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ABSTRACT

This course entitled "Chemistry" is one of a ser... of instructional guides prepared by teachers for the Sahuarita Hi... School (Arizona) Career Curriculum Project. It consists of three packages, the first dealing with solids, liquids and solutions, the second with acids, bases and anions, and the third with cation analysis. These packages are further divided into units of study which cover the topics of kinetic-molecular theory, gas laws, solution-suspension, ionization, acids-bases, anions analysis, oxidation-reduction, and cation analysis. The units provide objectives, sources of information, notebook questions, laboratory activities, and evaluations. Twenty-two behavioral objectives are listed for the course. For related units in this series see SE 016 635 - SE 016 643. (JR)

SAHUARITA HIGH SCHOOL

CAREER

CURRICULUM

PROJECT

COURSE TITLE: CHEMISTRY

PACKAGE TITLE: SOLIDS - LIQUIDS - SOLUTIONS

BY

ROBERT LANE

COURSE TITLE: CHEMISTRY

Objectives:

1. State the three basic assumptions of the Kinetic-Molecular Theory orally.
2. Explain how the Kinetic Theory hescribes gases, liqiuds, and solids by written means.
3. State Le Chatelier's Principle and give an example when and how it applies to the Kinetic Theory.
4. Convert temperature readings between the Celsius and Kelvin temprature scales.
5. Identify a phrase diagram and how one may be used to illustrate the triple point of a substance such as water.
6. Explain in writing the difference between volatile and non-volatile substances as applied to solids and liquids.
7. Make a drawing of an open-end mercury manometer and explain how this manometer can be used to measure the pressure of a gas if the varometric pressure is known. (Pressure to be expressed in mm Hg.)
8. Solve problems involving the reaction between heat energy, mass of water, and change of water temperature. (Metric units).
9. Solve problems involving the relation between pressure and volume of a gas.
10. Solve problems involving partial pressures such as water vapr pressre and volume of a gas.
11. Solve problems involving the relation between temperature and volume of a gas.

12. State Boyle's Law and Charle's Law orally.

13. Solve problems involving gas density, volume, mass, temperature, and volume with 80% accuracy.

14. Explain reasons for deviations between real gases and ideal gases.

15. Distinguish between a solvant and a solute in any given chemical solution.

16. Discuss and demonstrate at least 4 means of hastening the solution process.

17. List the various types of solutions possible.

18. Determine be mathematical means the molarity or molality of a solution given the amount of solute used and the volume or weight of solvent.

19. Determine by mathematical means the amount of solute needed to prepare a given amount of solution molarity.

20. State Henry's Law.

21. State the range of colloidal sizes.

22. List the eight types of suspensions.

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INTRODUCTION TO QUARTER:

This quarter is more oriented around laboratory activities and you will be involved in techniques as well as discovery or proof. The "teacher talks" will be used to point out job opportunities in various areas of chemistry in each lab type activity as well as pertinent information about the chemistry. One major idea to keep in mind about lab exercises is that the time before and after an actual experiment is usually more important than the actual "happenings".

OBJECTIVES:

1. Career cluster

   A. Agri-business and Natural Resources
   B. Health
   C. Environment

2. Specific Career areas

   A. Lab Technician
   B. Chemist

3. Copy specific behavioral objectives from each unit

Chemistry Unit V

Kinetic - Molecular Theory
Solids - Liquids

Sources of Information:

1. Chemistry A Modern Course, Smoot, Price, and Barrett, 1965, Merrill, pages 166-176, 184-185, 178-191.

2. Modern Chemistry, Metcalfe, Williams, Castka, 1970, pages 156-158, 163-164, 193-214.

3. Concepts in chemistry, Greenstone, Sutman, Hollingworth.

NOTEBOOK QUESTIONS:

Source #1 pages 174-177; problems 5,6,9,12,14; pages 193-194 problems 1, 3,5,7,10,14 and #3 in One More Step (or) Source #2 page 171 questions 1,3,5,9; pages 215-217 #19.

LAB ACTIVITY:

1. Allotropic Forms of Sulfur

2. Percent of Water in a Hydrate

OBJECTIVES:

When you have completed this unit you will be able to do the following:

1. State the three basic assumptions of the Kinetic-Molecular Theory orally.

2. Explain how the Kinetic Theory describes gases, liquid, and solids by written means.

3. State Le Chatelier's Principle and give an example when and how it applies to the Kinetic Theory.

4. Convert temperature readings between the Celsius and Kelvin temperature scales.

5. Identify a phase diagram and how one may be used to illustrate the triple point of a substance such as water.

6. Explain in writing the difference between volatile and nonvolatile substances as applied to solids and liquids.

Unit V
Objective 4 Help Sheet

All gas law problems are based on the absolute temperature scale or, as is usually stated, the Kelvin scale.

