hello everybody welcome to the 4th lecture
in this discussion on chemical kinetics   just a brief recap actually a very
quick recap
you know what we did last class was we were we started looking at kinetic
reaction profiles
right and this was the reaction profile we were   looking at this was an example
where the
reactants were hypochlorite and bromide and   the products were hyper bromide
and chloride
so very simple reaction the stoichiometry   is one for each reactant and each
product and then
what we were saying was that the if you look at   the blue lines the blue lines
are belonging to
those of the reactants what are we plotting here   we are plotting concentration
versus time right
here time being in seconds and because the blue   lines correspond to the
reactants and since with
the progress of the reaction the reactants are   going to be decreasing that
means used up the
products are going to be formed hence you see that   the blue lines the
concentration if you go along
the blue line the concentration is decreasing   ok as a function of time the
reverse happens
for the products why because for the products   here these are being formed as
the reactants are
being used up and hence the products according to   the green line or along the
green line they
are increasing as a function of time then   we started asking the question as to
how fast is
this happening can we have a quantitative estimate   of the same right
 so how can we have that or how
did we write that last time
 so if you remember   the rate of reaction can be
either expressed in terms of rate of disappearance of reactance or it can be
expressed
as rate of appearance of products
 so you can either do it in terms of the reactants
which are decreasing as a function of time or you   can do it in terms of
products which are
increasing as a function of time right   because it is the rate of disappearance
we
also discussed this last time
 so for reactants   if you are expressing the rate of
reaction in terms of the reactants   and in this case the reactants being
hypochlorite
and bromide we can express them as
 so this i will   just cancel what i meant was the rate of reaction
you can express them like this the change   of the reactant hypochlorite over a
defined time interval with a negative sign or the change of the concentration of
bromide over
a time interval with the change in sign then we   also said that suppose my
delta hypochlorite which
is this one the delta hypochlorite corresponds to   say c one and c three that
means c three minus c

one and the delta t i am talking here delta t the   delta t corresponds to t three minus t one
 so what
you will see is if i express it like this again c three minus c one then t three minus t
one ok the first one is a negative quantity   that means the numerator is a negative quantity
the denominator is a positive quantity and we get   a negative value out here because
this is negative because this is   negative the rate cannot be negative
 so you have
a negative sign out here this negative and this   negative cancels out and finally you have a
positive value for the rate of the reaction   now this is extremely important that you
understand for any reactant this is always   maintained if you are expressing the rate of the
reaction in terms of products right
 so that means   again if i expressing the rate of reaction
in terms of products i can express them as this delta t right and if you take the same intervals
for example suppose you take t one t three for   hyper bromide or chloride then t three minus t one
is obviously positive because time is increasing   and again if you consider this concentration
and this consideration this concentration is   higher than that
 so this is positive over positive
which gives you a positive quantity
 so in terms   of products it is always a positive quantity
right ok
 so now lets start with a reaction
 so lets consider a very general
reaction right a very general reaction   lets see how we can represent that so
general reaction goes like this right a small a which is the stoichiometric coefficient
of this chemical species a small b the small b is   the stoichiometric coefficient of the reactant
b plus other reactants giving you this reaction
 so on
 so this is a very general
representation of a reaction
 so what a and b c and
 so on are the reactants right then small a small a small b small c
these are the corresponding stoichiometric coefficients similarly p q and if i write
r out there these are products and in the same way small p the
small q the small r these are   stoichiometric coefficients of the products the
point i am trying to make out here is this   let the stoichiometric coefficients be
represented as something referred to as nu ok new spelled as n u nu if the
general symbol   of the stoichiometric coefficient is given
as new then then what we can write is   and this is extremely important that
we follow and we understand that for reactants or reactant species
this new is a negative quantity for products nu is a positive quantity ok

