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**Include file name:** Chemistry\_Worksheet\_0008

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1. A sample of milk has  $\text{pH} = 6.45$ . Calculate  $[\text{H}^+]$ ,  $[\text{OH}^-]$ , and  $\text{pOH}$  for this sample.
2. A solution of hypochlorous acid,  $\text{HOCl}$ , is used to disinfect a shower stall. If the solution is  $0.680 \text{ M HOCl}$ , and has a  $\text{pH} = 3.84$ , what is its  $K_a$  value? Calculate the % error of your answer from the value found in Table 14.2 (p. 659).
3. Calculate the degree of ionization for the hypochlorous acid in Question #8.
4. Calculate the  $\text{pH}$  of a  $0.520 \text{ M}$  solution of hydrogen sulfate ion ( $\text{HSO}_4^-$ ), which has an acid dissociation constant,  $K_a$ , equal to  $0.014$  at a particular temperature. Set up the ICE table and apply the 5 % rule.
5. Set up an ICE table and calculate the  $\text{pH}$  of a  $0.80 \text{ M}$  solution of ethylamine ( $K_b = 5.6 \times 10^{-4}$ ). Use an equation similar to Eqn 14.6 on p. 678.
6. How many drops of  $0.050 \text{ M}$  hydrochloric acid would you have to add to neutralize all of the hydroxide in  $10.0 \text{ mL}$  of the ethylamine solution in Question 11?  $20 \text{ drops} = 1.0 \text{ mL}$ . Assume that no more hydroxide is produced other than what is produced in the equilibrium in Question #11.
7. A solution of  $1.40 \text{ M}$  benzoic acid was mixed with  $250.0 \text{ mL}$  of a  $0.550 \text{ M}$  sodium hydroxide solution and the resulting solution had  $\text{pOH} = 0.534$ . How many milliliters of the benzoic acid solution were initially added? Assume benzoic acid and hydroxide react on a one-to-one basis.
8. The  $\text{pH}$  of a  $0.0242 \text{ M}$  solution of ammonia at a particular temperature is  $10.80$ . Calculate  $K_b$ . Use an equation similar to Eqn 14.6 on p. 678.
9. Tractor tires are partly filled with water to give them added weight. Calcium chloride,  $\text{CaCl}_2$ , is added to keep the water from freezing. If a tire solution is  $3.57 \text{ m CaCl}_2$ , what is the mole fraction of calcium chloride in the solution and what is the molarity of the solution? Assume the density of the solution is  $1.27 \text{ g/mL}$ .  
 $\text{CaCl}_2 = \underline{\hspace{2cm}}$       Molarity =  $\underline{\hspace{2cm}}$
10. Ether boils at  $34.7 \text{ deg C}$  and freezes at  $-116 \text{ deg C}$ . Enough eugenol, which produces the flavor and smell of cloves, was dissolved in  $200.0 \text{ grams}$  of ether to make a  $0.566 \text{ molal}$  solution. If the freezing point depression and boiling point elevation constants of ether are  $1.79 \text{ deg C kg/mol}$  and  $2.02 \text{ deg C kg/mol}$ , respectively, what are the freezing point and boiling point of the solution?  
 $\text{fp} = \underline{\hspace{2cm}}$        $\text{bp} = \underline{\hspace{2cm}}$
11. If the molecular formula of eugenol is  $\text{C}_{10}\text{H}_{12}\text{O}_2$ , what was the mass of the eugenol used in Question #2?  
Mass =  $\underline{\hspace{2cm}}$
12. The vapor pressure of benzene is  $40.4 \text{ torr}$  at  $7.57 \text{ deg C}$ . If  $\Delta H_{\text{vap}}$  for benzene is  $30.8 \text{ kJ/mol}$ , at what Celsius temperature does it have a vapor pressure of  $404 \text{ torr}$ ?

$$\ln \frac{P_1}{P_2} = \frac{\Delta H_{\text{vap}}}{R} \left[ \frac{1}{T_2} - \frac{1}{T_1} \right], \text{ where } R = 8.314 \text{ J/mol K}$$

T = \_\_\_\_\_

13. At a high temperature nitric oxide and hydrogen react according to the following equation:  $2\text{H}_2(\text{g}) + 2\text{NO}(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g}) + \text{N}_2(\text{g})$

An initial rate experiment was run and the following data was collected:

Trial	[H <sub>2</sub> ]	[NO]	Rate
1	0.0100	0.0250	2.40 x 10 <sup>-6</sup>
2	0.0050	0.0250	1.20 x 10 <sup>-6</sup>
3	0.0100	0.0125	0.60 x 10 <sup>-6</sup>

Determine the rate law for the reaction, and determine the value of the rate constant, k, for all three trials. What is the value of k? Be sure to include units of k.

