Chapter 15 Reading Guide **Name:**

AP Chemistry 2016-2017 **Date:** **Period:**

This chapter contains concepts found in Big Idea 6 of the AP Chemistry curriculum. Everything in the chapter except Lewis acids and bases and calculations with polyprotic acids is essential content in the AP Chemistry curriculum. Traditionally, all AP Chemistry exams include questions pertaining acid-base equilibria.

15.1 Heartburn

1. What causes heartburn?

2. What is the main acid in the stomach?

3. What makes up proteins? DNA?

15.2 The Nature of Acids and Bases

4. List four characteristics of acids.

5. For each of the following acids, write their formula and list one use of each acid.

Table 15.1 – Some Common Acids

Name	Formula	Occurrences/Uses
Hydrochloric Acid		
Sulfuric Acid		
Nitric Acid		
Acetic Acid		
Citric Acid		
Carbonic Acid		
Hydrofluoric Acid		
Phosphoric Acid		

6. What acid is the main component of vinegar?

7. What is a carboxylic acid? Include a formula and draw a structure or Lewis Dot Diagram in your answer.

8. List four properties of bases.

9. For each of the following bases, write their formula and list one use of each base.

Table 15.2 – Some Common Bases		
Name	**Formula**	**Occurrences/Uses**
Sodium Hydroxide		
Potassium Hydroxide		
Sodium Bicarbonate		
Sodium Carbonate		
Ammonia		

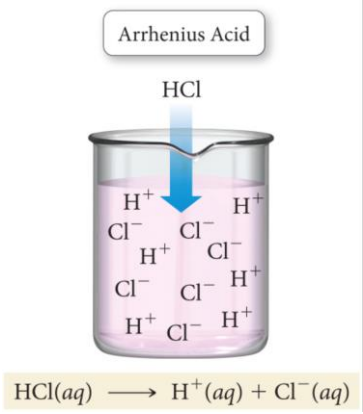
15.3 Definitions of Acids and Bases

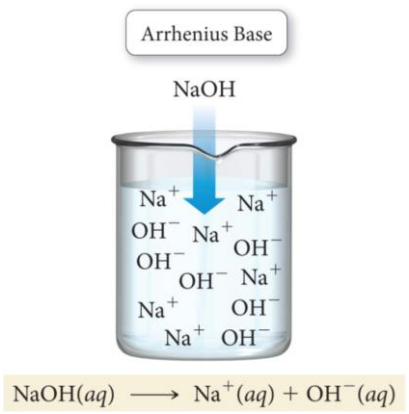
10. What is the definition of an Arrhenius acid? Arrhenius base?

11. What is a hydronium ion and what is its formula?

12. What formula is used interchangeable with hydronium?

13. What does the term *dissociate* mean? Why is this term used with acids and bases? Include the following figures in your explanation.





14. What are the definitions of a Bronsted-Lowry acid and base? Why must an acid and base always occur together in this theory?

15. Why are the Bronsted-Lowry definitions of acids and bases considered more useful?

16. What does the term *amphoteric* mean? Give an example of an amphoteric substance.

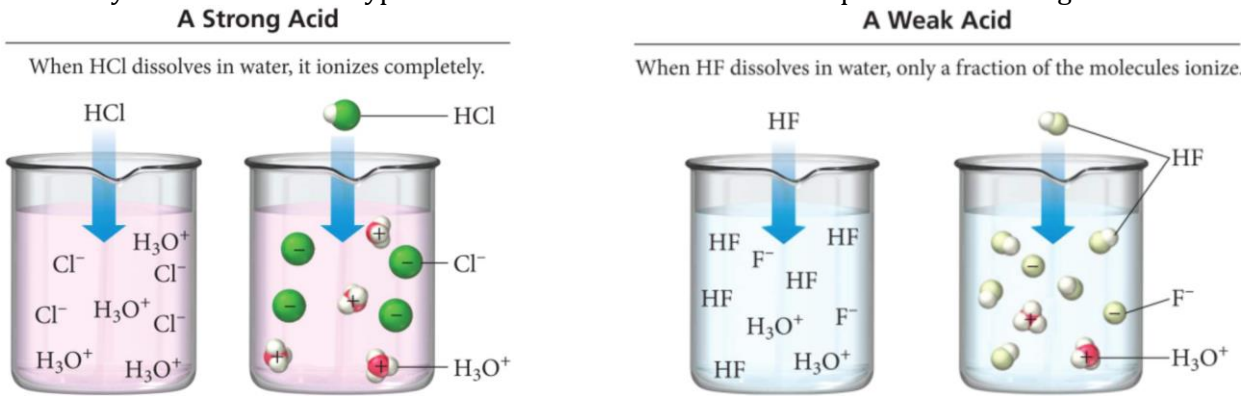
17. What are conjugate acid-base pairs? How can they be identified (use the figures below to help you with your answer)?

