ChemQuest 68

Intro to Acids and Bases

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Hour: \_\_\_\_\_

# **Information**: Definitions of Acids and Bases

Arrhenius definitions

1. acid: substance that when dissolved in water increases [H+]; (note: H+ exists bonded to water as the hydronium ion, H3O+, so [H+] and [H3O+] are equivalent expressions)
2. base: substance that when dissolved in water increases [OH-]

Bronsted-Lowry definitions

1. acid: substance that donates a proton, H+, in a reaction
2. base: substance that accepts a proton, H+, in a reaction

**Critical Thinking Questions**

1. Using the Bronsted-Lowry definitions, explain why C2H3O2- acts like a base in the following reaction: C2H3O2- + H2O 🡪 HC2H3O2 + OH-
2. Using Arrhenius definitions, explain why C2H3O2- acts like a base in the reaction given in question 1.
3. Given the following reaction, explain why HCN is an acid according to Bronsted-Lowry, but not according to Arrhenius: HCN + SO42- 🡪 HSO4- + CN-

4. Given the following reaction, identify the acid or base: H2CO3 + H2O 🡪 H3O+ + HCO3-

**Information**: Acid-Base Equilibrium

Table 1: Equilibrium constants (at 25oC) for some acid-base equilibrium reactions.

|  |  |
| --- | --- |
| **Reaction** | **Kc** |
| 1. C2H3O2- + H2O 🡨🡪 HC2H3O2 + OH-2. HCN + SO42- + H2O 🡨🡪 HSO4- + CN- + H2O3. HC2H3O2 + H2O 🡨🡪 H3O+ + C2H3O2-4. H2CO3 + H2O 🡨🡪 H3O+ + HCO3- 5. HCl + H2O 🡨🡪 H3O+ + Cl- | 1.07 x 10-114.9 x 10-113.09 x 10-77.82 x 10-92.0 x 104 |

# **Critical Thinking Questions**

1. List all of the reactants in Table 1 that are Arrhenius acids.
2. a) What is the strongest acid among the reactants in reactions 3-5 inTable 1? Explain.

b) What is the weakest acid among the reactants in reactions 3-5 inTable 1? Explain.

1. Consider Reaction 3.
2. What substance is formed (by the acid) after the acid loses a proton?
3. Is this substance an acid or a base? (Hint: look at reaction 1.)
4. Drawing a conclusion from question 7, what can be said about a substance after it loses a proton? Is the substance formed acidic or basic?

# **Information**: Conjugate Acid-Base Pairs

After an acid loses a proton in a reaction, the substance formed behaves like a base. Verify this by examining Reactions 3 and 1 in Table 1. Notice from reaction 3 that HC2H3O2 is an acid. After it loses a proton it becomes the acetate ion, C2H3O2-. The acetate ion is a base, as seen in reaction 1; there is a special name for this base: it is a conjugate base. So, C2H3O2- is the conjugate base of HC2H3O2. Similarly, HSO4- is the conjugate acid of SO42-. Verify this by examining Reaction 2.

# **Critical Thinking Questions**

1. Describe how a conjugate base is formed.
2. How is a conjugate acid formed?
3. For each of the acids below, write the reaction of the acid with water and circle the formula of the conjugate base in your reaction.
4. H2SO4
5. HCO3-
6. HF
7. For each of the bases below, write the reaction of the base with water and circle the formula of the conjugate acid in your reaction.
8. NH3
9. OH-
10. NO3-