Acid Base Chemistry Notes

1. _____is the Father of the Arrhenius Theory of Acids and Bases, a Nobel Prize Winner, and a Swedish Chemist Extraordinaire

2. ACIDS are aqueous solutions containing _____

3. BASES are aqueous solutions containing _____

4. All the acids we need to know are listed in _____

   Acetic acid (last on the list) is also called _____ at home.

5. Acids are strong because they _____ well

For example: when HCl goes into water practically all of it turns into _____ + _____. Hardly any $HCl_{(AQ)}$ remains

6. The more _____ ions in solution, the _____ the acid

7. Further down, especially acetic acid (vinegar) the acids do NOT _____ well.
8. Further down, especially acetic acid (vinegar) these acids _____

	Acid goes into water	Dissociates this way*
9 ~100%	$HCl_{(G)} \xrightleftharpoons{water}$	
10 ~100%	$HNO_{2(G)} \xrightleftharpoons{water}$	
11 ~45%	$H_2SO_{4(G)} \xrightleftharpoons{water}$	
12 ~10%	$H_3PO_{4(G)} \xrightleftharpoons{water}$	
14 ~5%	$HC_2H_3O_{2(S)} \xrightleftharpoons{water}$	

BASES

15. All of the bases we need to know about are listed in _____ ALL ionic compounds that are aqueous and contain hydroxides are bases. Examples include: _____

16. One base is "special" because it does not have _____ ions in solution. It is _____

17. Bases have more _____ than _____ ions in solution.

18. The more _____ the _____ the base.

    The stronger bases will _____ into _____ + _____ readily.

19, _____ does not follow the Arrhenius theory for bases. It is a _____ base.

20. Strong acids and strong bases have _____ in solution.

    Strong acids and strong bases are _____ _____ because they have so many ions in solution.

21. All acids and bases are _____ because they contain loose _____ in solution. The more ions in solution, the better they will conduct electricity.

22. Their relative electrolytic strength is easy, their strength is listed on Table K and L _____ to _____

Arrhenius theory states that aqueous solutions with excess hydrogen ions are acids, and that aqueous solutions with excess hydroxide ions are bases. It goes on to say…

23.

24. Salts are

25. This type of reaction is called:

26. The formula for water is

27. It can also be written this way which will make balancing these reactions much easier.

28. Let's balance the "classic" acid base neutralization reaction. Hydrochloric acid and sodium hydroxide…

_____ + _____ → _____ + _____

Underline the ACID H^{+1} ion and underline the BASE OH^{-1} ion. UNDERLINE them in the products as well.
It's the ACID ion that combines to the BASE ion that makes the NEUTRALIZATION. Not acid and not base anymore.

Balance these word equations by writing formulas, THEN name the products too. USE PHASE SYMBOLS!

29. Nitric acid + Potassium hydroxide →

_____ + _____ → _____ + _____

30. Hydrochloric acid + calcium hydroxide →

_____ + _____ → _____ + _____

31. Phosphoric acid plus lithium hydroxide →

_____ + _____ → _____ + _____

32. Nitric Acid and Magnesium hydroxide →

_____ + _____ → _____ + _____

33. _____ % of all acids and bases follow the _____ theory

34. _____ % of all acids and bases follow different theories. We will learn only about one of them, which is called the ALTERNATE theory of acids and bases, but it's named after 2 guys called _____ & _____ that describes how _____ can be a base even though it has no _____ ions.

35. When ammonia goes into water ,this is what happens. (you must memorize this, for real)

$NH_{3(G)} + HOH_{(L)} \rightleftharpoons$ _____ + _____

36. Ammonia…

water…

37. When put into water…

38. Every acid and base makes a salt and water. Practice these acid base neutralization reactions by writing the formulas from Table K & Table L, balancing the reactions, then naming the products. Use phase symbols.

Carbonic acid + lithium hydroxide → _____ + _____

_____ + _____ → _____ + _____

Acetic acid + calcium hydroxide → _____ + _____

_____ + _____ → _____ + _____

Phosphoric acid + sodium hydroxide → _____ + _____

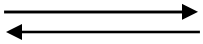
_____ + _____ → _____ + _____

Acid Base Indicators

39. An acid/base indicator is a compound (usually a weak acid in dynamic equilibrium) that…

The molecules are ONE COLOR while the anions are a DIFFERENT COLOR.

