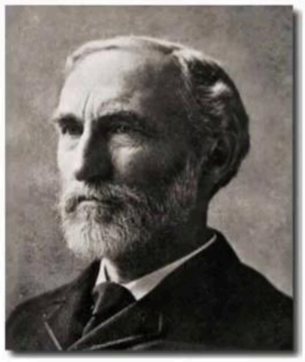
ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

RESCIF
Réseau d'excellence des sciences de l'ingénieur de la Francophonie

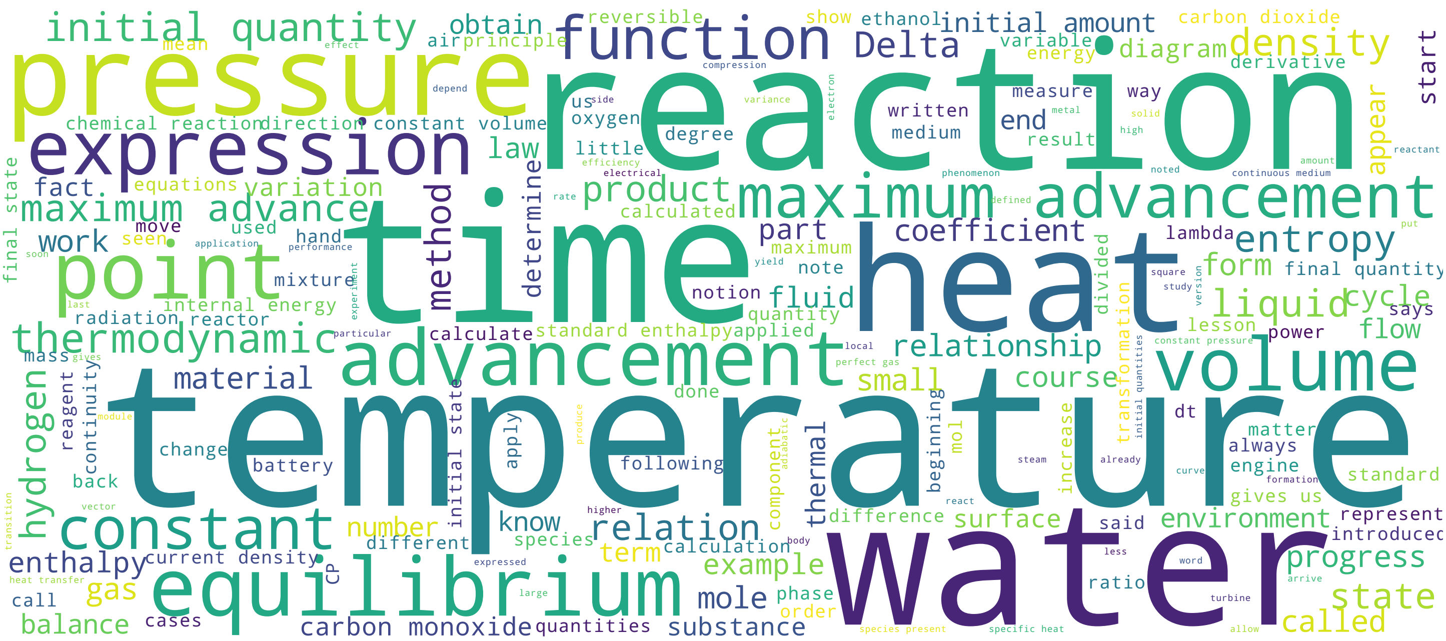
Thermodynamique

AVANCEMENT DE REACTION



Josiah Willard Gibbs, 1839-1903

Dr. Théophile MBANG, ENSP – Yaoundé - Cameroun



Video

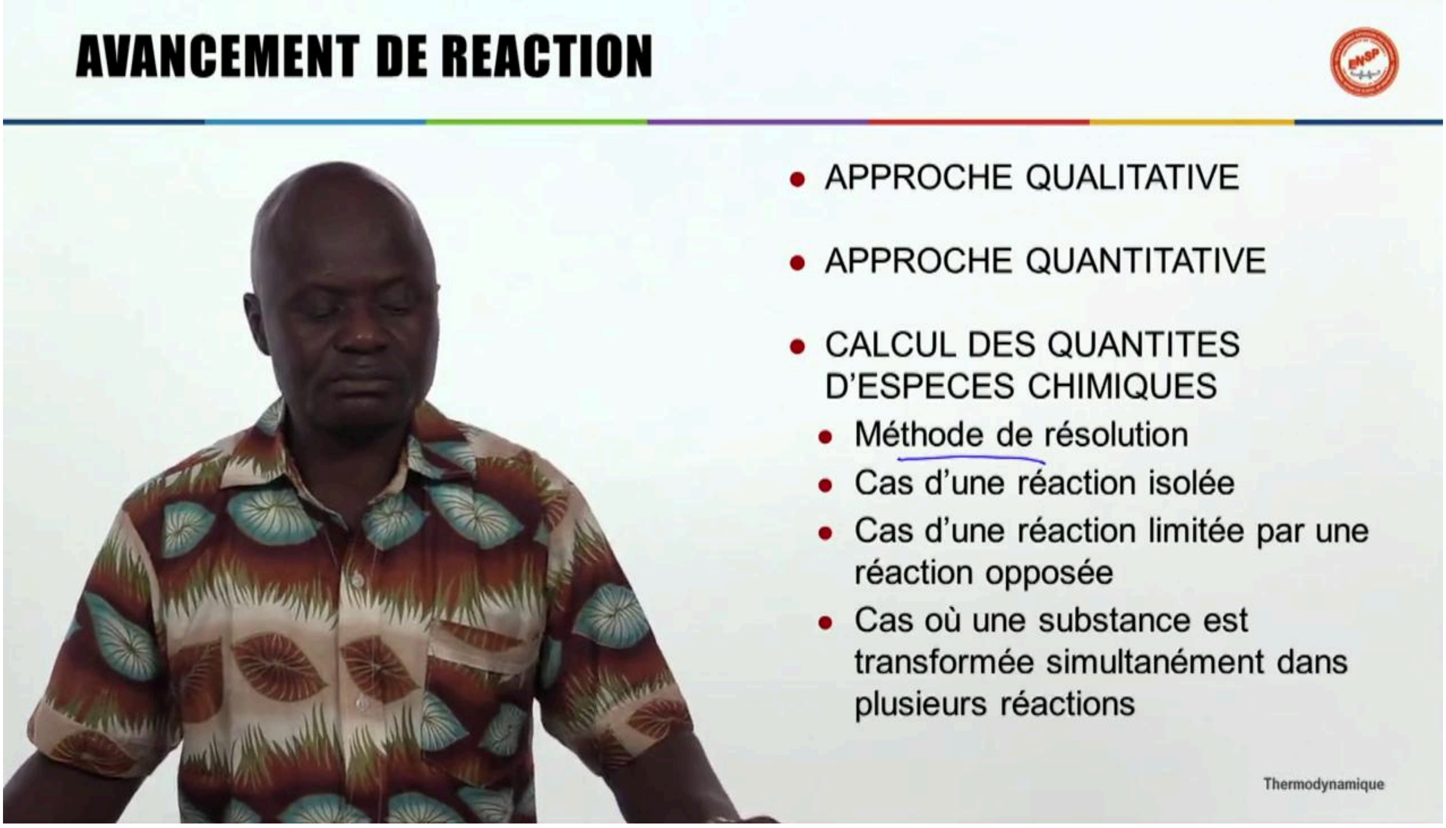
EPFL

Hello. It is a great pleasure to contribute to the course of coordinated thermodynamics by the École Polytechnique Fédérale de Lausanne and BFL in Switzerland. I am a chemistry teacher at the School National Superior Polytechnic and MS of Yaoundé in Cameroon. We will contribute to the thermo chemistry part. To do this, we will start by the notion of reaction progress which is a method of calculation the quantities and materials of the species present in the reaction medium.

