

Georgia Department of Education

6<sup>th</sup> Grade

Opening Task

Determine the area of Figure A below:

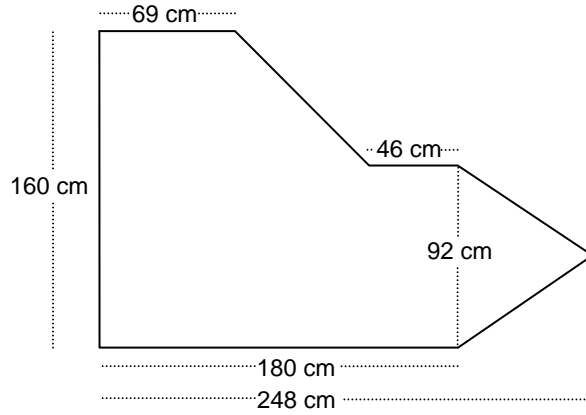


Figure A

Determine the area of Figure B below:

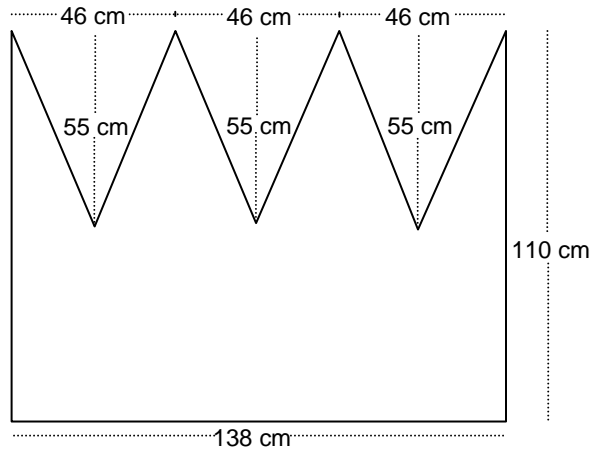


Figure B

Did you use the same method or a different method to determine the areas?

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### What's New

#### **Ratios and Proportional Relationships**

Proportional Reasoning without cross multiplication – not specifically mentioned

#### **The Number System**

Introduction to Integers (Plotting points in all four quadrants) - came from 7<sup>th</sup> grade

Computation Fluency – came from Elementary

#### **Expressions and Equations**

Write and Read Algebraic Expressions – came from Elementary

Use commutative, associative, and distributive properties to evaluate and simplify expressions – came from 7<sup>th</sup> grade

Solve and graph inequalities – came from 8<sup>th</sup> grade

#### **Geometry**

Find areas by composing and decomposing – came from elementary

#### **Statistics and Probability**

Box plots – came from 7<sup>th</sup> grade

Mean Absolute Deviation – came from 9<sup>th</sup> grade

### Focus Task

Show (using manipulatives or a drawing):

$$3(2x + 1) = 6x + 3$$

### Coherence Task (<http://illustrativemathematics.org/>)

Selina bought a shirt on sale that was 20% less than the original price. The original price was \$ 5 more than the sale price. What was the original price? Explain or show work.

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### Overview of Middle School Math

#### **6<sup>th</sup> Grade**

##### **1. Connecting ratio and rate to whole number multiplication and division and using concepts of ratio and rate to solve problems**

Students use reasoning about multiplication and division to solve ratio and rate problems about quantities. By viewing equivalent ratios and rates as deriving from, and extending, pairs of rows (or columns) in the multiplication table, and by analyzing simple drawings that indicate the relative size of quantities, students connect their understanding of multiplication and division with ratios and rates. Thus students expand the scope of problems for which they can use multiplication and division to solve problems, and they connect ratios and fractions. Students solve a wide variety of problems involving ratios and rates.

##### **2. Completing understanding of division of fractions and extending the notion of number to the system of rational numbers, which includes negative numbers**

Students use the meaning of fractions, the meanings of multiplication and division, and the relationship between multiplication and division to understand and explain why the procedures for dividing fractions make sense. Students use these operations to solve problems. Students extend their previous understandings of number and the ordering of numbers to the full system of rational numbers, which includes negative rational numbers, and in particular negative integers. They reason about the order and absolute value of rational numbers and about the location of points in all four quadrants of the coordinate plane.

