**Activity 34: Chemical Equilibrium, Le Châtelier’s Principle, and Weak Acids**

***Learning Objectives***

*Part 1 Provide an equilibrium expression for an equilibrium equation*

*Distinguish between endothermic and exothermic reactions*

*Predict the progress of a reaction given a value for K*

*Part 2 Predict the direction that an equilibrium reaction will shift if products, reactants, or heat are added or removed from the reaction*

*Predict the effect of a catalyst on an equilibrium reaction*

*Part 3 Recognize conjugate acid–base pairs*

*Identify the conjugate acid given a weak base and a conjugate base given a weak acid*

**Estimated Completion Time** 60 Minutes

**Instructor Information**

Equilibrium is introduced along with the terms *endothermic* and *exothermic*. The focus here should be on the definition of K as [products]/[reactants] as opposed to writing equilibrium expressions. K and Le Châtelier’s principle will become important in the next activity when Kas and buffers are introduced. The relationship between weak acids and their conjugates is emphasized in Part 3.

**ANSWERS TO QUESTIONS**

**Part 1. Chemical Equilibrium**

1.

|  |  |  |
| --- | --- | --- |
|  | No. of Nitrogen Atoms | No. of Hydrogen Atoms |
| Reactants | **2** | **6** |
| Products | **2** | **6** |

2. Exothermic. The reverse is endothermic.

3. More reactants (N2 and H2).

4.

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5. K = [OH-][H3O+] Note that the activity states that H2O does not appear in equilibrium expressions as a solvent.

6. H2O molecules

**Part 2. LeChâtelier’s Principle**

1. a. Exothermic

b.

c. Shift right

d. Shift left

e. Shift right

f. No. A catalyst does not affect the equilibrium; it just speeds up a chemical reaction.

**Activity 34: Skill Development - LeChâtelier’s Principle**

1. a. Reaction A is endothermic, and Reaction B is exothermic.

b. Shift right

c. Shift right

d. Reaction A would shift right, and Reaction B would shift left if heat were added.

**Part 3. Weak Acids**

1. It donates or loses a proton.

2. It accepts or picks up a proton.

3.



Base Acid Conj. acid Conj. base

4. An acid and a base that differ by one proton (H+).

5.



6. a. HS- b. H2O c. H2PO4- d. CO32-

**Activity 34: Skill Development—Weak Acids**

1. a. H3PO4 (*aq*) + H2O (*l*) H3O+ *(aq*) + H2PO4- (*aq*)

A B CA CB

b. CO32- (*aq*) + H2O (*l*) OH- *(aq*) + HCO3- (*aq*)

B A CB CA

c. H3PO4 (*aq*) + NH3 (*aq*) NH4+ *(aq*) + H2PO4-(*aq*)

A B CA CB

2. a. CO32- b. H2O c. PO43- d. NO2-

3. a. HSO4- b. HCN c. H2O d. HClO2

4.



**OH-(*aq*)**