Unit 7 Ions, Formulas, and Reactions

Unit Overview:

(9 Days) This unit introduces students to six major types of chemical reactions (synthesis, decomposition, combustion, polymerization, single displacement, and double displacement). One of its presentations introduces common monoatomic and polyatomic ions and how such ions, along with oxidation states, parentheses, and subscripts, are used to write formulas for ionic compounds. In addition, students will learn how to use dimensional analysis / the factor-label method to solve common conversion problems.

Lesson 7-1 Ions, Formulas, and Oxidation Numbers

CN 7:1 – Ions, Formulas, and Oxidation Numbers
Homework: rft Worksheet 7:1 – Ions, Formulas, and Reaction Types

Goal(s): This lesson introduces students to common monoatomic and polyatomic ions and the oxidation numbers typical of each. In addition, students learn how to use oxidation numbers, parentheses and subscripts to write ionic formulas correctly.

Objective(s): By the end of this lesson, students will be able to

- name representative monoatomic ions from groups 1, 2, 13, 16, and 17 and identify the charge on each
- write the formula and charge for the ammonium ion
- write the formula and charge for the following polyatomic anions: hydroxide, sulfate, carbonate, nitrite, nitrate, phosphate, and bicarbonate
- write the symbol and charge for the following monoatomic anions: chloride, fluoride, bromide, iodide, oxide, and sulfide
- correctly write the formulas for Iron II Oxide and Iron III Oxide
- write the formulas for ionic compounds such as calcium phosphate, calcium chloride, magnesium hydroxide, and aluminum hydroxide
- given the formula for the above substances and others similar to them, correctly name the substance and identify the oxidation states of the atoms and/or the ions of which it is composed
- correctly calculate representative oxidation numbers

Vocabulary: monoatomic cations monatomic anions oxidation numbers
polyatomic cations polyatomic anions

Procedure: Use overhead transparencies or PowerPoint to present class notes 7:1. If using the overhead transparencies, use a piece of paper to cover all information on each overhead except for the single detail, principle, or example being discussed. As the class copies each item, be sure to read each fact or example two or three times aloud as they write (sometimes this works well by inviting student volunteers to read some items). Also add your own comments and examples. *Notice that this methodology introduces today's information to the brain by visual, auditory, verbal, and kinesthetic pathways*. If you happen to finish early, have students summarize one or more diagrams or graphs in your course text.

Background: Read over class notes 7:1 before presenting them in class. Also find and read over associated information in your district's adopted text. Finally, read your Teachers' Version Answer Keys to student workbook item WS 7:1

Homework: Assign students to compete student rft Worksheet 7:1 as homework due on (Insert day and date of Lesson 7-3).

Assessment: Award each student participation points and/or notebook points for their good efforts exhibited during today's presentation.

Lesson 7-2 Dimensional Analysis

Class Notes 7:2 Dimensional Analysis and Conversions

Goal(s): This lesson introduces dimensional analysis and the factor label method of solving complex conversion problems.

Objective(s): By the end of this lesson, students will

- solve assorted conversion problems using dimensional analysis or the factor-label method
- create "definitional fractions" that are equal to "1" (For example, by definition, one day equals 24 hours so that the fraction 1 day/24 h represents 1/1 which is equal to "1")
- arrange definitional fractions beside one another in a way that allows most numerator and denominator units to cancel out

Vocabulary: dimensional analysis factor-label method definitional fractions

Lecture Procedure: Use an overhead projector or PowerPoint software to present class notes 7.2. If using overhead transparencies, use a piece of paper to cover all information on each overhead except for the single detail, principle, or example being discussed. As the class copies each item, be sure to read each fact or example two or three times aloud as they write (sometimes this works well by inviting student volunteers to read some items). Also add your own comments and examples. *Notice that this methodology introduces today's information to the brain by visual, auditory, verbal, and kinesthetic pathways*. If you happen to finish early, have students begin work on their dimensional analysis worksheets, WS 7:2.

Background: Read class notes 7:2 before presenting them in class. Also find and read over associated information in your district's adopted text. Also see the Teachers' Version Answer Keys to student workbook item 7:2.

Lesson 7-3 Ions, Formulas, and Dimensional Analysis – Two Worksheets

Two rft Worksheets 7:1 and 7:2
Demonstration Activity AD-28 A Musical Tribute to Mendeleev

Goal(s): Today's flexibility day is intended to provide a change-of-pace and an opportunity to conduct extra labs or enrichment

Objective(s): By the end of this lesson, students will

- record 100% correct answers to all items on student rft WS 7:1
- record 100% correct answers to all items on student rft WS 7:2

Today's Pacing:

❶ Begin today's class with individual student seatwork on worksheet WS 7:1 for approximately 8-10 minutes. Then switch to a verbal review of the correct answers to all WS 7:1 items, using our usual procedures as outlined below.