18. In the following equation, identify the acid, base, conjugate acid, and conjugate base. Show lines between acid-base pairs.

$$HCl_{(aq)} + H_2O_{(l)} \rightarrow H_3O^+_{(aq)} + Cl^-_{(aq)}$$

15.4 Acid Strength and the Acid Ionization Constant (K_a)

19. What is the difference in the percent of dissociation between a strong acid and a weak acid? Use the figures below in your answer. What types of arrows are used in chemical equations for strong acids? Weak acids?



20. Define each type of acid and include one example:
    a. Monoprotic:

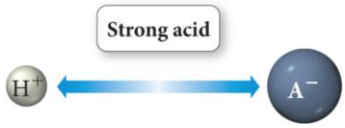
    b. Diprotic:

    c. Triprotic:

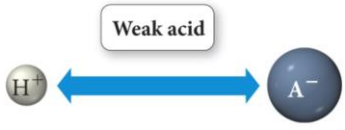
21. Name and give the formula of five strong acids.

22. Draw a picture showing what happens when the acid HBr is added to water.

23. Explain the diagram to the right. What characteristic indicates in an acid will be strong or weak?



24. Name and give the formulas of three weak acids



25. How does the acid ionization constant (K_a) indicate the strength of the acid?

26. Why is water not included in K_a expressions?

27. Write the chemical equation and K_a expression for acid acid being added to water.

15.5 Autoionization of Water and pH

28. Explain what is meant when someone says water undergoes autoionization. Use an equation in your answer.

29. What is K_w? At 25°C, what is the value of K_w? At this temperature, why is water neutral?

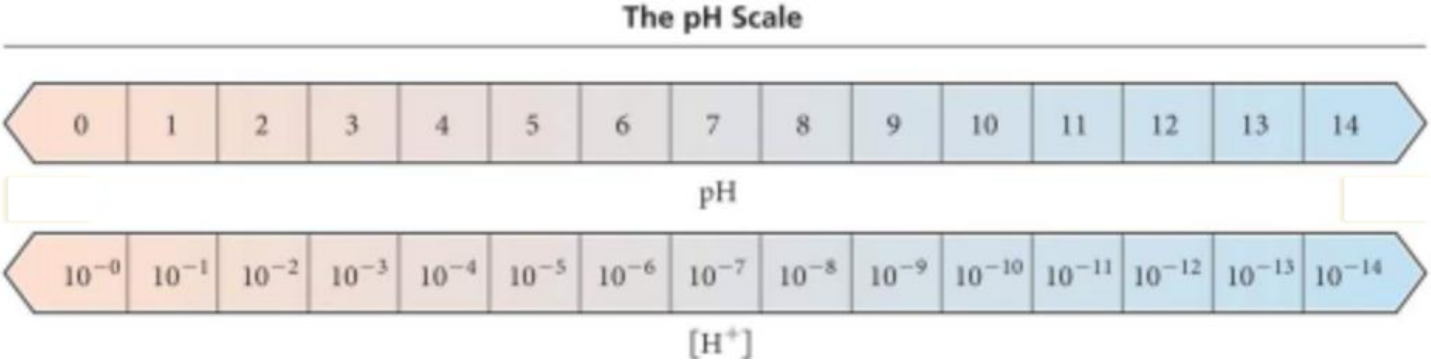
30. How can the concentrations of hydronium and hydroxide be calculated in an acidic or basic solution?

31. What is the relationship between hydronium and hydroxide in acidic solution? What is the relationship between hydronium and hydroxide ion a basic solution?

