

AP Chemistry  
Partner Quiz: Sections 16.1 - 16.7

Name Key  
Date 2/15/08 Period \_\_\_\_\_

**Directions:** Choose the best answer for each of the following questions. Darken in all of your answers on your scantron. You may use a calculator. There is only one correct answer for each question! Notes, handouts, problem sets and problems we worked in class are allowed on this quiz. (25 points)

1. A Bronsted-Lowry acid is defined as a substance that \_\_\_\_\_.
- a. increases  $[H^+]$  when placed in  $H_2O$
  - b. decreases  $[H^+]$  when placed in  $H_2O$
  - c. increases  $[OH^-]$  when placed in  $H_2O$
  - d. acts as a proton acceptor in any system
  - e. acts as a proton donor in any system

2. A substance that is capable of acting as both acid and as base is \_\_\_\_\_.
- a. autosomal
  - b. conjugated
  - c. amphoteric
  - d. autocratic
  - e. aceybasey

3. What is the conjugate acid of  $NH_3$ ?
- a.  $NH_3$
  - b.  $NH_2^+$
  - c.  $NH_3^+$
  - d.  $NH_4^+$
  - e.  $NH_4OH$

4. What is the conjugate acid of  $OH^-$ ?
- a.  $O_2$
  - b.  $O^-$
  - c.  $H_2O$
  - d.  $O^{2-}$
  - e.  $OH^-$

5. What is the pH of a solution in which the molar concentration of HCl is  $1.3 \times 10^{-11}$ ?
- a. 1.00
  - b. 10.89
  - c. 3.11
  - d. 6.00
  - e. 7.00

$pH = -\log(1.3 \times 10^{-11})$

6. What is the pH of a 0.015 M solution of barium hydroxide?
- a. 12.48
  - b. 12.08
  - c. 1.82
  - d. 10.35
  - e. 1.52

$0.015 M Ba(OH)_2 = 0.030 M OH^- ; pOH = -\log(0.030M) = 1.52$

7. In basic solution,
- a.  $[H_3O^+] = [OH^-]$
  - b.  $[H_3O^+] > [OH^-]$
  - c.  $[H_3O^+] < [OH^-]$
  - d.  $[H_3O^+] = 0 M$
  - e.  $[OH^-] > 7.00$

$pH = 14 - 1.52 =$

12.48

8. A weak base ionizes 2.30%. If the initial concentration of the base is 0.0100 M, then the pH of this solution is \_\_\_\_\_ and the  $K_b$  is \_\_\_\_\_.

- a. 10.36;  $2.3 \times 10^{-6}$
- b. 3.64;  $5.4 \times 10^{-6}$
- c. 3.64;  $1.9 \times 10^{-9}$
- d. 10.36;  $5.4 \times 10^{-6}$
- e. 10.36;  $1.9 \times 10^{-9}$

$\% I = 2.30\% = \frac{x}{0.0100M} \times 100$

$x = [OH^-] = 2.3 \times 10^{-4} M$

$pOH = -\log(2.3 \times 10^{-4} M) = 3.64$

$K_b = \frac{(2.3 \times 10^{-4})^2}{0.0100 - 2.3 \times 10^{-4}} = 5.4 \times 10^{-6}$

$pH = 10.36$

9. All of the strong acids are \_\_\_\_\_ compounds. All of the strong bases are \_\_\_\_\_ compounds.

- a. molecular, ionic
- b. ionic, molecular
- c. amphoteric, ionic
- d. molecular, amphoteric
- e. ionic, amphoteric