Notes

Summary

0m 04s

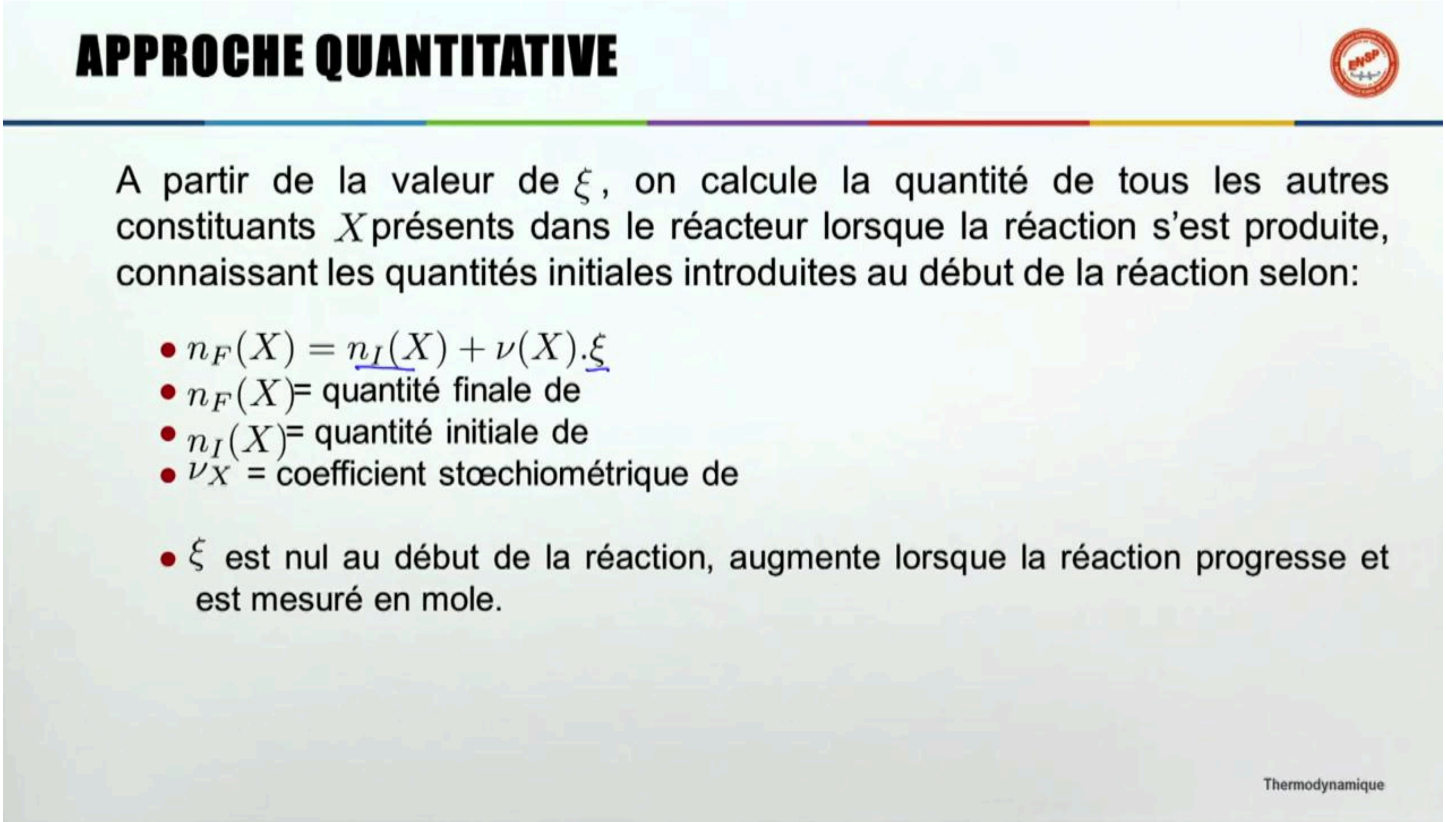


We will do a qualitative approach. You have to know how to write the equation. From a chemical reaction. Towards the quantitative approach. And. Here we need to know the stoichiometric coefficient. He makes calculations, quantities of matter. Chemical species. Then we will give the method, the method of resolution. We will apply to cases of an isolated reaction. Case of a version limited by an opposite reaction. And when a substance is transformed simultaneously in several reactions.