The Kelvin temperature scale is convenient for very low temperatures. It has the same unit degree as the Celsius scale, but a zero point at absolute zero (approximately -273°C).

To convert between scales use the following formulas:

°K = °C + 273 °C = °K - 273

Example:

A gas is collected at 20°C, what is the Kelvin temperature?

°K = 20°C + 273 = 293°K

The unit of heat energy is the calorie (cal.). One calorie is the amount of heat needed to raise the temperature of one gram of water one Celsius degree. (Officially this is between 14.5° and 15.5°C). It is also possible to relate the amount of energy needed for a phase change (ice to water, and water to steam) in calories but we won't introduce that at this time.

Example:

How many calories are needed to raise 21 g of water from 2°C to 25°C?

Since it takes 1 $\frac{\text{calorie}}{\text{degree}}$ and we have a 23°C change (25-2)

then; $\frac{1 \text{ calorie}}{1 \text{ degree}} \times \frac{23°C}{1} = 23$ calories

Exercises:

1. Convert the following temperatures from one temperature scale to another as indicated:

A) 828°K to °C

B) 751°C to °K

C) 16°C to °K

D) 3°K to °C

2. How many calories of energy are needed to raise 50 g of water from 20°C to 96°C?

3. How many kilocalories of energy are needed to raise the temperature of 500 g of water 95°C?

Chemistry

Name__________
Date__________

Unit V Evaluation

Answer each of the following questions as fully as possible on this sheet and any others you may need.

1. Explain as completely as possible how the Kinetic-Molecular Theory explains the various forms of matter such as gases, liquids, and solids.

2. Convert the following temperature readings as directed:

A) 0°K to °C B) 467°C to [illegible] C) 22°C to °K

3. What is the difference between a volatile liquid and a non-volatile liquid?

4. What does the triple point of a substance refer to? What is this point for water?

5. Be prepared to state orally the three basic assumptions of the Kinetic-Molecular Theory.

Chemistry Unit VI

Gas Laws

Sources of Information:

1. Chemistry: A Modern Course, Smoot, Price, and Barrett, 1965, Merrill, pages 221-241, 256-259.

2. Modern Chemistry, Metcalfe, Williams, Castka, 1970, Holt Rinehart Winston, pages 159-171, 174-188.

Notebook Questions and Problems:

Source #1 pages 171-174; numbers 1, 2, 5, 6; pages 226-242; numbers 1, 4, 5, 7, 9, 11, 15, 17, 19.

(AND/OR)

Source #2 page 171 Group A; 8, 10, 11, 16, 17, 18, 21; pages 172-173 Group A 3, 6, 10; page 189 Group A 1, 2, 3, 9.

Laboratory Activities:

1) Boyle's Law Demonstration and student calculations
2) Molar Volume of a Gas

Objectives:

When you have completed this unit you will be able to do the following:

1. Make a drawing of an open-end mercury manometer and explain how this manometer can be used to measure the pressure of a gas if the barometric pressure is known. (Pressure to be expressed in mm of Hg.)

2. Solve problems involving the reaction between heat energy, mass of water, and change of water temperature. (Metric units).

3. Solve problems involving the relation between pressure and volume of a gas.

4. Solve problems involving partial pressures such as water vapor pressure and volume of a gas.

5. Solve problems involving the relation between temperature and volume of a gas.

6. State Boyle's Law and Charle's Law orally.

7. Solve problems involving gas density, volume, mass, temperature, and volume with 80% accuracy.

8. Explain reasons for deviations between real gases and ideal gases.

Chemistry

Name_______________

Date_______________

VI Gas Laws

Evaluation

Solve the following problems: Show your problem set-up if you use a slide rule or other calculator and all computations if you don't use a calculator.

1. How many calories of energy are exchanged ... ling 55.0g of water from 98°C to 22°C?

2. The following volumes of gases were collected over water under the indicated conditions. Correct each volume to the volume that the dry gas would occupy at standard pressure and the indicated temperature.
   a.) 900 ml. at 40.5°c. and 150 mm Hg

   b.) 32.0 ml. at 60°c and 587mm. Hg

3. Correct the following volumes of gases for a change from the temperature indicated to standard temperature. (Pressure remains constant)
   a.) 6.09 liters at 83°K

   b.) 594 ml at 79°C

4. Correct the volumes of the following gases as indicated:

   a.) 2.50 l at 60°C and 3.76 atm to STP

   b.) 390 ml at 18°C and 760 mm Hg to 68°C and 618 mm Hg

5. Calculate the density of water vapor (H_2O) at S.T.P. to three significant figures.

6. ,.· ·pared to state Charle's Law and Boyle's Law orally.