10. Of the following, \_\_\_\_\_ is a weak acid.

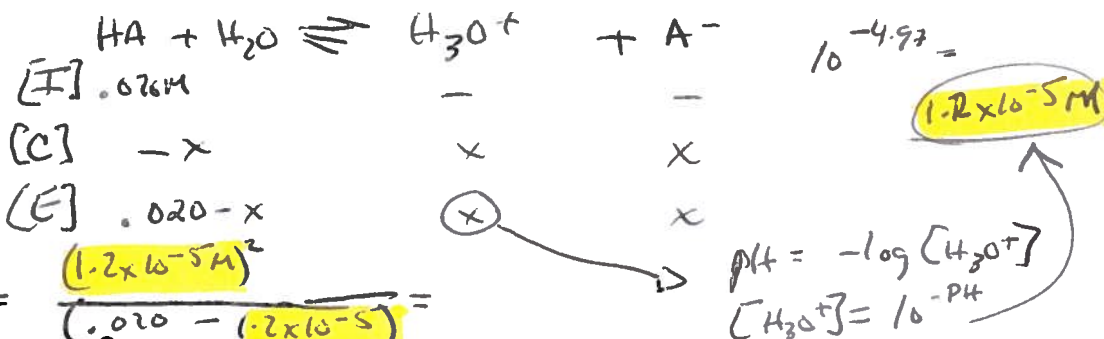
- a. HF
- b. HCl
- c. HBr
- d. HNO<sub>3</sub>
- e. HClO<sub>4</sub>

11. Which one of the following is the weakest acid?

- a. HF ( $K_a = 6.8 \times 10^{-4}$ )
- b. HClO ( $K_a = 3.0 \times 10^{-8}$ )
- c. HNO<sub>2</sub> ( $K_a = 4.5 \times 10^{-4}$ )
- d. HCN ( $K_a = 4.9 \times 10^{-10}$ )
- e. Acetic acid ( $K_a = 1.8 \times 10^{-5}$ )

12. HA is a weak acid. An aqueous solution of HA is prepared by dissolving 0.020 mol of HA in sufficient water to yield 1.00 L of solution. The pH of the solution was 4.93 at 25°C. The  $K_a$  of HA is \_\_\_\_\_.

- a.  $1.2 \times 10^{-5}$
- b.  $7.0 \times 10^{-9}$
- c.  $1.4 \times 10^{-10}$
- d.  $9.9 \times 10^{-2}$
- e.  $2.8 \times 10^{-12}$



$$K_a = \frac{(1.2 \times 10^{-5})^2}{(0.020 - 1.2 \times 10^{-5})} =$$

13. The  $K_a$  of HClO is  $3.0 \times 10^{-8}$ . What is the pH at 25°C of an aqueous solution that is 0.020 M in HClO?

- a. +2.45
- b. -2.45
- c. -9.22
- d. +9.22
- e. +4.61

$$K_a = 3.0 \times 10^{-8} = \frac{x^2}{0.020 - x}; \quad x = 2.45 \times 10^{-5}\text{M} = [\text{H}^+]$$

$$\text{pH} = -\log(2.45 \times 10^{-5}\text{M}) = 4.61$$

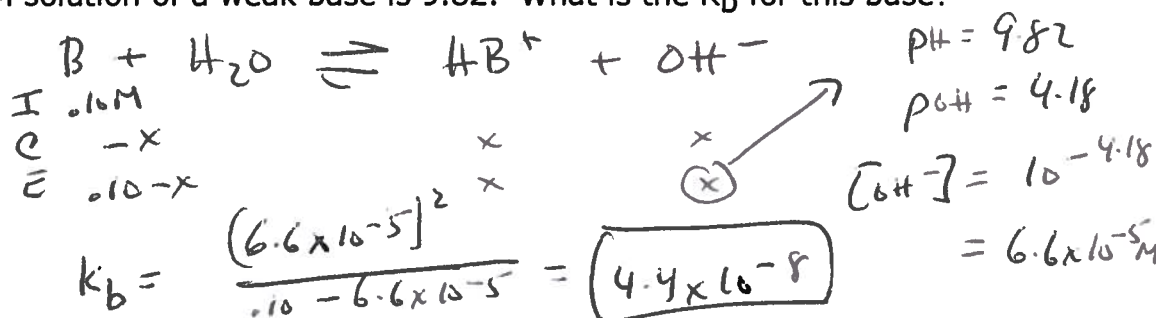
14. A 0.0035 M aqueous solution of a particular compound as pH = 2.46. The compound is

- a. a weak base
- b. a weak acid
- c. a strong acid
- d. a strong base
- e. a salt

$$-\log(0.0035\text{M}) = 2.46$$

15. The pH of a 0.10 M solution of a weak base is 9.82. What is the  $K_b$  for this base?

- a.  $2.1 \times 10^{-4}$
- b.  $4.4 \times 10^{-8}$
- c.  $8.8 \times 10^{-8}$
- d.  $6.6 \times 10^{-4}$
- e.  $2.0 \times 10^{-5}$



16. How many liters of distilled  $H_2O$  must be added to 1.0 liter of an aqueous solution of HCl with a pH of 1 in order to create a solution with a pH of 2?