so that means
if you go back to this if you go back   to this equation then if i am writing nu for a
 so if i am writing nu for a then it would be minus a if i am writing nu for b it would be
minus b on the other hand if i am writing nu for   p it would be sorry it would be plus p if i
am writing nu for q it would be plus q and
 so on
 so that means that means as i have
written it here for reactants the storage   the stoichiometric coefficient is considered
to be negative for products the stoichiometric   coefficient is considered to be positive right now
why did we do this exercise you will soon realize   let us go back to our very general reaction and
let us take a shortened form of that reaction
 so let us write the reaction again
 so the
reaction again is can be written like this a plus b giving us the product p plus the product q
so this is the reaction we are looking at ok   now again as defined a and b are the reactants
p and q are the products small a small b are the   corresponding stoichiometric coefficients
of the reactants and small p small q are   the corresponding stoichiometric coefficients of
the products good now what we will do is we will   bring in one more term or parameter
that is something referred to as the degree of advancement of a reaction now it is very similar
to something which you have known   from other topics in chemistry which is the
degree of dissociation here we see there is   a degree of advancement this degree of
advancement is given by the symbol psi ok the degree of advancement is given by the
symbol psi
 so this tells you by how much the   reaction has progressed or advanced as a function
of time right now what we can do is we can write   a certain expression which i say that
n i i just tell you what these mean   is equal to n i not or zero plus nu i z ok
 so if z is the degree of advancement of the
reaction and let this be equation one if z is the   degree of advancement of the reaction you know
what i can write is the n i what is n i it is the number of moles of the chemical species i
 so that specific chemical species
 so i will
write in detail later but just to make the   point or make the connection
 so if if this i was
referring to a then this would be n a
 so it is   then n a means the number of moles of a or n i is
the number of moles of the reactant or the product   represented by that i this

is a b being the
reactants or p q being the products now what about you know n i naught
so this n i naught is
very significant
so this n i not or zero is the number of moles of the chemical species i then psi is equal to zero
so is the number of moles of
chemical species i when the degree of advancement as i said the degree of advancement i write it
again the degree of advancement of the reaction is zero you go back to this equation
so n
i is equal to n i zero plus nu i times i if psi is equal to zero as i was telling you
if psi is equal to zero then ni is equal to ni0
so what does this mean this means that this
is the initial concentration the initial number of moles here i am referring to the number of moles
i have not yet brought in the volume but is which will convert it to the concentration units
so the
initial number of moles is at that point where the psi is zero that means the reaction has not
advanced at all
so this is your initial condition ok again what is nu i by this time
you know the nu i is the corresponding stoichiometric coefficient ok
so now what we have done is we have taken
this equation and we have tried to define each and every term in this equation where n i is the
number of moles of the chemical species i right then n i naught what is n i naught or n i zero n
i zero is that number of moles of the species when psi is equal to zero that means the degree
of advancement of the reaction is zero that means the reaction has not progressed at all
and whatever nu i as you just figured out in our previous discussion right a few minutes ago
it is the corresponding stoichiometric coefficient whether we are talking about the reaction or
whether we are talking about a product right now as defined by kinetics right what this kinetic
kinetics means you are looking at the change as a function of time right that is what kinetics is so
what we will do now is we will go back to equation one
so let me write that again we will go back to
equation one which is n i n i zero plus nu i psi
so this was our equation one right now this is our
equation one because it is a change with respect to time what we do is we differentiate this
equation with respect to time
so differentiate one with respect to time because that's what
kinetic is we want to follow something as a function of time that means how it changes with
respect to time

so then this equation becomes $\frac{dn_i}{dt}$ is equal to $\frac{dn_{i0}}{dt}$ plus $\frac{d\nu_i\psi}{dt}$ now pay attention

so what have you done you have

done what you have done is you have taken one and you have differentiate each and every

term of that equation with respect to t okay let this be equation two

so some simplifications

can be done straight away look at this term this term is equal to zero why is it equal

to zero it is equal to zero because you know differentiation of a constant with respect

