Multiplications and Proportions

Variables and Proportions

Alexis Wall

Bemidji High School

Alexis\_wall@bemidji.k12.mn.us

Joy Cooley

New York Mills

Jcooley@nymills.k12.mn.us

Grade Level:  7-12

Executive Summary

What we were trying to accomplish in these two units is to tie the algebra tiles from 7th grade to 8th grade to 9th grade and then eventually into 11th grade algebra.  We wanted our students to start with a concept and understand what is going on and then take that concept to the next level over and over.  The standards we are addressing are involved with each lesson.  Students will be looking at what a variable is, how to write and simplify algebraic expressions, how to compare two complicated algebraic expressions, how to solve for a variable if you know that two expressions are equal, and how to solve problems.  We also get into

Table of Contents

Unit 1

Pre-Test

Lesson 1-What is a variable?

Lesson 2-What’s the perimeter?

Lesson 3-What does “minus” mean?

Lesson 4-What makes zero?

Lesson 5-How can I simplify the expression?

Lesson 6-Which is greater?

Lesson 7-how can I write it?

Lesson 8-What if both sides are equal?

Lesson 9-What is x?

Post Test with answers

Sample MCA lll questions that deal with Unit 1

Unit 2

Pre and Post Test with answers

Lesson 1 - Exploring an Area Model

Lesson 2 - Multiplying Binomials and Distributive Property

Lesson 3 - Using Generic Rectangles to Multiply

Lesson 4 - Solving Equations with Multiplication

Lesson 5 - Working with Multi-Variable Equations

Lesson 6 - Solving Equations without Manipulatives

Sample MCA lll questions that deal with Unit 2

Algebra Connections

**Unit 1**

**Pre-Test**

(I choose problems 1, 4, 5, 6, 7, 11, 13, 14, and 16 out of the question bank for Algebra Connections for the pre and post test)

 **Lesson 1-What is a variable?** Adapted from CPM Algebra Connections

(For more information, check out page 40-43, Algebra Connections)

To demonstrate with the tiles online, visit <http://technology.cpm.org/general/tiles/>)

**Objective:** Students will explore what a variable is and learn to combine like terms

**Materials:** Algebra Tile, Lesson 2.1.1 Resource page

**Homework**: 2-6 to 2-11

**Standard:** 7.2.2.4 Represent real-world or mathematical situations using equations and inequalities involving variables and positive and negative rational numbers

7.2.3.1 Use properties of algebra to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents. Properties of algebra include associative, commutative and distributive laws.

**Launch:**

I brought in this jar of buttons today. I need to figure out how to organize them. What are some ideas? What about the size, the color, whether it has 2 holes or four, etc… If I have this unknown amount of button, the big question is, using 4 buttons on a pair of mittens-2 big and 2 small, how many pairs of mittens can I make?

In mathematics this year and your future years to come, you will work with unknown quantities that can be represented using variables. What I ultimately want you to figure out today is what a variable is and how can we use it. With this goal, I want you to work with this bag I have. In the bag I found all these unique shapes and colors. Can you help figure out how many different shapes there are, are the shapes the same or different, and are the shapes related and can they fit together? Problem 2-1) –Hand out the algebra tiles to students in groups of 2-4. (For more information, check out page 40-43, Algebra Connections)

**Explore:**

Have students play with the tiles and answer the questions on page 41, 2-1. Students should be looking at the difference between the pieces by there shapes and the colors. Then explore what students came up with. Have student continue with problem 2-2.

**Share**:

Students will share what they came up with for 2-1 out loud in their groups, but then have students go up to the projector to show what they came up with for 2-2. This is where students should come to the conclusion that you can’t get any of the pieces to align with one another. Explain the word non-commensurate.

The teacher then puts a pile of positive tiles on the projector. Have the students go through 2-3 using the names the class just came up with. Have people in their own group come up with a stack of jumbled piles and have others come up with the answer. When it seems everyone is there, have them build the questions in 2-4. After everyone is done, assign 2-6 to 2-11 as homework.

**Summarize:**

The main idea in this lesson is that students understand or at least see what a variable is and how it can be used. Students will be able to combine x’s and y’s using the algebra tiles and come up with an expression of what the pile represents. Let the students know that this will be used later on more and more, so to have a concrete idea of what a variable is right now is a great concept to have.