40. Phenolphthalein works like this…

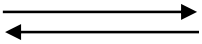


ADD ACID IONS

ADD BASE IONS

Adding hydroxide (base) ions is the same thing as…

41. Bromthymol Blue works like this…



ADD ACID IONS

ADD BASE IONS

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42. Write the titration math formula FIXED. Make sure you fix this on the back of the reference table too!

43. These symbols mean…

$\#H^{+1}$ _____ M_A _____ V_A _____

$\#OH^{-1}$ _____ M_B _____ V_B _____

44. If 7.91 mL of 1.25 M $H_2CO_{3(AQ)}$ is neutralized by 16.2 mL of NaOH, what's the molarity of this base?

On paper this is clear. In the titration lab we use long tubes called burets to measure the amounts of acid and base we use. They measure from zero mL on top, down to 50.0 mL at the bottom. They measure how much we start with, and how much we end with. It's the DIFFERENCE between those measures that is how much we use. We measure the difference at the end of titration, which we will learn happens with a color change from an indicator. Draw ONE buret, label start and end volumes.

45. If 25.8 mL of HCl of 2.75 Molarity will neutralize 43.8 mL of calcium hydroxide, what is the molarity of this base? (write the formula or else)

46. It takes 12.4 mL of 1.90 M HCl to neutralize 104 mL of NaOH. What is the molarity of the base?

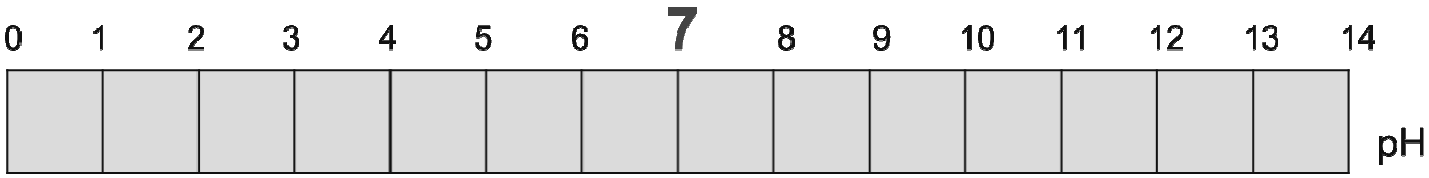
To measure the strength of acids and bases we use a special scale called pH.

47. We will use the…

48. It's an odd scale….

49. A pH of 7 is…

50. Label this diagram



A pH of 7 means…

51. The pH scale is a _____ scale, which refers to the exponents.

52. Each whole number change in pH is a _____ change in hydrogen ion strength. An acid of pH 3.5 is _____ stronger than an acid of pH 4.5

ex	pH of solution A	pH of solution B	comparison
ex	2.5	5.5	10x10x10 or A is 1000X more acidic than B
53	7.9	9.9	10x10 or solution A is 100X less basic than B
54	1.0	6.0	
55	13.1	7.1	
56	1.2	5.2	

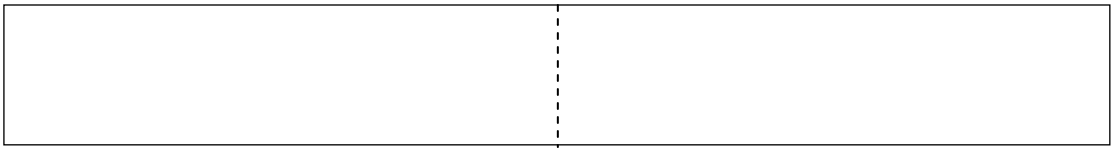
57. The math formula that explains the pH scale is this: pH =

58. Which means…

In math…

59. Whatever…

Table M - Acid Base Indicators. Methyl Orange (mark your pH scale, 0, 7, and 14, as well as 3.1 + 4.4)



60. Clearly the table says that methyl orange….

61. Acid Base indicators…

62. If 782.2 mL of KOH base to neutralize 1500. mL of sulfuric acid that has a 1.56 M, what is the molarity of this base?

63. What volume of 3.75 M $H_2SO_{4(AQ)}$ is necessary to exactly neutralize 34.7 litersof 1.88 M KOH?

64. 12.45 mL of 2.00 M H_3PO_4 is neutralized with 25.33 mL $Be(OH)_2$. What is the molarity of the base?

65. Acid Base indicators are mostly _____ _____.

66. When you put these indicators into solutions containing H^{+1} ions or OH^{-1} ions, they will undergo a

_____ _____ , shifting forward or reverse.

The formula for phenolphthalein is: $HC_{20}H_{13}O_4$ Show the dissociation of phenolphthalein when it is put into H_20 and forms a dynamic equilibrium. Show the stresses of adding acid ions, and of adding base ions.

