

Name: _____ Date: _____

Chemistry ~ Ms. Hart

Class: Anions or Cations

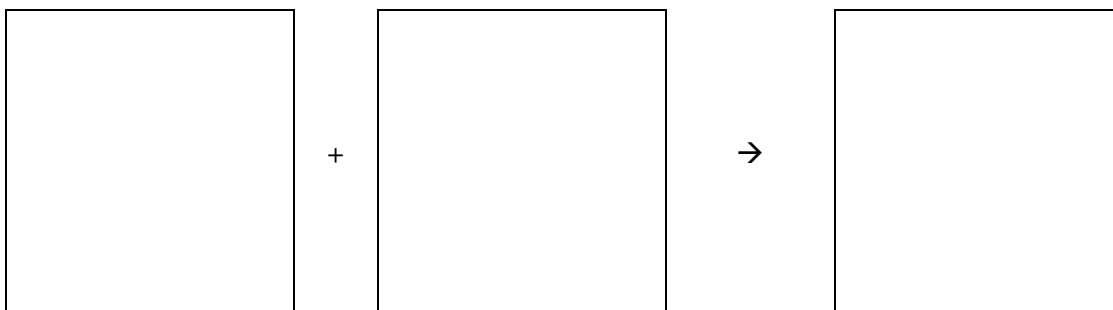


7.2 - Chemical Equilibrium - Guided Notes

What is equilibrium? (Fancy name, simple concept.)

- Remember! In a chemical _____, reactants collide to form a new _____.

***In the space below draw a particle diagram of the following reaction after balancing it:**

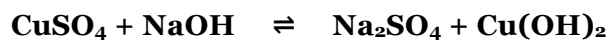


- Chemical reactions proceed from _____ (reactant side) to _____ (product side)
- BUT! Chemical reactions can also go in the _____ direction
 - From _____ (product) to _____ (reactant)
- When the _____ reaction is happening at the same _____ as the _____ reaction, the reaction is in _____.
- We represent reactions that can reach equilibrium with a double arrow _____.

***Therefore the reaction making water is actually:**



Observe and Learn!



Time	Observation	Which reaction rate is faster? (forward or reverse?)
Before reaction		
First seconds of the rxn		
2 minutes after the rxn		

- Reactions will reach equilibrium no matter how much reactant/product with start with! After reaching equilibrium, the concentrations will be _____.

Physical Equilibrium

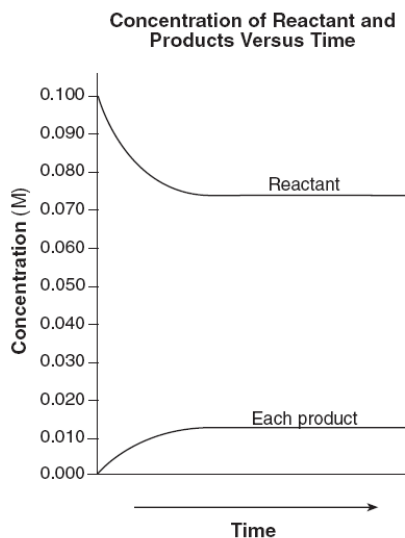
- Equilibrium can also occur for _____ changes.

To summarize:

- Reactants combine to form products (_____ reaction)
- Products break apart and turn back to reactants (_____ reaction)
- EVENTUALLY, it looks like nothing is changing. However, #1 and #2 start happening at the same time. Then, the reaction is HAPPY! This is equilibrium.

TAKE HOME MESSAGE:

Regents Ex.: State, in terms of concentration, evidence that the system in the flask has reached equilibrium.



Classwork/Homework

- Which factors must be equal when a reversible chemical process reaches equilibrium?
 - mass of the reactants and mass of the products
 - rate of the forward reaction and rate of the reverse reaction
 - concentration of the reactants and concentration of the products
 - activation energy of the forward reaction and activation energy of the reverse reaction
- For any chemical reaction at equilibrium, the rate of the forward reaction is
 - less than the rate of the reverse
 - greater than the rate of the reverse
 - equal to the rate of the reverse
 - unrelated to the rate of the reverse

3. Given the reaction system in a closed container at equilibrium and at a temperature of 298K:



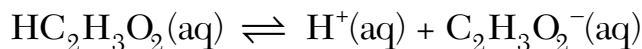
The measurable quantities of the gases at equilibrium must be

- (1) decreasing
- (2) increasing
- (3) equal
- (4) constant

4. Which statement must be true for any chemical reaction at equilibrium?

- (1) The concentration of the products is greater than the concentration of the reactants
- (2) The concentration of the product is less than the concentration of the reactants
- (3) The concentration of the products and the concentration of the reactants are equal
- (4) The concentration of the products and the concentration of the reactants are constant

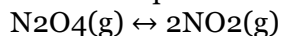
6. A beaker contains 100.0 milliliters of a dilute aqueous solution of ethanoic acid ($\text{HC}_2\text{H}_3\text{O}_2$) at equilibrium. The equation below represents this system.