**Lesson 2-What is perimeter?** Adapted from CPM Algebra Connections

(For more information and problems, check out page 44-46, Algebra Connections)

**Objectives:** Students will simplify expressions by combining like terms

**Materials:** Algebra Tiles

**Homework**: 2-17 to 2-21

**Standard:** 7.2.3.1 Use properties of algebra to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents. Properties of algebra include associative, commutative and distributive laws

**Launch:** My dog keeps getting out and wants to run away. I think she wants to see the dog next door, since he keeps bringing her back. So, to keep my dog on my property, I want to build a fence around my yard. I know my yard is 20 feet long by 30 feet wide. How much fencing do I need to buy? Today we are going to be talking about perimeter. A reminder that perimeter is the distance around an object or shape. Distribute the algebra tiles and ask students to do problem 2-12 on page 44.

**Explore:** Students will work in their groups and answer 2-12 on page 44.

Share: Students will then share what they have and their simplified versions. On the board, I am hoping to see different representations of simplifying. I am looking for 1 + 1 + x + x and 1 + x + 1 + x and x + x + 1 + 1. This shows us that how we add numbers and variables doesn’t matter. Since these are all the same, we have just showed the commutative property of addition. Teacher will build students vocabulary of commutative property of addition and extent to the commutative property of multiplication. Students will continue to work on 2-13 to 2-16 in their groups. After everyone is close to done, have students talk about what they have learned in their learning log. They will share with everyone in their group and then have each group share one of them.

**Summarize:** The main idea in this lesson is for students to see that how there are multiple ways to see and interpret a problem. The commutative property of addition and multiplication are also important.

**Lesson 3-What does minus mean?** Adapted from CPM Algebra Connections

(For more information and problems, check out page 47-50, Algebra Connections)

**Objective:** Students will write algebraic expressions

**Materials:** Algebra Tiles, Lesson 2.1.3 Resource page (expression mat)

**Homework:** 2-29 to 2-33

**Standard:** 7.2.3.1 Use properties of algebra to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents. Properties of algebra include associative, commutative and distributive laws.

**Launch:** I was sorting through my buttons and found that I have 64 big buttons and 87 small buttons. I have 6 pairs of mittens done and ready to have the buttons put on. How many of each button will I need? How many are left for the next pairs I make? I emphasis is on how are students going to represent subtraction of the large and small buttons, which will start out lesson out.

**Explore:** Have students start individually on page 47, problem 2-22. Then have a whole class discussion about the meaning of “-“. This text will use minus.

Do a couple of examples with the students to build the understanding of how to use the mat by doing 2-23 and 2-24 together as a whole group.

Have students work with a partner or by themselves if confident and do 2-25 to 2-27.

**Share:** Come together and have students explain what they came up with on the board. Have students write in their journal problem 2-28 and the methods and meanings.

**Summarize:** Students should be able to simplify problems involving the expression mat and tiles. Don’t worry about if students are not simplifying yet as they will in the lessons to come. This text will use minus. The goal is for students to understand that “-“has three meaning: negative, opposite, and subtraction. Explain to students the expression mat and that the tiles have two meanings-positive on one side and negative on the other. Hit on important vocabulary: evaluate, order of operations (parentheses, exponents, multiplication or division and addition or subtraction).

**Lesson 4-What makes zero?** Adapted from CPM Algebra Connections

(For more information and problems, check out page 51-54, Algebra Connections)

**Objective:** Students will use zero to simplify algebraic expressions

**Materials:** Algebra Tiles and expression mat

**Homework:** 2-41 to 2-46

**Standard:** 7.2.3.1 Use properties of algebra to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents. Properties of algebra include associative, commutative and distributive laws

**Launch:** At the craft show this weekend, I had a great show. My mittens sold very well and now I have to figure out how many to make and of each size. I started with 35 large, 20 medium, and 15 small pairs of mittens. At the end of the show I had 16 large, 8 medium, and no smalls left. Show me on the mats how to represent each of the sizes. Distribute expression mat to each student along with the algebra tiles. Pose the question about how do you represent zero on the expression mat. Then groups work together to build and simplify expression by “removing zeros”. Have students demonstrate their approaches and expressions using the overhead projector.