❷ Conduct today's simple change-of-pace demonstration AD-28 in between the two worksheets. Allow approximately 6 minutes for this activity. See section AD-28 later in this Guide for particular details of this activity.

❸ Thirdly, assign students to individual seatwork on Worksheet 7:2 and allow about 9-11 minutes for this individualized work. Then proceed to a verbal review of the correct answers to all items using our usual worksheet procedures as outlined below. Announce a quiz or possible quiz at the beginning of class tomorrow.

Demonstration Procedures: See section AD-28 later in this guide for details concerning this activity which is musical salute to Mendeleev and Element Number Z = 101. You will need a CD player or a computer with speakers to play the song. Students will enjoy the song more if you type up the lyrics and distribute copies for them to follow as they listen.

Procedure for "rtf" worksheets: See lesson 1-4 for general points 1 through 4

Begin this section with approximately seven minutes of individual seatwork on rft WS 7:1. Encourage students to finish all the easiest items first and to skip items that they are unsure of. Explain that you and the class as a whole will be going over all items together so that everyone will be able to record correct answers for any items that they were unable to answer on their own.

After students have worked on their worksheets individually, go over the correct answers to all WS 7:1 items using the following procedure: Have students read (one by one and each in turn) the questions from Worksheet 7:1 and ensure that everyone has the correct answer. Proceed in this way, row by row, allowing Andrea to read the first question and its answer, and Tyrone to read the second question and its answer, etc. In this way, you ensure that all students have the correct answers available for study purposes. Then proceed to today's AD-28 demonstration activity.

After the demonstration, assign individual seatwork on student rft WS 7:2. Allow about ten or twelve minutes for this individual work and then begin the verbal review of all correct answers, using the same procedures outlined for WS 7:1 above. IMPORTANT: *Ask for two or three student volunteers to write correctly-solved math items on the blackboard*. (Check the work and answer of each volunteer before making your selections.)

Assessment: Award each student participation points and/or notebook points for their good efforts exhibited during today's presentation.

Lesson 7-4 Quiz and Flexibility / Enrichment Options

Suggested Quiz: We suggest a quiz at the beginning of today's class. Begin by having students write the formulas and charges for two monoatomic and two polyatomic ions. Next name two ionic compounds and have everyone write the correct formula for each. Finally, write one dimensional analysis problem on the blackboard and have students solve it showing all of their steps and circling their final answer.

Announce unit seven exam one week from today.

Goal(s): Today's flexibility day is intended to provide a change-of-pace and an opportunity to conduct extra labs or enrichment activities, to offer individual help to students who have been absent or who are having trouble with a concept, to work on critical reading and math skills and/or other state or district mandated standardized skills, to present a guest speaker or video presentation, or to accommodate occasional school-wide assemblies, testing, and similar activities.

Objective(s): Objectives will vary from school to school depending on which goal above is targeted for today's lesson.

Procedures: This guide attempts to intersperse an assortment of activities into each week and each unit. Some of these are demonstrations or labs, others are lectures, and still others are reading or computer activities. By adding periodic flexibility days to this mix, we build a necessary versatility into our curricula to accommodate real-world necessities and interruptions such as standardized testing, preparation for standardized testing, student assemblies, extra labs that you may wish to incorporate, make-up days, occasional student or video presentations, assorted enrichment activities, and/or guest speakers.

We do not specify a particular activity for these sessions because conditions will differ from one school to another. Earlier in this guide, however, we do suggest lists of extra labs and science video titles suitable for this course. When appropriate, choose a lab kit, enrichment activity, or video from a science supply vendor or choose a suitable science title from your school's media center. In the case of an extra lab or demonstration, follow the procedures and safety precautions suggested by your textbook publisher or supply vendor. In the case of a video presentation, have students turn in 20-30 facts from the film as written work. This ensures that each student records information from the presentation and also helps keep everyone on task.

Lesson 7-5 Six Common Types of Chemical Reactions

Class Notes 7:3 Six Common Types of Chemical Reactions
rft Worksheet 7:3

Goal(s): This lesson introduces students to six fundamental types of chemical reactions: synthesis, decomposition, combustion, polymerization, single displacement, and double displacement. In addition, students are introduced to (and assigned to memorize) the formulas and charges of common monoatomic and polyatomic ions.

