Name____________________________________Date______________________________ Period______

Topic: Acids & Bases

Outline

1. **An electrolyte is a substance which when dissolved in water forms a solution capable of conducting an electric current. The ability of a solution to conduct an electric current depends upon the concentration of *ions* present.**
   - ✓ Ionic compounds are conductors of electricity when melted OR dissolved in water. Under these circumstances, the charged particles (ions in this case) are free to move (mobile).
   - ✓ There are 3 categories of electrolytes: acids, bases and salts.
   - ✓ Arrhenius theory states that an **acid** is an substance that dissolves in water to **produce H^+** (H_3O^+) ions (called "hydronium" ions on Table E).
   - ✓ Arrhenius theory states that a **base** is an substance that dissolves in water to **produce OH^-** ions (called "hydroxide" ions on Table E).
   - ✓ A salt is any ionic compound producing a positive ion other than H^+ and a negative ion other than OH^-.
   - ✓ Common acid and base names and formulas are given on Tables K and L.
   - ✓ *You should be able to sort compounds as acids, bases or salts, given their chemical formulas*

2. **Properties of many acids and bases can be explained by the Arrhenius theory. Arrhenius acids and bases are electrolytes.**
   - ✓ Acid properties include sour taste, less than 7 pH, ability to neutralize bases, and ability to affect indicator colors. These properties are due to the H^+ ion.
   - ✓ Base properties include bitter taste, greater than 7 pH, ability to neutralize acids, and ability to affect indicator colors. These properties are due to the OH^- ion.
   - ✓ *When given properties, you should be able to identify substances as Arrhenius acids or Arrhenius bases*

3. **The acidity or alkalinity of a solution can be measured by its pH value.**
   - ✓ For every change in pH of one unit, the acidity changes by a factor of 10. A pH 4 solution is 10 times more acidic that a pH 5 solution. A pH 4 solution is 100 times more acidic that a pH 6 solution.
   - ✓ *You should be able to identify solutions as acid, base, or neutral based upon the pH. Neutral is a pH of 7.*

4. **The relative level of acidity or alkalinity of a solution can be shown by using indicators.**
   - ✓ Various indicators are shown on Table M. Make sure you know how to interpret the info on it!
   - ✓ Example: IF bromothymol blue is yellow in color, we know the pH is 6 OR LESS. If its color is blue, we know the pH of the solution is 7.6 OR GREATER.

5. **In the process of neutralization, an Arrhenius acid reacts with an Arrhenius base to form a salt and water.**
   - ✓ Example: $Ba(OH)_2 + 2\ HBr \rightarrow BaBr_2 + 2\ H_2O$
   - ✓ These reactions are double replacements.
   - ✓ These reactions are NOT redox reactions.
   - ✓ *You should be able to write simple neutralization reactions when given the reactants*

6. **Titration is a laboratory process in which the volume of a solution of known concentration is used to determine the concentration of another solution.**
   - ✓ *You should be able to calculate the concentration or volume of a solution, using titration data*
   - ✓ In order to do this, use the titration equation on Table T: $(M\times V)_{acid} = (M\times V)_{base}$

7. **The Bronsted acid - base theory views acids as "H^+ donors", and bases as "H^+ acceptors."**

Acids & Bases – questions from previous Regents exams

1. An Arrhenius base yields which ion as the only negative ion in an aqueous solution?
   (1) hydride ion (3) hydronium ion
   (2) hydrogen ion (4) hydroxide ion

2. According to one acid-base theory, a water molecule acts as an acid when the water molecule
   (1) accepts an H^+ (3) donates an H^+
   (2) accepts an OH^- (4) donates an OH^-

3. Which two formulas represent Arrhenius acids?
   (1) CH_3COOH and CH_3CH_2OH
   (2) $HC_2H_3O_2$ and H_3PO_4
   (3) $KHCO_3$ and $KHSO_4$
   (4) NaSCN and $Na_2S_2O_3$

4. Which substance is an Arrhenius acid?
   (1) $Ba(OH)_2$ (3) H_3PO_4
   (2) CH_3COOCH_3 (4) NaCl

5. Which compound releases hydroxide ions in an aqueous solution?
   (1) CH_3COOH (3) HCl
   (2) CH_3OH (4) KOH

6. What are the products of a reaction between KOH(aq) and HCl(aq)?
   (1) H_2 and KClO (3) KH and HClO
   (2) H_2O and KCl (4) KOH and HCl

7. Which volume of 0.10 M NaOH(aq) exactly neutralizes 15.0 milliliters of 0.20 M HNO_3(aq)?
   (1) 1.5 mL (3) 3.0 mL
   (2) 7.5 mL (4) 30. mL

8. Which indicator, when added to a solution, changes color from yellow to blue as the pH of the solution is changed from 5.5 to 8.0?
   (1) bromcresol green (3) litmus
   (2) bromthymol blue (4) methyl orange

9. What is the pH of a solution that has a hydronium ion concentration 100 times greater than a solution with a pH of 4?
   (1) 5 (3) 3
   (2) 2 (4) 6