**Explore:** Have a student read the problem 2-34 out loud. Have a discussion about how to represent these different scenarios. Have students work on 2-35 and have students present their ideas so the class realizes that there are many different ways to represent zero. Then work on problem 2-36 and talk about their results.

**Share:** Have groups work on 2-37 and 2-28. Explain the three common ways to simplify.

Have students come up to the overhead projector and share their solutions. Come together as a whole class and represent different strategies to take away zero. Before students start on 2-39, express how you want students to show their work. Have students end this lesson by writing 2-40 in their notes.

**Summarize:** Students will start to see different ways to represent zero. Using the algebra tiles, they can see the concept in action and develop a deeper meaning as what zero is. In their notes, make sure students include the vocabulary: property of zero, associative property of addition and multiplication, identity property of addition and multiplication.

**Lesson 5-How can I simplify the expression?** Adapted from CPM Algebra Connections

(For more information and problems, check out page 55-58, Algebra Connections)

**Objective**: Students will use algebra tiles to simplify algebraic expressions

**Materials:** Algebra Tiles, Lesson 2.1.5 Resource page (cut before class), Lesson 2.1.5B Resource page (expression comparison mat)

**Homework:**  2-52 to 2-56

**Standard:** 7.2.3.1 Use properties of algebra to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents. Properties of algebra include associative, commutative and distributive laws.

**Launch:** My dog and son were having so much fun last night. They were running around and throwing a stuffed animal. Well, the stuffed animal happen to hit all my organized containers of buttons and luckily only one of them happen to spill out. I wanted Hunter, my son, to learn his lesson that when he makes a mess, he has to make it right by fixing it. So, I told him to try and put the buttons back in the container. He started by grouping a certain color of them together. How would you guys put the buttons back in the case?

**Explore:** Have a volunteer read the lesson introduction. Then have groups work briefly on problem 2-47 to prepare for a class discussion of simplification strategies. Pull the class together and have a whole-class discussion based on problem 2-48, which introduces the expression comparison mat. Distribute the expression comparison mat. Have a student come up and demonstrate building and simplifying each side of the expression comparison math given in problem 2-48. Explain what simplifying through combining like terms and through balancing are. Have students explain back to the teacher to make sure they have a good understanding.

**Share:** Students will come up and present their strategies for determining which mat is greater. The teacher or students may spill out words like “illegal” and “legal” make sure to help students understand why they can or cannot do these illegal things. Do a couple of problems on the mat to make sure students understand what is “legal” or “illegal”. Have students write in their notes how to explain and make a diagram for each of the “legal” moves. Have others in the group help to make sure these are “legal”.

Have students copy 2-51 in their notes and the methods and meanings.

**Summarize:** Students are developing steps to simplify expressions and tell which expression is greater. Students are learning about how the tiles can be used to develop the deeper understanding about each expression and tell which one is greater even when there are not numbers being used. Important vocabulary: combining like terms and term.

**Lesson 6-Which is greater?** Adapted from CPM Algebra Connections

(For more information and problems, check out page 59-62, Algebra Connections)

**Objective**: Students will use algebra tiles to compare expressions

**Materials:** Algebra Tiles and expression comparison mat

**Homework:** 2-59 to 2-63

**Standard:** 7.2.3.1 Use properties of algebra to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents. Properties of algebra include associative, commutative and distributive laws.

**Launch:** We had two craft shows this last weekend. One was is New York Mills and the other was in Park Rapids. My mom was at one and I at the other selling my mittens. She said she made $220 and sold 6 pairs of medium and 9 pairs of small. I sold $220 and 8 pairs of medium and 6 pairs of large. Who sold more? The class will then have a discussion about the price and what is considered more. Then lead off with what we are doing today.

Today we will be working with the algebra tiles and expression mats to try and figure out which mat is greater. Let’s go through the “legal” moves that you found yesterday.

**Explore:** Have students work in groups on 2-57 and 2-58. Periodically stop them to make sure they are doing legal moves.

**Share**: Have students write down the methods and meanings in their note books.

**Summarize:** Students are not supposed to be masters at this time, but starting to understand how to simplify and what things they can and cannot do. They might have more questions than answers and don’t like to leave a question without a definite answer and that’s okay.

