


## Reading

English/Language Arts
Mathematics


## Science

Social Studies

## Chapter 3

## Mathematics

By the end of Grade 8, students will know that there are numbers that are not rational, and approximate them using rational numbers. Students will work with radicals and integer exponents. Students will understand congruence and similarity using physical models, transparencies, or geometry software. Students will understand and apply the Pythagorean Theorem. Students will solve real-world and mathematical problems involving volume of cylinders, cones, and spheres. Students will understand the connections between proportional relationships, lines, and linear equations. Students will analyze and solve linear equations and pairs of simultaneous linear equations. Students will define, evaluate, and compare functions, and use functions to model relationships between quantities. Students will investigate patterns of association in bivariate data.

The Mathematics activities are focused on some of the concepts that are assessed on the Grade 8 CRCT Mathematics domains. These domains are as follows:

## (1) Number and Operations

## (2) Geometry

## (3) Algebra

## (4) Data Analysis and Probability

The Standards for Mathematical Practices are integrated across the four domains.
Mathematical Practices are listed with each grade's mathematical content standards to reflect the need to connect the mathematical practices to mathematical content in instruction.

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report Adding It Up: adaptive reasoning, strategic competence, conceptual
understanding (comprehension of mathematical concepts, operations, and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently, and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

## Activities



## (1) Number and Operations <br> Common Core Georgia Performance Standards MCC8.NS.1, MCC8.NS.2, MCC8.EE.1, MCC8.EE.2, MCC8.EE.3, and MCC8.EE. 4

Within the Number and Operations domain, students learn that there are numbers that are not rational, and approximate them using rational numbers. They will work with radicals and integer exponents.

The following activities develop skills in this domain:

- To practice finding square roots and using radicals, students will set up and solve simple radical equations involving the side lengths of squares. In The Perfect Square Gardens, there are four gardens that are perfectly square. Garden A has an area of 81 square yards, Garden B has an area of 121 square yards, Garden C has an area of 196 square yards, and Garden D has an area of 225 square yards. The head gardener is going to make four new square gardens and he wants:
- The side length of Garden E to be twice the side length of Garden C
- The side length of Garden $F$ to be the sum of the side lengths of Gardens A and B
- The side length of Garden G to be the difference of the side lengths of Gardens A and D
- The ratio of the side lengths of Garden H to Garden B to have the same ratio as the side lengths of Garden D to Garden A

Use $\sqrt{81}, \sqrt{121}, \sqrt{196}$, and $\sqrt{225}$ to set up and solve equations and proportions to find the side lengths of the four new perfectly square gardens. After finishing the problem, students should describe in their own words the relationship between the radical sign, the square root of a number, and the side length of a square with a given area.

- To develop fluency with the laws of exponents, students will build exponential expressions that are equivalent to a given exponential expression. Each student will write a different simple exponential expression, such as $2^{6}$, on three index cards. For their unique expression, the students should make five additional index cards according to these rules:
- The first index card should have an expression that reduces to the original exponential expression using the addition law of exponents. For example, for $2^{6}$ students might write $2^{2} \times 2^{4}, 2^{3} \times 2^{3}$, or $2^{5} \times 2$.
- The second index card should have an expression that reduces to the original exponential expression using the multiplication law of exponents. For example, for $2^{6}$ students might write $\left(2^{3}\right)^{2}$ or $\left(2^{2}\right)^{3}$.
- The third index card will have an expression that reduces to the original exponential expression using the division law of exponents. For example, for $2^{6}$ students might write $\frac{2^{12}}{2^{6}}$ or $\frac{2^{10}}{2^{4}}$.
- The fourth index card will have an expression that reduces to the original exponential expression using the addition and division laws of exponents. For example, for $2^{6}$ students might write $\frac{2^{4} 2^{5}}{2^{3}}$ or $\frac{2^{2} 2^{6}}{2^{2}}$.
- The fifth index card will have an expression that reduces to the original exponential expression using the multiplication and division laws of exponents. For example, for $2^{6}$ students might write $\frac{\left(2^{3}\right)^{3}}{2^{3}}$.

