Acid-Base Ka, Kb, pKa & pKb Worksheet

1. Calculate the

a) [H3O+],

b) the pH and,

c) the % dissociation for a 0.50 mol/L HCN solution.

2. Calculate the

a) [H3O+],

b) the pH,

c) the pOH and,

d) the % dissociation for a 0.10 mol/L solution of NH_4^+ derived from a salt such as NH_4NO_3.

3. Write equations which represent the dissociation of each of these acids or bases in aqueous solution. Use a single arrow in the case of a strong acid or base, and a double arrow to represent the equilibrium condition that exists in the solution of a weak acid or base. Show each step of dissociation for polyprotic acids.

a) KOH, b) H_3AsO_4, c) $HClO_4$, d) HCN, e) $C_6H_5NH_2$ (a weak base)

4. Benzoic acid, $C_6H_5CO_2H$, is an organic acid whose sodium salt , $C_6H_5CO_2Na$, has long been used as a safe food additive to protect beverages and many foods against harmful yeasts and bacteria. The acid is monoprotic. Write the equation for it's Ka.

5. The pKa of HCN is 9.21 and that of HF is 3.17. Which is the stronger Bronsted base: CN- or F-?

6. What is the percent ionization in a 0.15 M solution of HF? What is the pH of this solution?

7. Periodic acid, HIO_4, is an important oxidizing agent and a moderately strong acid. In a 0.10 M solution, [H+]=3.8 X 10-2 mol/L. Calculate the Ka and pKa for periodic acid.

8. Barbituric acid, H-Bar, was discovered by Adolph von Baeyer (of Baeyer aspirin fame) and maned after a friend, Barbara. It is the parent compound of widely used sleeping drugs, the barbiturates. Its pKa is 4.01. What will be the $[H^+]$ and pH of a 0.050 M solution of H-Bar?

9. Hydrazine, N_2H_4, has been used as a rocket fuel. Like ammonia, it is a Bronsted base. A 0.15 M solution has a pH of 10.70. What is the Kb and pKb for hydrazine and the pKa of its conjugate acid?

10. Codeine, a cough suppressant extracted from crude opium, is a weak base with a pKb of 5.79. What will be the pH of a 0.020 M solution of codeine? (Use Cod as a symbol for codeine.)

11. Quinine, an important drug in treating malaria, is a weak Bronsted base that we may represent as Qu. At 25^oC its pKb is 5.48. To make it more soluble in water, it is put into a solution as its conjugate acid, which we may represent as H-QuCl. What is the calculated pH of a 0.15 M solution of $H\text{-}Qu^+$?

12. Nicotinic acid, $HC_2H_4NO_2$ is a B vitamin. It is also a weak acid with $Ka=1.4 \times 10^{-5}$. What is the $[H^+]$ and the pH of a 0.010 M solution?

13. Write the equilibrium equations and the equations for Kb for each of the following Bronsted bases.

(a) CN^- (cyanide ion)

(b) $C_2H_3O_2^-$ (acetate ion)

(c) $C_6H_5NH_2$ (aniline)

(d) H_2O

14. Few substances are more effective in relieving intense pain then Morphine. Morphine is an alkaloid (an alkali-like compound obtained from plants) and alkaloids are all weak bases. In 0.010 M morphine, the pH is 10.10. Calculate the Kb for morphine.