Unit 1:

Square Roots, Cube Roots, and Irrational Numbers

Student Book

Catapult Learning™

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Garden Challenge

Part 1: Use **square tiles** to model the described garden. Then write two expressions to represent the area.

1. Michelle helps build a garden at her school that is 12 feet on each side. What is its area?

a. Multiplication expression: _____

b. Exponential expression: _____

c. The area of Michelle's garden is _____ square feet.

2. Theo builds a small garden in his yard. It is 7 feet on each side. What is the area?

a. Multiplication expression: _____

b. Exponential expression: _____

c. The area of Theo's garden is _____ square feet.

3. Luna builds a garden that is 10 feet on each side. What is the area of her garden?

a. Multiplication expression: _____

b. Exponential expression: _____

c. The area of Luna's garden is _____ square feet.

Part 2: Answer the questions. Use **square tiles** to help.

4. Henry builds a square garden that is 11.7 feet on one side. Is the area of his garden a perfect square? How do you know?

_____

_____

5. Amelia builds a tiny garden on her apartment balcony that is 1 foot on each side. Is the area of her garden a perfect square? How do you know?

_____

_____

Flower Power

Review the example problem. Then complete the table by writing two equations, one with multiplication and one with exponents, that tell how big the area is. You may use **square tiles** to help.

Example

Some people in the city have decided to grow flower gardens. Raj makes a square garden. He measured one side of his garden and found that it was 2 feet long. What is the area of Raj's garden?

Step 1

Use the formulas for the area of a square.

$A = s \times s$

$A = s^2$

Step 2

Substitute the given side length in the formula.

$A = 2 \times 2$

$A = 2^2$

Step 3

Multiply.

$A = 2 \times 2 = 4$

$A = 2^2 = 4$

The area of the garden is 4 square feet.

Person	**Side Length** (in feet)	**Equations**	**Area**
Levi	3		
Freya	8		
Landon	11		
Lilly	16		
Noah	5		
Lincoln	9		
Lorelei	15		
Wyatt	4		
Astrid	13		
Naomi	14		

Lesson 1 Exit Ticket

Part 1: Use **square tiles** to model the described garden. Then write two expressions to represent the area.

1. Finn helps build a community garden that is 4 feet on each side. What is its area?

Multiplication expression: _____

Exponential expression: _____

The area of the community garden is _____ square feet.

2. Sofia wants to build a square garden in her backyard. She has a small yard, and the garden cannot be wider than 6 feet. What will be the area of her garden?

Multiplication expression: _____

Exponential expression: _____

The area of the Sofia's garden is _____ square feet.

Part 2: Answer the questions. Use **square tiles** to help.

3. Elliott builds a garden that has a length of 6 feet and a width of 7 feet. Is the area of his garden a perfect square? How do you know?

_____

_____

_____

_____

4. Ophelia builds a garden that has a length of 8 feet and a width of 8 feet. Is the area of her garden a perfect square? How do you know?

_____

_____

_____

_____

Extra Practice: Perfect Squares

Part 1: Match the side length to the area of a square with that side length.

10 meters	36 square meters
6 meters	64 square meters
9 meters	81 square meters
8 meters	100 square meters

Part 2: Complete the exponential equations to find the perfect squares. Then, color in the perfect squares in the grid. Use **square tiles** to help.

1^2 = _____ 8^2 = _____ 15^2 = _____ 6^2 = _____

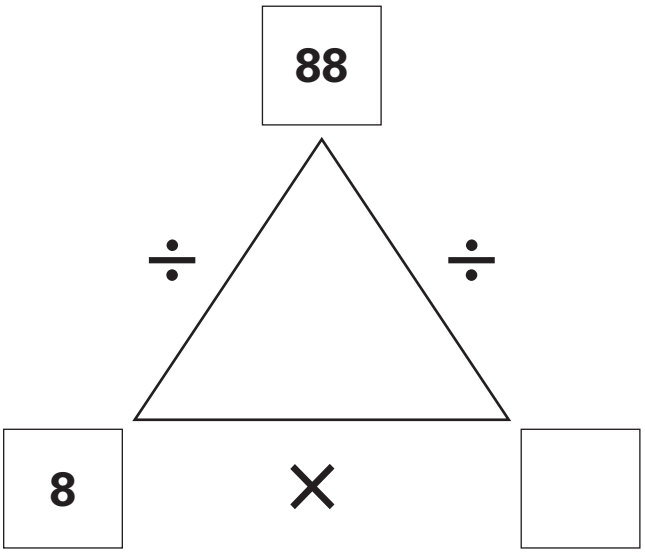
12^2 = _____ 13^2 = _____ 5^2 = _____ 10^2 = _____

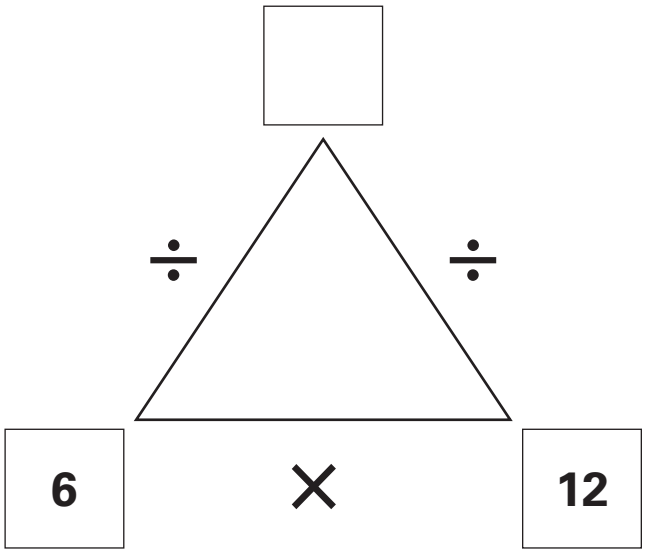
3^2 = _____ 16^2 = _____ 7^2 = _____ 14^2 = _____