Solutions - Suspensions

Sources of Information:

1. Chemistry A Modern Course, Smoot, Price, and Barrett, 1965, Merrill, pages 286-309, 462-475.

2. Modern Chemistry, Metcalfe, Williams, Castka, 1970, Holt, Rinehart, Winston pages 219-239, 302-318.

NOTEBOOK QUESTIONS OR PROBLEMS:

Source #1 pages 302-311; problem numbers 1, 4, 6, 8, 9, 10; pages 465-477 numbers 1,6,7,9. Extra Credit pp. 308 #7, pp. 312 #11, 12.
Source #2 pages 240-242; Question numbers 2, 3, 6, 9, 14; Problem numbers 1, 3, 5, 10; pages 318-319; Question numbers 2, 3, 7, 10, 13, 20, 24.

LABORATORY ACTIVITIES:

1. Factors Affecting Solution, Physical Separation: Solubility (may be done earlier in the year).

2. A Few Representative Calliods.

OBJECTIVES:

When you have completed this unit you will be able to do the following:

1. Distinquish between a solvent and a solute in any given chemical solution.

2. Discuss and demonstrate at least 4 means of hastening the solution process.

3. List the various types of solutions possible.

4. Determine by mathematical means the molarity or molality of a solution given the amount of solute used and the volume or weight of solvent.

5. Determine by mathematical means the amount of solute needed to prepare a given amount of solution molarity.

6. State Henry's Law.

7. State the range of colloidal sizes.

8. List the eight types of suspensions.

QUEST:

1. Construct a solubility graph from supplied information or actual experimentally gained information on two or more separate solutes in a water solution.

2. Discuss the flotation process for separating of specific metal ores in order to form concentrates.

Solution-Suspension
Evaluation A

Answer each of the following questions as fully as possible on this sheet and any others that you may need.

1. Discuss fully the various ways one can use to hasten the solution process given a solid solute and a liquid solvent.

2. A solution contains 31.0g of ethylene glycol, $C_2H_4(OH)_2$, in 100 g of water. What is the molality of the solution?

3. How do chemists distinguish between a solution and a suspension?

4. List the 9 various types of solutions possible.

5. Be prepared to state Henry's Law orally to the teacher.

Chemistry Unit VII

Solutions-Suspension
Evaluation B

Answer each of the following questions as fully as possible on this sheet and any others that you may need.

1. Discuss fully the various ways one can use to hasten the solution process given a solid solute and a liquid solvent.

2. How many grams of NaCl are required to make 250 ml of 0.500-M solution?

3. How do chemists distinquish between a solution and a suspension?

4. List the 8 various types of suspensions possible.

5. Be prepared to state Henry's Law orally to the teacher.

SAHUARITA HIGH SCHOOL

CAREER

CURRICULUM

PROJECT

COURSE TITLE: CHEMISTRY

PACKAGE TITLE: ACIDS - BASES - ANIONS

BY

ROBERT LANE

CONTENTS

INTRODUCTION TO QUARTER

This quarter employs more activity in the lab than the previous two quarters and exposes the student to more techniques which may be useful in a lab technicians job. The importance of thoughtful, careful labortory techniques is stressed the the activities as well as the observations and conclusions reached in each experiment. Job information will be included in "teacher talks" and a field trip to a medical laboratory will be a part of the quarter's work.

OBJECTIVES

I. Career Cluster

   A. Health

   B. Marine Science

   C. Manufacturing

   D. Environment

II. Specific Career Areas

   A. Chemist

   B. Lab Technician

III. *Copy behaviorial objectives from problems in the units

CAREER MATERIALS

1. "Jobs" files

2. Teacher talks

3. Field trip to a medical laboratory at St. Mary's Hospital

4. Hospital Health Services, Claire Roth and Lilian Weiner, Careers for Tomorrow, 1964.

5. Your Career in Chemistry, Arnule Esterer, Julian Messner, 1966.

6. So You Want to Be a Chemist, Alan Nourse, Harper & Row, 1964.

IONIZATION

Sources of Information: #1 Modern Chemistry, Metcalfe, Williams, Castka, Holt Rinehart, Winston, 1970, pages 243-255; #2 Chemistry, A Modern Course, Smoot, Price, and Barrett, 1965, Merrill, pages 298-299, 308, 366-385, 447-458; Concepts in Chemistry, Greenstone, Sutman, Hollingworth.

Notebook Questions or Problems: Source #1 pages 256-257, questions 1, 2, 5, 9, 16, 19, 26; Source #2 pages 459-460, problem numbers 3, 6, 8, 10.

Laboratory Exercise: (1) Ionization; (2) Ion Exchange; (3) Complex Ions.

OBJECTIVES: When you have completed this unit you will be able to do the following:

1. Be able to explain the difference between an electrolyte and a ronelectrolyte and point out the effect of each on the freezing or boiling point of a solution.

