

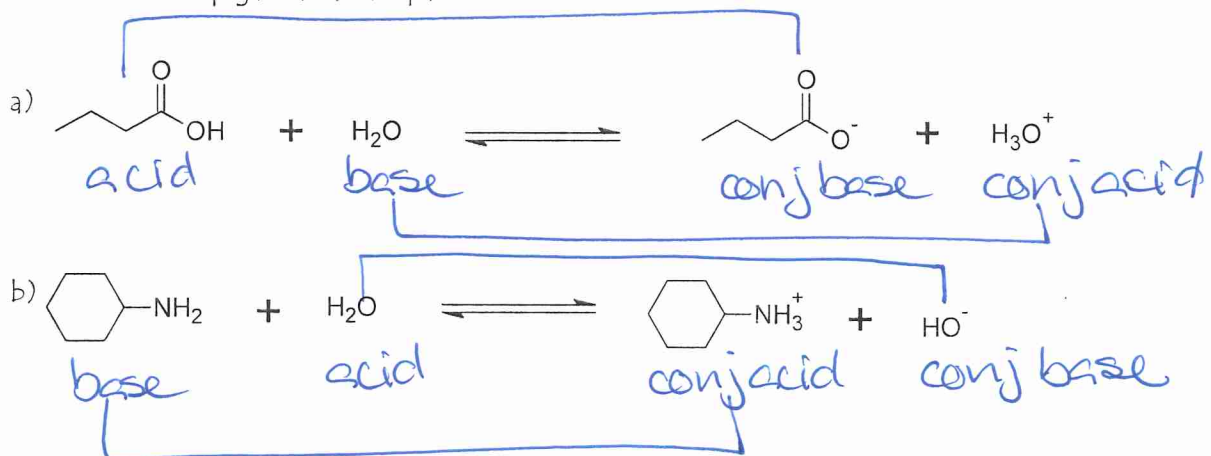
1. Give the formula and name for the conjugate base of each acid.

	formula of conj base	name of conj base
a) $\text{HSO}_4^-$	$\text{SO}_4^{2-}$	sulfate
b) $\text{H}_2\text{CO}_3$	$\text{HCO}_3^-$	bicarbonate
c) $\text{H}_2\text{PO}_4^-$	$\text{HPO}_4^{2-}$	biphosphate
d) $\text{HNO}_3$	$\text{NO}_3^-$	nitrate

2. Give the formula for the conjugate acid of each base.

a) $\text{CO}_3^{2-}$	$\text{HCO}_3^-$
b) $\text{H}_2\text{PO}_4^-$	$\text{H}_3\text{PO}_4$
c) $\text{CH}_3\text{NH}_2$	$\text{CH}_3\text{NH}_3^+$
d) $\text{Cl}^-$	$\text{HCl}$

3. Identify the reactants as acids and bases and the products as their corresponding conjugates. Draw lines to connect the conjugate acid base pairs.



4. Which of the following statements are correct at equilibrium?

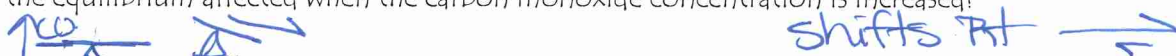
- a) The concentration of reactants is always equal to the concentration of the products. **False**
- b) No reactants are converted into products. **False**
- c) The rate of the forward reaction is equal to the rate of the reverse reaction. **True**

5. When carbon monoxide gas reacts with hydrogen gas, methanol gas is formed in an equilibrium reaction.

a) Write the balanced reaction paying attention to the reaction arrow.



b) How is the equilibrium affected when the carbon monoxide concentration is increased?



c) How is the equilibrium affected when the hydrogen concentration is decreased?



d) How is the equilibrium affected when the pressure is increased?



e) How is the equilibrium affected when the volume is increased?



6. Calculate the  $\text{H}_3\text{O}^+$  concentration present in water when

a)  $1 \times 10^{-5} \text{ M OH}^-$

$$[\text{H}_3\text{O}^+] = 1 \times 10^{-9} \text{ M}$$

b)  $1 \times 10^{-9} \text{ M OH}^-$

$$[\text{H}_3\text{O}^+] = 1 \times 10^{-5} \text{ M}$$

c)  $5 \times 10^{-10} \text{ M OH}^-$

$$[\text{H}_3\text{O}^+] = 2 \times 10^{-5} \text{ M}$$

d)  $5 \times 10^{-3} \text{ M OH}^-$

$$[\text{H}_3\text{O}^+] = 2 \times 10^{-12} \text{ M}$$

$$K_w = 1 \times 10^{-14} = [\text{H}_3\text{O}^+][\text{OH}^-]$$

7. For each of the solutions above, classify the solution as acidic, neutral, or basic. You can make this determination directly from the hydronium concentration.

