*Show any other work on a separate sheet of paper and staple it to one copy of this tutorial per group. Please write names of all group members on your work.*

1)

a) Write an equilibrium reaction between water (H2O(l)) acting as an acid with water acting as a base. Label the acids and bases for the forward and reverse reaction. Identify the conjugate acid/base pairs.

b) When a substance is able to act as an acid or a base, what is this type of substance called? Why is this type of substance able to do this?

2) Complete the following conjugate acid/base chart below:

|  |  |
| --- | --- |
| Conjugate Acid | Conjugate Base |
|  | H2BO3- |
| C6H5OH |  |
| HSO3- |  |
|  | HC2O4-‑ |
|  | Al(H2O)5(OH)2+ |
| NH4+ |  |
| HAsO42- |  |

3) Write the ionization reactions of the following with water:

a) H2C6H5O7- (acid)

b) H2C6H5O7- (base)

c) In which case was water acting as an acid? How do you know?

4) Why don't we typically write Ka or Kb expressions for strong acids or bases?

5) Write the three equations showing the stepwise dissociation of arsenic acid H3AsO4.

Step 1:

Step 2:

Step 3:

6) Identify and circle the amphiprotic species in the table below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| HO2- | H2CO3 | NH3 | HCO3- | HCOO- |
| HNO3 | HPO4- | HC2O4- | H2S | H2O |
| CH3COO- | HIO3 | H2BO3- | H2PO4- | H2O2 |

7) Write the ionization reaction with water and the Ka/Kb expression for the following:

a) CH3COOH

b) SO32-

c) NH4+

d) CN-

8) Of the 2 acids and the 2 bases given in the above question, which one is the stronger acid/base? How do you know quantitatively?

Bonus Question:

For the following chemical reaction:

HNO2 (aq) + CO32-­(aq)­ <-> NO2- (aq) + HCO3- (aq)

a) Write the equilibrium expression for this reaction.

b) Write the acid ionization reaction and Ka expression for the 2 acids.

c) How could you combine these two Ka expressions in #b to yield the equilibrium expression for the chemical reaction on the previous page? Show your steps.

d) Using your acid table and your response in #c, find the value of your equilibrium expression. Are products or reactants favored? Based on what you know about stronger acids and bases, why might this be the case?