

This is BCE#18.

I recommend you print out this page and bring it to class. [Click here](#) to show a set of five BCE18 student responses randomly selected from all of the student responses thus far in a new window.

John , here are [your responses](#) to the BCE and the [Expert's response](#).

A second definition of acids and bases is the Bronsted-Lowry definition. According to this definition an acid is a proton,  $H^+$ , donor and a base is a proton acceptor.

1. In the following equation, label the Bronsted-Lowry acid and base (on the reactants side) and the Bronsted-Lowry acid and base on the product side;



|                |                             |                             |   |   |
|----------------|-----------------------------|-----------------------------|---|---|
| Your Response: | base<br><i>100%</i><br>Base | acid<br><i>100%</i><br>Acid | conjugate acid<br><i>100%</i><br>conjugate acid | conjugate base<br><i>100%</i><br>conjugate base |
|----------------|-----------------------------|-----------------------------|---|---|

2. A Bronsted-Lowry conjugate acid/base pair differ by ONLY a proton,  $H^+$ . In Q1 there are two Bronsted-Lowry conjugate acid/base pairs? Write the pair using the following format....acid/base.

$HNO_3/NO_3^-$  conjugate acid/base pair #1 *70%* *18% change*

$NH_3/NH_4^+$  are a conjugate acid/base pair because they differ by a proton.

$NH_4^+/NH_3$  conjugate acid/base pair #1 *70%* *18% change*

$HNO_3/NO_3^-$  are a conjugate acid/base pair because they differ by a proton.

3. For the reaction in Q1, the equilibrium constant, K, is VERY large. Using the chemical equation in Q1, and knowing that K is very large, identify the strongest acid and the strongest base in the equation.

$HNO_3$  formula of the strongest acid *76%*

$\text{HNO}_3$  is the strongest acid. Since  $K$  for the reaction is very large, the products will be present in the larger amount compared to the reactants.  $\text{HNO}_3$  is the strongest acid because there is very little of it in solution, the stronger acid ( $\text{HNO}_3$  or  $\text{NH}_4^+$ ) will be present in the smallest amount.

$\text{NH}_3$  formula of the strongest base 76%

$\text{NH}_3$  is the strongest base. Since  $K$  for the reaction is very large, the products will be present in the larger amount compared to the reactants.  $\text{NH}_3$  is the strongest base because there is very little of it in solution, the stronger base ( $\text{NH}_3$  or  $\text{NO}_3^-$ ) will be present in the smallest amount.

You are given a solution with the label 0.500 M formic acid ( $\text{HCOOH}$ ). Formic acid is known to be a weak acid. Answer the following questions.

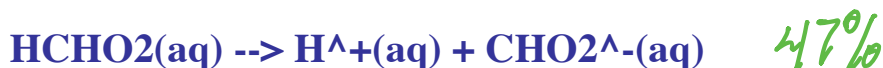
5. Is the concentration of  $\text{HCOOH}$  in the solution actually 0.500 M? Explain.

No, the concentration of formic acid is slightly smaller 94%

No. The concentration of  $\text{HCOOH}$  will not be 0.500 M. Since formic acid is a weak acid a small amount of it will dissociate according to the chemical equation



6. Write an Arrhenius or a Bronsted-Lowry chemical equation which describes how formic acid behaves as an acid.

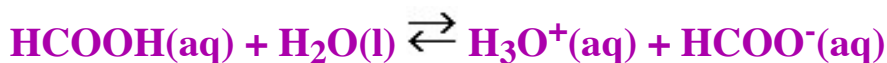


47% removed the wrong  $\text{H}^+$

The Arrhenius chemical reaction for formic acid acting as a weak acid is



The Bronsted-Lowry chemical reaction for formic acid acting as a weak acid is



7a. The pH of the 0.500 M  $\text{HCOOH}$  solution is 2.02, calculate the  $[\text{H}^+]$  in this solution.

$$\text{pH} = 9.55 \times 10^{-3} \quad 94\%$$

$$\text{pH} = -\log [\text{H}^+]$$

$$-2.02 = \log [\text{H}^+]$$

$$[\text{H}^+] = 10^{-2.02} = 9.55 \times 10^{-3} \text{ M}$$

b. If formic acid were a strong acid, what would be the pH of the solution? (Hint: You may want to set up an ICE table.)

$$\text{pH} = 0.301 \quad 60\%$$

To calculate the pH of the solution we have to know the  $[\text{H}^+]$ . Assuming  $\text{HCOOH}$  completely dissociates we can set up the ICE table,

|   | $\text{HCOOH}(\text{aq})$ | $\text{H}^+(\text{aq})$ | $+\text{HCOO}^-(\text{aq})$ |
|---|---------------------------|-------------------------|-----------------------------|
| I | 0.500 M                   | ~0                      | 0                           |
| C | -0.500 M                  | +0.500 M                | +0.500 M                    |
| E | 0                         | +0.500 M                | +0.500 M                    |

If formic acid behaves as a strong acid all of the formic acid dissociates into hydrogen ions and formate ions.

$$\text{pH} = -\log [\text{H}^+]$$

$$\text{pH} = -\log (0.500)$$

$$\text{pH} = 0.301$$

8. Is there anything about the questions that you feel you do not understand? List your concerns/questions.

nothing

**9. If there is one question you would like to have answered in lecture, what would that question be?**

**nothing**