##### **3. Writing, interpreting, and using expressions and equations**

Students understand the use of variables in mathematical expressions. They write expressions and equations that correspond to given situations, evaluate expressions, and use expressions and formulas to solve problems. Students understand that expressions in different forms can be equivalent, and they use the properties of operations to rewrite expressions in equivalent forms. Students know that the solutions of an equation are the values of the variables that make the equation true. Students use properties of operations and the idea of maintaining the equality of both sides of an equation to solve simple one-step equations. Students construct and analyze tables, such as tables of quantities that are in equivalent ratios, and they use equations (such as  $3x = y$ ) to describe relationships between quantities.

##### **4. Developing understanding of statistical thinking**

Building on and reinforcing their understanding of number, students begin to develop their ability to think statistically. Students recognize that a data distribution may not have a definite center and that different ways to measure center yield different values. The median measures center in the sense that it is roughly the middle value. The mean measures center in the sense that it is the value that each data point would take on if the total of the data values were redistributed equally, and also in the sense that it is a balance point. Students recognize that a measure of variability (interquartile range or mean absolute deviation) can also be useful for summarizing data because two very different sets of data can have the same mean and median yet be distinguished by their variability. Students learn to describe and summarize numerical data sets, identifying clusters, peaks, gaps, and symmetry, considering the context in which the data were collected.

Students in Grade 6 also build on their work with area in elementary school by reasoning about relationships among shapes to determine area, surface area, and volume. They find areas of right triangles, other triangles, and special quadrilaterals by decomposing these shapes, rearranging or removing pieces, and relating the shapes to rectangles. Using these methods, students discuss, develop, and justify formulas for areas of triangles and parallelograms. Students find areas of polygons and surface areas of prisms and pyramids by decomposing them into pieces whose area they can determine. They reason about right rectangular prisms with fractional side lengths to extend formulas for the volume of a right rectangular prism to fractional side lengths. They prepare for work on scale drawings and constructions in Grade 7 by drawing polygons in the coordinate plane.

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### 7<sup>th</sup> Grade

#### **1. Developing understanding of and applying proportional relationships**

Students extend their understanding of ratios and develop understanding of proportionality to solve single- and multi-step problems. Students use their understanding of ratios and proportionality to solve a wide variety of percent problems, including those involving discounts, interest, taxes, tips, and percent increase or decrease. Students solve problems about scale drawings by relating corresponding lengths between the objects or by using the fact that relationships of lengths within an object are preserved in similar objects. Students graph proportional relationships and understand the unit rate informally as a measure of the steepness of the related line, called the slope. They distinguish proportional relationships from other relationships.

#### **2. Developing understanding of operations with rational numbers and working with expressions and linear equations**

Students develop a unified understanding of number, recognizing fractions, decimals (that have a finite or a repeating decimal representation), and percents as different representations of rational numbers. Students extend addition, subtraction, multiplication, and division to all rational numbers, maintaining the properties of operations and the relationships between addition and subtraction, and multiplication and division. By applying these properties, and by viewing negative numbers in terms of everyday contexts (e.g., amounts owed or temperatures below zero), students explain and interpret the rules for adding, subtracting, multiplying, and dividing with negative numbers. They use the arithmetic of rational numbers as they formulate expressions and equations in one variable and use these equations to solve problems.

#### **3. Solving problems involving scale drawings and informal geometric constructions, and working with two- and three-dimensional shapes to solve problems involving area, surface area, and volume**

Students continue their work with area from Grade 6, solving problems involving the area and circumference of a circle and surface area of three-dimensional objects. In preparation for work on congruence and similarity in Grade 8 they reason about relationships among two-dimensional figures using scale drawings and informal geometric constructions, and they gain familiarity with the relationships between angles formed by intersecting lines. Students work with three-dimensional figures, relating them to two-dimensional figures by examining cross-sections. They solve real-world and mathematical problems involving area, surface area, and volume of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes and right prisms.

#### **4. Drawing inferences about populations based on samples**

Students build on their previous work with single data distributions to compare two data distributions and address questions about differences between populations. They begin informal work with random sampling to generate data sets and learn about the importance of representative samples for drawing inferences.