Objective(s): By the end of this lesson, students will be able to

- identify, upon examination, (a) A synthesis reaction; (b) A decomposition reaction; (c) A combustion reaction; (d) A polymerization reaction; (e) A single displacement reaction, and (f) A double replacement reaction
- explain that individual molecules called monomers can often be attached to one another, forming long chains called polymers
- identify nylon, PVC, starch, cellulose, proteins, and DNA as examples of polymers
- explain that displacement reactions that occur in a solution may directly involve certain ionic species while other ionic species do not participate at all and are often called "spectator" ions

Vocabulary: synthesis decomposition combustion polymerization monomers net ionic equation polymers single displacement double displacement spectator ions

Background: Read over class notes 7:3 before presenting them in class. Also find and read over associated information in your district's adopted text. Finally, read over your Teachers' Version Answer Keys to student workbook item 7:3 for an additional overview of today's principle topics.

Lecture Procedure: Use an overhead projector or PowerPoint software to present CN 7:3. If using overhead transparencies, use a piece of paper to cover all information on each overhead except for the single detail, principle, or example being discussed. As students copy each item, be sure to read each fact or example two or three times aloud as they write

(sometimes this works well by inviting student volunteers to read some items). Also add your own comments and examples. *Notice that this methodology introduces today's information to the brain by visual, auditory, verbal, and kinesthetic pathways*. If you happen to finish early, have students begin work on rft Worksheet 7:3.

Assessment: Award each student participation points and/or notebook points for their good efforts exhibited during today's presentation.

Lesson 7-6 Two rft Worksheets and Demonstration Activity

rft Worksheets 7:3 and 7:4
Demonstration Activity AD-27 "The Mole Song"

Goal(s): Today's worksheets are intended to help students prepare for the mathematics, formulas, ions, key concepts, and vocabulary that will be emphasized on this week's unit seven exam.

Objective(s): By the end of this lesson, students will

- record 100% correct answers to all items on student rft WS 7:3
- record 100% correct answers to all items on student rft WS 7:4

Today's Pacing:

❶ Begin today's class with individual student seatwork on rft WS 7:3 for approximately 6 minutes. Then switch to a verbal review of the correct answers to all WS 7:3 items, using our usual procedures as outlined below.

❷ Conduct today's simple change-of-pace demonstration AD-27 in between the two worksheets. Allow approximately 6 minutes for this activity. See section AD-27 later in this Guide for particular details of this activity.

❸ Thirdly, assign students to individual seatwork on Worksheet 7:4 and allow about 7 minutes for this individualized work. Then proceed to a verbal review of the correct answers to all items using our usual worksheet procedures as outlined below.

Demonstration Procedures: See section AD-27 later in this guide for details concerning this activity which is a "musical salute to a mole." You will need a CD player or a computer with speakers to play the song. Students will enjoy the song more if you type up the lyrics and distribute copies for them to follow as they listen.

Procedure for "rtf" worksheets: See lesson 1-4 for general points 1 through 4

Begin this section with approximately six minutes of individual seatwork on rft WS 7:3. Encourage students to finish all the easiest items first and to skip items that they are unsure of. Explain that you and the class as a whole will be going over all items together so that everyone will be able to record correct answers for any items that they were unable to answer on their own.

After students have worked on their worksheets individually, go over the correct answers to all WS 7:3 items using the following procedure: Have students read (one by one and each in turn) the questions from Worksheet 7:3 and ensure that everyone has the correct answer. Proceed in this way, row by row, allowing Andrea to read the first question and its answer, and Tyrone to read the second question and its answer, etc. In this way, you ensure that all students have the correct answers available for study purposes. Then proceed to today's AD-27 demonstration activity.

After the demonstration, assign individual seatwork on student rft WS 7:4. Allow about six or seven minutes for this individual work and then begin the verbal review of all correct answers, using the same procedures outlined for WS 7:4 above.

Assessment: Award each student participation points and/or notebook points for their good efforts exhibited during today's presentation.

Lesson 7-7 Student Lab Activity and Additional Review for Exam

Lab Activity AL-27 Radial Chromatography Filter Paper and T-shirts

See section AL-27 later in this Guide for a description of the materials, procedures, and safety considerations associated with this lab activity. *Note that an outdoor modification and open-air ventilation are required, along with no inhalation of fumes, and no sources of ignition, among others*.

Before beginning this lab, allocate about 10-12 minutes to administer a "What-If" quiz to your class. *Explain that this is not an actual quiz*, but a "what if" I were to assign the following dimensional analysis problem or conversion as a quiz? Look at the two dimensional analysis conversions on this week's unit seven exam. Make up a similar problem to serve as this "what if" quiz and allow students about seven minutes to attempt to solve it. Ask how many students think that got the item correct? Use the next five minutes to go over the correct answer and allow everyone to correct their papers if they need to. It may be useful to ask for a student volunteer to place the solved problem and its correct answer on the blackboard. Point out to students that this week's exam will have two problems along these lines.