to time in this case with respect to time will obviously be zero right because it does not

change there is no change with respect to time

so what is $n_i$ naught

so $n_i$ naught as based on

our definition is the initial number of moles which is a constant right

so $n_i$ naught

is the number of moles where psi was zero

so $n_i$ naught essentially is the number of moles

i started with ok

so again i define because $n_i$ naught is a constant which as defined was

the initial number of moles hence $\frac{dn_i}{dt}$ is equal to zero

so this is $\frac{dn_{i0}}{dt}$ is equal to zero

so that means the initial concentration of the initial number of moles in

this case of that particular reactant or product is known to you is known to you is known to you

when when psi is equal to zero that means when the reaction is not yet progressed at all and because

this is a constant because you know it then the differentiation of this with respect to

time is zero ok the next point is if you look at this factor now or this term over $dt$ this can be written as nu

$\nu_i \frac{d\psi}{dt}$ why can i write that the reason i can write this is because

$\nu_i$ is a constant right what is $\nu_i$ this is a constant why is it a constant this is

my stoichiometric coefficient of that species i

so then simplifying this whatever we have done we

put this back in equation two and see what we get

so then i have this $\frac{dn_i}{dt}$

is equal to $\nu_i \frac{d\psi}{dt}$ or i can write it like this $\frac{d\psi}{dt}$ is equal to $\frac{1}{\nu_i}\frac{dn_i}{dt}$

so if i give this say equation number three this is a very important step is a very

important step you will realize that this term this term $\frac{d\psi}{dt}$

what does it say it is the rate of advancement of the reaction or we can

simply say the rate of the reaction we can simply say the rate of the reaction right

so you already have a term which gives you the rate of the reaction and

what is that it is the v it is the way or the differentiation of a degree of small

advancement with respect to time that is $\frac{dz}{dt}$ that is the rate of the reaction or the

rate of advancement of the reaction of the rate of   progress of the reaction does not
matter which way you define it   now that is equal to what that is equal to 1 by
nu i where nu is the stoichiometric coefficient   times d of ni over d of t and what does this mean
it means that d of n i over d of t represents what   the change in the number of moles of species
i over time this times the inverse of the   stoichiometric coefficient which is one by nu i is
equal to the degree of advancement of the reaction   it is very similar it is very similar to something
you must have seen in ah any discussion chemical   kinetics or something we are going to discuss
down the line but what you have to understand   is one more thing if you go back to this equation
when i am writing this n i is the number of moles   n i zero is the number of moles at the initial
time when psi is equal to zero nu y is a constant   it is a stoichiometric coefficient hence this psi
is also the number of moles by which the reaction   has advanced
 so then d z by d t when we are doing
this when we are writing this equation finally   when we are writing this equation final
equation three everything is in terms of the   change in number of moles yes number of moles is
proportional to concentration but i have not yet   brought in the concentration as yet that
means the volume is not yet brought in   whatever this reaction is representing is
the advancement of the reaction in terms   of the number of moles being expressed like
this
 so that means d psi by dt which is the   change in the advancement of the reaction is equal
to one by nu i d n i over d of t
 so this is how   you know the very familiar equation you
have seen or you see typically being   discussed in books on chemical kinetics in
any book on chemical kinetics comes about   now to elaborate this a little more let us go back
to our reaction
 so if you remember what a reaction   was i will write again because we are flipping
through pages
 so we might forget b b giving p and q
 so this was the one we started with then   based on equation one we had said that n
i is equal to n i zero plus nu i z right   this was a equation one now if you remember
equation this was our equation now suppose   i am doing it for i where i is a that means
i am taking the reactant a if i am taking   the reactant a how does this equation change

