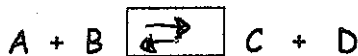


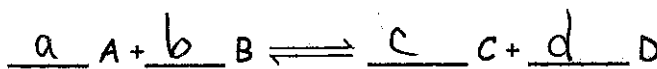
A reaction in which the Products can react to form the reactants is called a reversible reaction.



Chemical EQUILIBRIUM occurs when the REACTANTS in a REVERSIBLE reaction form PRODUCTS at the same RATE that PRODUCTS form REACTANTS

At equilibrium:

- the Concentration of the reactants and products does not change.
- the concentration of reactants can be equal to, greater, or less the concentration of the products.

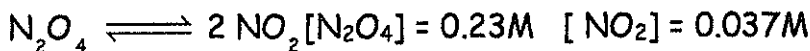


$$K_{eq} = \frac{[C]^c [D]^d}{[A]^a [B]^b}$$

If K_{eq} is 1 reaction is favored

= 1	neither
< 1	reverse
> 1	forward

Ex. #1: Calculate K_{eq} for the following reaction using the given equilibrium concentrations. Then determine whether the forward or reverse reaction is favored.



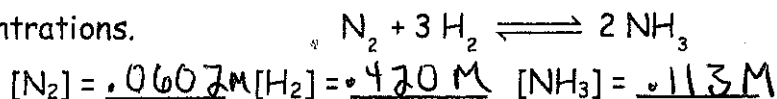
$$K_{eq} = \frac{[NO_2]^2}{[N_2O_4]} = \frac{[0.037]^2}{[0.23]}$$

$$K_{eq} = 6.0 \times 10^{-3}$$

Not
on

Exam

Ex. #2: Calculate K_{eq} for the following reaction using the given equilibrium concentrations.



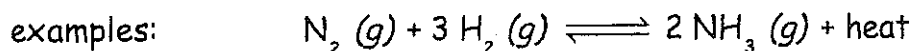
The Forward reaction is favored.

LeChatelier's Principle:

When a stress is applied to a system in equilibrium, the system reacts in a way to reduce the stress.

STRESS	SYSTEM WILL SHIFT
addition of a chemical	away from added chemical
removal of a chemical	toward the removed chemical
increase in temperature	away from source of energy
decrease in temperature	away fr.
* increase in pressure	toward less moles of gas
* decrease in pressure	toward more moles of gas
addition of a catalyst	no shift in equilibrium

* applies to reactions involving gases only



- When H_2 is added to the system, the reaction shifts to the right to use up the extra H_2 . The amount of NH_3 produced will increase.
- What if N_2 is removed, the reaction shifts to the left trying to replenish the N_2 .
- When the temperature increases, the reaction shifts to the left.
- When the pressure of the system increases, the reaction shifts to the right, toward the side with smaller amt gas particles.
- When a catalyst is added no shift in equilibrium.

When an equilibrium system shifts to the:	[products]	[reactants]
right	↑	↓
left	↓	↑

The Chemistry Quiz
CR1. CR2.

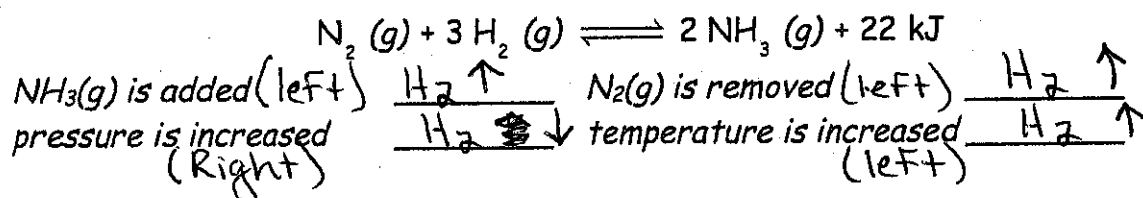
1. 2. 3. 4. 5.

If a system at equilibrium is subjected to a Stress, the equilibrium is displaced in the direction that relieves the Stress.

- A stress is defined as any change which could affect the Rate of either or both the forward and/or reverse reaction.
- When, because of an applied stress, the forward reaction is faster than the reverse reaction, the system is said to shift to the (right) (left). As a result, the [products] will (increase) (decrease) and the [reactants] will (increase, decrease).
- When, because of an applied stress, the reverse reaction is faster than the forward reaction, the system is said to shift to the (right) (left). As a result, the [products] will (increase, decrease) and the [reactants] will (increase, decrease).

In simpler terms: If anything is added to a system at EQUILIBRIUM, the system will try to consume whatever was added. If anything is removed from a system at equilibrium, the system will try to replace whatever was removed. So, the reaction is favored away from what is (added) (removed) and toward what is (added, removed).

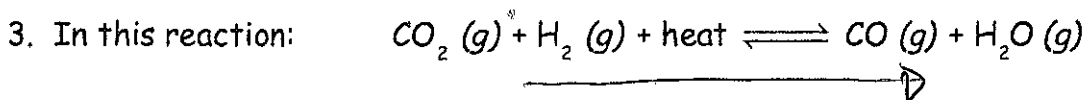
1. In the following reaction, will the $[H_2]$ increase or decrease when equilibrium is reestablished after these stresses are applied?



2. Note reaction: $2NO(g) + H_2(g) \rightleftharpoons N_2O(g) + H_2O(g) + 36\text{ kJ}$

In which direction, left or right, will the equilibrium shift if the following changes are made?

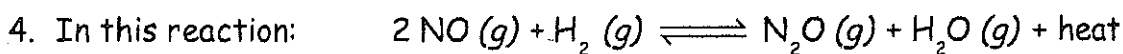
NO is added	<u>Right</u>	the system is cooled	<u>Right</u>
H_2 is removed	<u>left</u>	pressure is increased	<u>Right</u>
N_2O is added	<u>left</u>	H_2 is removed	<u>left</u>



a. Is heat absorbed or released by the forward reaction?
absorbed (heat with reactants) - ENDO

b. In which direction will the equilibrium shift if these changes are made?

CO is added	<u>left</u>	temperature is increased	<u>right</u>
CO ₂ is added	<u>right</u>	system is cooled	<u>left</u>
H ₂ is removed	<u>left</u>	pressure is increased	<u>no shift</u>
catalyst is added	<u>No shift</u>	(equal moles)	



What will happen to the [H₂O] when equilibrium is reestablished after these stresses are applied?

temperature is increased	<u>shift left, H₂O ↓</u>
a catalyst is added	<u>No shift, H₂O unchanged</u>
pressure is decreased	<u>shift left, H₂O ↓</u>
NO is added	<u>shift right, H₂O ↑</u>
N ₂ O is removed	<u>shift right, H₂O ↑</u>

5. How would an increase in pressure affect the [H₂] in the following reactions?