**Lesson 7-How can I write it?** Adapted from CPM Algebra Connections

(For more information and problems, check out page 63-67, Algebra Connections)

**Objective:** Students will simplify and record work

**Materials:** Algebra Tiles and expression comparison mat

**Homework:** 2-68 to 2-71

**Standard:** 7.2.3.1 Use properties of algebra to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents. Properties of algebra include associative, commutative and distributive laws.

**Launch:** Just like yesterday, we talked about the two craft shows I had last weekend. Using the same information from yesterday (she made $220 and sold 6 pairs of medium and 9 pairs of small. I sold $220 and 8 pairs of medium and 6 pairs of large). The one who sold more, gets treated by the other person to supper at Red Lobster. How would I write something up stating who sold more?

**Explore:** Have the partners work on problems 2-64 to 2-67.

**Share:** Have students pair up and discuss what the main idea was yesterday to their partner. Bring the whole class back together and go over 2-65 demonstrating how to show work. Ask the students what is different about this lesson from yesterday. Students should see that there are problems with no answer and how to show their work. Note that there are many ways to show their work, with an explanation. The table below shows some examples. Then have students work on 2-66 and 2-67. Then come back together and go over their findings. Have them copy down methods and meanings and start the homework.

**Summarize:** Students should see that there are problems with no answers and how to show their work to record their findings. Note that there are many ways to show their work, with an explanation.

**Lesson 8-What if both sides are equal?** Adapted from CPM Algebra Connections

(For more information and problems, check out page 67-70, Algebra Connections)

**Objective:** Students will use algebra tiles to solve for x

**Materials:**  Algebra Tiles, Lesson 2.1.8 Resource page (equation mat)

**Homework:** 2-77 to 2-81

**Standard:** 7.2.3.1 Use properties of algebra to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents. Properties of algebra include associative, commutative and distributive laws.

**Launch:** Back to our discussion of the two craft shows that we have been talking about. Are the outcomes for the two craft shows the same? They both sold $220.00? What happens if we both sold the same number of mittens instead of having the same total? Today we are going to look at what happens when the mats seem to be the same or are they really different!

**Explore:** Have the students grab some tiles and place them on each mat and work at figuring out which side is greater. Pose the question that what would happen if we ended up with the same on each side. Have students work on 2-73. Give some time and then go over the problem.

Have students go through 2-74.

**Share:** Go over 2-74 as a class.

Move groups on to 2-76 and then share their results. Have students copy down the methods and meanings.

S**ummarize:** Big ideas by asking questions, 1) how can you simplify?, 2) how can you get x alone? 3) how do you know what x is? 4) is there more than one way to simplify? 5) is there always a solution? Today’s lesson will strengthen student’s simplification skills and they will begin to solve equations.

**Lesson 9-What is x?** Adapted from CPM Algebra Connections

(For more information and problems, check out page 71-73, Algebra Connections)

**Objective:** Students will solve equations

**Materials:** Algebra Tiles and equation mat

**Homework:** 2-86 to 2-90

**Standard:** 7.2.3.1 Use properties of algebra to generate equivalent numerical and algebraic expressions containing rational numbers, grouping symbols and whole number exponents. Properties of algebra include associative, commutative and distributive laws.

**Launch:** My nextcraft show is this weekend. I realize that I have spent over $325 on supplies. I only have 55 pairs of mittens left, but my mom owes me $50. How much should I charge for each pair of mittens to make sure I am not in debt? Have students work in partners to try and figure out the answer. Come together as a group and discuss their strategies.

**Explore:** Hand out algebra tiles and equation mats to every student or pair of students. In partners, have students go through 2-82. This is review of yesterday. Today I would like everyone in this room to be comfortable with solving for x. Have groups do problems 2-83 and 2-84. Students will get stuck, so carefully walk around the room and listen carefully.

**Share:** Have the partners come up to the board and demonstrate the two problems. Make special attention to when x = o, x can be any number, and when you just get an answer. Then have students copy down 2-85 and the looking deeper in their notes.

**Summarize:** Students will continue solving equations for x and will begin to consider special types of solutions such as “all numbers” and “no solution”. This lesson will also strengthen their simplification and recording skills. The big goal is to make sure students are comfortable with writing and solving equations.