or you know how do we make this equation more   visible to you
 so then because i is a i can write
n of a is equal to n of a 0 or not
 so this n of a   zero means what means the initial number
of moles of a you had at time zero where   the reaction had not yet started that means the
degree of advancement in the reaction was zero plus nu of a and then psi let me go ahead and write this one
like this
 so n of a is equal to n of a   not now remember going back to our discussion today in the initial part of the class nu of a   this is the stoichiometric coefficient of the
reactant a and i told you that the stoichiometric   coefficient of the reactant a is going to
have a negative sign
 so then i give minus   a
 so this being a with the negative sign the
reactant times psi
 so then i if i differentiate it then i differentiate it d
t
 so this is equal to what n a over d of t minus d t right or i can write it
plus right now then minus a psi ah going forward it should be very clear
to you that this is equal to zero and hence   this equation cannot be written as
d of n a over   d of t is equal to the first term was
zero then minus a d psi over d of t or as you had written again before one by a d n a over d of t
so now what have you done   what you have done is or what we have done is
that we have expressed this rate of reaction we have expressed this rate of reaction in
terms of the change in the number of moles of a which is reactant a
 so to carry on with this suppose i try to express this in terms of
the reactant b see when i say now let i be b   the reactant b then obviously i have n b
which is the number of moles of b is equal to   n b naught that the initial number
of moles of b i had present plus nu b   the stoichiometric coefficient associated with
the reactant b then the corresponding z again nu b is negative that means
n b is n b naught minus b psi i differentiate with respect to time   d n b over d of t is equal to
d n b naught over d of t plus and once i have done this
realize that this one is again   zero and i have d n b over d of t is equal
to minus b d psi over d of t or i can write   d z i over d of t is equal to minus one by b
d n b over d of t
 so which is very similar to   what we had done here i did not write the rest so
from here i can write d of n a d of t is equal to   minus a d psi over d of t right if you look at
these two if you look at these two here you can   see what i have done here d psi by d t is equal to
minus one by b d n b over d of t right here also   you can write t psi by d t is equal to minus
one by a dna over d of t

so let me write here
so let me write this one here
then i can write likewise that d   psi over d of t is equal to minus one by a d n a
over d of t what is the similarity similarity is   this or are these there are similarities in both
cases you have the rate of the reaction d i by d t   the rate of the reaction is being expressed
either in terms of the reactant a the reactant b   right which is d n a or d of t or d n b over d of
t that means the change in the number of moles of   reactant a or reactant b is a function of time
what are these associated with on the right hand   side these are associated with the corresponding
the inverse of their corresponding stoichiometric   coefficients
so for a it is 1 by a for b it is
1 by b not only that go back to our discussion   in the previous class or with the initial
part of this class where we were saying that   the rate of the reaction in terms of reactants
are always associated with a negative quantity   isn't it and you see this negative is coming
out where does this negative come out in this   case where we have said negative this negative is
coming out from the fact that your stoichiometric   coefficient of the reactant by definition is
negative and hence you get that corresponding   rates of reactions both in terms of the reactant
a or in terms of reactant b
so obviously it goes   without saying that if i now go to the product side a similar thing would come about
so lets   now again say for the same reaction
let me write the reaction again giving p plus q with the corresponding
stoichiometric coefficients let i be now   p ok
so that means now i represents the product
p if i represent the product p then i can write n p is equal to n p zero plus nu i or nu p i
would write nu p then psi ok we go ahead and   simplify it a little further
so n p
is equal np naught now we say plus   p then psi
so this is where you know the
difference between that of a reactor and   that of a product
so in case of the reactant the
stoichiometric coefficient had a negative quantity   was or was a negative quantity had a negative sign
but in case of the product because we are getting   the product you are producing the product right
as the reaction goes by the product is coming   into existence its concentration is increasing
so the stoichiometric coefficient of the product   typically is given a positive value it is com
associated with the positive sign hence you can   differentiate it again p by d of t is equal to
d n p zero over d of t plus d of t then p psi   again this is equal to zero