Students then shuffle the cards, exchange them, find and match all the equivalent expressions, and label each index card with the law or laws that were used to reduce the expression on it.

- To practice converting to, and using numbers in, scientific notation, students will make a model of the universe and calculate the time it would take to travel from Earth to the different locations at the speed of light. On a large sheet of paper or poster board, students should draw the Sun, the eight planets, Alpha Centauri, Sirius, Deneb, and the Galactic Center. Students should label their distances from Earth in scientific notation and should not be concerned with making the drawing to scale.

| Location | Distance from Earth in standard form ( $\mathbf{k m}$ ) | Distance from Earth in scientific notation (km) | Column <br> $3 \div$ speed of light = number of seconds | Column <br> $4 \div$ seconds per year = years to reach location |
| :---: | :---: | :---: | :---: | :---: |
| Sun | 149,570,000 |  |  |  |
| Mercury | 91,620,000 |  |  |  |
| Venus | 41,460,000 |  |  |  |
| Mars | 78,270,000 |  |  |  |
| Jupiter | 628,570,000 |  |  |  |
| Saturn | 1,277,430,000 |  |  |  |
| Uranus | 2,720,730,000 |  |  |  |
| Neptune | 4,350,330,000 |  |  |  |
| Alpha <br> Centauri | 40,396,400,000,000 |  |  |  |
| Sirius | 81,738,800,000,000 |  |  |  |
| Deneb | 13,263,600,000,000,000 |  |  |  |
| Galactic <br> Center | 262,151,000,000,000,000 |  |  |  |

Students will then:
1 Divide the distances by the speed of light ( $3.0 \times 10^{6} \mathrm{~km} / \mathrm{s}$ ).
2 Divide the quotient from No. 1 by the number of seconds in a year ( $3.1556926 \times 10^{7}$ s) to determine the time it would take in years to reach Earth by traveling at the speed of light. This information should also be included on their drawings.

- Students will review definitions and follow the steps of a flow chart to help them distinguish between rational and irrational numbers. Irrational numbers will include the estimated value of a non-perfect square. Prepare a deck of $3 \times 5$-inch cards ahead of time. On each card, write either a rational or an irrational number:
- Rational numbers can include fractions, terminating decimals, square roots of perfect squares (showing the perfect square inside a radical with an equal sign indicating the root), repeating decimals, and integers.
- Irrational numbers can include square roots of non-perfect squares (showing the non-perfect square inside a radical with an equal sign indicating the root), and non-terminating, non-repeating decimals.

To begin the lesson, post the following definitions:

- Rational number: A number that can be expressed as a ratio of two integers. In other words, a rational number can be written as a fraction, a repeating decimal, a terminating decimal, or a whole number.
- Irrational number: A number that cannot be expressed as a ratio of two integers. In other words, any number that is not rational.

Next, use the board or chart paper to show examples of rational and irrational numbers:

- For a rational number, show that the fraction 1/1000 can also be expressed as 0.001 .
- For an irrational number, write the symbol $\pi$ and ask students for the value of the symbol. Elicit that $\pi$ is usually written as the rounded off decimal of 3.14 . Demonstrate that $\pi$ is an irrational number because it can be written as $3.1415926535897932384626433832795 \ldots$... Explain that the value of $\pi$ goes on forever, without repeating or terminating.

Then, display the following flow chart. Explain that students will determine whether various numbers are rational or irrational numbers using the chart. They will begin at the rectangle and follow the various pathways depending upon how they answer questions about each rational or irrational number. Demonstrate using 1/1000 and 3.1415926535897932384626433832795....


Next, distribute one prepared index card to each student. Each card should have either a rational or irrational number written on it. Each student will use the flow chart to determine if his or her card displays a rational or irrational number. They may achieve this process in one of the following ways:

- Post the flow chart on the board or chart paper. One student at a time will tell the class how he or she moves through the flow chart for his or her number.
- Distribute a copy of the flow chart to each student. Students will trace the correct path for the numbers on their cards.
- Reproduce the flow chart with masking tape on the floor. Students will walk through the flow chart.
- As a group, plot the approximate location of $\pi$ on a number line between 0 and 10 in increments of 1.