**1. Formulating and reasoning about expressions and equations, including modeling an association in bivariate data with a linear equation, and solving linear equations and systems of linear equations**

Students use linear equations and systems of linear equations to represent, analyze, and solve a variety of problems. Students recognize equations for proportions ( $y/x = m$  or  $y = mx$ ) as special linear equations ( $y = mx + b$ ), understanding that the constant of proportionality ( $m$ ) is the slope, and the graphs are lines through the origin. They understand that the slope ( $m$ ) of a line is a constant rate of change, so that if the input or  $x$ -coordinate changes by an amount  $A$ , the output or  $y$ -coordinate changes by the amount  $m \cdot A$ . Students also use a linear equation to describe the association between two quantities in bivariate data (such as arm span vs. height for students in a classroom). At this grade, fitting the model, and assessing its fit to the data are done informally. Interpreting the model in the context of the data requires students to express a relationship between the two quantities in question and to interpret components of the relationship (such as slope and  $y$ -intercept) in terms of the situation.

Students strategically choose and efficiently implement procedures to solve linear equations in one variable, understanding that when they use the properties of equality and the concept of logical equivalence, they maintain the solutions of the original equation. Students solve systems of two linear equations in two variables and relate the systems to pairs of lines in the plane; these intersect, are parallel, or are the same line. Students use linear equations, systems of linear equations, linear functions, and their understanding of slope of a line to analyze situations and solve problems.

**2. Grasping the concept of a function and using functions to describe quantitative relationships**

Students grasp the concept of a function as a rule that assigns to each input exactly one output. They understand that functions describe situations where one quantity determines another. They can translate among representations and partial representations of functions (noting that tabular and graphical representations may be partial representations), and they describe how aspects of the function are reflected in the different representations.

**3. Analyzing two- and three-dimensional space and figures using distance, angle, similarity, and congruence, and understanding and applying the Pythagorean Theorem**

Students use ideas about distance and angles, how they behave under translations, rotations, reflections, and dilations, and ideas about congruence and similarity to describe and analyze two-dimensional figures and to solve problems. Students show that the sum of the angles in a triangle is the angle formed by a straight line, and that various configurations of lines give rise to similar triangles because of the angles created when a transversal cuts parallel lines. Students understand the statement of the Pythagorean Theorem and its converse, and can explain why the Pythagorean Theorem holds, for example, by decomposing a square in two different ways. They apply the Pythagorean Theorem to find distances between points on the coordinate plane, to find lengths, and to analyze polygons. Students complete their work on volume by solving problems involving cones, cylinders, and spheres.

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**Deep Understanding Task**

Create a dotplot for the following data: {1, 3, 4, 5, 5, 5, 7, 7, 8}

Determine the Distance (deviation) from the mean for each “dot”

How would you find the average distance from the mean for all the data points?

Why do we need MAD, wouldn't range be enough?

Take a look at the following data sets is the mean and range enough to distinguish between them?

$$A = \{1, 1, 1, 1, 5, 9, 9, 9, 9\};$$

$$B = \{1, 5, 5, 5, 5, 5, 5, 5, 9\};$$

$$C = \{1, 3, 3, 3, 6, 6, 7, 7, 9\}$$

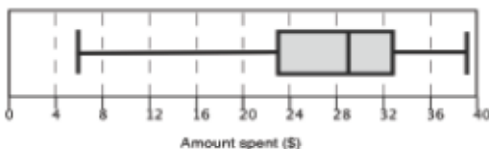
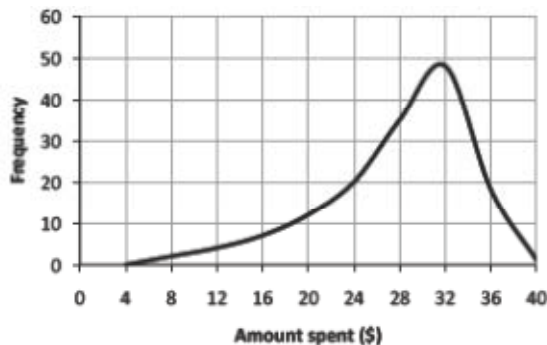
Which set has the least variation?

Which set has the greatest?