Algebra Connections

**Unit 1**

**Post Test**

(I choose problems 1, 4, 5, 6, 7, 11, 13, 14, and 16 out of the question bank for Algebra Connections for the pre and post test)

Unit 1 MCA lll Practice Questions

1. For a building project, Rita needs 24 large bolts and a matching nut for each bolt. Each bolt costs $0.39 and each nut costs $0.16. To calculate the total cost of her purchase, she evaluated the expression: (24 × $0.39) + (24 × $0.16).

Part A How could Rita have written the expression in simpler form?

Part B What is the total cost?

1. Which is a verbal description of the Associative Property of Addition?

A. The sum of zero and any number is equal to the number.

B. The sum of two numbers added to a third number is the same as adding the first number to the sum of the second and third numbers.

C. The order of two numbers being added can be switched without affecting the sum.

D. The product of a number and the sum of two other numbers is equal to the sum of the products of the first number with each of the other two numbers.

1. Which of the following can be used to simplify this expression? 37 × 419

A. (30 + 419) × (37 + 419)

B. (30 × 400) + 19

C. (37 × 400) + (37 × 10) + (37 × 9)

D. (37 + 400) × (37 + 10) × (37 + 9)

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MCA questions are taken from http://www.shakopee.k12.mn.us/Page/4457

Unit 2

Problems are taken from CPM Algebra textbook, chapter 5.

Pre Test and Post Test:

5-3 page 191

5-15 page 194

5-40 page 202

5-26 page 198

5-49 page 205

5-56 page 207

Unit 2:  Multiplication

Lesson 1 Objectives:  Exploring an Area Model

Materials:  Algebra Tiles

Homework:  5-4 to 5-9

Number of Days:  1

Standard:  use factors, multiples, prime factorization, and relatively prime numbers to solve problems;

Launch:

I will start the lesson with a story about mowing lawns of different sizes, but they all have the same area of 36.  So I will have the students come up with a list of different possible options and talk about how they came up with those numbers.  I’ll draw a picture of the different rectangles and show that they multiplied two positive integers together to get their number.

Then I will display one x squared tile, six x tiles, and eight one unit tiles.  I will ask the students to use the corner piece and these tiles to make a rectangle that would represent the area.  When looking at the rectangle, they should see that one side has (x+2) and the other side had (x+4).  The area as a product will be (x+2)(x+4) and as a sum will be x^2+6x+8.  I’ll make sure they know that (x+2)(x+4) is an expression of the area which is length times the width.

Then I will display one x squared tile, six x tiles, and eight one unit tiles.  I will ask the students to use the corner piece and these tiles to make a rectangle that would represent the area.  When looking at the rectangle, they should see that one side has (x+2) and the other side had (x+4).  The area as a product will be (x+2)(x+4) and as a sum will be x^2+6x+8.  I’ll make sure they know that (x+2)(x+4) is an expression of the area which is length times the width.

5-1 page 191

Explore:  Work in groups of 4.

5-2 page 191

Share:

Students will come up with the different equations for area with their partner.  After finding them I will put all the expressions on the board and have 10 groups come up to show and explain their answers as a product and as a sum.

Summarize:  Go over major concepts of finding the area with algebra tiles.  Emphasize area as a product and as a sum are the same, just written differently.

Post Test:

5-3 page 191

Practice Problems:  Work with partner.

5-4 to 5-9 page 192

Lesson 2 Objectives:  Multiplying Binomials and Distributive Property

Materials:  Algebra Tiles

Homework:  5-15 to 5-20

Number of Days:  1

Standard:  use factors, multiples, prime factorization, and relatively prime numbers to solve problems

Launch: Yesterday we found different dimensions of the area of a lawn.  Today we will be given dimensions and be finding the area.  Then we will do the same thing using algebra tiles.

Give them different dimensions of 2x14, 3x18… and have them find the area.

Then we will move to algebra tiles.

5-10 page 193

Explore:  Students will work in pairs on the next problems.

5-11 page 193

Share:  Students will display answers on the board and explain how they got there.  Groups that have not gone yet will start.

Students will work in groups again on the next few problems.

5-12 to 5-14 page 194

Summarize:  After working on these problems, I will make sure they all understand the main concepts.  We will review the different factored expressions and the distributive property.