Notes

Summary

0m 43s

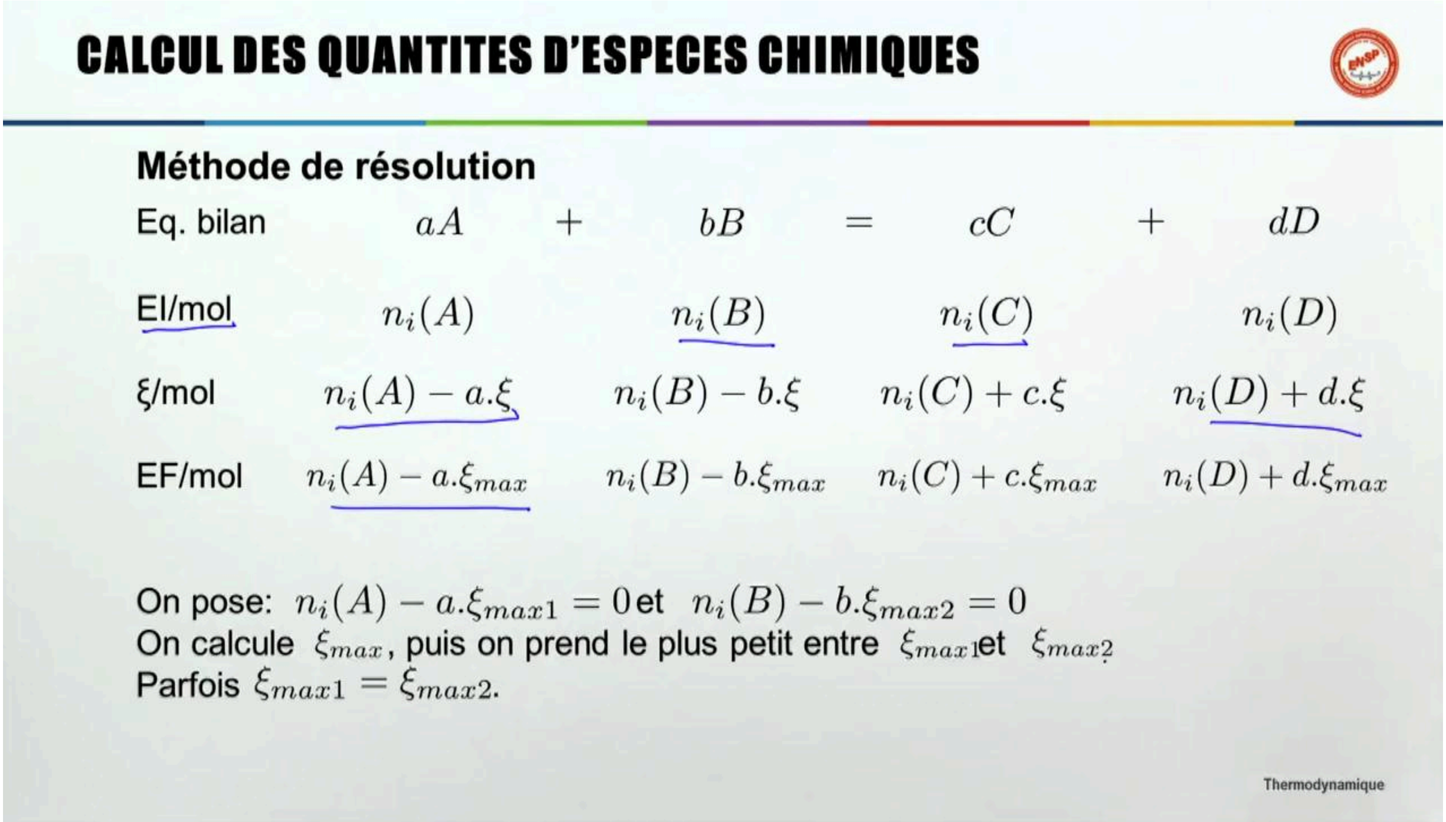


For the quantitative approach, I said it is necessary to know the stoichiometric coefficient. Let be the chemical reaction. Small in Grantham, smaller in Granby. Give as products, small, who knows and small, said Gandhi. Music, this is the number in front of each construction of the crisis participating in the chemical reaction. Null X is positive for the products and negative for the reagents used. Thus, given the Ghandi and You go the appetite of the Innu, fashionable tentacles to. The progress of the reactions noted, which. Let ski be the common value calculated from any species chemical reagent or product involved in the chemical reaction. From the value of the ski, the value of the. The advancement of Erasmus which, the quantity of all hosts is calculated, is a large participating axis. To the reaction. In all cases, the granitic reagent present in the reactor when the reaction occurred knowing the initial quantities introduced at the beginning of the reaction. As soon as the final quantity fixes the initial quantity and when x. More naked. X times the advancement. Which. The ski advance is zero at the beginning of the version and increases as the version progresses and is measured in moles.

Notes

Summary

1m 35s

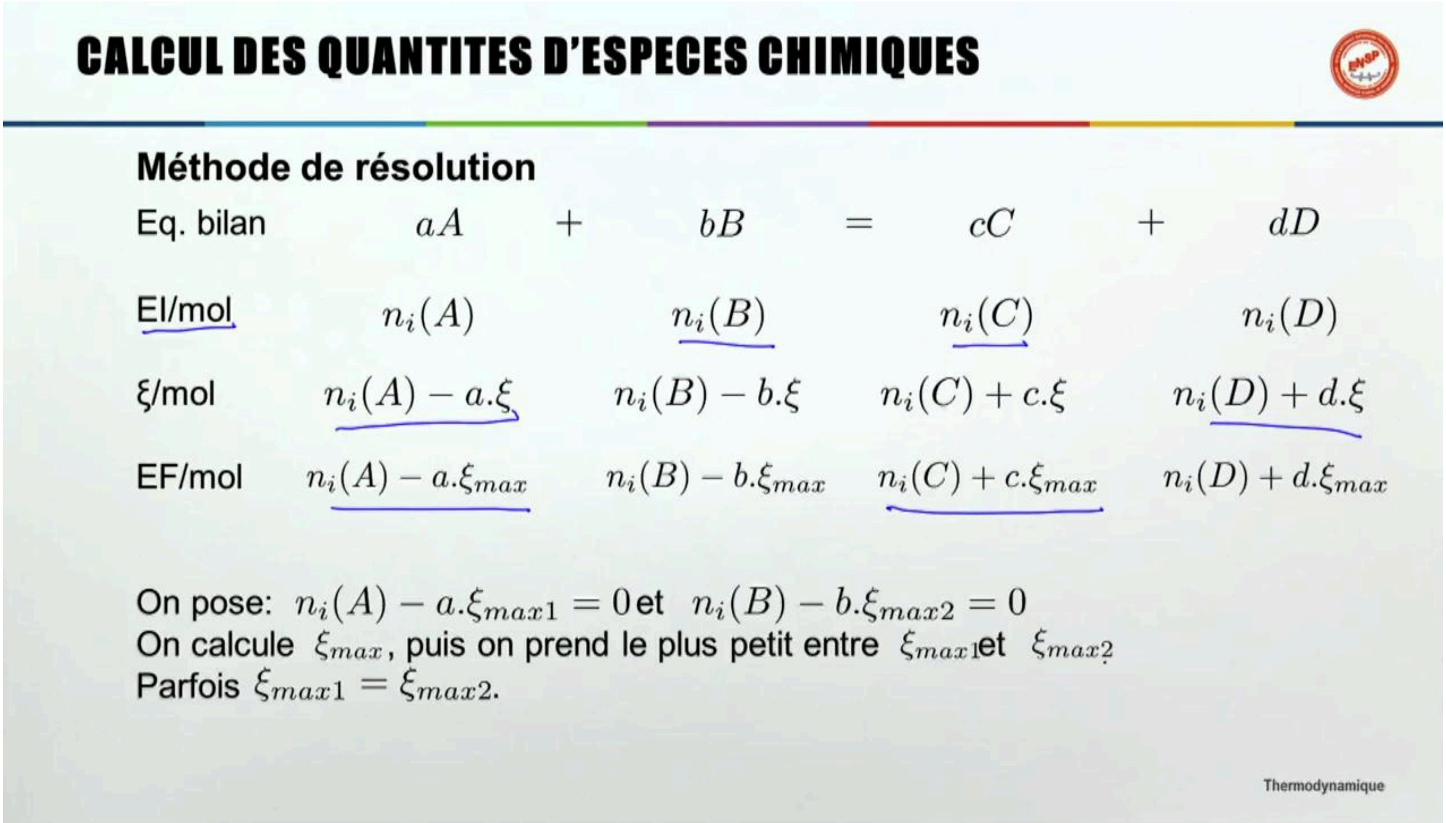


For the calculation of quantities of chemical species. What is the method of resolution? This method was presented in the form of tables. You have to know how to write the lines. The first line is needed. The balance equation must be written. Small in Grantham. It reacts with mercy to give more than here. And who says as said. the Endemol Initial Statement. It's that we had to produce. We have the initial quantity of Granta and an initial of large bi has been introduced. And there were in our reactors already an initial quantity of the French product and, initial quality of the grown product. The third line. It is to the ski advancement in Mol. We have. In the reactor the initial quantity of average size. And who has faith? Advancement. And the initial amount of large bays, less small bays. Advancement time. And it will end up like the product. As the initial quantity says of the product grows smaller, sometimes the progress, but not the final state. At Mol, we're going to take the progress to the state of progress, which. But here the advancement is called the maximum advancement. Or the reactive grantham. We have the initial quantity of Granta. Small time maximum advancement.