2. Be able to state the modern theory of ioniaztion.

3. Be able to explain the process of ionization that takes place when a particular solute is dissolved in water.

4. Be able to explain electrolysis in terms of ionization.

5. Be able to show the difference between dissociation and ionization by chemical equations and drawings.

6. Identify several complex ions and explain how various ligands attach to form the complex ion with different geometric shapes.

Quest: Demonstrate Ionic Reactions and Ionic Equilibrium reactions.

IONIZATION

PROBLEM: How Does the Theory of Ionization Explain the Action of Solutions of Acids, Bases, and Salts?

A. EFFECT OF WATER ON IONIZATION

a) Place a small amount of oxalic acid on a dry glass slide. Touch it with a piece of dry blue litmus paper.

1) Result? ________________

Add a drop of water to the acid and again test with litmus.

2) Result? ________________

3) What ions in acids cause this change in color? ________________

4) Complete the equation for the formation from oxalic acid of ions in solution. $H_2C_2O_4$ = ____ + ____.

5) What is necessary in order to bring about the ionization of acids of this type? ________________

b) In a perfectly dry test tube mix a spatulaful of oxalic acid with an equal amount of solid sodium carbonate.

6) Is there any evidence, such as the formation of a new product or the evolution of a gas, to indicate that a chemical reaction is taking place.

Now add 1 ml of water to the test tube and look closely for evidence of a chemical reaction.

7) Result? ________________

Complete the equations showing the formation of ions.

8) Na_2CO_3 = ____ + ____. $H_2C_2O_4$ = ____ + ____.

In the following equation show how these ions combine, forming two new compounds. The positive ions of the one compound combine with the negative ions of the other.

9) $Na_2CO_3 + H_2C_2O_4$ ____ + ____

The carbonic acid formed immediately breaks up into carbon dioxide and water. $H_2CO_3 \rightarrow$ [illegible]

10) What is the effect of water on the ions of water on the ions of a salt or acid. ________________

c) Place a few crystals of cupric bromide on a galss slide and examine the salt.

11) What is the color? ________________

Transfer the crystals of the copper bromide to a test tube and add 1 ml of water.

12) What is the color of the solution? ________________

13) This color is characteristic of a solution of ________________ ions.

14) Write the equation for the formation from cupric bromide of ions in solution. ________________

d) Repeat the above procedure, using 1 ml of ethyl alcohol and cupric bromide.

15) What is the color of the solution? ________________

16) Why is it different from that of the water solution? (Answer in terms of ions.) ________________

e) Add a spatulaful of white anhydrous cupric sulfate* to a test tube one third full of water. Save this solution for Part B.

17) How do you know that copper ions are present? ________________

____

18) Write the equation for the formation from copper sulfate of ions in solution. ________________.

B. EXCHANGE OF IONS IN SOLUTION.

a) Put a spatulaful of iron filings into the test tube containing the copper sulfate solution prepared above. Allow the solution to stand for several minutes. Note carefully the change in color of the solution.

Since you have shown that the blue color of a copper sulfate solution is caused by the presence of copper ions, it is evident that copper ions are leaving the solution. If the solution were allowed to stand long enough, all the copper ions would disappear and the solution would be perfectly clear. Now examine the iron filings.

Explain in detail why the color of the solution has changed and what has happened to the iron filings. Remember that you are speaking in terms of atoms and ions. ________________

____

____

____

____

19) Complete the equation: $Cu^{++} + (SO_4)^{--} + Fe^0$ ______ + ______ + ______

b) Place a piece of mossy zinc in a test tube containing 1 ml of lead nitrate. After a few minutes note the appearance of the zinc.

20) Explain what happens to the ions of lead and to the atoms of zinc and write the equation for the reaction. ______________

____

____

C. IONS THAT ARE CHARACTERISTIC OF ACIDS AND BASES.

a) Acids contain hydrogen ions which are replaceable by a metal. To a test tube containing 1 ml of water add 1 ml of concentrated hydrochloric acid and a piece of mossy zinc. Note the gas evolved. By means of ionic equation show how this gas forms.

21) Equation ______________________________

b) Bases or bydroxides contain hydroxyl (OH) ions. Recall the effect of sodium hydroxide on red litmus paper?

22) What ions cause this change with litmus? ______________

23) When an acid reacts with a base, what happens to the characteristic ion of the acid and the characteristic ion of the base? ______________________________

____

* If the anhydrous cupric sulfate is not white, put a spatulaful of the salt into a test tube and heat until all the water of crystallization has been driven off.

IONIZATION EVALUATION

1. Illustrate as well as possible by drawings and written explanation the difference between ionization and dissociation.

2. Explain fully how the action of water on a polar compound like hydrogen chloride produces ionization. You may use diagrams to assist your written explanation.