a) basic

$$[\text{H}_3\text{O}^+] > 1 \times 10^{-7} \text{ M}$$

is acidic

b) acidic

c) acidic

d) basic

8. For each of the solutions above, calculate the pH.

a)  $\text{pH} = 9.0$

b)  $\text{pH} = 5.0$

c)  $\text{pH} = 4.7$

d)  $\text{pH} = 11.7 \text{ or } 12$

$$\text{pH} = -\log [\text{H}_3\text{O}^+]$$

9. What is the hydronium concentration when the

$$[\text{H}_3\text{O}^+] = 10^{-\text{pH}}$$

- a) pH is 4  $10^{-4} \text{ M}$
- b) pH is 12  $10^{-12} \text{ M}$
- c) pH is 7.4  $4 \times 10^{-8} \text{ M}$
- d) pH is 2.5  $3.2 \times 10^{-3} \text{ M}$

10. What is the hydroxide concentration when the

$$\text{pH} + \text{pOH} = 14$$

$$[\text{OH}^-] = 10^{-\text{pOH}}$$

- a) pH is 3  $\text{pOH} = 11$   $[\text{OH}^-] = 10^{-11} \text{ M}$
- b) pH is 13  $\text{pOH} = 1$   $[\text{OH}^-] = 10^{-1} \text{ M}$
- c) pH is 7.4  $\text{pOH} = 6.6$   $[\text{OH}^-] = 2.5 \times 10^{-7} \text{ M}$
- d) pH is 1.5  $\text{pOH} = 12.5$   $[\text{OH}^-] = 3.2 \times 10^{-13} \text{ M}$

11. Alkali metals react with water to produce alkaline (basic) solutions. For example, sodium metal reacts with water to form a sodium hydroxide solution and hydrogen gas.

a) Write the balanced reaction described above.



b) Which reactant is oxidized?  $\text{Na}$   $\text{Na}^0 \rightarrow \text{Na}^+ + 1e^-$   $\text{LEO}$

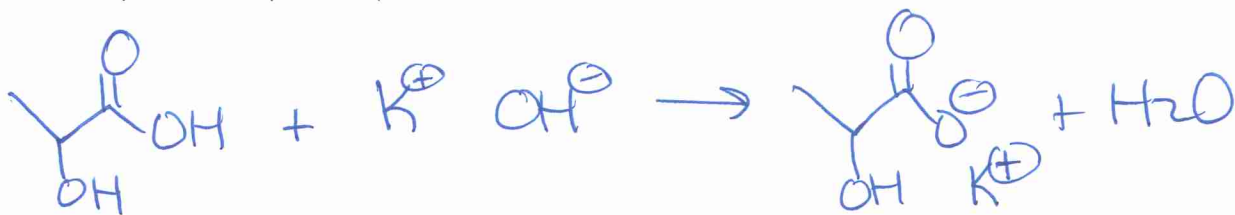
c) Which reactant is reduced?  $\text{H}_2\text{O}$   $2 \text{H}^+ \rightarrow \text{H}_2^0$   $\text{GER}$   
 $+2e^-$

d) Which reactant is the oxidizing agent?  $\text{H}_2\text{O}$

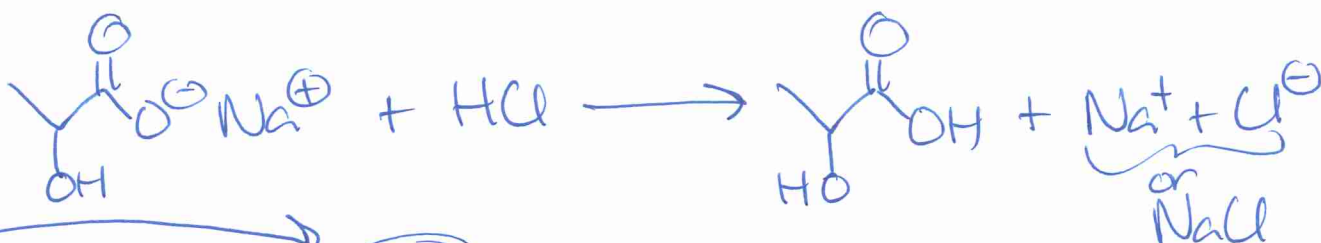
e) Which reactant is the reducing agent?  $\text{Na}$