Repeat again on a number line from 3 to 4 in increments of tenths.


Repeat a third time using a number line from 3.1 and 3.2 in increments of hundredths.


Discuss with students which number line gives the most accurate approximation.

How could they make a number line that is even more accurate?
Have students work in pairs or alone to create number lines to accurately approximate the locations of irrational numbers such as $\sqrt{2}, \sqrt{5}$, Golden Ratio (1.6180339887. . ), $\sqrt{99}$, etc.

Compare different number lines created by the students and discuss which ones show the best approximation of the number.

## Activities



## (2) Geometry

Common Core Georgia Performance Standards MCC8.G.1, MCC8.G.2, MCC8.G.3, MCC8.G.4, MCC8.G.5, MCC8.G.6, MCC8.G.7, MCC8.G.8, and MCC8.G. 9

The Geometry domain addresses students' understanding of congruence and similarity using physical models, transparencies, or geometry software. They will understand and apply the Pythagorean Theorem. Students will solve real-world and mathematical problems involving volume of cylinders, cones, and spheres.

The following activities develop skills in this domain:

- To experience the outcome when parallel lines are cut by a transversal, students will make and put together puzzles formed by parallel lines and transversals. Students place masking tape on paper to make two parallel lines, one transversal, and a second set of parallel lines that cross the first set. Students then separate the angles by cutting the piece of paper along the masking tape edge. Students will measure and label one angle formed by the single transversal and one angle formed by the parallel line crossings. They then switch pieces, put the puzzle back together, and label all the angles. After they finish, students should be able to explain the following:
- Why they needed only one angle measurement from each set of line crossings
- Why they couldn't have found the measures of all the angles if they had been given only one angle from a single transversal intersection
- The rules they used to find the missing angle measures
- Students will strengthen their ability to use congruence by labeling corresponding angles and sides of congruent figures in different positions. First, students should cut out different triangles, quadrilaterals, and polygons from a piece of paper. On a separate piece of paper for each shape, students should choose a position for tracing the figure. Then, based on that position, students should do the following:
- Measure and label the angles and side lengths of the original figure. (Students will need a ruler and protractor.)
- Trace the figure translated to the right two inches.
- Trace the figure reflected horizontally and vertically.
- Trace the figure rotated $90^{\circ}$ and $270^{\circ}$.

Students then exchange tracings and use different colored markers to show congruent sides and angles. They will label the angle measures and side lengths and briefly describe how they used the properties of congruence to find the measurements.

- To develop students' sense of transformations in the coordinate plane, students will play a game in which the board is a portion of the coordinate plane, and the pieces are plane figures that move around the board by transformations. Students should make a $10 \times 10$ grid, highlight the middle lines as the $x$ - and $y$-axes, cut out the five pieces of each color shown in the sample below, and start with them in the given positions.


The goal of the game is to capture all of your opponent's pieces. The rules are:

- On any turn only one piece can be moved:
- Rectangles can rotate $90^{\circ}, 180^{\circ}$, or $270^{\circ}$ about the origin, but cannot move in any other way. (Note: To challenge students, describe the rotations as $-90^{\circ},-180^{\circ}$, and $-270^{\circ}$. Point out that when a degree is positive, the object is moved in a counterclockwise direction. When it is negative, the object is moved in a clockwise direction. Students should experiment until they see that pairs of rotations [ $-90^{\circ}$ and $270^{\circ}, 90^{\circ}$ and $-270^{\circ}$, and $180^{\circ}$ and $-180^{\circ}$ ] make the object rotate to the exact same position on the grid.)
- Triangles can translate horizontally and vertically a total of three units or reflect across the $y$-axis.
- Circles can translate one unit horizontally or vertically.
- Only rectangles can move over another piece.
- A player cannot have two pieces occupying the same square.
- If a player places any part of one of his or her pieces on top of any part of one of his or her opponent's pieces of the same shape, he or she captures that piece.
- If a player places any part of one of his or her pieces on any part of one of his or her opponent's pieces of a different shape, the opponent's piece is frozen until the player's piece moves on.