3. Describe what a ligand is and name two common ligands.

4. Be prepared to state the modern theory of ionization orally and also be able to state and explain the observed differences between electrolytes and nonelectrolyte solutions.

Chemistry Unit IX

Acids - Bases

Sources of Information: #1 Chemistry, A Modern Course, Smoot, Price, and Barrett; Merrill 1965, pages 314-333. #2 Modern Chemistry. Metcalfe, Williams, Castda; Holt, Rinehart Winston; 1970, pages 258-296.

Notebook Questions: Source #1 pages 333-334, numbers 1-7; Source #2 pages 297-300 Questions Group A--2, 4, 7, 9, B13, 22; Group A problems 1, 5, 18.

Laboratory Activities: "A Study of Acids and Bases"; "Measurement of pH by Indicators"; "Titration"

Objectives: When you have completed this unit you will be able to do the following:

1. Be able to identify an acid or base in water solution by means of long range or short range indicators including litmus, pHydrion paper, methyl orange, and phenolphthalim.

2. Be able to write a discussion of the various explanations of acids and bases by such men as Arrhenius, Bronsted-Lowry, and Lewis.

3. Be able to predict what action will take place when an acid reacts with various substances such as oxides of metals, carbonates, metals, and hydroxides.

4. Be able to predict what action will take place when an acid reacts with various types of substances such as oxides of non-metals, and acids.

5. Be able to list the rules for naming binary and ternary acids.

6. Be able to define pH and relate it to whether the solution is basic or acidic.

7. Solve problems dealing with meutralization, given a known solution and a solution of unknown concentration.

8. Be able to determine the nolarity of an unknown solution by titration with a known solution.

9. Be able to demonstrate techniques of mass determination and instrument manipulation used in lab occupations.

A STUDY OF ACIDS AND BASES

INTRODUCTION

The recognition of acidic and alkaline properties of substances and the division of certain chemical compounds into acids and bases was one of the early classifications of chemistry. We still retain the classfication, but the type of compounds included in the classification has changed.

According to the Arrhenius, or classical theory, acids were defined as substances containing replaceable bydrogen ions. Bases were defined as substances with replaceable hydroxyl ions. However, in the more modern Bronsted theory, an acid is considered to be any substance that acts as a proton donor. A base is any substance that acts as a proton acceptor. You can see htat the Bronsted theory ts considerably broader in scope so that more types of compounds are classified as acids or bases.

Let us consider, for example, the ionization of hydrochloric acid, as it would be written according to each of these theories. You will recall that one of the conditions necessary for the dissociation of ions in the Arrhenius theory is the presence of water.

Arrhenius theory: $HCl \xrightarrow{(H_2O)} H+ + Cl-$

Note how water is used in the Bronsted theory.

Bronsted theory: $\underset{(acid_2)}{HCl} + \underset{(base_2)}{H_2O} \quad \underset{(acid_2)}{H_3O+} + \underset{(base_2)}{Cl-}$

The H_3O^+ ion is called the hydronium ion.

In this experiment we will write equations according to the classical theory. However, you should remember whenever writing the hydrogen ion that the hydronium ioniis the more correct one. We will also study and review some of the fundmantal properties of acids and bases.

LABORATORY PROCEDURE

A. Testing Some Physical Properties

a) Place three small drops of hydrochloric acid on a clean, dry slide so that the drops are separated as far as possible. Test one of the drops with litmus paper. Add a drop of phenolphthalein to the second drop of acid, and a drop of methyl orange to the third. Observe the effect of hydrochloric acid on each of these indicators. Write your observation in your notebook.
b) Place three small drops of dilute sulfuric acid on a clean, dry glass slide. Test the sulfuric acid, as you did before, with litmus, phenolphthalein, and methyl orange indicators. Observe the effect of sulfuric acid on these indicators. Describe any difference between the color reactions in

in Sections a and b. Will a concentrated acid give the same reaction?

c) Place three small drops of calcium hydroxide solution (limewater) on a clean, dry galss slide. Repeat the tests using the same three indicators. Observe the effect of calcium hydroxide on these indicators.

d) Repeat the above tests using sodium hydroxide and the same three indicators. Observe the effect of sodium hydroxide on these indicators. Summarize the effect of acids and bases in general on phenolphthalein, litmus, and methyl orange.

B. Some Other Physical Properties of Acids and Bases
a) In each of two small test tube place 2 ml of water. To one test tube and 5 drops of hydrochloric acid and to the other add 5 drops of acetic acid (SR). Taste each of the acids by dipping a clean stirring rod into the solution and touching it to your tongue.

C. Verifying the Feel of Bases

Place 2 ml of water in a small test tube and add 10 drops of sodium hydroxide solution between your fingers and describe the effect (if any) which you notice. Associate this "feel" of a hydroxide with another common substance.