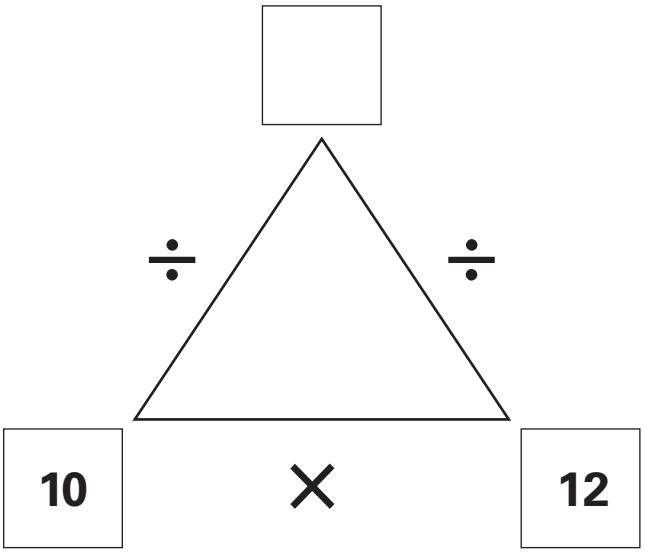
9^2 = _____ 2^2 = _____ 11^2 = _____ 4^2 = _____

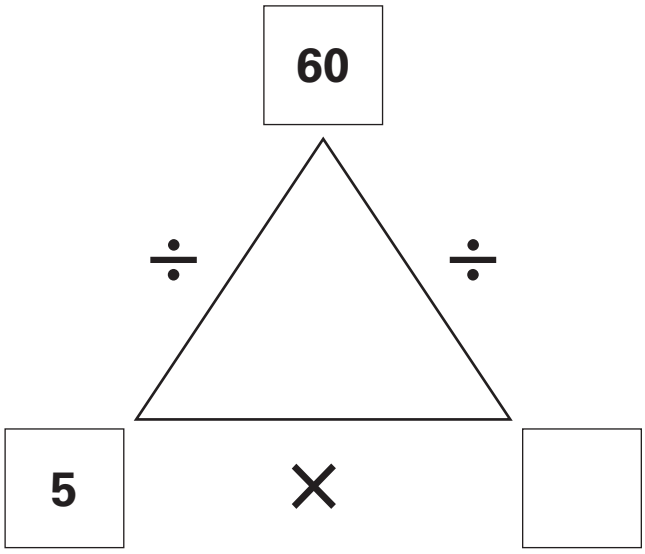
1	3	4	7	9	11	14	16	20	25
32	36	40	45	49	52	60	64	81	84
92	96	100	110	115	121	124	132	135	144
169	172	175	196	200	208	225	248	256	264