- a. 10. L
- b. 0.90 L
- c. 2.0 L
- d. 9.0 L
- e. 100.0 L

$$M_1 V_1 = M_2 V_2$$

pH = 2  
 $[H^+] = 0.01 M$

$$(0.10 M)(1.0 L) = (0.010 M) V_2$$

$$V_2 = 10.0 L$$

So you need to add 9.0 L

17. Which **one** of the following species is best classified as amphoteric?

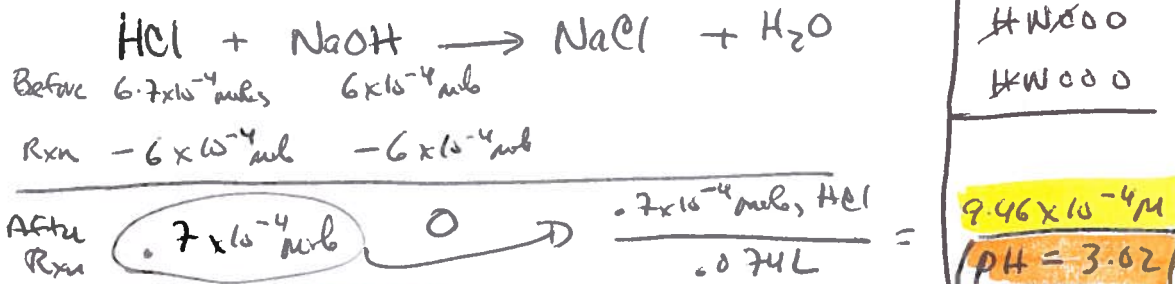
- a.  $HNO_3$
- b.  $HC_2H_3O_2$
- c.  $HSO_3^-$
- d.  $H_3PO_4$
- e.  $ClO_4^-$

18. Which of the following is the acid anhydride of a monoprotic acid?

- a.  $CaO$
  - b.  $SO_3$
  - c.  $FeO$
  - d.  $CO_2$
  - e.  $N_2O_5$
- $HNO_3$   
 $H_2SO_3$   
 $H_2CO_3$

19. If 50.0 mL of a 0.0134 M HCl solution is mixed with 24.0 mL of a 0.0250 M NaOH solution, what is the pH of the final mixture?

- a. 1.87
- b. 12.40
- c. 5.29
- d. 3.02
- e. 10.98



20. What is the percent dissociation of a 0.15 M HCN solution? ( $K_a$  for HCN is  $4.9 \times 10^{-10}$ )

- a.  $7.35 \times 10^{-11}$
- b.  $8.57 \times 10^{-3}$
- c.  $8.57 \times 10^{-3}$
- d.  $5.71 \times 10^{-3}$
- e.  $5.71 \times 10^{-5}$

$$4.9 \times 10^{-10} = \frac{x^2}{0.15 - x}$$

$$x = [H^+] = 8.57 \times 10^{-6} M$$

$$\% \text{ I} = \frac{8.57 \times 10^{-6}}{0.15} \times 100 = 5.71 \times 10^{-3} \%$$

3<sup>or</sup> %D

21. How many moles of  $\text{HC}_2\text{H}_3\text{O}_2$  in a 200. mL solution are required to produce a solution with  $\text{pH} = 2.90$ ?  $K_a$  for  $\text{HC}_2\text{H}_3\text{O}_2 = 1.80 \times 10^{-5}$ .