Students will make a three-column table to use as a transformation log. They will record the type of transformation in the left column, the coordinates before the transformation in the middle column, and the coordinates after the transformation in the right column. They should identify the relationship between each pair of coordinates and explain how this relationship is associated with the transformation recorded. For example, if the transformation was a horizontal translation, the values of the $y$-coordinates would not change, but the values of the $x$-coordinates would. In evaluating a horizontal translation, students should also note the similarity to a reflection across the $y$-axis and the inverse relationship to a vertical translation.

- Students will apply the Pythagorean Theorem to construct lines with lengths that are irrational numbers. The square root of any positive integer that is not a perfect square is an irrational number. Students should first draw four right triangles with the following leg lengths:
- 1 inch and 1 inch
- 1 inch and 2 inches
- 2 inches and 3 inches
- 4 inches and 4 inches

Students will then find the lengths of the hypotenuses, leaving them in radical form. Students should then answer the following questions:

1 Which lines have lengths that are irrational?
2 How did you find the lengths?
3 How were you able to use the Pythagorean Theorem to create and measure the lengths accurately?
4 Could you have measured these lengths accurately using a standard ruler?

- To make a connection between the algebraic equation and geometric meaning of the Pythagorean Theorem, students will find the square of the hypotenuse of a right triangle using the squares of its legs. Students will cut out 1 -inch squares from two $8.5 \times 11$ pieces of paper.

1 First, students should draw a right triangle with leg lengths 3 inches and 4 inches. They will then use the 1-inch square papers to build a $3 \times 3$ square and a $4 \times 4$ square along the respective legs. They then will use those 1 -inch square papers to build a square along the hypotenuse and write what happened in their own words.

2 Second, students should draw an acute triangle that has side lengths 3 inches and 4 inches. Students should predict and verify whether the third side length will be less than or greater than 5 inches. They then will build $3 \times 3$ and $4 \times 4$ squares along the 3 - and 4 -inch sides using the 1-inch paper squares. Students will then try to build a square of 1-inch paper squares along the third side and write what happens.
3 Finally, students should draw an obtuse triangle with side lengths 3 inches and 4 inches. They should predict and verify whether the third side length will be less than or greater than 7 inches. They then will build the $3 \times 3$ and $4 \times 4$ squares on the 3 - and 4 -inch sides with the 1-inch paper squares. Students will then try to build a square of 1-inch paper squares along the third side and write what happens.
4 Students then repeat steps 1-3 using leg lengths and side lengths of 6 inches and 8 inches, and 5 inches and 12 inches.

After finishing the activity, students will answer these questions:

- What does the Pythagorean Theorem say about the areas of the squares formed on the legs and hypotenuse of a right triangle?
- Was the third side of the acute triangle shorter or longer than the hypotenuse of the right triangle? How did this affect the relationship between the areas of the squares formed on the 3 - and 4 -inch sides and the area of the square formed on the third side?
- Was the third side of the obtuse triangle shorter or longer than the hypotenuse of the right triangle? How did this affect the relationship between the areas of the squares formed on the 3-and 4-inch sides and the area of the square formed on the third side?
- Why didn't the Pythagorean Theorem work for the acute and obtuse triangles?
- Volume is a common measure used for cylinders, cones, and spheres. To apply volume measures, students should choose the cylindrical water storage container that will meet Williamsburg's water storage needs, as outlined in the activity below:
- The new water storage system Williamsburg is installing must have a capacity (volume) that is at least the same as the capacity of a spherical water tank with a radius of 5 meters. The town would like to keep the height of the container as small as possible. Which tank should the town choose and why? Be sure to give details comparing the various options.