D. Chemical Reactions of Acids and Bases
a) The acid (H_3O+) base (OH-) combination: Place 5 ml of water in a clean beaker and add to it 8 drops of concentrated hydrochloric acid and 1 drop of phenolphthaleim indicator. Now add a 10% solution of sodium hydroxide from your reagent tray, a drop at a time, until one drop changes the color of the indicator. Feel the bottom of the beaker before and after the addition of sodium hydroxide. If desired, the solution may be stirred with a thermometer and the temperature before and after the addition of NaOH noted.

b) An amphoteric hydroxide: Dilute 10 drops of aluminum sulfate solution with 2 ml of water. Add 5 drops of sodium bydroxide to the dilute solution of aluminum sulfate. Shake and pour half of the resulting mixture into a second small test tube. To one test tube add hydrochloric acid, a drop at a time, until a definite change is noted. To the other test tube add sodium hydroxide until a change occures.

Acids - Bases Evaluation A

1. Complete the following equations from your knowledge of acid and base reactions with the various substances shown:

   a) $Zn + HCl$

   b) $CuO + H_2SO_4$

   c) $KOH + HNO_3$

2. Write a brief discussion about the similarities and differences in theories of acids and bases by the following men: Bronsted-Lowry, Arrhenius, and G. N. Lewis.

3. In a laboratory titration, 15.0 ml of 0.275 m H_2So_4 solution neutralizes 20.0 ml of NaOH solution. What is the nolarity of the NaOH solution?

4. Take an unknown solution from the teacher and identify the approximate pH by indicators available and indicate below plus whether it is acidic or basic.

Chemistry Unit X

Anion Analysis

Sources of Information: #1, Chemistry, A Modern Course, Smoot, Price, and Barrett, 1965. Merrill, pages 480-490; Source #2, Modern Chemistry, Metcalfe, Williams, Castka; 1970; Holt, Rinehart, Winston; pages 565-572, 584-593; 597-608.

Notebook Questions: Source #2 pages 609-610, Questions 1, 3, 11, 16, 18, 24, 25.

Laboratory Activity: "Anion Analysis"

Objectives: When you have completed this unit you will be able to do the following:

1. Demonstrate a technique for identifying selected anions by semi-micro wet chemistry.

2. Identify the Halogens and describe the characteristics used to identify these elements.

3 List uses of nitrogen and sulfur anions as well as oxide ions complexes of these two elements.

Evaluation Prodedure:

This evaluation sonsists of 3 parts:

1. Analysis of the Silven anion group
2. Analysis of the Barium anion group
3. Objective questions dealing with anions

When you have completed the first two parts you should then request the third but if you don't complete 1 or 2 you will still be given a deadline for part three.

The following material has been deleted: Qualitative Analysis

Chemistry Unit X

Anion Evaluation

Answer the following questions by placing the letter of the best item in the blank before the statement.

_____ 1. When nitric acid is exposed to sunlight the resultant deep yellow color is du to dissolved (a) N_2 (b) N_2O (c) NO (d) NO_2

_____ 2. A reagent used in testing for a sulfate is (a) sodium sulfide (b) lead acetate (c) sodium carbonate (d) barium chloride

_____ 3. The halogen which is a liquid at room temperature is (a) iodine (b) bromine (c) flourine (d) chlorine.

_____ 4. The halogen which has the least affinity for electrons is (a) F (b) Br (c) Cl (d) I.

_____ 5. The weakest binary halogen acid is that of (a) Br (b) I (C) Cl (d) F

_____ 6. The compound usually used in antiknock gasoline to increase the efficiency of tetraethyl lead is ethylene (a) flouride (b) bromide (c) iodide (d) chlorate.

_____ 7. Dyes which are bleached with chlorine water undergo the process of (a) dehydration (b) oxidation (c) reduction (d) neuralization.

_____ 8. Fluorine combines with the noble gas (a) helium (b) krypton (c) neon (d) argon.

_____ 9. The addition of a solution of silver nitrate to an unknown solution (a) must be sodium chloride (b) could be potassium chlorate (c) may be magnesium chloride; (d) could not be hydrochloric acid.

_____ 10. The halogens which most closely resemble each other in physical properties are (a) iodine and bromine (b) bromine and chlorine (c) chlorine and fluorine (d) fluorine and iodine.

_____ 11. Of the following metals the one whose chloride is insoluble is that of (a) Al (b) K (c) Pb (d) Cu.

_____ 12. The vapor of iodine is (a) violet (b) yellow (c) brown (d) red.

_____ 13. The of a solution of iodine in carbon disulfide is (a) violet (b) steel gray (c) orange-red (d) brown.

_____ 14. Most photographic film contains a light-sensitive halogenide of (a) silver (b) sodium (c) sulfur (d) mercury.

_____ 15. Chlorine water is mixed with a solution of iodine and shaken with a few drops of carbon tetrachloride. The carbon tetrachloride layer is colored (a) violet (b) blue (c) red-orange (d) yellow-green.