Notes

Summary

3m 20s

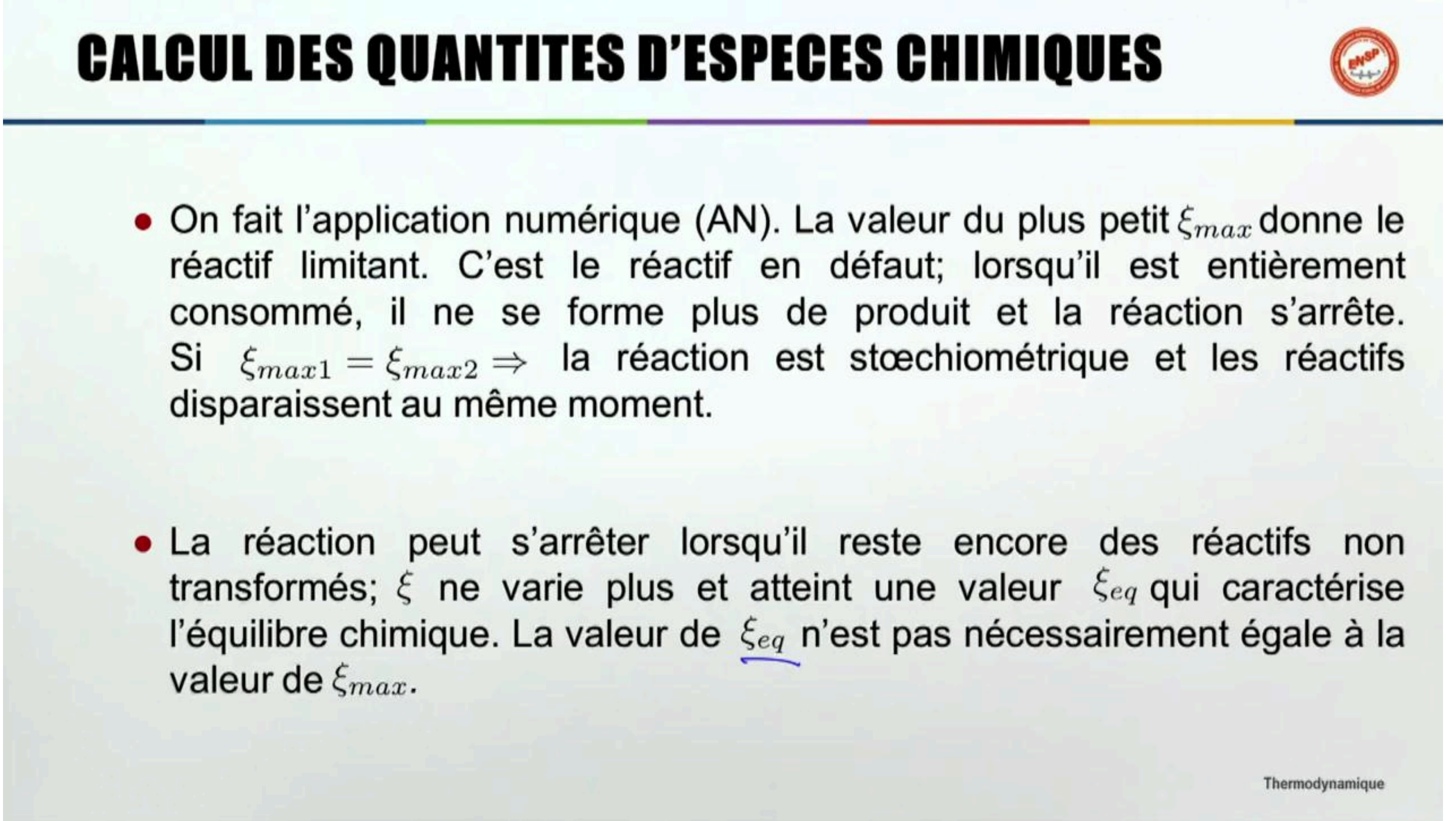


Similarly for the Grand B reagent and for the grain product if we have the initial quantity of the product. Thus more these times the maximum advancement. Likewise for the product grows. When we said reagent, it only meant the initial quantity, larger, less small at maximum advance. One. The first reagent equal to zero. Similarly for the second, reactive, will the maximum advance B equal zero? The maximum advance is calculated. We will calculate the two and we will take the smallest one, between maximum advancement and maximum advancement. Which max two. Sometimes the maximum advancement is equal to the maximum advance two in this case, as we will see later.