Tank One: radius 3 m , height 8 m
Tank Two: radius 3 m , height 3 m
Tank Three: radius 7 m , height 4 m
Tank Four: radius 7 m , height 3 m
Tank Five: radius 8 m , height 3 m
Tank Six: radius 8 m , height 2 m

## Activities



## (3) Algebra

Common Core Georgia Performance Standards MCC8.EE.5, MCC8.EE.6, MCC8.EE.7, MCC8.EE.8, MCC8.F.1, MC.C8F.2, MCC8.F.3, MCC8.F.4, and MCC8.F. 5

The Algebra domain addresses students' ability to understand the connections between proportional relationships, lines, and linear equations. They will analyze and solve linear equations and pairs of simultaneous linear equations. Students will define, evaluate, and compare functions, and use functions to model relationships between quantities.

The following activities develop skills in this domain:

- Students will work with data about the Georgia state bird, the brown thrasher, to recognize relations and functions, to distinguish between relations and functions, and to show how the same function can be represented in a variety of ways. First, review the definitions of relation and function with the class. Post the following definitions on the board or chart paper:
- Relation: a set of ordered pairs, showing a correspondence between two groups
- Function: a rule of matching elements of two sets of numbers in which an input value from the first set has only one output value in the second set

Next, explain to students that they will work with data about the brown thrasher's nest-building heights and the number of eggs the brown thrasher lays in the nest.

Distribute copies of the following table, or post on the board or chart paper:

| Height of the nest <br> from the ground <br> in inches <br> $(\boldsymbol{x})$ | Number of eggs <br> in the nest |
| :--- | :--- |
| 6 | $(\boldsymbol{y})$ |
| 8 | 2 |
| 10 | 1 |
| 2 | 5 |
| 5 | 3 |
| 3 | 5 |
| 4 | 4 |
| 6 | 6 |
| 9 | 4 |
| 7 | 2 |

Then, ask the class whether the information provided in the table represents a relation that is a function or is not a function. Elicit the correct answer: the table represents a relation that is not a function. Students will notice that for the $x$ value of 6 , there are two possible $y$ values, 2 and 4 .

Tell students to use the Vertical Line Test as an additional way to prove whether or not a group of ordered pairs represents a relation that is a function. Explain that a relation is not a function if a vertical line can be drawn through two or more points because, for some value of the input, $x$, there are at least two values for the output, $y$. Students test this proof:

- Provide each student with a grid similar to the one that follows.

- Students will plot the 10 ordered pairs from the nest/egg table.
- Students will then examine the plot to see whether a vertical line can be drawn to connect any two or more plotted points.
- Students will find that the ordered pairs $(6,2)$ and $(6,4)$ can be connected by a vertical line, proving that the relation is not a function.

Distribute or post the following table and inform the class that the table shows data regarding a brown thrasher population. Explain that the table shows the population of one group of brown thrashers, which began with 500 birds and declined at a constant rate over five years due to the loss of habitat.

| Year <br> $\mathbf{( x )}$ | Population <br> $(\boldsymbol{y})$ |
| :---: | :---: |
| 0 | 500 |
| 1 | 450 |
| 2 | 405 |
| 3 | 365 |
| 4 | 328 |
| 5 | 295 |

Once again, ask the class whether the information provided on the table represents a relation that is or is not a function. Elicit the correct answer: the table represents a relation that is a function. For each $x$ value, there is one, and only one, $y$ value.

Distribute another grid. Students will use the Vertical Line Test to prove that the population data does represent a function. Students will not be able to draw a vertical line to connect two or more plotted points.

Conclude the activity with a discussion of how functions can be represented in a variety of ways. Explain that the two columns of data represent the function in a tabular representation. Have students connect the plotted ordered pair points from their second grid and explain that the downward sloping line is a graphical representation of the function.

## Activities



## (4) Data Analysis and Probability

Common Core Georgia Performance Standards MCC8.SP.1, MCC8.SP.2, MCC8.SP.3, and MCC8.SP. 4

The Data Analysis and Probability domain addresses students' ability to investigate patterns of association in bivariate data.