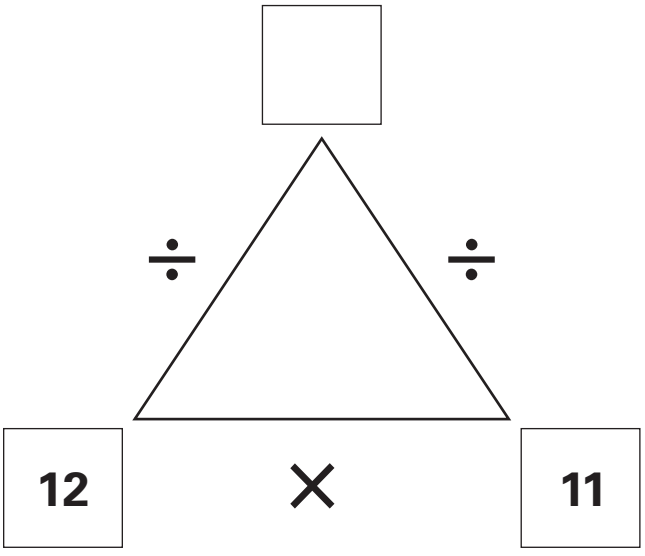
Number Triangles

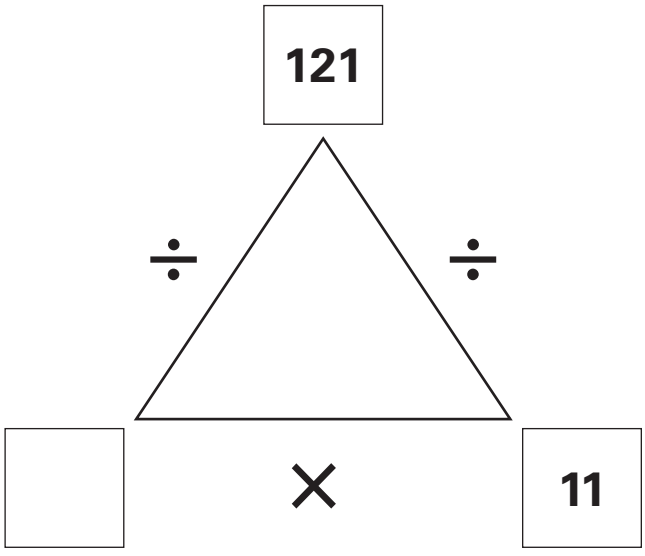




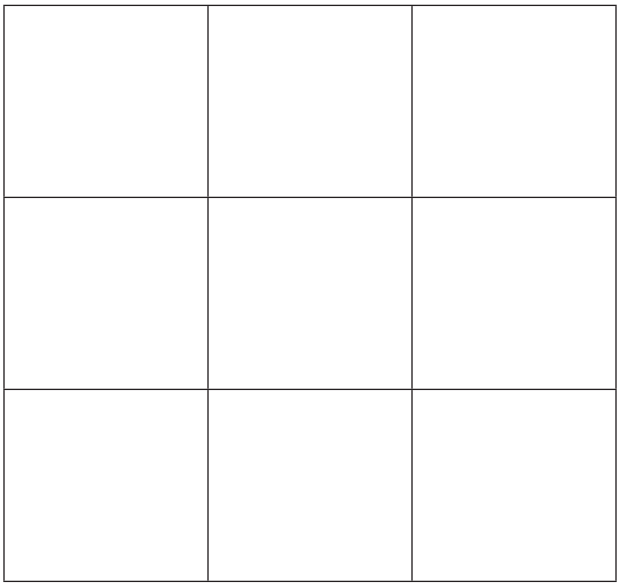


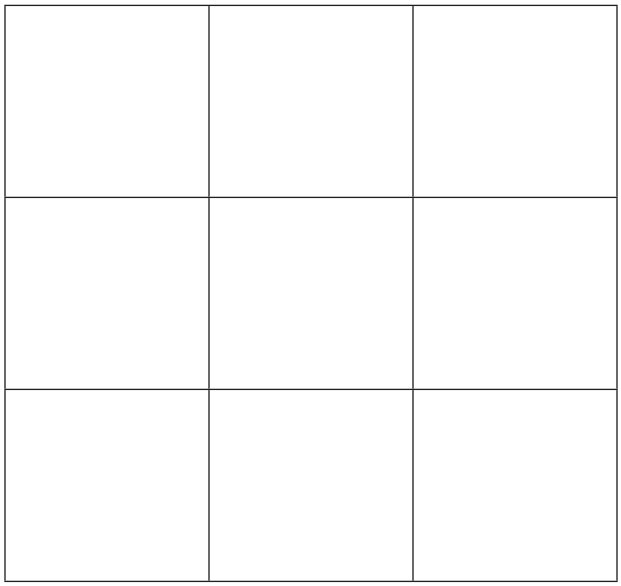


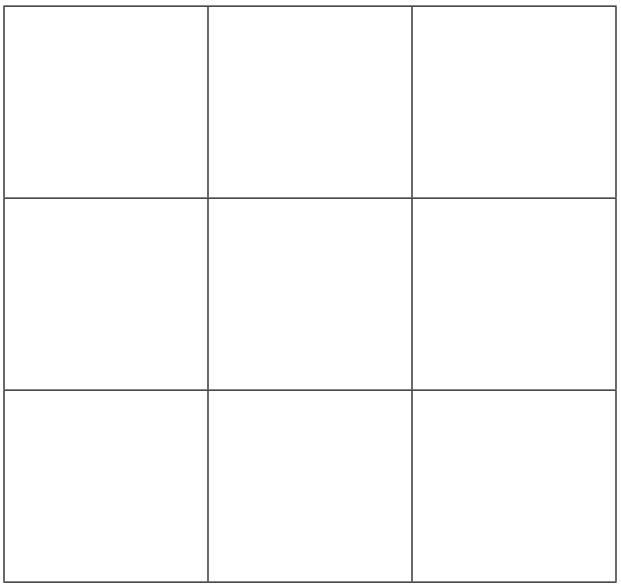


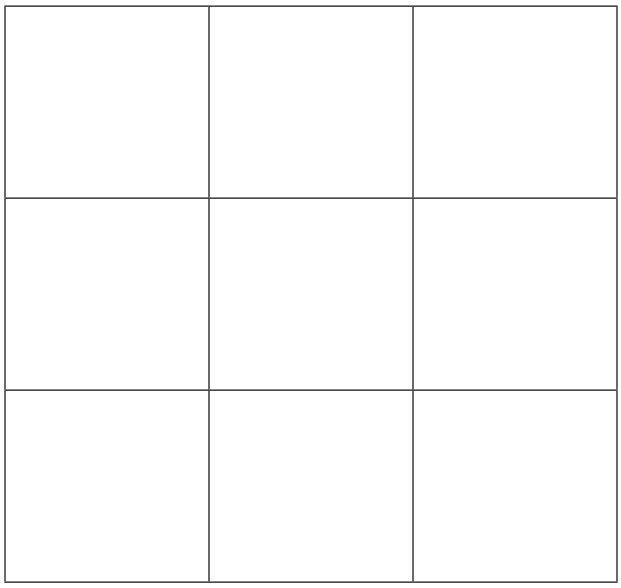


Square Root Bingo Playing Cards









Square Root Bingo
Number Cards

1^2	2^2	3^2	4^2
5^2	6^2	7^2	8^2
9^2	10^2	11^2	12^2
13^2	14^2	15^2	16^2

Mosaic Madness

Gabe's classmates are also making mosaics for the ceramics class final project. Draw each mosaic on **graph paper**. Then complete the equations.

1. Rhianna uses 49 one-inch tiles to make her square mosaic. What is the length of one side of her mosaic?

$\_\_\_\_\_ = s \times s$ $\quad$ $\_\_\_\_\_ = s^2$ $\quad$ $\sqrt{\_\_\_\_\_} = \sqrt{s^2}$ $\quad$ $\sqrt{\_\_\_\_\_} = \_\_\_\_\_$

The side length of Rhianna's mosaic is _____ inches.

2. Simon uses 121 one-inch tiles to make his square mosaic. What is the length of one side of his mosaic?

$\_\_\_\_\_ = s \times s$ $\quad$ $\_\_\_\_\_ = s^2$ $\quad$ $\sqrt{\_\_\_\_\_} = \sqrt{s^2}$ $\quad$ $\sqrt{\_\_\_\_\_} = \_\_\_\_\_$

The side length of Simon's mosaic is _____ inches.