32. How can the pH of a solution be calculated?

33. Explain how to determine the number of significant figures in a pH value.

34. On the pH scale, what values are acidic? Neutral? Basic? Label these values on the number line below.



35. What factor represents the difference between a pH of 2 and 3? 2 and 5?

36. What is a pOH scale? How is pOH calculated? How is this scale different from a pH scale?

37. Which equation allows you to change from the pH scale to the pOH scale?

38. What is pK_a? What does pK_a represent?

15.6 Finding the [H_3O^+] and pH of Strong and Weak Acid Solutions

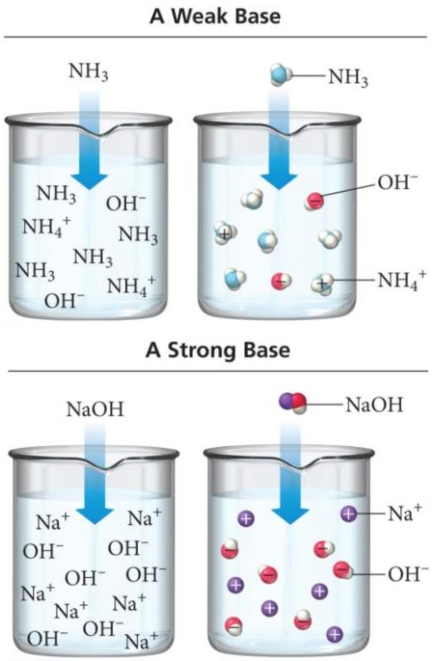
39. How is pH calculated for a strong acid? Why is this different for a weak acid? Explain.

40. How is the percent ionization of a weak acid calculated? What is the relationship between the percent ionization of the acid and the concentration of a weak acid?

41. When two acids are mixed, how is the pH calculated?

15.7 Base Solutions

42. Contrast the dissociations of a strong base and a weak base. Use the diagrams as evidence to support your claims about the dissociations of strong and weak bases.

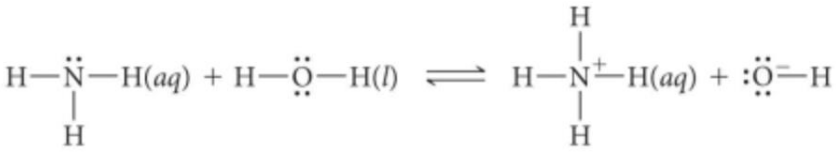


43. What metals form strong bases?

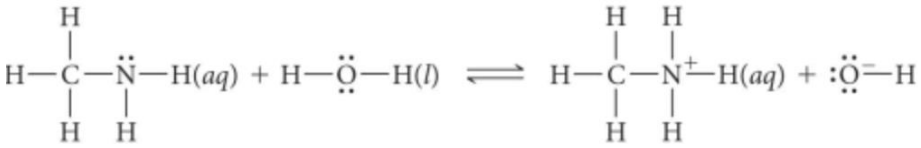
44. What is K_b? What is pK_b?

45. Write the Kb expression for the reactions represented here.

a.



b.



46. Explain how to calculate the pOH and [OH^-] in a basic solution.

47. Which bases are in antacids?

15.8 The Acid-Base Properties of Ions and Salts

48. What is a salt? List three examples of salts.

49. Which cations act as acids? Explain your answer.

50. Which anions are neutral? Which cations are neutral?

51. Which anions are bases? Explain your answer.

52. Which types of salts are neutral? List three examples.

53. Which types of salts are acidic? List three examples.

54. Which types of salts are basic? List three examples.

55. What is the relationship between K_a and K_b?

56. What is the relationship between pK_a and pK_b?

57. Fill in the table with cations and anions of salts.

pH of Salt Solutions			
		Anion	
		Conjugate base of strong acid	Conjugate base of weak acid
Cation	Conjugate acid of a weak base		
	Small, highly charged metal ion		
	Counterion of strong base		

15.9 Polyprotic Acids

58. What are polyprotic acids? List three examples.

59. Write the dissociation equations for phosphoric acid. Which dissociation contributes the most to the pH of the acid? Why?

15.10 Acid Strength and Molecular Structure

60. How does bond polarity affect acid strength in binary acids? Explain your answer.

61. How does bond strength affect the strength of an acid in binary acids? Explain your answer.

62. Explain how bond strength and electronegativity affect the following acids:

6A	7A
H_2O	HF
H_2S	HCl
H_2Se	HBr
H_2Te	HI

63. What is an oxyacid?

64. Which factors are used to determine the strength of an oxyacid?

65. Analyze the data below and explain why the trend occurs for oxyacids.

Acid	**Electronegativity of *Y***	**K_a**
H – O – I	2.5	2.3×10^{-11}
H – O – Br	2.8	2.0×10^{-9}
H – O – Cl	3.0	2.9×10^{-8}

66. Analyze the Ka values of the oxyacids below and explain why the trend occurs

Acid	**K_a**
$HClO_4$	Strong
$HClO_3$	1
$HClO_2$	1.1×10^{-2}
HClO	2.9×10^{-8}