right because np not
being the initial number of moles of p the product   p is a constant you know that
 so we can write d
n p over d of t is equal to p d psi over d of t therefore i can write d psi over d of t
is equal to one by p d n p over d of t right
 so see what we have
 so this is what we had   for the reactant b this is what we had for the reactant a
 so that means d psi by d the rate of   the reaction was given by minus one by a dna
over d of t ok in terms of b the reactant b d   z by d t was given by minus one would be d n
b over d of t in terms of the product however   d psi over d of t is given by one by p no negative
sign a positive sign dnp over d of t right hence   extending this
 so it is left as an exercise
for you to show that d z by d t is equal to   one by q d n q o d of t i can write this straight
away that d psi over d of t can be expressed how minus one by a d n a over d of t this is equal to
minus one by b d n b over d of t this is equal to   one by p d n p over d of t and this
is equal to one by q d n q over d of t
 so what we have been able to do through this
exercise is we have been able to define the rate   of the reaction which is d psi by d t that
means the rate of advancement of the reaction   that is what your reaction kinetics is or
defined as is defined in terms of what here   in terms of the rate of disappearance of the
products a and b and also the rate of appearance   of the products p and q these being associated
with the corresponding stoichiometric coefficients   and the stoichiometric coefficients are
also associated with the respective signs   what are those for the reactant species the
stoichiometric coefficients come with negative   signs for the product species the stoichiometric
coefficients come with positive signs right   this is extremely important for you to keep in
mind never forget this that the stoichiometric   coefficient i repeat the stoichiometric
coefficient associated with the reactant is   a negative number that means is associated with
negative sign while the stoichiometric coefficient   for the product species is associated with
the positive sign again just to clarify   what i said just now the stoichiometric
coefficient the stoichiometric coefficient is always positive ok is always
positive only when it is for the reactant we preceded that means we put a
negative sign before the stoichiometric coefficient if it
is product we put a positive sign before the stoichiometric coefficient

and this obviously is understandable   based on a discussion why because the reactant we are losing as a function of time
 so we put a negative sign before the stoichiometric coefficient to represent   the fact that it is decreasing as a function of
time and the product we put a positive sign to say   or to represent that this species or product is
coming into existent existence rather that means   growing as a function of time hence again as a
clarification please remember the stoichiometh   the stoichiometric coefficient is always positive
though it is just that when we define a reactant   or a product if it is a reactant then we preceded
by a negative sign if it is a product then there   is a positive sign before the stoichiometric
reactant rather the stoichiometric coefficient   ok because we want to differentiate between the
reactant and the product and we know that any   in every reaction the reactant is going to be
lost and the product is going to be produced   or come into existence ok what we can do is
we can just quickly take reaction a specific   reaction or chemical reaction or equation and
see how this comes out
 so let us consider this   two n two o five ok i am considering what
i am considering the decomposition of   n two o five two plus o two based on this
reaction n two of five is my reactant species   i am looking at the decomposition of that
decomposition into what there are two products   four n o two n o two plus o two
 so the products
are no2 and o2 and then obviously you have to make   sure that the reaction is balanced then what can
i do i go back and i look at this definition of d   psi by dt based on this definition can i write
down the degree of advancement of the reaction   for this specific equation ok how do i write
it
 so i write then d psi by d of t is equal to let us consider the reactant first the reactant is   d number of moles of n two o five over d of t
it should be associated with this corresponding   stoichiometric coefficient but with the negative
sign what is that i write it is minus one by   two why because this two is the corresponding
stoichiometric coefficient of n two of five   and nu nu n two o five has to have or has to
be associated with a negative quantity
 so that   is what i have out here
 so this is the only
reactant species we have then this is equal   to i write the degree of advancement of the
reaction or d z by d t in terms of the products   this would be d the change in number of moles of
n or two with respect to time i will be having one by four out here similarly i