Post Test:

5-15 page 194

Homework:  Can be done in groups of 4 or less.

5-16 to 5-20 page 195

Lesson 3 Objectives:  Using Generic Rectangles to Multiply

Materials:  Algebra Tiles

Homework:  5-27 to 5-32

Number of Days:  1

Standard:  use factors, multiples, prime factorization, and relatively prime numbers to solve problems

Launch:

Talk about how the students have found the dimensions of an area when given the area, then they found the area when given the dimensions.  Now they will be given different pieces of information to help find the area and dimensions.  When mowing lawns, they will be given different sections to mow.  They will know the area of some of the sections and dimensions of the other parts.  With this information they will be able to find the missing information.

Then ask the students if they can find any area given any dimensions.  And given the product, can they find the sum?

5-21 page 196

Do these problems as a class.

Explore:  Have the students work in groups of 4 on the next problems.

5-22 to 5-24 page 196

Share:

Have different groups go over each problem with the class and explain how they go there.

Summarize:

Make sure they understand the Distributive Property concept.

Methods and Meanings 198

Post Test:

5-26 page 198

Homework:

5-27 to 5-32 page 199

Lesson 4 Objectives:  Solving Equations with Multiplication

Materials:  Algebra Tiles and equation mat

Homework:  5-49 to 5-54

Number of Days:  1

Standard:  use factors, multiples, prime factorization, and relatively prime numbers to solve problems

Launch:  Now we have a lawn mowing business.  Nick works for $11/hour.  If he works 3 hours how much will he get paid?  4 hours?  5 hours?

5-33 page 200

Once they understand this problem, we can move forward.

5-34 page 200

Explore:  Students will work in groups of four on these next problems.  They will need to come up with an answer and needs to be able to defend their answer.  I will have one group go over each section of the problems and defend their answers.

5-35 to 5-36 page 200

After those problems the students will work in pairs for this next one.

5-37 page 201

Students will go back to their groups for this next one.

5-38 page 201

Share:  Have the students go over their answers for each of the problems before moving on.

Summarize:  I will make sure to go over how to solve equations and show students how they can check their answers.

Methods and meanings 201

Post Test:

5-40 page 202

Homework:

5-39 to 5-44 page 202

Lesson 5 Objectives:  Working with Multi-Variable Equations

Materials:  Algebra Tiles and equation mat

Homework:  5-50 to 5-54

Number of Days:  1

Standard:  use factors, multiples, prime factorization, and relatively prime numbers to solve problems

Launch:  Tell a story about the lawn mowing business starting.  They have to go into debt to start by buying lawn mowers and trailers to haul them around.  Then Nick works for $11/hour.  When will he break even, and when will he start to make profit.

5-45 page 203

Explore:  Students will work in pairs.

5-46 to 5-48 page 203

Share:  Students will go around and explain how they solved their equations and came up with the slope intercept formula.

Summarize:  I’ll make sure the students know how to arrive at the slope intercept form and are able to recognize y-intercept and slope.

Methods and Meanings page 205

Post Test

5-49 page 205

Homework:

5-50 to 5-54

Lesson 6 Objectives:  Solving Equations without Manipulatives

Materials:  algebra tiles

Homework:  5-57 to 5-62

Number of Days:  1

Standard:  use factors, multiples, prime factorization, and relatively prime numbers to solve problems

Launch:  Use the lawn mowing business problem to write different equations that for different hourly rates.

Today we will go over everything we learned the past few days and solve algebraic equations while moving away from algebra tiles.

5-55 page 207

Explore:  Have the students work in groups on these problems and slowly move away from algebra tiles and learning how to represent the equations on paper.

5-57 to 5-59 page 208

Share:  Groups will share their answers with the class and write how they got their answers on the board.

Summarize:  I will go over anything the students still had questions on or points that were not brought up when going over these problems.

Post Test:

5-56 page 207

Homework:  Work in groups.

5-60 to 5-62 page 208

MCA Practice Questions for Unit 2





Retrieved from:  <http://minnesota.pearsonaccessnext.com/resources/item-samplers/math/item-samplers/grade11/G11_Math_MCA_12_point_Accommodated_Item_Sampler.pdf>

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