3. Donald uses 196 one-inch tiles to make his square mosaic. What is the length of one side of his mosaic?

$\_\_\_\_\_ = s \times s$ $\quad$ $\_\_\_\_\_ = s^2$ $\quad$ $\sqrt{\_\_\_\_\_} = \sqrt{s^2}$ $\quad$ $\sqrt{\_\_\_\_\_} = \_\_\_\_\_$

The side length of Donald's mosaic is _____ inches.

4. Zoë uses 36 one-inch tiles to make her square mosaic. What is the length of one side of her mosaic?

$\_\_\_\_\_ = s \times s$ $\quad$ $\_\_\_\_\_ = s^2$ $\quad$ $\sqrt{\_\_\_\_\_} = \sqrt{s^2}$ $\quad$ $\sqrt{\_\_\_\_\_} = \_\_\_\_\_$

The side length of Zoë's mosaic is _____ inches.

Art Display

Review the example problem. Then find the square root of each number.

Example

Calvin and Veronica are displaying paintings for the art show. Each display will be a square. Calvin's display is **81** square feet. Veronica's display is **92** square feet. How wide will each of their displays be?

Step 1	**Step 2**
Decide whether the given area is a perfect square. **81** is a perfect square because $9 \times 9 = \mathbf{81}$. **92** is a *not* a perfect square because no integer multiplied by itself equals **92**.	Write an equation for the side length. Simplify the square root for perfect squares. $\sqrt{81} = 9$ Calvin's display will be 9 feet wide. $\sqrt{\mathbf{92}} = \sqrt{\mathbf{92}}$ Veronica's display will be $\sqrt{\mathbf{92}}$ feet wide.

1. $\sqrt{64} =$ _____

2. $\sqrt{144} =$ _____

3. $\sqrt{98} =$ _____

4. $\sqrt{108} =$ _____

5. $\sqrt{88} =$ _____

6. $\sqrt{32} =$ _____

7. $\sqrt{100} =$ _____

8. $\sqrt{225} =$ _____

9. $\sqrt{103} =$ _____

10. $\sqrt{256} =$ _____

11. $\sqrt{1} =$ _____

12. $\sqrt{224} =$ _____

13. $\sqrt{253} =$ _____

14. $\sqrt{4} =$ _____

15. $\sqrt{77} =$ _____

16. $\sqrt{48} =$ _____

17. $\sqrt{169} =$ _____

18. $\sqrt{81} =$ _____

19. $\sqrt{167} =$ _____

20. $\sqrt{56} =$ _____

Lesson 2 Exit Ticket

Part 1: Use **square tiles** or **graph paper** to model each mosaic. Then complete the equations.

1. Francia uses 169 one-inch tiles to make her square mosaic. What is the length of one side of her mosaic?

$\_\_\_\_\_ = s \times s$ $\quad$ $\_\_\_\_\_ = s^2$ $\quad$ $\sqrt{\_\_\_\_\_} = \sqrt{s^2}$ $\quad$ $\sqrt{\_\_\_\_\_} = \_\_\_\_\_$

The side length of Francia's mosaic is _____ inches.

2. Jason uses 81 one-inch tiles to make his square mosaic. What is the length of one side of his mosaic?

$\_\_\_\_\_ = s \times s$ $\quad$ $\_\_\_\_\_ = s^2$ $\quad$ $\sqrt{\_\_\_\_\_} = \sqrt{s^2}$ $\quad$ $\sqrt{\_\_\_\_\_} = \_\_\_\_\_$

The side length of Jason's mosaic is _____ inches.

Part 2: Find the square root of each number.

3. $\sqrt{204} =$ _____

4. $\sqrt{25} =$ _____

5. $\sqrt{4} =$ _____

6. $\sqrt{120} =$ _____

7. $\sqrt{16} =$ _____

Extra Practice: Squares Galore!

State whether each of the following sentences is true or false.

1. A square root is always a whole number. _____

2. Taking the square root of a number is the same as dividing the number by two. _____

3. The symbol used to indicate a square root is called the radical sign. _____

4. A square root is the opposite of a squared number. _____

5. When using an array to model the square root of a perfect square, you will never have tiles left over. _____

Shade each radical expression that is equal to an integer. Use **square tiles** or **graph paper** to help.

$\sqrt{85}$	$\sqrt{106}$	$\sqrt{169}$	$\sqrt{72}$
$\sqrt{36}$	$\sqrt{25}$	$\sqrt{96}$	$\sqrt{64}$
$\sqrt{148}$	$\sqrt{121}$	$\sqrt{200}$	$\sqrt{225}$
$\sqrt{115}$	$\sqrt{48}$	$\sqrt{49}$	$\sqrt{176}$

Square Root Cards

$\sqrt{4} =$	$\sqrt{9} =$
$\sqrt{16} =$	$\sqrt{25} =$
$\sqrt{36} =$	$\sqrt{49} =$
$\sqrt{64} =$	$\sqrt{81} =$

Square Root Cards

$\sqrt{100} =$

$\sqrt{121} =$

$\sqrt{144} =$

$\sqrt{169} =$

$\sqrt{196} =$

$\sqrt{225} =$

$\sqrt{256} =$

Square Root Cards

2	3
4	5
6	7
8	9

Square Root Cards

10	11
12	13
14	15
16	

Box Bonanza

Use **linking cubes** to model each cube. Then answer the questions and write an equation using an exponent.

1. Spencer buys his mom chocolate candies for a gift. He packs the candies in a cube-shaped box. He measures one edge of the box and finds that it is 3 inches long.

What is the length of the box? _____

What is the width of the box? _____

What is the height of the box? _____

What is the volume of the box? _____

Equation: _____

2. Spencer buys his brother a keychain. He puts it in a cube-shaped box that has an edge that is 2 inches long.

What is the length of the box? _____

What is the width of the box? _____

What is the height of the box? _____

What is the volume of the box? _____

Equation: _____

3. Spencer buys his grandmother a ring and puts it in a cube-shaped box. His grandmother loves math and when she sees the box, she measures one edge and finds that it is 1 inch long. "A perfect cube!" she exclaims. Explain why Spencer's grandmother would describe the box as a perfect cube.