_____ $\rightleftharpoons$ _____ + _____

67. This is the WORST PART of chemistry of the whole year for me. I can't stand this, you have to know it, it is silly, and it's on the regents. Ouch! Another way to describe an acid is this:

68. The acid…

69. Hydronium ion:

70. FOUR WAYS to describe an acid are…

71. Balance these chemical equations from these word equations…

Hydrochloric acid + calcium hydroxide → _____ + _____

_____ + _____ → _____ + _____

Sulfuric acid + beryllium hydroxide yields → _____ + _____

_____ + _____ → _____ + _____

Nitrous acid + magnesium hydroxide yields → _____ + _____

_____ + _____ → _____ + _____

72. The dissociation (or ionization) of sulfurous acid in water is written this way…

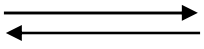
73. The dissociation of potassium hydroxide in water is written this way…

74. How many milliliters of 1.25 M NaOH base can 12.0 mL of 2.50 M HCl acid neutralize?

75. How many mL of H_3PO_4 acid of 1.15 M is needed to exactly neutralize 56.0 mL of 2.50 M $Mg(OH)_2$?

76. How many mL of 0.760 M NaOH is required to neutralize 145 mL of 4.33 M HCl acid?

77. Show the dynamic equilibrium of the acid base indicator Bromthymol blue, stress it by adding acid ions and by adding base ions, showing the LeChatelier shifts.



78. Show the set ups for these 3 problems… Don't do the math, just formula, put numbers in the right place

You neutralize 134 mL of 2.45 M $H_3PO_{4(AQ)}$ with 202 mL of $KOH_{(AQ)}$. What is the molarity of the base?

A bottle of 2,012 mL of 4.00 M $NaOH_{(AQ)}$ is spilled in lab. You use a weak hydrochloric acid of just 0.450 M to clean up. How many mL are used?

When 45.6 mL $HNO_{3(AQ)}$ is neutralized with 33.2 mL $Ca(OH)_2$ solution of 1.24 M. What is strength of the acid?

79. Draw this diagram. It's a "cartoon" but it explains the relationship between acid and base strength and the relative amounts of H^{+1} ions and OH^{-1} ions.

At pH 2.5 the hydrogen ion concentration is $1 \times 10^{-2.5}$ moles H^{+1} ions per liter of solution. Make sure, right now, you see where the exponent goes when describing the pH.

80: $1 \times 10^{-6.5}$ moles H^{+1} ions per liter of solution. pH is _____

81: $1x\ 10^{-11.3}$ moles H^{+1} ions per liter of solution, pH is _____

To compare the solutions on the left, to the solutions on the right, compare their pH values.

	Solution 1	Solution 2	Solution 1 is…
ex	pH 4.3	pH 6.3	100x more acidic
82	pH 11.2	pH 13.2	
83	pH 1.2	pH 0.2	
84	pH 12.0	pH 8.0	
85	pH 1.3	pH 6.3	

86. Acid Base Indicators change colors in solution. What colors would these turn? (look at table M!)

Methyl orange indicator into an ammonia solution. _____

Bromthymol blue indicator into vinegar. _____

Thymol blue into your deionized water. _____

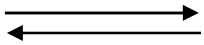
Litmus into your potassium hydroxide. _____

Bromcresol green into Mr. Arbuiso's Mixed Berry seltzer. _____

87. One last time, prove you know why ammonia is a base according to the alternate theory.

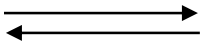
Thymol Blue is an acid base indicator, it's a weak acid. It's formula is: $HC_{27}H_{29}O_5S$

88. Show the dissociation of this weak acid in water, then stress it with adding acid and then adding base. What is the color of the molecule, what color is the anion?



Methyl Orange is an acid base indicator, it's a weak acid. It's formula is: $HC_{14}H_{13}N_3NaO_3S$

89. Show the dissociation of this weak acid in water, then stress it with adding acid and then adding base. What is the color of the molecule, what color is the anion?



90. List the four ways to chemically describe acids (with symbols and/or words).

91. This is hard. How many hydrogen ions are present per liter in a solution with a pH of 3.0?

92. Show the dissociation of a strong acid HCl and a weak acid ethanoic acid in dynamic equilibrium.

HCl

$HC_2H_3O_2$