- a) Compare the rate of the forward reaction to the rate of the reverse reaction for this system.

7. What is the difference between the concentration of products and reactants being equal versus being constant?

8. Given the reaction system in a closed container at equilibrium and at a temperature of 298 K:



The measurable quantities of the gases at equilibrium must be

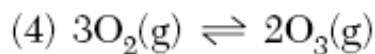
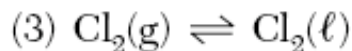
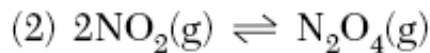
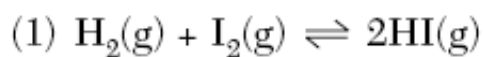
- (1) decreasing
- (2) increasing
- (3) equal
- (4) constant

9. A student adds solid KCl to water in a flask. The flask is sealed with a stopper and thoroughly shaken until no more solid KCl dissolves. Some solid KCl is still visible in the flask. The solution in the flask is

- (1) saturated and is at equilibrium with the solid KCl
- (2) saturated and is not at equilibrium with the solid KCl
- (3) unsaturated and is at equilibrium with the solid KCl
- (4) unsaturated and is not at equilibrium with the solid KCl

10. The equation for the saturated solution of potassium nitrate (KNO_3) is shown below. $\text{KNO}_3(\text{s}) + \text{energy} \leftrightarrow \text{K}^+(\text{aq}) + \text{NO}_3^-(\text{aq})$ Compare the rate of dissolving KNO_3 with the rate of recrystallization of KNO_3 for the saturated solution.

5. Which balanced equation represents a phase equilibrium?



11. Which statement correctly describes a chemical reaction at equilibrium?
- (1) The concentrations of the products and reactants are equal.
 - (2) The concentrations of the products and reactants are constant.
 - (3) The rate of the forward reaction is less than the rate of the reverse reaction.
 - (4) The rate of the forward reaction is greater than the rate of the reverse reaction.
12. Given the reaction at equilibrium: $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \leftrightarrow 2 \text{HBr}(\text{g})$ The rate of the forward reaction is
- (1) greater than the rate of the reverse reaction
 - (2) less than the rate of the reverse reaction
 - (3) equal to the rate of the reverse reaction
 - (4) independent of the rate of the reverse reaction
13. Which statement about a system at equilibrium is true?
- (1) The forward reaction rate is less than the reverse reaction rate.
 - (2) The forward reaction rate is greater than the reverse reaction rate.
 - (3) The forward reaction rate is equal to the reverse reaction rate.
 - (4) The forward reaction rate stops and the reverse reaction rate continues.
14. A solution that is at equilibrium must be
- (1) concentrated
 - (2) dilute
 - (3) saturated
 - (4) unsaturated
15. Which statement must be true for any chemical reaction at equilibrium?
- (1) The concentration of the products is greater than the concentration of the reactants.
 - (2) The concentration of the products is less than the concentration of the reactants.
 - (3) The concentration of the products and the concentration of the reactants are equal.
 - (4) The concentration of the products and the concentration of the reactants are constant.
16. Which balanced equation represents a phase equilibrium?
- (1) $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \leftrightarrow 2\text{HI}(\text{g})$
 - (2) $2\text{NO}_2(\text{g}) \leftrightarrow \text{N}_2\text{O}_4(\text{g})$
 - (3) $\text{Cl}_2(\text{g}) \leftrightarrow \text{Cl}_2(\text{l})$
 - (4) $3\text{O}_2(\text{g}) \leftrightarrow 2\text{O}_3(\text{g})$
17. Which statement must be true when solution equilibrium occurs?
- (5) The solution is at STP.
 - (6) The solution is supersaturated.
 - (7) The concentration of the solution remains constant.
 - (8) The masses of the dissolved solute and the undissolved solute are equal.
18. What is a forward reaction versus a reverse reaction?
19. Explain how you can determine when equilibrium is reached for a reaction.
20. What is equal at equilibrium? What is constant at equilibrium?