_____

_____

_____

_____

_____

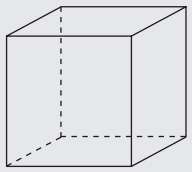
_____

Aquariums

Review the example problem. Then write the expressions to represent the volume of the aquarium shown.

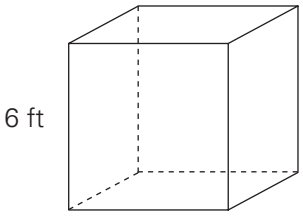
Example

Carmen's grandpa has a cube-shaped aquarium that Carmen loves to look at. The aquarium has the edge length shown. What is the volume of the aquarium?



Step 1	Step 2	Step 3
Use the edge length to write an exponential equation to represent the volume. $V = e^3$ $V = \mathbf{5}^3$	Use the edge length to write a multiplication equation to represent the volume. $V = e \times e \times e$ $V = \mathbf{5} \times \mathbf{5} \times \mathbf{5}$	Multiply to find the volume. $V = \mathbf{5}^3$ $V = \mathbf{5} \times \mathbf{5} \times \mathbf{5}$ $V = 125$ The volume of Grandpa's aquarium is 125 cubic feet.

1. Carmen goes to the city's aquarium and looks at the seahorses. Look at the tank below. What is the volume of the seahorse tank?

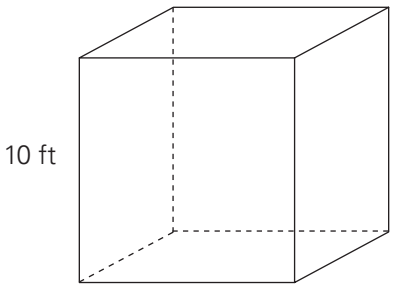


Multiplication expression: $V =$ _____

Exponential expression: $V =$ _____

The volume of the seahorse tank is _____.

2. Carmen loves to look at the little sharks in the big tank at the aquarium. Look at the tank below. What is the volume of the shark tank?



Multiplication expression: $V =$ _____

Exponential expression: $V =$ _____

The volume of the shark tank is _____.

Lesson 3 Exit Ticket

Part 1: Use **linking cubes** to model each cube. Then answer the questions.

1. Spencer buys his dad a little musical snow globe for a gift. He packs the globe in a cube-shaped box. He measures one edge of the box and finds that it is 4 inches long.

What is the length of the box? _____

What is the width of the box? _____

What is the height of the box? _____

What is the volume of the box? _____

What is 4 cubed? _____

2. Spencer cubes 3.333 and rounds the answer to 37. Is 37 a perfect cube? How do you know?

_____

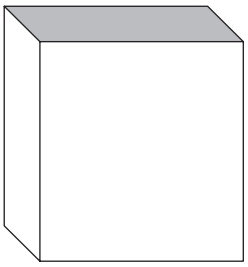
_____

_____

Part 2: Write the expression to represent the volume of the cubes shown.

3.

8 ft



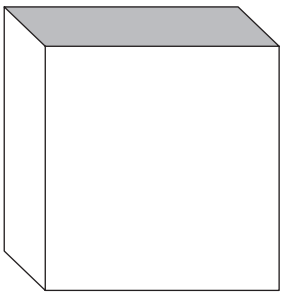
Multiplication expression: V = _____

Exponential expression: V = _____

The volume of the cube is _____

4.

9 ft



Multiplication expression: V = _____

Exponential expression: V = _____

The volume of the cube is _____

Extra Practice: Food Containers

Willow bought a set of cube-shaped containers to hold different snacks in her pantry. She made a list of the volume she needs for each snack:

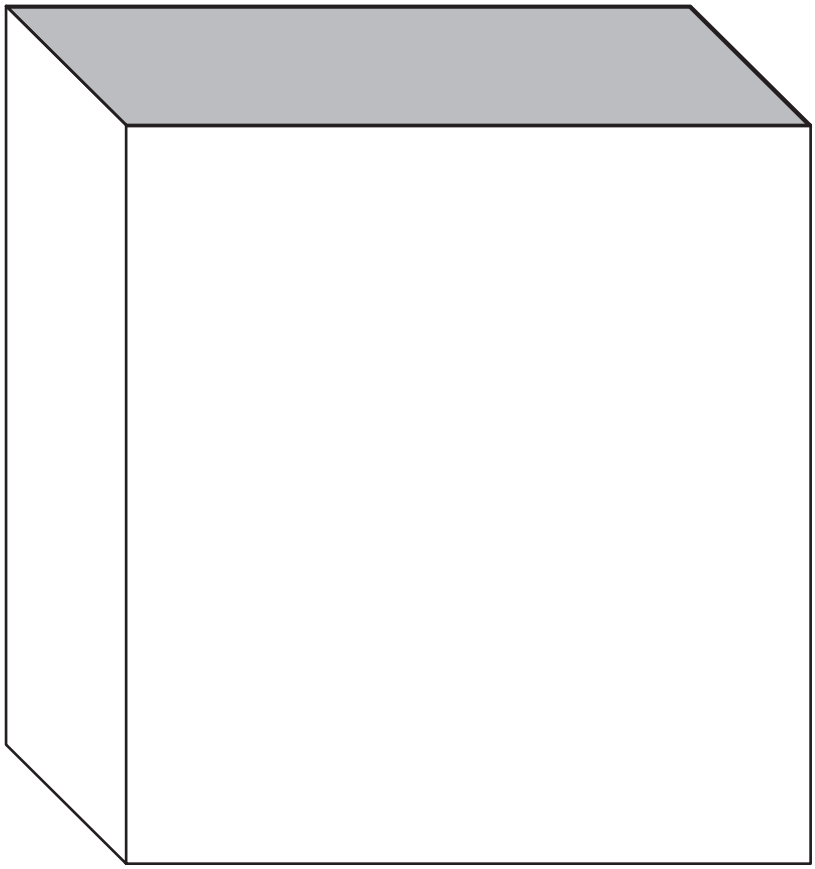
- Dried apricots: 325 cubic inches
- Pretzels: 475 cubic inches
- Raisins: 60 cubic inches
- Coconut chips: 25 cubic inches
- Cheese puffs: 1,000 cubic inches
- Popcorn: 725 cubic inches
- Granola: 210 cubic inches