can write d ah sorry let me change this again let me
write it here clearly d n two over d of t   what should i write here you see for n o two the
stoichiometric coefficient was four for o to the   stoichiometric equation is one
 so it is one by one
so i am not writing anything about it because they   are essentially one times d n o two over d of t
so going back to this expression again of for d z   of d f t we have taken a specific reaction we are
expressing d z over d of t that means the rate of   the reaction in terms of these given species
so for n two of five which is reactant it is   minus one by two two being the corresponding
stoichiometric coefficient into the rate of change   of number of moles of n two o five right or d
into phi of d of t is obviously a function of time   this is equal to one by four remember this is a
positive this is a product n o two it's a positive   quantity or positive sign
 so one by four d n o
two over t of t if that is the case if that is the   case you can see that we have this is a positive
sign out here this one by four d n of t of d of t   right and this is equal to the change in the
number of moles of oxygen over time what is the   stoichiometric coefficient it is one or plus one
and hence this is how it comes about
 so hopefully   you understand that this is how the rates of
reactions are written in terms of the change   in the number of moles now generally generally
what happens is generally what happens is   all these things are done under constant volume
conditions right all these things are done under   constant volume conditions
 so let us take a
specific ah example or let us ok let us go back   to our you know equation 1
 so you will understand
what i am trying to say
 so we can say since most of the reactions are done under constant volume
conditions then from one which was n i n i naught plus nu i psi
this was our equation one right and we had written   d psi over d of t is equal to one by nu i d
n i over d of t think this was equation three   because this is done at constant
volume what i can write is by definition it is a constant volume what i can
do is i can write like this one by v
 so i put one   by v on the left hand side of the equation dzi
over d of t is equal to one by v because i put   in one by v on this side i have to make sure that
i cancel by the same factor on the other side then one by mu i d n i over d of t again
keep in mind that v which is the volume is constant v is constant now if this is
constant remember this equation what i can do out
here is i can take this i can bring v   inside this differential form say i can
v inside

this derivative right and hence i can write d then in within brackets psi
v d of t see i have brought in   one by v inside or i have gotten one by v
inside is equal to one by nu i then d n i v d of t by doing this simple
assumption which is mostly valid   for most of the reactions that's what you
are
doing you are doing reactions at constant volume   what about n i by v
 so see this is the rate
of the reaction
 so again i write d psi by v d of t is equal to one by nu i the stoichiometric
coefficient obviously remains as it is it is   a constant right then this can be
written
as the concentration of the species i over   d of t
 so this i is concentration of species i now immediately you realize that
you have come back or you have been able   to reach a point which is very
familiar
to you and is used universally in   chemical kinetics what is it that the rate
of
the reaction the rate of the reaction which   is this the rate of the reaction
which is
this is given by the change in concentration   of that chemical species in
this case which is i over d of t associated with one by e y when u i is a
corresponding stoichiometric coefficient and   how did we make this conversion
from ni over v to
consideration of i its very simple simple is that   what is concentration
suppose molar concentration
is moles over liter what is n i n i is   the number of moles and if you have v
in let us   you can always do the conversion
 so you have the
corresponding concentration term
 so this again   is an extremely important equation i have to see
what is a number i can give just let me check let me give this equation four and
remember now this is the rate of reaction
 so the rate of the reaction is having this
expression which is given by the change in   concentration of species i with
respect
to time weighted by or is associated by   the inverse of its of the
corresponding
stoichiometric coefficient of species i right   good
 so now what we have done is we have been able
to define the rate of the reaction in terms of the   change in constant of the
reaction or the change
in consider of the reactant species or the product   species right whatever you
can think of using
you can feel free to use as a function of time
 so what i will do is i will ah you know start with
the specific ah example let us do an example and   see whether you know we have
some we if we have a
feeling of what we have just discussed right now
 so what we are going to do is we go we take
an example that we are going to focus on
 so here we have acetaldehyde gaseous giving me methane plus carbon monoxide
both in the gaseous states   now what is the question or what is the
problem the problem is that the rate of this reaction can be followed by
measuring can be