- a.  $1.79 \times 10^{-2}$
- b.  $8.82 \times 10^{-2}$
- c.  $8.95 \times 10^{-2}$
- d.  $1.62 \times 10^{-3}$
- e.  $1.79 \times 10^{-3}$

$$1.8 \times 10^{-5} = \frac{(10^{-2.90})^2}{[\text{HC}_2\text{H}_3\text{O}_2] - 10^{-2.90}}$$

$$(1.8 \times 10^{-5})([\text{HC}_2\text{H}_3\text{O}_2] - 2.26 \times 10^{-8}) = (2.26 \times 10^{-8})^2$$

$$[\text{HC}_2\text{H}_3\text{O}_2] = 0.0893 \text{ M}$$

$$\frac{0.0893 \text{ moles}}{L} \times \frac{0.200 \text{ L}}{1} = \boxed{0.0179 \text{ moles}}$$

22. Ascorbic acid,  $\text{H}_2\text{C}_6\text{H}_6\text{O}_6$ , is a polyprotic acid containing two ionizable hydrogens.  $K_{a1}$  is  $8.0 \times 10^{-5}$  and  $K_{a2}$  is  $1.6 \times 10^{-12}$ . Calculate the  $\text{pH}$  of a  $2.0 \times 10^{-3} \text{ M}$  solution of ascorbic acid.

- a.  $\text{pH} = 3.40$
- b.  $\text{pH} = 4.50$
- c.  $\text{pH} = 1.20$
- d.  $\text{pH} = 5.10$
- e.  $\text{pH} = 5.85$

$$8.0 \times 10^{-5} = \frac{x^2}{2.0 \times 10^{-3} - x}$$

$$x = [\text{H}^+] = 4 \times 10^{-4}$$

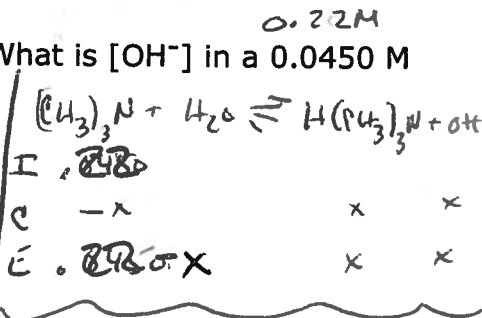
$$\boxed{\text{pH} = 3.40}$$

23.  $K_b$  for trimethylamine,  $(\text{CH}_3)_3\text{N}$ , a weak base, is  $7.4 \times 10^{-5}$ . What is  $[\text{OH}^-]$  in a  $0.0450 \text{ M}$  trimethyl amine solution?

- a.  $3.3 \times 10^{-6} \text{ M}$
- b.  $4.0 \times 10^{-3} \text{ M}$
- c.  $1.2 \times 10^{-3} \text{ M}$
- d.  $2.6 \times 10^{-2} \text{ M}$
- e.  $4.4 \times 10^{-5} \text{ M}$

$$7.4 \times 10^{-5} = \frac{x^2}{0.0450 - x}$$

$$\boxed{[\text{OH}^-] = 4.0 \times 10^{-3} \text{ M}}$$



24. Which species from the following list would be the strongest Bronsted-Lowry base?

- a.  $\text{ClO}_4^-$
- b.  $\text{NO}_3^-$
- c.  $\text{Br}^-$
- d.  $\text{Cl}^-$
- e.  $\text{F}^-$

comes from the weakest acid!

25. Calculate the  $\text{pH}$  of  $0.163 \text{ M}$  sulfurous acid ( $\text{H}_2\text{SO}_3$ ) where  $K_{a1} = 1.7 \times 10^{-2}$  and  $K_{a2} = 6.4 \times 10^{-8}$

- a. 4.48
- b. 1.35
- c. 1.77
- d. 7.19
- e. 1.01

$$1.7 \times 10^{-2} = \frac{x^2}{0.163 - x} \quad (\text{Must use quadratic})$$

$$x = [\text{H}_3\text{O}^+] = 0.0526, \quad \boxed{\text{pH} = 1.28} \quad \text{No Quad so}$$

Real pH higher (more basic)