The table shows the volume of the different containers. Complete the table by writing a multiplication and an exponential equation to find the volume. Then write the name of the snack that best fits in that container.

Container Side Length (Inches)	**Multiplication Equation**	**Exponential Equation**	**Snack**
8			
3			
4			
7			
10			
6			
9			

Nine-Inch Cube

9 in.



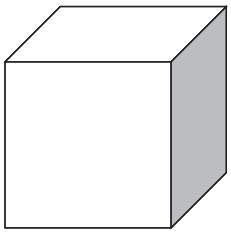
Exponent Race

1	8	27	64	125	216

Comfy Cubes

Label the edge lengths of each cube. Use factoring or **linking cubes** to solve.

1. $V = 8$ cubic inches.

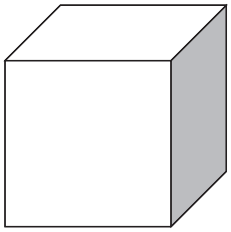


Height: _____ in.

Width: _____ in.

Length: _____ in.

2. $V = 512$ cubic inches.

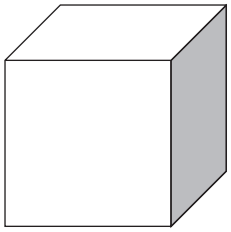


Height: _____ in.

Width: _____ in.

Length: _____ in.

3. $V = 64$ cubic inches

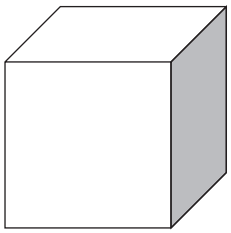


Height: _____ in.

Width: _____ in.

Length: _____ in.

4. $V = 1$ cubic inch



Height: _____ in.

Width: _____ in.

Length: _____ in.

Build a Box

Review the example problem. Then, use factoring to find the cube roots.

Example

Ronnie builds beautiful, small cube boxes out of different kinds of wood. A customer has asked for a specially made box to have a volume of **343** cubic inches. What will the edge length of this box be?

Step 1	Step 2	Step 3	Step 4
Factor the volume. Look for a factor that appears three times to make the product. **343** = 7 × 49 **343** = 7 × 7 × 7 **343** is a perfect cube.	Write a cube root equation for perfect cubes. $\sqrt[3]{\mathbf{343}} = 7$	Find the edge length of the cube. The edge length of this special box will be 7 inches.	Leave the cube root of non-perfect squares as the cube root of the number. 17 is not a perfect cube. $\sqrt[3]{17} = \sqrt[3]{17}$

1. Ronnie's most popular wooden box has a volume of 512 cubic inches. What is the cube root of 512?

$\sqrt[3]{512}$ = _____ Is 512 a perfect cube? _____

2. Ronnie's largest wooden box has a volume of 1,000 cubic inches. What is the cube root of 1,000?

$\sqrt[3]{1{,}000}$ = _____ Is 1,000 a perfect cube? _____

3. Ronnie's least popular box has a volume of 650 cubic inches. What is the cube root of 650?

$\sqrt[3]{650}$ = _____ Is 650 a perfect cube? _____

4. Ronnie's smallest wooden box has a volume of 139 cubic inches. What is the cube root of 139?

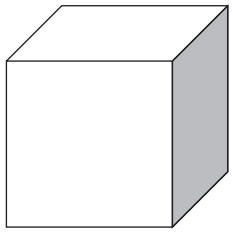
$\sqrt[3]{139}$ = _____ Is 139 a perfect cube? _____

Lesson 4 Exit Ticket

Part 1: Label the edge lengths of the cube. Use factoring or **linking cubes** to solve.

1. $V = 27$ cubic inches.

Height: _____ in.

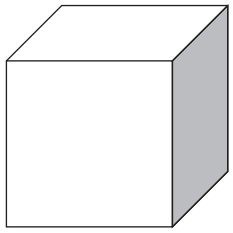


Width: _____ in.

Length: _____ in.

2. $V = 216$ cubic inches.

Height: _____ in.



Width: _____ in.

Length: _____ in.

Part 2: Find the cube root and complete the equation. If the cube is a perfect cube, write the cube root as an integer. If the cube is not a perfect cube, write the cube root using cube root notation.

3. $\sqrt[3]{729}$ = _____

4. $\sqrt[3]{96}$ = _____

5. $\sqrt[3]{125}$ = _____

6. $\sqrt[3]{600}$ = _____

Extra Practice: Gargantuan Games

Part 1: Label the following sentences true or false.

1. The number 125 is not a perfect square. _____

2. The cube root of a perfect cube is an integer. _____

3. Taking the cube root and cubing a number are opposite operations. _____

4. The symbol for a cube root and a square root is the same. _____.

5. You can use cuber roots to find the edge length of a cube given just the volume because all edge length in a cube are the same length.? _____

Part 2: Draw a circle around the perfect cubes and write the cube root. Draw a square around the cube roots that are not perfect.

6.