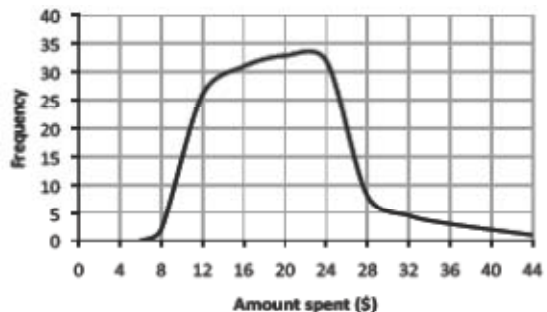
Application Task

**Cell Phones 2**

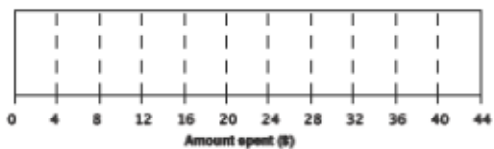
Here is a frequency graph that shows the monthly spending of a group of students on their cell phones:



Here is another frequency graph that shows the monthly spending of a second group of students on their cell phones:



- Use a ruler to draw a possible box plot for this graph. Describe your box plot, by adding explanations to the graph or box plot.



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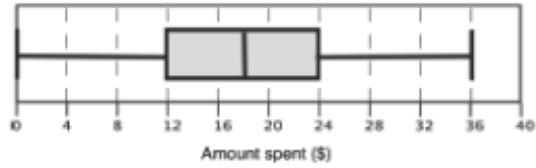
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Representing Data Using Box Plots

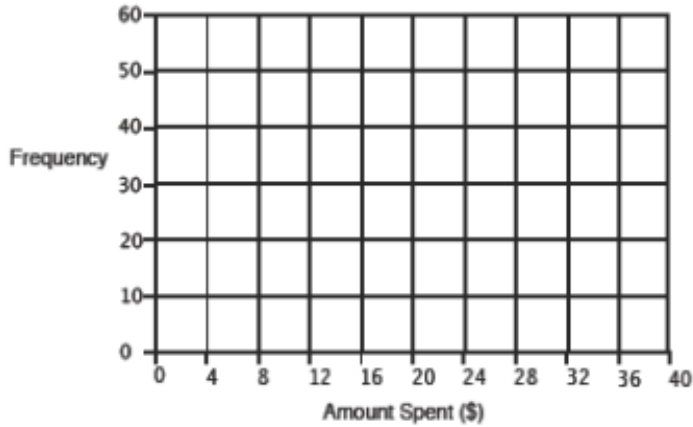
Student Materials

Alpha Version August 2011

2. This box plot shows the monthly spending of a third group of students on their cell phones:



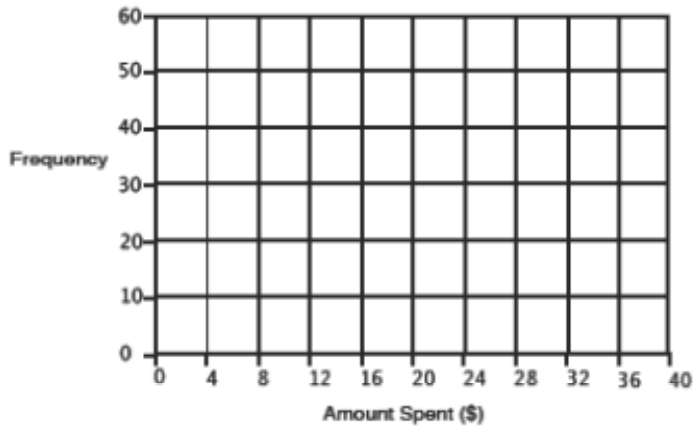
Sketch two possible frequency graphs for this box plot:



I have drawn the graph this shape because .....

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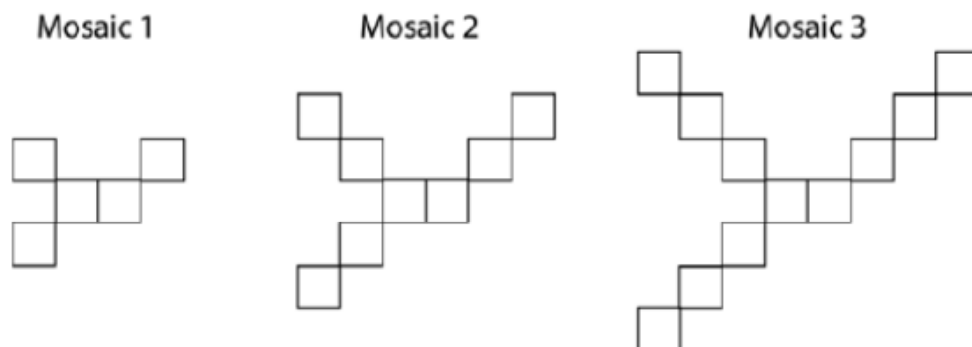


I have drawn the graph this shape because .....

