

Factors Affecting Equilibrium

I. Le Chatelier's Principle

1. Define the term Le Chatelier's Principle.

Le Chatelier's Principle – if a stress is applied to a system at equilibrium, the system shifts in the direction that relieves the stress

II. Concentration

1. Changing the concentrations of the reactants or products puts stress on equilibrium.

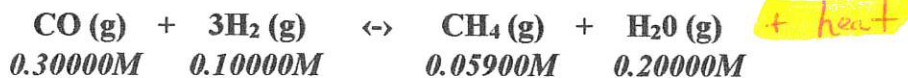
(Circle One) :

True

False

Ex: Running on a treadmill (adjust to increased speed)

2. Determine the equilibrium constant involving the production of methane (CH₄).



$$K_{eq} = \frac{[\text{CH}_4][\text{H}_2\text{O}]}{[\text{CO}][\text{H}_2]^3} = \frac{(0.05900)(0.20000)}{(0.30000)(0.10000)^3} = 3.933$$

3. Using Le Chatelier's Principle, calculate the equilibrium constant if more reactant concentration is increased.



$$K_{eq} = \frac{[\text{CH}_4][\text{H}_2\text{O}]}{[\text{CO}][\text{H}_2]^3} = \frac{(0.06648)(0.02746)}{(0.99254)(0.07762)^3} = 3.933$$

4. By increasing the reactants, more methane (product) is produced.

5. In which direction will equilibrium shift if :

Reactants Added :

Right

Products Added :

Left

Reactants Removed :

Left

Products Removed :

Right

III. Volume & Pressure

1. State Boyle's Law.

$$P_1V_1 = P_2V_2 \quad (\text{under constant temperature})$$

2. In a piston, if the volume is decreased, then the pressure increases.

3. As pressure increases the number of reactant collisions increase.

4. What develops by decreasing volume (and increasing pressure) within a piston?

Equilibrium stress

5. The equilibrium stress can be relived by shifting equilibrium to the right.

6. As a result, more products is produced (as pressure is not reduced).

(methane)

If # of moles is same on both sides, volume has no effect.

IV. Temperature

1. Define each of the following terms :

$(-\Delta H^\circ)$ →

Exothermic Reaction - reaction or process in which more energy is released than is required to break bonds in the initial reactants

$(+\Delta H^\circ)$ →

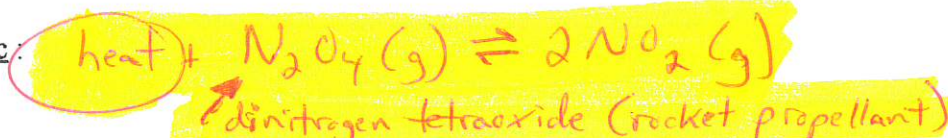
Endothermic Reaction - reaction or process in which a greater amount of energy is required to break the existing bonds in the reactants than is released when the new bonds form

2. Write an example of an exothermic and endothermic reaction.

Exothermic :



Endothermic :



3. What develops by changing the temperature of an equilibrium reaction?

Equilibrium stress

4. In which direction will equilibrium shift in each situation?

Exothermic Reaction

(Keq decreases)

Raise Temperature :

Left - More reactants

Lower Temperature :

Right - More products

Endothermic Reaction

(Keq increases)

Raise Temperature :

Left - More reactants

Lower Temperature :

Right - More products

5. Any change in temperature will result in a change in the Keq.

(Circle One) :

True

False

V. Catalysts

1. Catalysts can change product concentrations in equilibrium reactions.

(Circle One) :

True

False

* Reaches equilibrium quicker.

Concentration Change → Due to Amount, Volume, Temperature

speed of reactions only