$\sqrt[3]{27}$ $\sqrt[3]{60}$

$\sqrt[3]{81}$ $\sqrt[3]{729}$ $\sqrt[3]{100}$

$\sqrt[3]{64}$

$\sqrt[3]{512}$ $\sqrt[3]{144}$

$\sqrt[3]{216}$

$\sqrt[3]{32}$

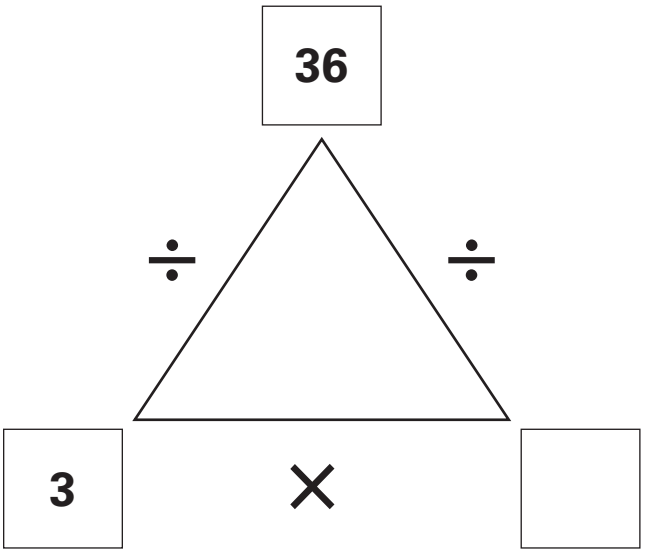
Part 3: Use factoring to find the edge length and answer the questions.

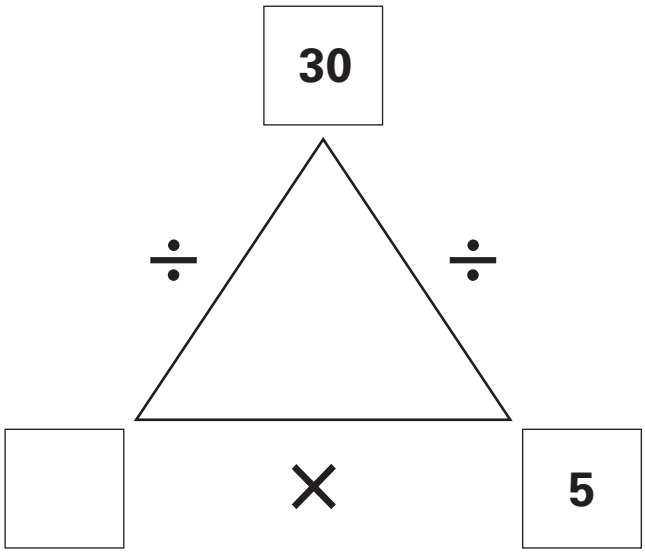
7. At Gargantuan Games, they have developed a new game that will fit in a box with a volume of 729 cubic inches.

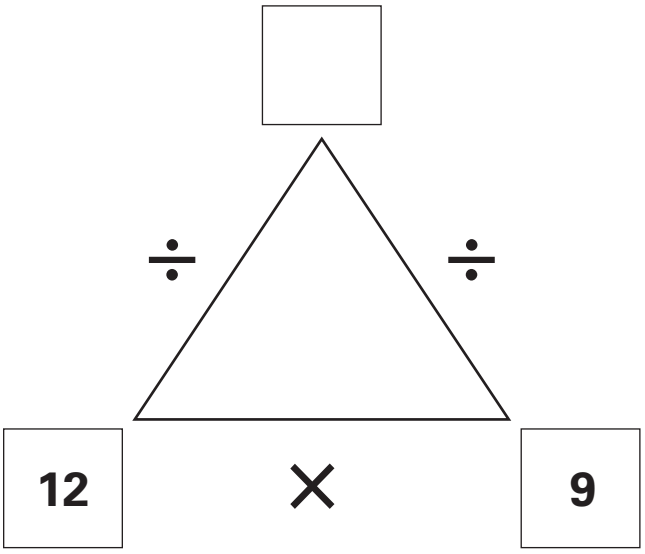
a. Write an equation to represent the problem. _____

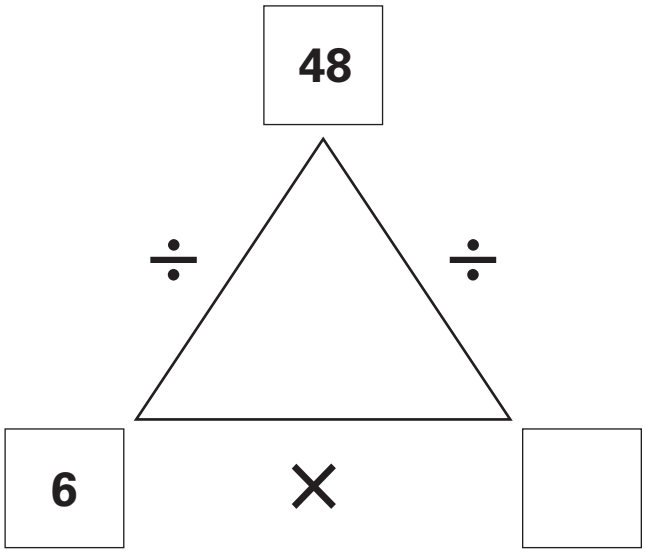
b. The edge length of the new game box is _____ inches.

