Acids/Bases Worksheet

acids Bases and Buffers Worksheet1_07.doc

Name Key

Date _____ Period _____

1. Given a .0004M solution of perchloric acid determine:

a) pH $-\log(.0004) = 3.4$

b) pOH $14 - 3.4 = 10.6$

c) $[H_3O^+]$ .0004 M

d) $[OH^-]$ $1.0\times10^{-14}/.0004 = 2.5\times10^{-11}$

e) How many perchlorate ions would there be in 35.0mL of this solution?

$.0004\ mol/L\ (.035L)(6.022\times10^{23}\ ions/mol)$

$= 8.43\times10^{18}$ ions

2. Determine the conjugate acids for the following species:

NO_2^- HNO_2 nitrous acid

NH_3 NH_4^+ ammonium

CO_3^{2-} HCO_3^- hydrogen carbonate (bicarbonate)

PO_4^{3-} HPO_4^{2-} hydrogen phosphate

3. Determine the pH of a solution formed from diluting a 15.0mL sample of .025M nitric acid to 750.mL

$M = \frac{mol}{L}$ $\frac{(.015L)(.025\ mol/L)}{(.750L)} = 5.0\times10^{-4}$

$-\log 5.0\times10^{-4} = 3.3$

4. Determine the hydroxide ion concentration for the solution formed in question 3 above.

$1.0\times10^{-14} = (5.0\times10^{-4})(OH^-)$

$[OH^-] = 2.0\times10^{-11}$

5. Calculate the hydronium and hydroxide ion concentrations for the following:

a. tomato juice; pH = 5

$[H_3O^+] = 10^{-pH} = 1.0\times10^{-5}\ M\ H_3O^+$

$[OH^-] = 1.0\times10^{-14}/1.0\times10^{-5} = 1.0\times10^{-9}\ OH^-$

b. seawater; pOH = 6.15

$[OH^-] = 10^{-6.15} = 7.1\times10^{-7}\ M$

$[H_3O^+] = 1.0\times10^{-14}/7.1\times10^{-7} = 1.4\times10^{-8}\ M$

6. What mass of potassium hydroxide is required to produce 2.00L of a solution that has a pOH of 4.5?

$[OH^-] = 10^{-4.5} = 3.16\times10^{-5}\ M$

$3.16\times10^{-5}\ M\ (2.00L) = 6.32\times10^{-5}\ mol$

$6.32\times10^{-5}\ mol\ (56.1056\ g/mol) = \underline{\underline{3.5\times10^{-3}}}\ g$

7. What is the final pH of a solution made from combining 55.0mL of a .0025M HNO_3 solution with 26.0mL of a .0085M HNO_3 solution?

$moles\ H^+ = (.055)(.0025) + (.026)(.0085)$

$= 3.585\times10^{-4}\ mol / .081L = 4.43\times10^{-3}\ M$

$pH = -\log(4.43\times10^{-3}) = 2.35$

8. Which solution will have a higher pH, a .005M formic acid solution or a .005M carbonic acid solution (use your book as reference). Explain.

Formic Acid $K_a = 1.9\times10^{-4}$

Carbonic acid $K_{a_1} = 4.4\times10^{-7}$

The Ka for formic acid is significantly higher ∴ more acidic = lower pH

Carbonic acid has the higher pH

9. Calculate the K_b value for a weak base that is known to ~~dissociate~~ hydrolyze by 2.00% in a 1.00M solution.

$B^- + H_2O \longrightarrow HB + OH^-$ $1.00M\ (.02) = .02 = x$

$K_b = \frac{[HB][OH^-]}{[B^-]}$

$K_b = \frac{(x)(x)}{(1.00-x)} = \frac{(.02)(.02)}{(1.00-.02)} = \underline{\underline{4.08\times10^{-4}}}$

10. What is the pH of a solution in which .25g of strontium hydroxide is dissolved in enough water to produce 1500.mL of solution?

$\frac{.25\text{g } Sr(OH)_2}{121.63\text{ g/mol}} \times \frac{2\text{ mol } OH^-}{1\text{ mol } Sr(OH)_2} = \frac{.00411\text{ mol } OH^-}{1.5\text{L}}$

$= .00274\text{M } OH^-$ $\quad -\log(.00274) = 2.56 = pOH$

$pH = 14.0 - 2.56 = 11.4$

11. How much water would need to be *added* to 250.mL of a solution with a pH of 5.6 to bring the pH to 6.0?

$pH = 6.0 \quad [H_3O^+] = 1.0\times10^{-6}\text{M}$

$pH = 5.6 \quad [H_3O^+] = 10^{-5.6} = 2.51\times10^{-6}\text{M}$

$2.51\times10^{-6}\text{M}\ (.250\text{L}) = 6.278\times10^{-7}\text{ mol } H_3O^+$

$\frac{6.278\times10^{-7}}{(.250+x)} = 1.0\times10^{-6} \quad x = .378\text{L} = 378\text{mL}$

12. Citric acid, abbreviated H_3Cit, gives Kool-Aid its tart taste. If 36.10mL of 0.293M NaOH neutralizes a 0.677g sample of citric acid, what is the molar mass of citric acid?

$H_3Cit_{(s)} + 3NaOH_{(aq)} \rightarrow Na_3Cit_{(aq)} + 3H_2O_{(l)}$

$\text{mol } NaOH = (.03610\text{L})(0.293\text{M}) = .0106\text{ mol}$

$.0106\text{ mol } NaOH \left(\frac{1\text{ mol Cit acid}}{3\text{ mol } NaOH}\right) = .0035\text{ mol Cit}$

$\frac{0.677\text{g}}{.0035\text{mol}} = 192\text{ g/mol}$

13. Determine what acid or base is formed when the following anhydrides are placed in water.

a. CaO $CaO + H_2O \rightarrow Ca(OH)_2$ base

b. SO_3 $SO_3 + H_2O \rightarrow H_2SO_4$ acid

c. CO_2 $CO_2 + H_2O \rightarrow H_2CO_3$ acid

d. K_2O $K_2O + H_2O \rightarrow 2KOH$ base

14. What was the pH of the initial solution of hydrobromic acid if a 10.0mL sample of that solution that has been diluted with water to 85.0mL has a pH of 6.2?

$[H_3O^+] = 10^{-6.2} = 6.31\times10^{-7}\text{M}$

$6.31\times10^{-7}\frac{\text{mol}}{\text{L}}\ (.085\text{L}) = 5.36\times10^{-8}\text{ mol } H_3O^+$

$\frac{5.36\times10^{-8}\text{ mol } H_3O^+}{.010} = 5.36\times10^{-6}$

$pH = -\log(5.36\times10^{-6}) = 5.27$

15. Determine the pOH of a .02M solution of ammonia, NH_3.

$NH_3 \quad K_b = 1.8\times10^{-5}$

$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

$K_b = [OH^-][NH_4^+]/[NH_3]$

$1.8\times10^{-5} = \frac{(x)(x)}{(.02-x)} \quad .02-x \approx .02$

16. Write the chemical equations showing the double dissociation of the diprotic acid, surfuric acid. Be sure to use single or double arrows where required.

① $H_2SO_4 + H_2O \rightarrow H_3O^+ + HSO_4^-$

② $HSO_4^- + H_2O \rightleftharpoons H_3O^+ + SO_4^{2-}$

$\frac{x^2}{.02} = 1.8\times10^{-5}$

$x = 6.0\times10^{-4} = [OH^-]$

$pOH = -\log(6.0\times10^{-4})$

$= 3.2$