12. A buffer can be prepared using lactic acid (2-hydroxypropanoic acid) and its conjugate base, lactate.

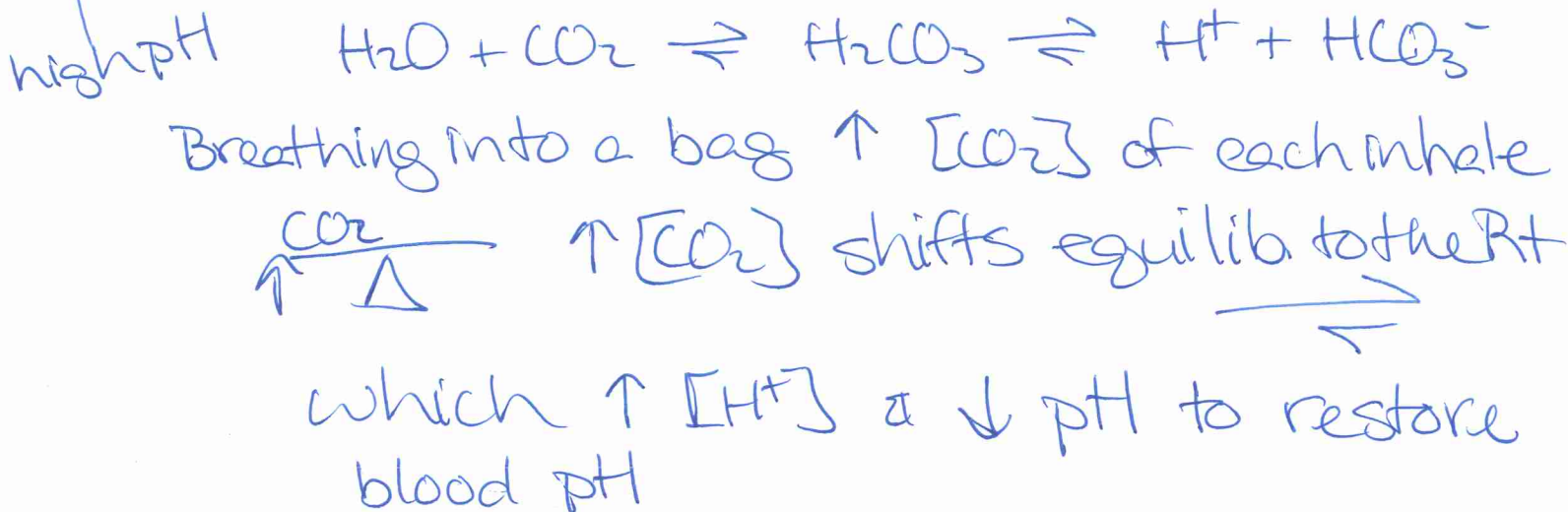
- a) Using skeletal-line structures for the organic compounds, write the reaction of lactic acid with potassium hydroxide to produce potassium lactate and water.



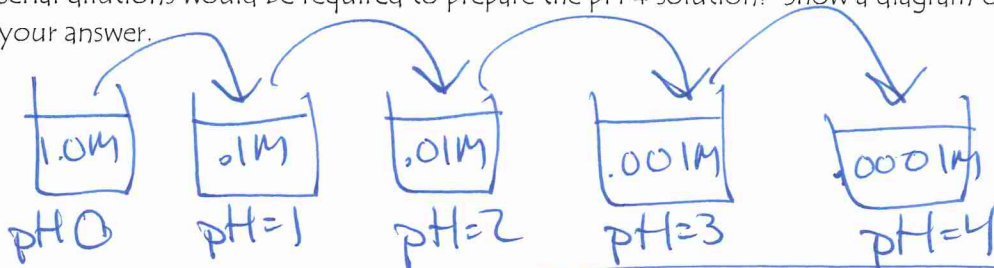
- b) Using skeletal-line structures for the organic compounds, write the reaction of sodium lactate with hydrochloric acid to produce lactic acid and sodium chloride.



13. One treatment for respiratory alkalosis is to breathe into a paper bag. Write the reaction for the bicarbonate buffer system to help explain how breathing into a paper bag helps restore the pH of the blood to its normal value.



14. You have a 1.0 M hydrochloric acid solution and need a pH 4 hydrochloric acid solution. How many 1:10 serial dilutions would be required to prepare the pH 4 solution? Show a diagram or calculations to support your answer.



4 1:10 dilutions required