The following activities develop skills in this domain:

- Students will practice making inferences from statistics by gathering price data for cereals, and making a scatter plot. Students will go to the grocery store and record the prices and weights of 15 different cereals. Students will then plot the values with the weights on the $x$-axis and the prices on the $y$-axis. Students will explain in their own words what they think is the relationship between the amount of cereal purchased and the purchase price.
- Sam collected the following data about students in his grade at his school:
- 78 boys participate in an afterschool sport
- 52 girls participate in an afterschool sport
- 28 boys watch more than 3 hours of television on weekdays
- 34 girls watch more than 3 hours of television on weekdays

Construct a two-way table with these data. Construct a two-way table using relative frequencies. What conclusions can be drawn about the differences in the behaviors of boys and girls at Sam's school and grade? What associations can be made between participating in afterschool sports and watching more than 3 hours of television on weekdays?

## Practice Quiz

1 Which number line shows the value that is closest to $\sqrt{\mathbf{8 9}}$ ?
$A \quad \underset{5}{+}$
B


C


D


2 What is the value of $\left(3^{6}\right)\left(3^{-2}\right)(3)$ ?
A 9
B 27
C 81
D 243

3 At a train station, Track A is parallel to Track C. Track B intersects Track A and Track C. Track A and Track B intersect at an angle of $150^{\circ}$ as shown.


What is the measure of the angle, $x$, formed by the intersection of Track B and Track C?
A $30^{\circ}$
B $50^{\circ}$
C $150^{\circ}$
D $180^{\circ}$

In this figure, $A^{\prime} B^{\prime} C^{\prime} D^{\prime}$ is a transformation of $A B C D$.


Which type of transformation is $A^{\prime} B^{\prime} C^{\prime} D^{\prime}$ ?
A dilation
B rotation
C reflection
D translation

5 Which expression is equivalent to $\mathbf{4}^{-4} \times \mathbf{4}^{\mathbf{2}}$ ?
A $\frac{1}{16^{2}}$
B $\frac{1}{4^{2}}$
C $4^{2}$

D $16^{2}$

6 Which relation does NOT represent a function?
A $\{(3,2),(-3,2),(2,3)\}$
B Input Output


C $x=-2$
D

| $x$ | $y$ |
| :---: | :---: |
| 3 | 4 |
| 5 | 7 |
| 7 | 10 |
| 9 | 13 |

7 Look at the equation.

$$
2 x+5 y=100
$$

Which graph represents this equation?
A

B

C

D


8 John gets price quotes from two different lawn-mowing services for the cost of mowing the field next to his house. Company A charges $\mathbf{\$ 8}$ plus an additional \$5 per hour. Company B charges $\mathbf{\$ 2}$ plus an additional $\$ 6$ per hour. The total price quote for each company is the same amount.

How many hours do the companies estimate it will take to mow the field?
A 6
B 10
C 21
D 38

## 9 Which equation represents a linear function?

A $y=3 x^{2}-5$
B $y=64 x+12$
C $y=8 x^{3}+27$
D $y=\frac{15}{x}-8$

10 Jerome asked students at his school how many different sports they played in a year and how many hours they spent on homework each week. He recorded the data in a two-way table.

Sports and Weekly Homework

|  | Less Than <br> 2 Hours | 2 to <br> 5 Hours | More Than <br> 5 Hours | Totals |
| :--- | :---: | :---: | :---: | :---: |
| No Sports | 2 | 3 | 6 | 11 |
| 1 Sport | 1 | 6 | 11 | 18 |
| 2 Sports | 2 | 8 | 20 | 30 |
| 3 Sports | 1 | 12 | 6 | 19 |
| 4 Sports | 3 | 6 | 5 | 14 |
| Totals | 9 | 35 | 48 | 92 |

## Which statement is correct?

A Students who play 4 sports are more likely to spend 2 to 5 hours on homework than students who play 1 sport.
B Students who play 4 sports are less likely to spend more than 5 hours on homework than students who play 3 sports.
C Students who play 1 sport and students who play 3 sports are equally likely to spend less than 2 hours on homework.
D Students who play no sports and students who play 2 sports are equally likely to spend less than 2 hours on homework.