Rate = \_\_\_\_\_ k = \_\_\_\_\_

14. Iodine-131 decays to xenon-131 in a first order process with a half-life of 8.1 days. If a technician starts with 60.0 grams of iodine-131, how much time must pass before he has only 5.00 grams left?

t = \_\_\_\_\_

#### 15. Autoionization of Water and the pH Scale. (Question 14.42)

At 40 °C, the value of  $K_w$  is  $2.92 \times 10^{-14}$ .

a. Calculate the [H<sup>+</sup>] and [OH<sup>-</sup>] in pure water at 40 °C.  
(Type your answer using the format 8.050e-3 for  $8.050 \times 10^{-3}$ .)

[H<sup>+</sup>] = \_\_\_\_\_ M, and [OH<sup>-</sup>] = \_\_\_\_\_ M

b. What is the pH of pure water at 40 °C?

pH = \_\_\_\_\_

c. If the hydroxide ion concentration in a solution is 0.37 M, what is the pH at 40 °C?

pH = \_\_\_\_\_

16. A solution is prepared by mixing 83.0 mL of 5.00 M HCl and 30.0 mL of 8.00 M HNO<sub>3</sub>. Water is then added until the final volume is 1.00 L. Calculate [H<sup>+</sup>], [OH<sup>-</sup>], and the pH for this solution. (Where needed, type your answer using the format 8.050e-3 for  $8.050 \times 10^{-3}$ .)

$$[\text{H}^+] = \text{ \_\_\_\_\_\_ } M$$

$$[\text{OH}^-] = \text{ \_\_\_\_\_\_ } M$$

$$\text{pH} = \text{ \_\_\_\_\_\_ }$$

### 17. Solutions of Acids. (Question 14.58)

Calculate the pH of a 0.39 M solution of iodic acid ( $\text{HIO}_3$ ,  $K_a = 0.17$ ).

$$\text{pH} = \text{ \_\_\_\_\_\_ }$$

### 18. Solutions of Acids. (Question 14.62)

Calculate the pH of a solution that contains 1.7 M HF and 1.7 M  $\text{HOC}_6\text{H}_5$ . Also calculate the concentration of  $\text{OC}_6\text{H}_5^-$  in this solution at equilibrium.

(Where needed, type your answer using the format 8.050e-3 for 8.050  $\times 10^{-3}$ .)

$$\text{pH} = \text{ \_\_\_\_\_\_ }$$

$$[\text{OC}_6\text{H}_5^-] = \text{ \_\_\_\_\_\_ } M$$

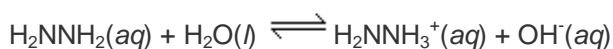
### 19. Solutions of Acids. (Question 14.70)

One mole of a weak acid was dissolved in 2.0 L of water. After the system had come to equilibrium, the concentration of HA was found to be 0.49 M. Calculate  $K_a$  for HA. (Type your answer using the format 8.050e-3 for 8.050  $\times 10^{-3}$ .)

$$K_a = \text{ \_\_\_\_\_\_ }$$

### 20. Solutions of Bases. (Question 14.84)

For the reaction of hydrazine ( $\text{N}_2\text{H}_4$ ) in water,



$K_b$  is 3.0  $\times 10^{-6}$ . Calculate the concentrations of all species and the pH of a 3.0 M solution of hydrazine in water.

$$[\text{H}_2\text{NNH}_2] = \text{ \_\_\_\_\_\_ } M$$

$$[\text{H}_2\text{NNH}_3^+] = \text{ \_\_\_\_\_\_ } M$$

$$[\text{OH}^-] = \text{ \_\_\_\_\_\_ } M$$

$$\text{pH} = \text{ \_\_\_\_\_\_ }$$

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