Culver City H.S. • Chemistry Honors

Name KEY

Period _____ Date _____

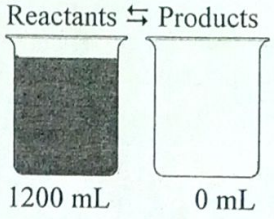
18 · Equilibrium

BEAKER DEMO: INTRO TO EQUILIBRIUM

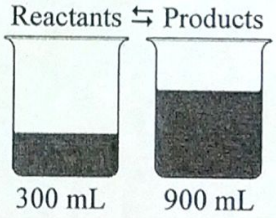
I. Consider the general reaction:

Reactants ⇆ Products

We can represent the amount of reactants with one beaker, and the amount of products with the other beaker. Suppose that at the beginning, we have 1200 mL reactants.



After the reaction proceeds for some time, the amounts of reactants and products appear to stop changing. The system is said to be "at equilibrium."



- What is equal at equilibrium?

The rate of change is equal at equilibrium

- How do we know when a system is at equilibrium?

The amounts of reactants and products remain constant

The equilibrium constant, Keq, is the ratio of the concentrations of reactants and products when our system is at equilibrium.

$$K_{eq} = \frac{[products]}{[reactants]}$$

For this reaction, $K_{eq} = \frac{900mL}{300mL} = 3$

This reaction is

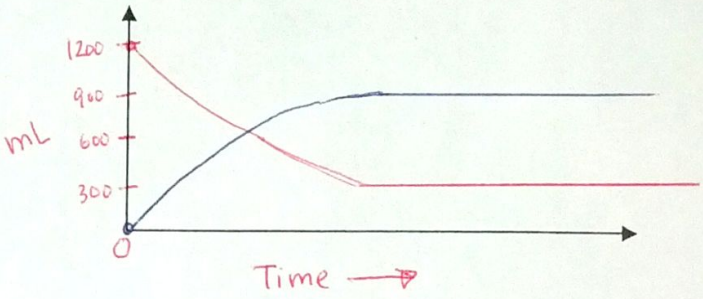
[reactant-favored | product-favored]

because:

$K_{eq} > 1$

there are more products than reactants at equilibrium.

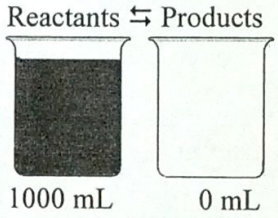
Draw a graph of how the amounts of reactants and products change over time.



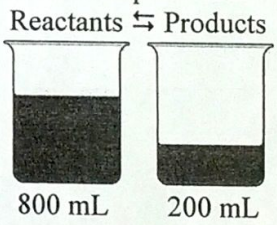
II. Consider *a different* reaction:

Reactants ⇆ Products

Suppose that at the beginning, we have 1000 mL reactants.



Here are the amounts at equilibrium:



The value of $K_{eq} = \frac{200mL}{800mL} = \frac{1}{4} = .25$

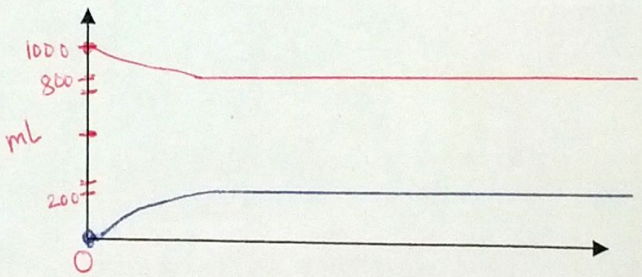
This reaction is

[reactant-favored | product-favored]

because:

$K_{eq} < 1$

Draw a graph of how the amounts of reactants and products change over time.

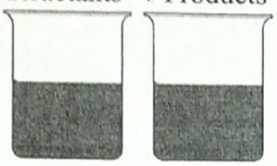


III. Look at the *same* reaction as in II.

Reactants ⇆ Products

Suppose that we start with 500 mL of both reactants and products initially.

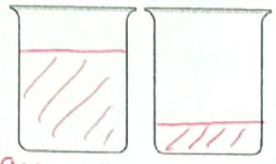
Reactants ⇆ Products



500 mL 500 mL

Predict their amounts at equilibrium:

Reactants ⇆ Products



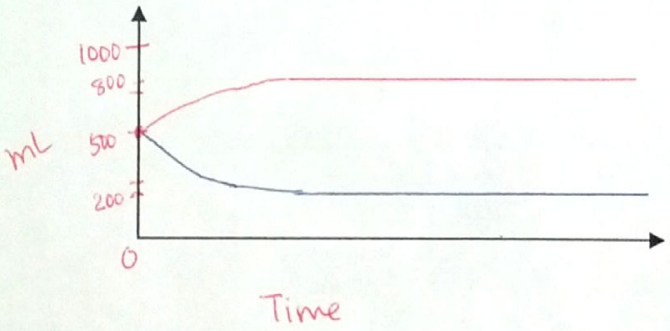
800 mL 200 mL

Explain your prediction.

$K_{eq} = \frac{1}{4} = .25$

K_{eq} must remain constant

Draw a graph of how the amounts of reactants and products change over time.



The Equilibrium Expression, K_{eq}

For chemical equations, you need to take into account the coefficients in the equation.

Example: $H_2 + I_2 \leftrightarrows 2HI$ or $H_2 + I_2 \leftrightarrows HI + HI$

$$K_{eq} = \frac{[HI][HI]}{[H_2][I_2]} = \frac{[HI]^2}{[H_2][I_2]}$$

Generalized equation: $aA + bB \leftrightarrows cC + dD$

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

Important Note: Since the concentrations of solids and liquids are constant, they are incorporated into the equilibrium constant, K_{eq}. That means, just leave them out of the expression. Only include (g) and (aq)!

The Meaning of K_{eq}

Fill in the blanks with product-favored, reactant-favored, and approximately equal

K_{eq}	State of Equilibrium
$K_{eq} >> 1$	product – favored
$K_{eq} << 1$	reactant – favored
$K_{eq} \approx 1$	approximately equal