10. The pH of an aqueous solution changes from 4 to 3 when the hydrogen ion concentration in the solution is
   (1) decreased by a factor of 3/4
   (2) decreased by a factor of 10
   (3) increased by a factor of 4/3
   (4) increased by a factor of 10

11. Which formula represents a hydronium ion?
   (1) H_3O^+ (3) OH^-
   (2) NH_4^+ (4) HCO_3^-

12. Which compound is an Arrhenius acid?
   (1) H_2SO_4 (3) NaOH
   (2) KCl (4) NH_3

13. The table below shows the color of the indicators methyl orange and litmus in two samples of the same solution.

Results of Acid-Base Indicator Tests

Indicator	Color Result from the Indicator Test
methyl orange	yellow
litmus	red

Which pH value is consistent with the indicator results?
   (1) 1 (3) 3
   (2) 5 (4) 10

14. Which ion is the only negative ion produced by an Arrhenius base in water?
   (1) NO_3^- (3) OH^-
   (2) Cl^- (4) H^-

15. Given the balanced equation representing a reaction:

$H_2SO_4(aq) + 2KOH(aq) \rightarrow K_2SO_4(aq) + 2H_2O(\ell)$

Which type of reaction is represented by this equation?

(1) decomposition (2) neutralization (3) single replacement (4) synthesis

16. In which 0.01 M solution is phenolphthalein pink?

a. $CH_3OH(aq)$ (2) $Ca(OH)_2(aq)$ (3) $CH_3COOH(aq)$ (4) $HNO_3(aq)$

17. As the pH of a solution is changed from 3 to 6, the concentration of hydronium ions

b. increases by a factor of 3
c. increases by a factor of 1000
d. decreases by a factor of 3
e. decreases by a factor of 1000

18. What color is bromcresol green after it is added to a sample of NaOH(aq)? [1]

19. Identify *two* indicators from Reference Table *M* that are yellow in solutions with a pH of 5.5. [1]

Base your answers to questions 20 and 21 on the information below.

Sulfur dioxide, SO_2, is one gas produced when fossil fuels are burned. When this gas reacts with water in the atmosphere, an acid is produced forming acid rain. The pH of the water in a lake changes when acid rain collects in the lake.

Two samples of the same rainwater are tested using two indicators. Methyl orange is yellow in one sample of this rainwater. Litmus is red in the other sample of this rainwater.

20. Identify a possible pH value for the rainwater that was tested. [1] _______________

21. Write the formula for *one* substance that can neutralize the lake water affected by acid rain. [1]

Base your answers to questions 22 through 24 on the information below.

A laboratory worker filled a bottle with a hydrochloric acid solution. Another bottle was filled with methanol, while a third bottle was filled with a sodium hydroxide solution. However, the worker neglected to label each bottle. After a few days, the worker could not remember which liquid was in each bottle.

The worker needed to identify the liquid in each bottle. The bottles were labeled *A*, *B*, and *C*. Using materials found in the lab (indicators, conductivity apparatus, and pieces of Mg metal), the worker tested samples of liquid from each bottle. The test results are shown in the table below.

Table of Tests and Results

Test	Test Results		
	Bottle A	**Bottle B**	**Bottle C**
methyl orange indicator	yellow	yellow	yellow
bromthymol blue indicator	blue	green	yellow
electrical conductivity	conductor	nonconductor	conductor
reactivity with Mg metal	no reaction	no reaction	reaction

22. Using the test results, state how the worker differentiated the bottle that contained methanol from the other two bottles. [1]

23. The worker concluded that bottle *C* contained hydrochloric acid. Identify *one* test and state the corresponding test result that supports this conclusion. [1]

24. Explain, in terms of pH, why the methyl orange indicator test results were the same for each of the three liquids. [1]

Base your answers to questions 25 through 27 on the information below.

In a laboratory activity, 0.500 mole of NaOH(s) is completely dissolved in distilled water to form 400. milliliters of NaOH(aq). This solution is then used to titrate a solution of HNO_3(aq).

25. Identify the negative ion produced when the NaOH(s) is dissolved in distilled water. [1] _____

26. Calculate the molarity of the NaOH(aq). Your response must include *both* a correct numerical setup and the calculated result. [2]

27. Complete the equation representing this titration reaction by writing the formulas of the products. [1]

HNO_3 + NaOH → ________________+ ______________

Base your answers to questions 28 through 30 on the information below.

In preparing to titrate an acid with a base, a student puts on goggles and an apron. The student uses burets to dispense and measure the acid and the base in the titration. In each of two trials, a 0.500 M NaOH(aq) solution is added to a flask containing a volume of HCl(aq) solution of unknown concentration. Phenolphthalein is the indicator used in the titration. The calculated volumes used for the two trials are recorded in the table below.

Volumes of Base and Acid Used in Titration Trials

		Trial 1	Trial 2
Solution (aq)	Molarity (M)	Volume Used (mL)	Volume Used (mL)
NaOH	0.500	17.03	16.87
HCl	?	10.22	10.12

28. Write a chemical name for the acid used in the titration. [1] ______________________

29. Using the volumes from trial 1, determine the molarity of the HCl(aq) solution. [1]

30. Based on the information given in the table, how many significant figures should be shown in the calculated molarity of the HCl(aq) solution used in trial 2? [1] _____________