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Dual Intensity Task**Mosaics**

Reuben learned in art class that a mosaic is made by arranging small pieces of colored material (such as glass or tile) to create a design. Reuben created a mosaic using tiles, then decided on a growing pattern and created a second and third mosaic. Reuben continued his pattern by building additional mosaics. He counted the number of tiles in each mosaic and then represented the data in multiple ways. He thinks he sees a relationship between the mosaic number and the total number of tiles in the mosaic.

1. Represent Reuben's data from the mosaics problem in at least three ways, including a general function rule, to determine the number of tiles in any mosaic.
2. Write a description of how your rule is related to the mosaic picture. Include a description of what is constant and what is changing as tiles are added.
3. How many tiles would be in the tenth mosaic? Use two different representations to show how you determined your answer.
4. Would there be a mosaic in Reuben's set that uses exactly 57 tiles? Explain your reasoning using at least one representation.
5. In Reuben's mosaic, there are 2 tiles in the center. How would the function rule change if the center of the mosaic contained 4 tiles instead? Explain your reasoning using two different representations.

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What's in 6 – 7A

Unit 8	Unit 9	Unit 10
<p><b>Operations with Rational Numbers</b></p>	<p><b>Expressions &amp; Equations</b></p>	<p><b>Ratios and Proportional Relationships</b></p>
<p><b><u>Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.</u></b>  <b>MCC7.NS.1</b> Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram.  <b>MCC7.NS.1a</b> Describe situations in which opposite quantities combine to make 0.  <b>MCC7.NS.1b</b> Understand <math>p + q</math> as the number located a distance <math> q </math> from <math>p</math>, in the positive or negative direction depending on whether <math>q</math> is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts.  <b>MCC7.NS.1c</b> Understand subtraction of rational numbers as adding the additive inverse, <math>p - q = p + (-q)</math>. Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts.  <b>MCC7.NS.1d</b> Apply properties of operations as strategies to add and subtract rational numbers.  <b>MCC7.NS.2</b> Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.  <b>MCC7.NS.2a</b> Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as <math>(-1)(-1) = 1</math> and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts.</p>	<p><b><u>Use properties of operations to generate equivalent expressions.</u></b>  <b>MCC7.EE.1</b> Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.  <b>MCC7.EE.2</b> Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related.  <b><u>Solve real-life and mathematical problems using numerical and algebraic expressions and equations.</u></b>  <b>MCC7.EE.3</b> Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations as strategies to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.  <b>MCC7.EE.4</b> Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.  <b>MCC7.EE.4a</b> Solve word problems leading to equations of the form <math>px + q = r</math> and <math>p(x + q) = r</math>, where <math>p</math>, <math>q</math>, and <math>r</math> are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.  <b>MCC7.EE.4b</b> Solve word problems leading to inequalities of the form <math>px + q &gt; r</math> or <math>px + q &lt; r</math>, where <math>p</math>, <math>q</math>, and <math>r</math> are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem.</p>	<p><b><u>Analyze proportional relationships and use them to solve real-world and mathematical problems.</u></b>  <b>MCC7.RP.1</b> Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.  <b>MCC7.RP.2</b> Recognize and represent proportional relationships between quantities.  <b>MCC7.RP.2a</b> Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.  <b>MCC7.RP.2b</b> Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.  <b>MCC7.RP.2c</b> Represent proportional relationships by equations.  <b>MCC7.RP.2d</b> Explain what a point <math>(x, y)</math> on the graph of a proportional relationship means in terms of the situation, with special attention to the points <math>(0, 0)</math> and <math>(1, r)</math> where <math>r</math> is the unit rate.  <b>MCC7.RP.3</b> Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.  <b><u>Draw, construct, and describe geometrical figures and describe the relationships between them.</u></b>  <b>MCC7.G.1</b> Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.</p>

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<p><b>MCC7.NS.2b</b> Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If <math>p</math> and <math>q</math> are integers then <math>-(p/q) = (-p)/q = p/(-q)</math>. Interpret quotients of rational numbers by describing real-world contexts.</p> <p><b>MCC7.NS.2c</b> Apply properties of operations as strategies to multiply and divide rational numbers.</p> <p><b>MCC7.NS.2d</b> Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats.</p> <p><b>MCC7.NS.3</b> Solve real-world and mathematical problems involving the four operations with rational numbers.</p>		
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