followed by measuring the pressure in the system at constant volume and temperature again you are given this reaction

acetaldehyde going to methane   and carbon monoxide and it said that the rate of this reaction   can be followed by measuring the pressure in the system at constant volume and temperature

so that means the volume of the vessel and the temperature   are being kept constant

so how do we proceed with this based on the discussions we had earlier

so let me write down the equation again

so before writing down let me tell you   this that when we are going to go through this

problem one assumption we are going to take is the following assume ideal gas behavior

assume ideal gas behavior of the gases assume ideal gas behavior of the gases

so let me write down the reaction again for the sake   of convenience because this is where we will

start working with the problem

so now having   written the reaction down let us think about the initial phase or the starting of the reaction

so the initial phase

so if i write this one as

initial

so if i write this one as my initial   condition

so the initially i have n naught moles of acetaldehyde in the reaction vessel but there are no moles of any of the products

present

so that means the only species i have   at the start of the reaction is acid aldehyde on

of that i have n naught or n zero number of moles   now with progress of the reaction what

will happen is

so here we write with reaction progress

so with reaction progress i can write n naught c h three c h o minus psi   psi being the extent of reaction of the degree

of advancement of the reaction which we just saw then psi enzyme

so that means the way the reaction is advancing what we are having we are having   as the reaction is progressing n naught mos

of acetaldehyde minus psi moles which is   the degree by which the reaction is advanced along with this i have psi moles of   ch four gas formed and xi moles of carbon

monoxide formed ok

so once we have this   you know once we have this lets now write down the number of moles of the individual components

so that means n c h three c h o is equal to n naught c h 3 c h o plus nu i psi but remember   this being a reactant this being a reactant

you are losing acetaldehyde as the reaction   is progressing

so nu i out here is negative

the value of nu i you saw from the previous slide or equation is one that is the coefficient

is one hence what we do now out here is we rewrite it as follows where $n_{CH_3CHO}$ is equal to $n_{0,CH_3CHO}$ minus psi right

so nu i the value of nu i is one and because you are losing acetaldehyde as a function of time hence its sign is negative so this one is important for the setup of the problem or the way we are going to work with the problem then accordingly i can write for methane

so the number of moles of methane which is $n_{CH_4}$ like we wrote the number of moles of acetaldehyde $n_{CH_3CHO}$ the number of moles of methane can be given by $n_{0,CH_4}$ plus nu i psi ok again if you go back to the reaction the coefficient before $CH_4$ is one right same for carbon monoxide the coefficient before carbon monoxide is one hence for methane then this nu i has a value of one and the sign is positive because reaction is progressing and the product is forming

so i can write then $n_{CH_4}$ is equal to $n_{0,CH_4}$ plus psi now also $n_{0,CH_4}$ which is the initial number of moles of $CH_4$ if you remember from the previous discussion is zero the same thing is also for carbon monoxide

so i can further simplify this by writing that $n_{CH_4}$ is equal to what psi why because $n_{0,CH_4}$ is equal to zero

so this is again this is again another important piece of information that you will need while we walk through the problem so we left with one more component which is one of the products carbon monoxide very similar to that of methane

so how do we write that

so then for carbon monoxide is what i write $n_{CO}$ there is a number of moles of carbon monoxide is equal to $n_{0,CO}$ that is the initial number of moles of carbon oxide present plus nu i is i same thing as that of methane this is equal to zero right n not carbon monoxide is equal to zero and nu i is plus one hence i write $n_{CO}$ is equal to zero plus psi or $n_{CO}$ is equal to psi

so then in a nutshell what have we done we have been able to express the number of moles of the respective components of the reaction be it reactant which is acetaldehyde or b their products which are methane carbon monoxide in terms of the extent of the reaction which is psi

so we will start from this in the next class you