SAHUARITA HIGH SCHOOL

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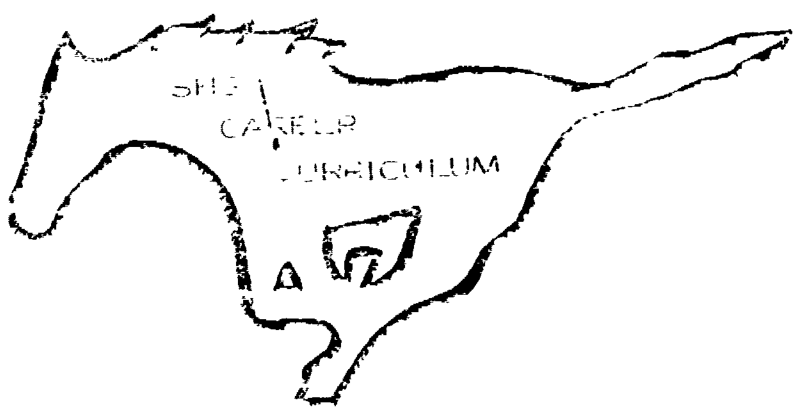
CURRICULUM

PROJECT



CHEMISTRY

CATION ANALYSIS

BY

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CONTENTS

Introduction

A major source of study in Chemistry as well as a source of employment is in the field of qualitative analysis. We will be using some modern means of analysis by paper chromatography as well as some important laboratory "wet" chemistry methods to give you a "feeling" for what is happening.

It is hoped we will be able to visit one of the area mine laboratories in order that you might see what the latest machine techniques for analysis are.

Objectives:

1. Career Cluster

   A. Health
   B. Marine Sciences
   C. Environment
   D. Agri-business and Natural Resources

2. Specific Career Areas

   A. Chemical Engineer
   B. Chemist
   C. Laboratory Technician
   D. Metallurgist
   E. Electroplater

3. *Copy behaviorial objectives from units.

Career Resources:

1. Handbook of Job Facts, James Murphy, SRA, 1963.

2. Aim for a Job in a Hospital, Richard Kirk, Richards Rosen Press, 1968.

3. Oceanographic Careers, Odom Fanning, Universal Publishing, 1969

4. Health Technicians, Robert Kinsinger, J.G. Ferguson Publishing Co., 1970.

5. A Job With a Future in the Petroleum Industry, Phillip Drotning, Grosset and Dunlap, 1969

6. A Job With a Future in Law Enforcement, Flora Schreiber, Grosset and Dunlap, 1970.

Chemistry Unit XI

Oxidation-Reduction

Information Sources: #1 Chemistry a Modern Cour. e, Smoot, Price and Bar ett, Merrill, 1965, pages 335-357. #2 Modern Chemistry, Metcalfe, Williams, Castha, 1970, Holt, Rinehart, Winston, pages 444-465.

Notebook Questions and Problems: Source #2 pages 466-467 Questions ., 6, 13, 16; Source #1 pages 343-358 numbe 1, 2, 3a, c, e, 5, 10.

Laboratory Activities: Oxidation-Reduction

Objectives: When you have completed this unit you should be able to do the following:

1. Determine by means of actual experimentation or chemical equation whether an oxidation-reduction action has taken place.

2. Determine by a chemical equation (specifically half reactions) which element has been oxidized.

3. Determine by a chemical equation (specifically half reactions) which element has been reduced.

4. Determine by a chemical equation which is the oxidizing agent and which is the reducing agent.

Quest: 1. By means of an oral discussion explain how the lead storage battery operates during charge and discharge cycles.

2. By means of a written discussion explain how standard Oxidation Potentials are used to predict metal replacement reactions.

Oxidation-Reduction Evaluation A

I. To the left of each of the equations listed below, write the word yes or no as to whether the equation is an oxidation-reduction type reaction.

For each of those reactions you listed as oxidation-reduction reactions do as directed by the following statement: (You may want to rewrite the total reaction as half-reactions.)

A.) Underline once the oxidizing agent in each reaction.
B.) Underline twice the reducing agent in each reaction.
C.) Draw a circle about each element that was reduced in each reaction.
D.) Draw a rectangle about each element that was oxidized in each reaction.