| Number | Correct Answer | Explanation |
| :---: | :---: | :---: |
| 1 | B | Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., $\pi^{2}$ ). (MCC8.NS.2) <br> The correct answer is Choice (B). Because 89 is between 81 and 100 , its square root will be between $\sqrt{81}=9$ and $\sqrt{100}=10$. Choice $(A)$ is incorrect because it is between 8 and 9 , possibly a calculation error. Choice (C) is incorrect and is half of 89 . Choice (D) is incorrect and is 89 itself. |
| 2 | D | Know and apply the properties of integer exponents to generate equivalent numerical expressions. (MCC8.EE.1) <br> The correct answer is Choice (D) 243. When multiplying powers with the same base, the exponents $6,-2$, and 1 are added to give an exponent of 5 : $3^{5}=243$. Choice $(A)$ is incorrect and may result from dividing 6 by 2 and then subtracting the unlabeled exponent of 1 to get $3^{2}=9$. Choice $(B)$ is incorrect and may result from dividing 6 by 2 and then ignoring the unlabeled exponent of 1 on top of 3 to get $3^{3}=27$. Choice (C) is incorrect and may result from mistakenly dividing 6 by 2 and then adding 1 to get $3^{4}=81$. |

[^0]| Number | Correct <br> Answer | Explanation |
| :--- | :--- | :--- |
| 4 | C | Describe the effect of dilations, translations, rotations, <br> and reflections on two-dimensional figures using <br> coordinates. (MCC8.G.3) |
|  |  | The correct answer is Choice (C) reflection. <br> Parallelogram $A B C D$ is reflected across the $y$-axis to <br> become parallelogram $A^{\prime} B^{\prime} C^{\prime} D^{\prime}$. Choice (A) is incorrect <br> because the figure would have changed size, and not <br> orientation, under a dilation. Choice (B) is incorrect. <br> A 270-degree rotation would put the image in quadrant I, <br> but the coordinates of the vertices would be different. <br> Choice (D) is incorrect because the figure has changed <br> orientation, which does not happen under a translation. |


| 5 | B $\quad \begin{array}{l}\text { Know and apply the properties of integer exponents to } \\ \text { generate equivalent numerical expressions. (MCC8.EE.1) }\end{array}$ |
| :--- | :--- | :--- |

The correct answer is Choice ( $\mathbf{B}$ ) $\frac{\mathbf{1}}{\mathbf{4}^{2}}$. It is an equivalent form of the expression $4^{-4} \times 4^{2}$. First the two factors are combined by adding the exponents $-4+2=-2$ to $4^{-2}$, then the reciprocal is used to get a positive exponent. Choice (A) is not correct because the two 4 s are multiplied before combining the exponents. Choice (C) is not correct because the exponent is shown as positive and not negative when combined. Choice (D) is not correct because the two 4 s are multiplied and the exponent is shown as positive when combined.

| 6 | C | Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. (MCC8.F.1) <br> The correct answer is Choice $(\mathbf{C}) \mathbf{x}=\mathbf{- 2 .} x=-2$ is a vertical line, which means there is more than one $y$ value that corresponds to the $x$ value of -2 . Choice (A) is incorrect and could represent a function because we do not see any repeated values in the input positions of the coordinate pairs. Choice (B) is incorrect. It represents a function because every input has only one arrow coming from it and, therefore, has only one output. Choice ( D ) is incorrect and represents a function because we don't see different $y$ outputs for a repeated $x$ input. |
| :---: | :---: | :---: |


| Number | Correct <br> Answer | Explanation |
| :--- | :--- | :--- |
| 7 | A | Construct a function to model a linear relationship <br> between two quantities. Determine the rate of change <br> and initial value of the function from a description of a <br> relationship or from two $(\mathrm{x}, \mathrm{y})$ values, including reading <br> these from a table or from a graph. Interpret the rate <br> of change and initial value of a linear function in terms <br> of the situation it models, and in terms of its graph or a <br> table of values. (MCC8.F.4) |

The correct answer is Choice ( $\mathbf{A}$ ). The $y$-intercept of the equation is 20 and the $x$-intercept is 50 . The only graph with a line with those intercepts is the graph in Choice (A). Choice (B) is incorrect and results from using the $x$ - and $y$-intercepts as the $x$ and $y$ values of a point on the line. Choice (C) is incorrect and results from making the $x$-intercept 20 and the $y$-intercept 50. Choice (D) is incorrect and results from using the $x$-intercept as the $y$ value and the $y$-intercept as the $x$ value of a point on the line.

