**Name: Period: Seat#:**

**Worksheet #8**

**Directions:** Show all work. Box your final answer.

1. For the following aqueous equilibria, designate the Brønsted-Lowry conjugate acid-base pairs and establish the weaker side.

|  |  |  |  |
| --- | --- | --- | --- |
| **a.** | **NH3 (aq) + H2O (*l*) ⇔ NH4+ (aq) + OH− (aq)** | | |
| *Brønsted-Lowry conjugate acid:* | | *Brønsted-Lowry conjugate base:* | *Weaker side:* |
| **b.** | **HCN (aq) + H2O (*l*) ⇔ H3O+ (aq) + CN− (aq)** | | |
| *Brønsted-Lowry conjugate acid:* | | *Brønsted-Lowry conjugate base:* | *Weaker side:* |
| **c.** | **NH4+ (aq) + CO32− (aq) ⇔ NH3 (aq) + HCO3− (aq)** | | |
| *Brønsted-Lowry conjugate acid:* | | *Brønsted-Lowry conjugate base:* | *Weaker side:* |

1. Complete the Brønsted-Lowry equilibria, label the components acid or base, and pair up the conjugate acid-base pairs:

|  |  |
| --- | --- |
| **a.** | HSO4− + H2O ⇔ |
| **b.** | NH3 + H2O ⇔ |
| **c.** | CN− + H2O ⇔ |
| **d.** | H− + H2O ⇔ |
| **e.** | HClO4 + H2O ⇔ |

1. Of the following acids, determine the items listed below

[i] HNO3 (aq) + H2O(*l*) ⇔ H3O+ (aq) + NO3− (aq) **Ka = very large**

[ii] HSO4− (aq) + H2O(*l*) ⇔ H3O+ (aq) + SO42− (aq) **Ka = 1.2 x 10−2**

[iii] HCN (aq) + H2O(*l*) ⇔ H3O+ (aq) + CN− (aq) **Ka = 4.0 x 10−10**

[iv] H2CO3 (aq) + H2O(*l*) ⇔ H3O+ (aq) + HCO3− (aq) **Ka = 4.2 x 10−7**

[v] NH4+ (aq) + H2O(*l*) ⇔ H3O+ (aq) + NH3 (aq) **Ka = 5.6 x 10−10**

[vi] HF (aq) + H2O(*l*) ⇔ H3O+ (aq) + F− (aq) **Ka = 7.2 x 10−4**

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| **a.** The strongest acid | **b.** The acid that produces the lowest [ ] of hydronium ions per mole of acid | **c.** The acid with the strongest conjugate base |
| **d.** The diprotic acid | **e.** The “strong” acid | **f.** The acid with the weakest conjugate base. |

1. What is the pH of the following?

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| **a.** 0.0010 M HCl solution? *3.0* |
| **b.** 0.15 M KOH solution? *13.2* |
| **c.\*** 10-8 M HNO3 solution? *6.96 \*Hint – this is SUPER tricky...when very low [H+] you can’t ignore the [H+] coming from the auto ionization of water! Remember... H2O ↔ H+ + OH- , you should remember the [ ]’s of each substance from the auto ionization of water...* |

1. Complete the table for each aqueous solution at 25°C. State whether the solutions are acidic or basic. You do not need to show your work for all of these, but you can always use binder paper if needed!

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **[H3O+]** | **[OH−]** | **pH** | **pOH** | **Acidic or Basic** |
| 2.0 x 10-5 |  |  |  |  |
|  |  | 6.25 |  |  |
|  | 5.6 x 10-2 |  |  |  |
|  |  |  | 9.20 |  |
| 8.7 x 10-10 |  |  |  |  |
| 1. If the pH of a sample of rainwater is 4.62, what is the hydronium ion concentration [H3O+] and the hydroxide ion concentration [OH−] in the rainwater? *[H3O+] = 2.4E-5, [OH−] = 4.2E-10* | | | | | |
| 1. Hydroxylamine is a weak base with a Kb = 6.6 x 10−9. What is the pH of a 0.36 M solution of hydroxylamine in water at 25°C? *9.69* | | | | | |

1. Which of the following salts, when dissolved in water to produce 0.10 M solutions, would have the lowest pH? Choose the correct multiple choice answer and then explain why.
   1. Sodium acetate
   2. Potassium chloride *Explain why:*
   3. Sodium bisulfate
   4. Magnesium nitrate
   5. Potassium cyanide

|  |
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| 1. Cyanic acid HOCN has a Ka = 3.5 x 10−4, what is the Kb for the cyanate ion OCN−? *Kb = 2.86 x 10-11* |
| 1. Phenol is a relatively weak acid, Ka = 1.3 x 10−10. How does the strength of its conjugate base compare with the strength of ammonia (Kb = 1.8 x 10-5), the acetate ion (Kb = 5.55 x 10-10), and sodium hydroxide? |