Notes

Summary

5m 05s

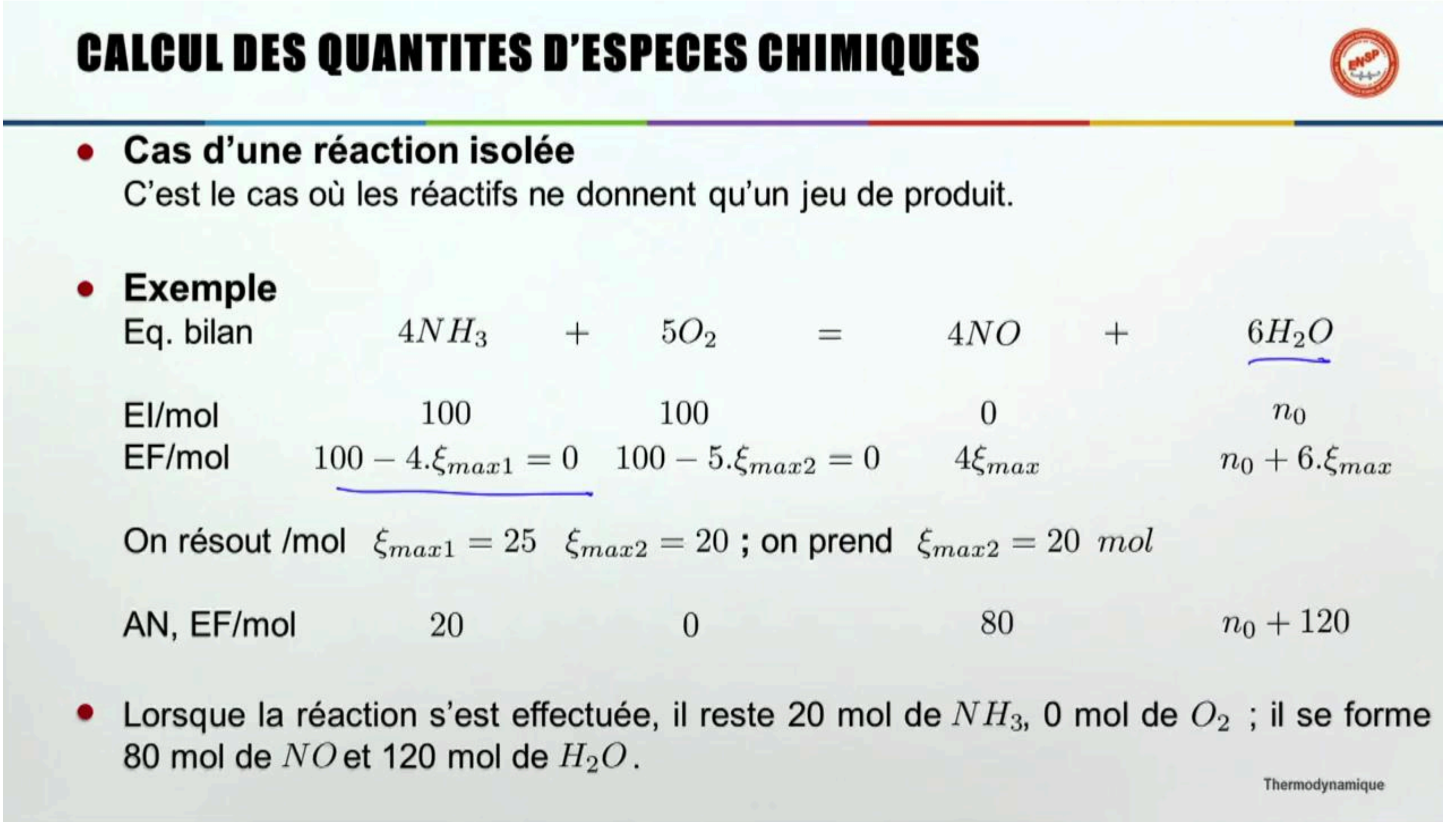


The reaction is stoichiometric. As soon as we have calculated and taken the smallest value, the maximum advance. In fact, the numerical application. The value of the small maximum advance gives the limiting reagent. This is the reagent. A defect when it is fully consumed. Its forms, no more products and the reaction stops. If, as I said at the beginning, if the maximum advancement was maximum two, then the reaction is stoichiometric and the reagents disappear at the same time. The reaction can stop when there is still still active, thus transforming the advancement, which does not vary anymore, and reach a value at the equilibrium which characterizes the chemical equilibrium. The value of advancement at equilibrium is not necessarily equal to the value of the advancement.

Notes

Summary

6m 02s

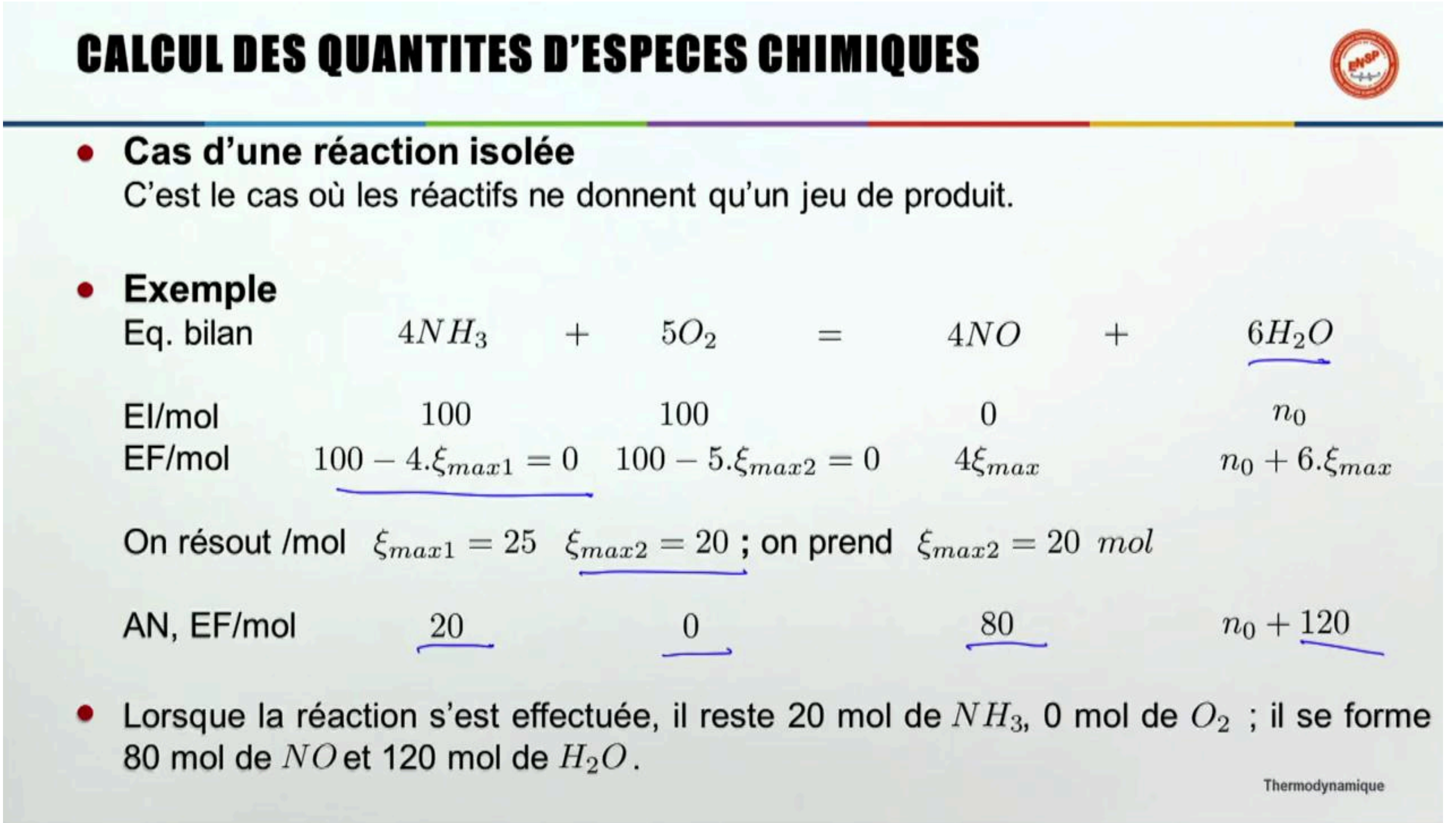


This is the method of solving cases. Take the case of an isolated reaction. This is the OCA or the reagents is only a set of products. Example. The balance equation is the reaction. Ammonia reacts with oxygen to form nitric oxide and water. In the initial state, 100 mol of ammonia and without oxygen, there was no nitric oxide. So we have zero and there was a certain amount of water in the environment that was not in the water. Zero. Now we move on to the final stage. The final step here, as we have seen, the method with the initial amount of ammonia symbol at least four times the maximum mass. Similarly for the reagents which oxygen -5 times the maximum advance and it has formed four times the maximum advancement and in water six times the maximum advance moles that will be added to N0 that was already in the water in the personal medium. We will therefore look for the maximum advancement. For the tough and active underdog. Here we call the maximum ransom one and the other the maximum value b. For oxygen, the number of five times the maximum advancement is equal to zero and 100 -5 times the maximum advance two equal to zero.

