o minus ok equals plus i minus aqueous giving
me c l minus aqueous plus i o minus aqueous right if if
this reaction had been an elementary reaction then i would have written that
r is equal to k c l o minus i minus or do you know what the observed
experimental law is something like this where r is equal to k c l o minus
i minus over o h minus you see this was this was the reaction this is the
observed rate law and this is would have this would have been the rate law had
the reaction
been elementary
 so this discrepancy between the you know this discrepancy between this
observed
rate law and the elementary reaction rate law that would have you would have
written down had
the reaction well elementary tells you that the reaction is composite or complex
in nature more about this in the next class thank you you