8 A Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. (MCC8.EE.8b)
The correct answer is Choice (A) 6. If $h=$ hours, the expression for the price quote from Company $A$ is $8+5 h$, and the expression for the price quote from Company $B$ is $2+6 h$. Because the two price quotes are equal, the two expressions should be written as an equality, $8+5 h=2+6 h$; by simplifying the equation (by subtracting 5 h from both sides and subtracting 2 from both sides) to isolate the variable, the result is $h=6$. Choice ( $B$ ) is incorrect and may result from incorrectly adding 2 to both sides instead of subtracting. Choice ( $C$ ) is incorrect and results from simply adding all the given numbers: $8+5+2+6=21$. Choice ( $D$ ) is incorrect and results from finding the dollar amount of the price quotes from either company.

| Number | Correct Answer | Explanation |
| :---: | :---: | :---: |
| 9 | B | Interpret the equation $y=m x+b$ as defining a linear function whose graph is a straight line; give examples of functions that are not linear. (MCC8.F.3) |
|  |  | The correct answer is Choice (B) $\mathbf{y}=\mathbf{6 4 x} \mathbf{+ 1 2}$ because the equation $y=64 x+12$ is in the form of $y=m x+b$ and the graph would be a straight line. Choice (A) is not correct because the equation $y=3 x^{2}-5$ is not in the form of $y=m x+b$ and the graph would not be a straight line. Choice ( C ) is not correct because the equation $y=8 x^{3}+27$ is not in the form of $y=m x+b$ and the graph would not be a straight line. Choice ( D ) is not correct because the equation $y=\frac{15}{x}-8$ is not the form of $y=m x+b$ and the graph would not be a straight line. |
| 10 | A | Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. (MCC8.SP.4) |
|  |  | The correct answer is Choice (A) Students who play 4 sports are more likely to spend 2 to 5 hours on homework than students who play 1 sport because the relative frequency of 4 sports and 2 to 5 hours of homework is greater than the relative frequency of 1 sport and 2 to 5 hours of homework. The relative frequency of 4 sports in this category is $(6 \div 14) \times 100=42.9 \%$ and the relative frequency of 1 sport in this category is $(6 \div 18) \times 100=33.3 \%$. Choice $(B)$ is not correct because the relative frequency of 4 sports and more than 5 hours of homework is $35.7 \%$ and the relative frequency of 3 sports and more than 5 hours of homework is $31.5 \%$. Choice (C) is not correct because the relative frequency of 1 sport and less than 2 hours of homework rounds to $5.5 \%$ and the relative frequency of 3 sports and less than 2 hours of homework is $5.2 \%$. Choice (D) is not correct because the relative frequency of no sports and less than 2 hours of homework is $18.2 \%$ and the relative frequency of 2 sports and less than 2 hours of homework is $6.7 \%$. |

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[^0]:    3
    A
    Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. (MCC8.G.5)

    The correct answer is Choice (A) $\mathbf{3 0} \mathbf{0}^{\circ}$. Angle $x$ is congruent to either of the acute angles formed by the intersection of Track A and Track B. When one of the acute angles is added to the $150^{\circ}$ angle, the result is a line forming a straight angle of $180^{\circ}$. Subtracting $150^{\circ}$ from $180^{\circ}$ gives an acute angle measuring $30^{\circ}$. Angle $x$ is congruent to these acute angles and has the same angle measure, $30^{\circ}$. Choice (B) is incorrect and may result from a calculation error when solving $x+150=180$. Choice (C) is incorrect and may result from thinking that angles inside the parallel lines on the same side of the transversal should be equal. Choice (D) is incorrect because $180^{\circ}$ represents the sum of $150^{\circ}$ and $30^{\circ}$.