Notes

Summary

7m 01s



So we solve and we find that the maximum advance is at the soft advance and the maximum advance B is equal to 20 mmol. And we take the water to the smallest advance which is the maximum advancement of the soft vein. And we do the numerical application. So in fact the mobile application in its final state. The mole has the best personal mole of ammonia and zero mole of dioxygen. Four moles of nitric oxide and 120 molecules of water were formed that were added to those in the water. Personal environment.

Notes

Summary

8m 42s

CALCUL DES QUANTITES D'ESPECES CHIMIQUES

- **Cas d'une réaction limitée par une réaction opposée**
  - On dit que le système est en équilibre chimique et à la fin de la réaction on obtient $\xi_{eq.}$
  - C'est l'exemple de l'estérification de l'éthanol et de l''éthanoïque dans les proportions stœchiométriques.

Thermodynamique

So you will see here the other case, the case of a reaction limited by an opposite reaction. We say that the system at equilibrium and the function of the reaction, we obtain the equilibrium advance. This is the state's example of electrification lol. Go to the Loïc state in stoichiometric proportions.

Notes

Summary

9m 28s

CALCUL DES QUANTITES D'ESPECES CHIMIQUES

- **Exemple**: calcul de quantités présentes à la fin de la réaction

$$n_I(C_2H_5OH) = n_I(CH_3COOH) = 0.1mol$$

Eq. bilan	C_2H_5OH	+	CH_3COOH	=	$CH_3COOC_2H_5$	+	H_2O
EI/mol	$n_I = 0.1$		$n_I = 0.1$		0		n_0
EF/mol	$n_I - \xi_{eq} = 0.033$		$n_I - \xi_{eq} = 0.033$		$\xi_{eq} = 0.067$		$n_0 + \xi_{eq}$

- Si la réaction était totale, on obtiendrait 0.1 mol d'acétate d'éthyle$= \xi_{max.}$. En réalité, on obtient 0.067 mol d'acétate d'éthyle à l'équilibre$= \xi_{eq}$ car la réaction est limitée.

Thermodynamique

Let's take the example of the quantities present here at the end of the reaction that we will look for to calculate, we introduced the initial quantities are the same initial quantities of ethanol and y. The initial amount of ethanol is 0.1 mole. We write the equation in the first line. Ethanol. It reacts with the techniques to give the caps of the tiles and water. In the initial state, one wheel, one hall and 0.1 wheel were introduced. One. Loïc. There was no tournament, was it zero mol and we had a quantity of water fifteen zero. At the final stage, we have the initial quantity of ethanol, minus the equilibrium advance. The same goes for the tabloids. For the State, law that, says it, we have the quantity. Here, it is the advancement to the balance. And it will add up. It will form the water, here the advancement to the equilibrium. But if by other methods, one can find the quantity, but the quantity, it is then, says it, that it is only found to be equal to 0.067 mol. Then we can go back in the calculations and prove that it remains in the water. Personal medium zero point zero 33 mol ethanol and 0.033 mol ethanol. And it also formed 0, 067 molecules of water.

Notes

Summary

9m 52s

CALCUL DES QUANTITES D'ESPECES CHIMIQUES

- **Cas où une substance est transformée simultanément dans plusieurs réactions**
- **Exemple**: Cas du « gaz à eau »

$$CH_4 + H_2O = 3H_2 + CO (1)$$
$$CO + H_2O = H_2 + CO_2 (2)$$

Soient ξ_1 et ξ_2 l'avancement de chacune de ces deux réactions.
Faisons le bilan des quantités de matière présentes lorsque les deux réactions ont avancé:

Inventaire	CH_4	H_2O	H_2	CO	CO_2
EI /mol	n_a	n_b	0	0	0
EF /mol	$n_a - \xi_1$	$n_b - \xi_1 - \xi_2$	$3.\xi_1 + \xi_2$	$\xi_1 - \xi_2$	ξ_2

