NAME: **HONORS CHEMISTRY**

SECTION: Mixed Practice: Acids and Bases

You should be able to:

* List properties of acids and bases.
* Classify a solution as neutral, acidic, or basic, given the hydrogen ion or hydroxide ion concentration.
* Calculate the pH of a solution given the hydrogen-ion or hydroxide-ion concentration.
* Calculate the hydrogen-ion or hydroxide-ion concentration given the pH of a solution.
* Define and give examples of Arrhenius acids and bases.
* Classify substances as acids or bases, and identify conjugate acid-base pairs in acid-base reactions according to Bronsted-Lowry theory.
* Distinguish between strong and weak acids and bases using the extent of ionization and the dissociation constants.

1. Compare the properties of acids and bases by completing the following table:

|  |  |  |
| --- | --- | --- |
| Category | Acids | Bases |
| Effect on litmus |  |  |
| Effect on phenolphthalein |  |  |
| pH |  |  |
| Taste |  |  |
| Reaction with metals |  |  |

1. Complete the following table comparing the two key acid-base theories.

|  |  |  |
| --- | --- | --- |
| **Theory** | **Acid Definition** | **Base Definition** |
|  | H+ producer |  |
| Bronsted-Lowry |  |  |

1. Write the formula for the conjugate base of each of the acids listed.
2. HPO42-
3. HNO3
4. HF
5. HC2H3O2
6. Write the formula for the conjugate acid of each of the bases listed.
7. NH3
8. HSO4-
9. HS-
10. OH-
11. In the following reaction, which species behave as Bronsted acids? As Bronsted bases? Complete the reactions with water (as shown in the example), then label the conjugate acid-base pairs.

H2SO4 (aq) + H2O(l) ⇌ HSO4-(aq) + H3O+(aq)

* 1. H2SO3
  2. H3PO4
  3. NH3
  4. N2H4
  5. HNO3

1. What does it mean to be an amphiprotic substance?
2. What is the difference between a strong acid and a weak acid in terms of % ionization? Include particle level models with your answer.
3. Consider the following table of Ka values for several acids. Which is the strongest acid on the list? Which is the weakest acid? Explain how you arrived at your answer.

|  |  |
| --- | --- |
| Acid | Ka |
| H3PO4 | 7.5 x 10-3 |
| HCO3- | 5.6 x 10-11 |
| HF | 3.5 x 10-4 |
| HNO2 | 4.6 x 10-4 |

Which of these is amphiprotic? Explain why.

1. Find the pH of a 0.075 M HCN solution that ionizes 0.00907%.
2. Find the pH of solutions with the following H3O+ concentrations.
3. 1.15 x 10-6 M
4. 5.8 x 10-8 M
5. 7.4 x 10-11 M
6. Find the [H3O+] and the pOH of the following solutions.
7. pH = 3
8. pH = 9.35
9. pH = 4.34
10. What is the hydroxide ion concentration in a solution with [H3O+] = 7.67 x 10-9 M?
11. What is the hydronium ion concentration in a solution with [OH-] = 4.4 x 10-2 M?

Answers to selected problems:

* 1. a) PO43- b) NO3- c) F- d) C2H3O2-
  2. a) NH4+ b) H2SO4 c) H2S d) H2O

8. strongest H3PO4 (highest Ka); weakest HCO3- (smallest Ka) HCO3- is amphoteric.

1. pH = 5.17
2. a) pH = 5.939 b) pH = 7.24 c) pH = 10.13
3. a) [H3O+] = 1 x 10-3 M pOH = 11 b) [H3O+] = 4.5 x 10-10 M pOH = 4.65

c) [H3O+] = 4.6 x 10-5 pOH = 9.66

1. [OH-] = 1.30 x 10-6 M

13. [H+] = 2.3 x 10-13 M