Then proceed to today's student lab activity AL-27 as noted above.

Lesson 7-8 Flexibility and Enrichment Options and Extra Test Review Day

Suggested Review: This is a last chance to "check for understanding" with your students concerning issues such as writing formulas correctly, solving dimensional analysis problems, etc. Use as much time as is needed during this flexibility day to help either the entire class with their weak areas, or to provide individual help to the extent possible.

If only three or four students are having trouble, you can show a science video (twenty facts due at the end of class) and help those students individually. Another useful approach is to pair a student who is having trouble with the math with a second student who understands this particular material more or less perfectly. Set them up just outside the classroom door and let them work on a practice problem or two.

After ensuring that everyone is well-prepared for tomorrow's test, use the rest of today's class for one of the other flexibility options of your choice.

Goal(s): Today's flexibility day is intended to provide a change-of-pace and an opportunity to conduct extra labs or enrichment activities, to offer individual help to students who have been absent or who are having trouble with a concept, to work on critical reading and math skills and/or other state or district mandated standardized skills, to present a guest speaker or video presentation, or to accommodate occasional school-wide assemblies, testing, and similar activities.

Objective(s): Objectives will vary from school to school depending on which goal above is targeted for today's lesson.

Procedures: This guide attempts to intersperse an assortment of activities into each week and each unit. Some of these are demonstrations or labs, others are lectures, and still others are reading or computer activities. By adding periodic flexibility days to this mix, we build a necessary versatility into our curricula to accommodate real-world necessities and interruptions such as standardized testing, preparation for standardized testing, student assemblies, extra labs that you may wish to incorporate, make-up days, occasional student or video presentations, assorted enrichment activities, and/or guest speakers.

We do not specify a particular activity for these sessions because conditions will differ from one school to another. Earlier in this guide, however, we do suggest lists of extra labs and science video titles suitable for this course. When appropriate, choose a lab kit, enrichment activity, or video from a science supply vendor or choose a suitable science title from your school's media center. In the case of an extra lab or demonstration, follow the procedures and safety precautions suggested by your textbook publisher or supply vendor. In the case of a video presentation, have students turn in 20-30 facts from the film as written work. This ensures that each student records information from the presentation and also helps keep everyone on task.

Lesson 7-9 Unit Seven Exam

Objective: This exam will assess student mastery of key vocabulary, concepts, and examples from unit seven, including, but not limited to: Synthesis reactions, decomposition reactions, combustion reactions, polymerization reactions, single displacement reactions, double displacement reactions, spectator ions, net ionic equations, common monoatomic cations and anions, polyatomic cations and anions; using ions, subscripts, oxidation states, and parentheses to correctly write formulas for ionic compounds, dimensional analysis, the factor-label method, conversion problems, and multiplying by definitional fractions, etc.

Assessment Instrument: A copy of the unit seven exam ("Ions, Formulas, and Reactions") is available in this guide in two versions with an answer key for each. The questions used are identical in both versions, but are arranged differently.

Rubric: The exam consists of 57 objective or short-answer questions and two dimensional analysis / conversion problems. By assigning a value of two points to each question objective or short-answer question, there are 114 possible points. By assigning a value of eight points to each of the two dimensional analysis problems, the total point value for this exam rises to 130. Count the first 50 objective questions as one test (100 points). Then count the two dimensional analysis and seven remaining short-answer questions as a separate math quiz or test.

Procedure: Most students will need approximately 30-40 minutes to complete the test, although some may finish very quickly. You may wish to have a video available that the class can watch when everyone has finished their exams.

You can use the second version of the exam in a variety of ways, depending upon your needs. You may wish to distribute the two versions so that students seated next to each other do not have the same version. Or you may decide to use one version of the test during one period of the day and the second version during another period.

If you use a Scantron scoring system, be sure that student answer sheets indicate which version of the test was used.

Comments: The unit worksheets and transparencies have been used to develop most of the test questions. Test questions are seldom worded exactly like worksheet items, but the concepts and vocabulary sampled in the test questions are generally taken from the worksheets. As a result, any student who knows, masters, and understands all the information on the unit one worksheets should be able to earn a high score ("A" or "B") on the unit exam. This honors chemistry curriculum is intended to teach students the key ideas, terms, and concepts of each unit as clearly as possible. And this subject's exams are intended to discover the degree to which each student has mastered those key terms, concepts, and ideas. The exam questions are not devised with the intent to be tricky or misleading, but are intended instead to be direct and straight-forward.

Make-Up Exams: Some students will be absent on exam day and will need to take a make-up exam. If you wish to test the same information without using exactly the same test, it is fairly easy to rewrite each question as its fill-in-the-blank equivalent.