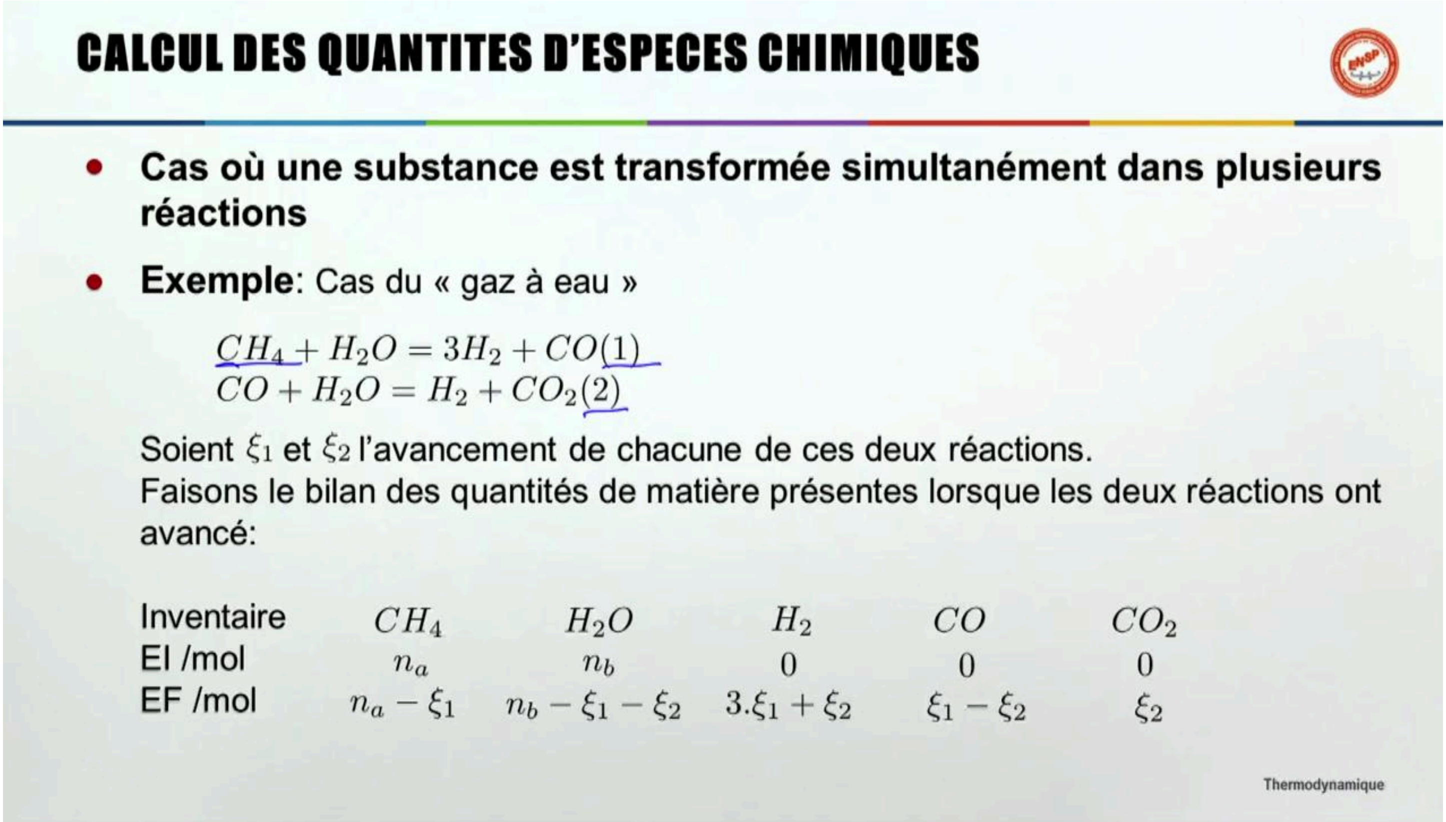
Thermodynamique

But by a method, we can calculate when it is reactive and it was proved that there was, there remained 0.033 mmol of ethanol. Then we can determine the advancement to equilibrium. Knowing the equilibrium advancement, we need to have maximum advancement sometimes. That said, if the reaction was total, we would get a soft cap, he says. Delta Lloyd Interstate, he says. This is what gives us the maximum advancement. We cannot determine the yield here, which is calculated by the advancement at equilibrium divided by the maximum advance. Generally, this is given as a percentage, but in reality we get 0.0107 words from this article. Is it in balance? So he gives us here the progress at equilibrium when the reversion is limited. So for the case now, we will apply the last case because a substance is transformed simultaneously in several reactions. Many start from two, three, four, five, six. I'll take both reactions. For all six. I can give you. Six clarifying and diversionary actions. But I take two, that's already several. Example of the case of gas at high. Methane reacts with water to give dihydrogen and carbon monoxide. This is the first version. The carbon monoxide formed reacts with water.

Notes

Summary

11m 35s



And to give hydrogen and carbon dioxide. This is reaction B. I'll stop here for both. Now, each reaction is characterized by its progress. Ski jumping and ski advancement each of these two reactions. Let's take stock of the quantities and materials present. When both versions have advanced. Hell is always the picture. We will make an inventory of the species present. The best is personal. I generally prefer to be reactive. Eliminated for the first reaction and I pass it behind to produce for the second person in order as here. We will see the water methane. After methane, we have water. Then it is dihydrogen, carbon monoxide and now the carbon monoxide, we already have it, we do not make twice batches of hydrogen, now we have carbon dioxide. the Initial State. We have introduced one mole of methane and, a little flat, water. There was no hydrogen in the brain and no carbon monoxide. It is zero or zero carbon dioxide in the final state. What do we have? You have to laugh at the equations. We have the initial amount of methane that n? A. Less progress in the peninsula. Kwasniewski who, because the omerta only intervenes as a reagent. Just in the first equation, the doctor does not appear in the second one.

Notes

Summary

13m 20s

CALCUL DES QUANTITES D'ESPECES CHIMIQUES

- **Cas où une substance est transformée simultanément dans plusieurs réactions**
- **Exemple**: Cas du « gaz à eau »

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EI /mol	n_a	n_b	0	0	0
EF /mol	$n_a - \xi_1$	$n_b - \xi_1 - \xi_2$	$3.\xi_1 + \xi_2$	$\xi_1 - \xi_2$	ξ_2