1. $MnO_2 + 4\ HCl \rightarrow 2\ H_2O + MnCl_2 + Cl_2\uparrow$

2. $C + O_2 \rightarrow CO_2\uparrow$

3. $NaCl + AgNO_3 \rightarrow AgCl\downarrow + NaNO_3$

4. $2H_2 + O_2 \rightarrow 2H_2O$

5. $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

6. $SO_2 + H_2O \rightarrow H_2SO_3$

Chemistry Unit XI

Oxidation-Reduction Evaluation B

I. To the left of each of the equations listed below, write the word yes or no as to whether the equation is an oxidation-reduction type reaction.

For each of those reactions you listed as oxidation-reduction reactions do as directed by the following statements: (You may want to rewrite the total reaction as half-reactions).

A.) Underline once the oxidizing agent in each reaction.
B.) Underline twice the reducing agent in each reaction.
C.) Draw a rectangle about each element that was oxidized in each reaction.
D.) Draw a circle about each element that was reduced in each reaction.

1. $H_2CO_3 \rightarrow H_2O + CO_2\uparrow$

2. $HNO_3 + I_2 \rightarrow HIO_3 \quad NO_2 + H_2O$

3. $3H_2 + N_2 \rightarrow 2NH_3$

4. $NaCl + AgNO_3 \rightarrow AgCl\downarrow + NaNO_3$

5. $S_{(s)} + O_{2(g)} \rightarrow SO_2\uparrow$

6. $2KClO_3 \rightarrow 2KCl + 3O_2\uparrow$

Cation Analysis

Information Sources: #1 Chemistry A Modern Course, Smoot, Price and Barrett, 1965, Merrill pages 480-490, #2 Modern Chemistry, Metcalfe, Williams, Castka, 1970, Holt, Rinehart, Winston, pages 47--493, 496 - 508, 512-542, 546-562.

Laboratory Activities: Cation Analysis Unknown Analysis

Objectives: When you have completed this unit you will be able to do the following:

1. Demonstrate the paper chromatography method of analysis.
2. Determine specific cations in a liquid unknown given a scheme for analysis by wet chemistry or paper chromatography.

Note: The specific number of ions determined will be dependent on the time and conditions of lab usage at the time--be sure to ask the teacher about this.

Procedure will be set by the teacher on an individual basis. Evaluations will be your unknown analysis reports.

Cations of Group V (Mg^{++}, Na^{+}, K^{+})

The identification of the ions of Group V is done by separate tests for each ion instead of by the stepwise precipitation method used in the other groups. Since ammonium compounds have been added several times during the analysis of previous groups, the filtrate from Group IV always contains ammonium ion. Consequently, the ammonium test is always made on a separate portion of the material to be tested before subjecting it to any other chemical process. We will not test for ammonium ion. The clear solution is tested for magnesium, sodium, and potassium ions.

#1 Identification of magnesium ion. Place about 5 drops of the solution to be tested in a test tube and add 2 drops of NH_4OH, 1 drop of ammonium sulfate [$(NH_4)_2SO_4$)] and 1 drop of ammonium oxalate [$(NH_4)_2C_2O_4 \cdot H_2$)]. If any precipitate forms, centrifuge and discard it. To the clear solution, add 3 drops of of NH_4OH and 3 drops of disodium hydrogen phosphate (Na_2HPO_4) solution. Stir and let this stand in a hot water bath for some time. A fine white precipitate indicates the presence of magnesium ion. Discard.

#2) Identification of sodium ion. To one half of the solution from Part 3, add 4 drops of magnesium uranyl acetate, $Mg(UO_2)_3(C_2H_3O_2)_8$. Shake the solution and warm it in the water bath. If no precipitate forms after the mixture has stood for five minutes, repeat the addition of the reagent and warm again. A granular, light yellow precipitate which usually settles out quite readily indicates the presence of sodium ion.

#3) Identification of potassium ion. To one half of the solution from Part 3, add a few drops of sodium cobaltinitrite reagent. Let it stand. Any organge yellow precipitate indicates the presence of potassium ion. The precipitate forms slowly if a low concentration of postasium ion is present.

1) Identification of magnesium ion. Ammonium sulfate and ammonium oxalate are added to remove any traces of the Group IV cations which may not have been completely removed in the group precipitation. Magnesium ion is then precipitated as $MgNH_4PO_4$:

$$Mg^{++} + NH_4^+ + Na_2HPO_4 \longrightarrow MgNH_4PO_4 + 2Na^+ + H^+$$

#2) Identification of sodium ion. The sodium test depends upon the the following reactions:

$$NaC_2H_3O_2 + Mg(UO_2)_3(C_2H_3O_2)_8 \longrightarrow NaMg(UO_2)_3(C_2H_3O_2)_9$$

#3 Identification of potassium ion. The potassium test involves the following reaction:

$$2K^+ + Na_3Co(NO_2)_6 \longrightarrow K_2NaCo(NO_2)_6 + 2Na^+$$

Note that a similar compound is used as the basis for the cobalt test.