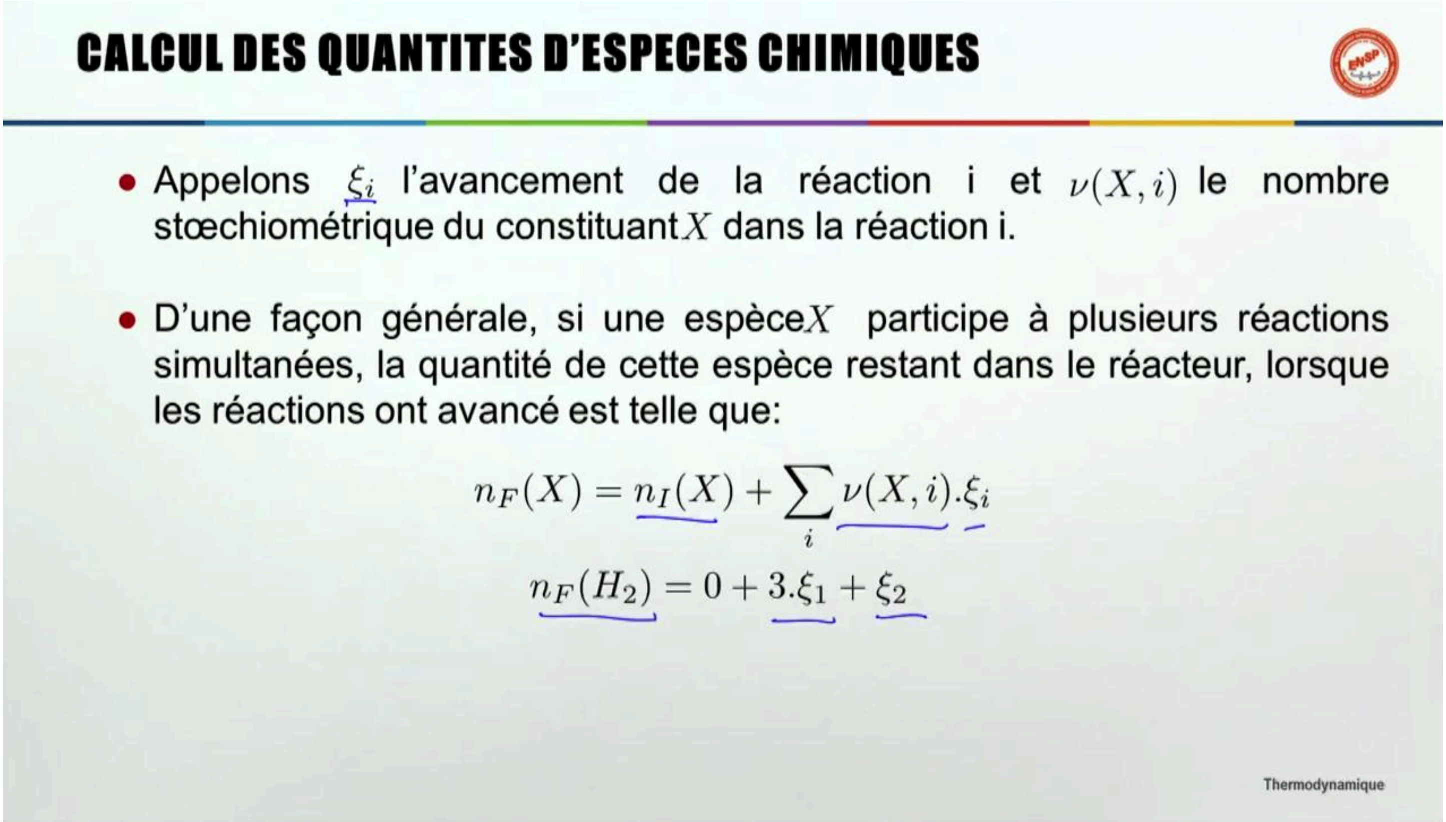
Thermodynamique

But not the species, water or. Water is involved in both equations, in the equation and as reactants, as well as in the second deal. The initial amount of water is small. NB minus what passes as reagent in the smoke. Equation two in the second equation. The hydrogen is used as a product in the equations. Good the initial amount of hydrogen. We don't need to write anymore as it is zero by the bread. In the first equation, it appears three times more, so it's three times the advancement. Which. More. The ski advance of for the second equation. There the carbon monoxide. It appears in the first equation as product and intervenes in the second equation as reactants. So that will make the initial amount of carbon monoxide here, which is zero. And no longer what is what happens in the first equation. But what matters is the reactant in the second equation. And for carbon dioxide, which is only formed in the second equation that is produced, and it appears what of.

Notes

Summary

15m 04s

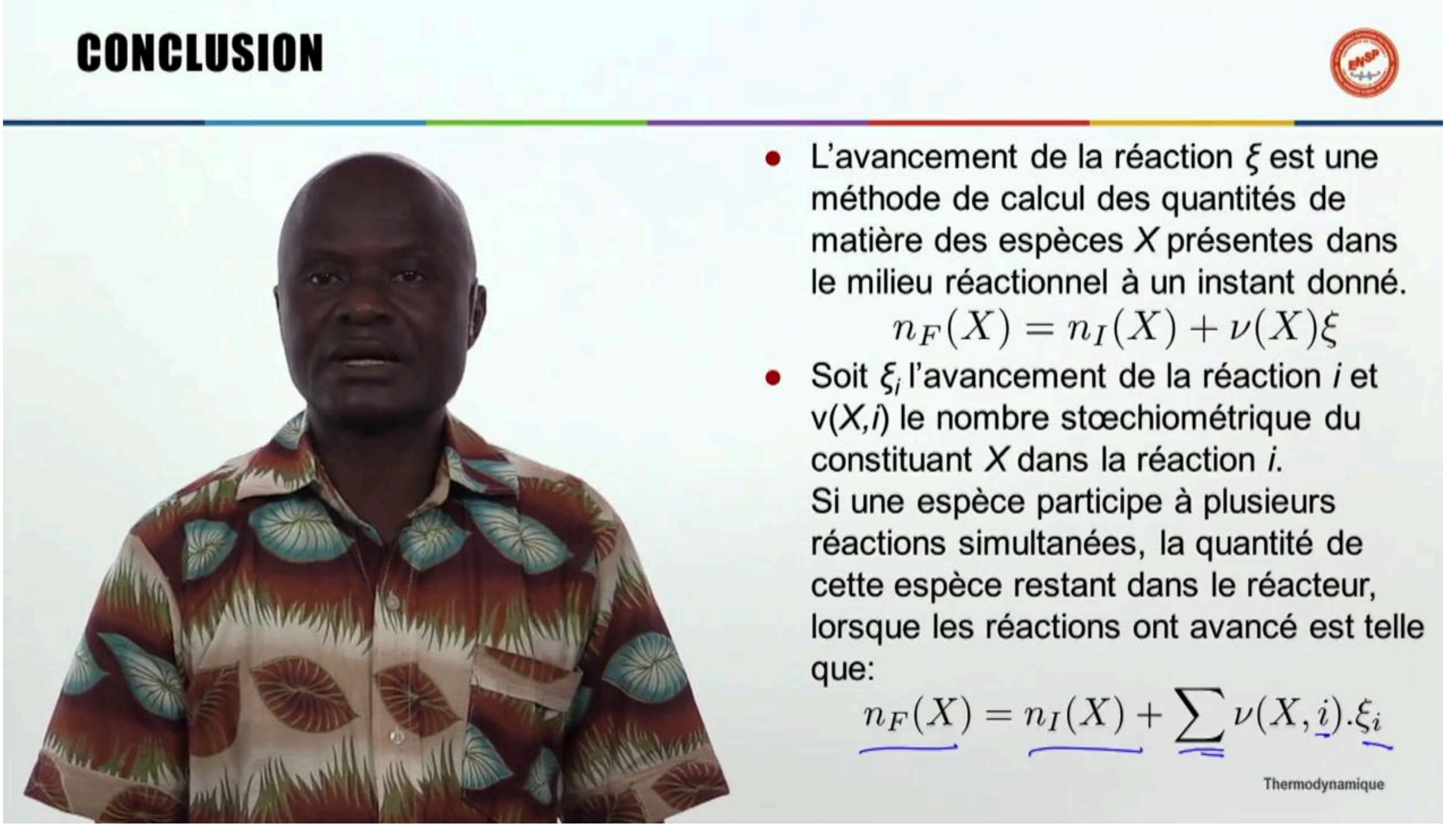


And if we can do all the calculations, we can generalize when we have six simple equations, say several equations calling for what. The progress of the small version. And null here the stoichiometric number of the component Big X in the reaction Y. Generally speaking, if a granitic species participates in several simultaneous reactions, the quantity of the remaining species in the reactor. When the advanced versions and such that the final quantity is large, x is equal to to the initial amount of screen X plus sum of bare x in the back are small once competitive advancement, which. If we go back to our previous cases where we had for local and hydrogen, we will apply this formula. So the final quantity of hydrogen is equal to zero of the initial quantity. Plus the amount. Nudes here that multiply the advancement of what is there in reaction. So I was saying that the final quantity of hydrogen is equal to zero plus three times the advancement, which to the first equation plus what two.

Notes

Summary

16m 29s



That's it, we're done. The first course that introduces us to thermo chemistry, in the notion of the progress of the reactions too, which is a method of calculating quantities of matter of the species present in the reaction medium at a given time. In the final quantity of the Big X. Is equal to the initial quantity and guarantees the most null. X times the advancement. To generalize here. Ski jumping. The progress of the reaction is small and a discount here. The stoichiometric number of the component X in the reaction that y. If a species participates in several simultaneous reactions. The amount of each species is remaining in the reactor. When the reactions have advanced is such that. The final quantity of X's is equal to the initial quantity of rosehip plus sum. Nudes in the of small to the advancement of the version little by little. Thank you and goodbye.

Notes

Summary

18m 01s