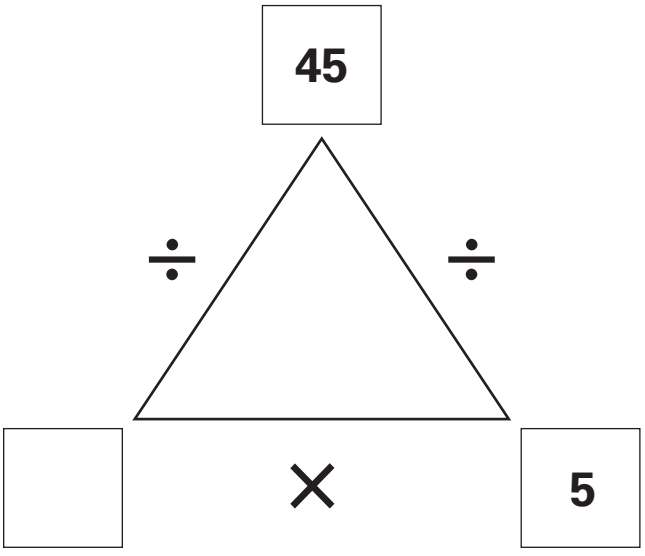
Number Triangles

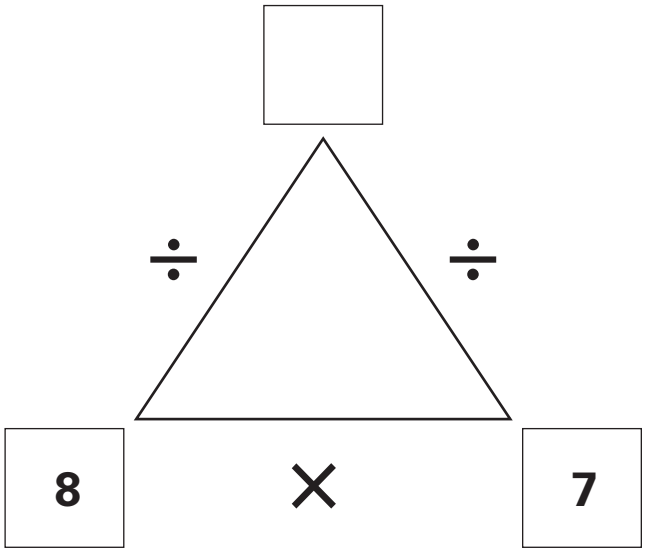








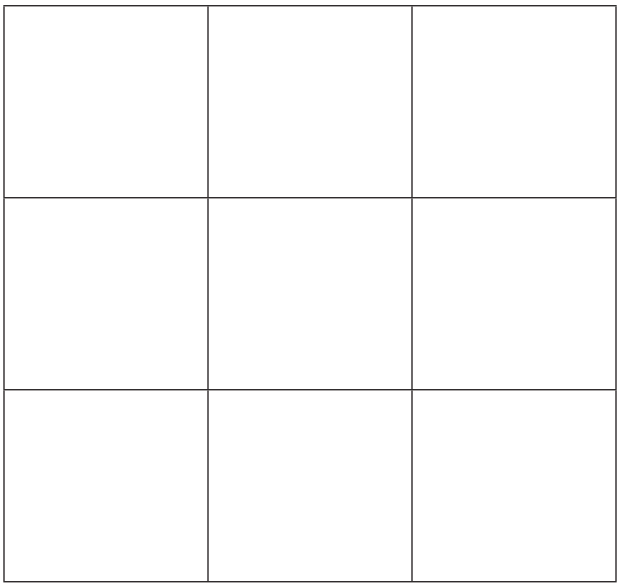


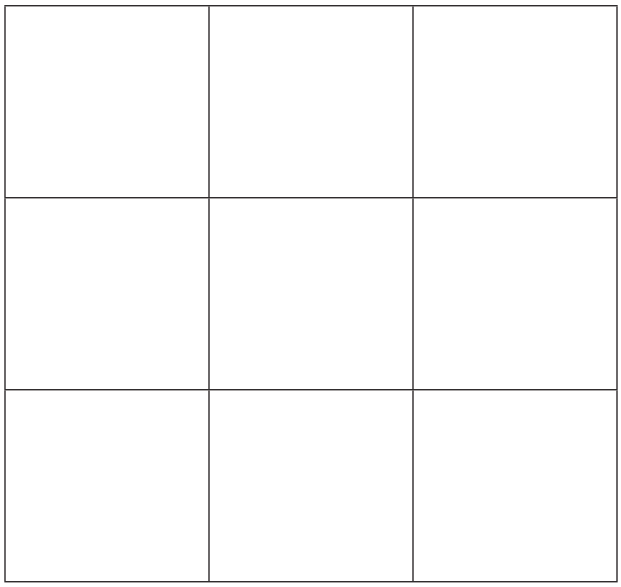


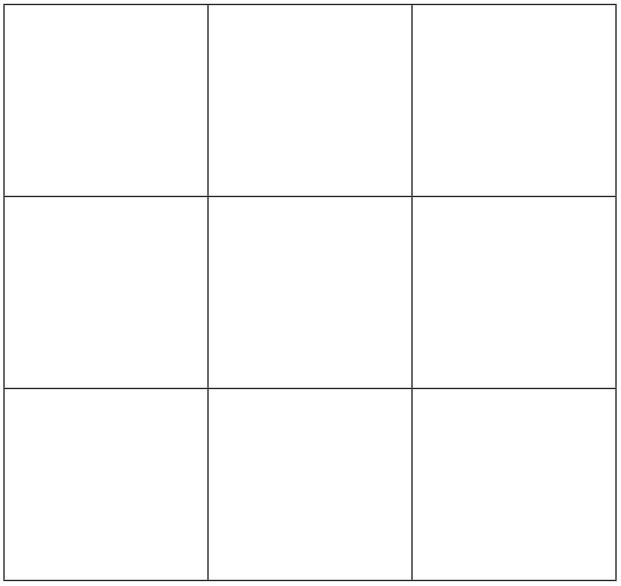
Cube Root Bingo
Number Expressions

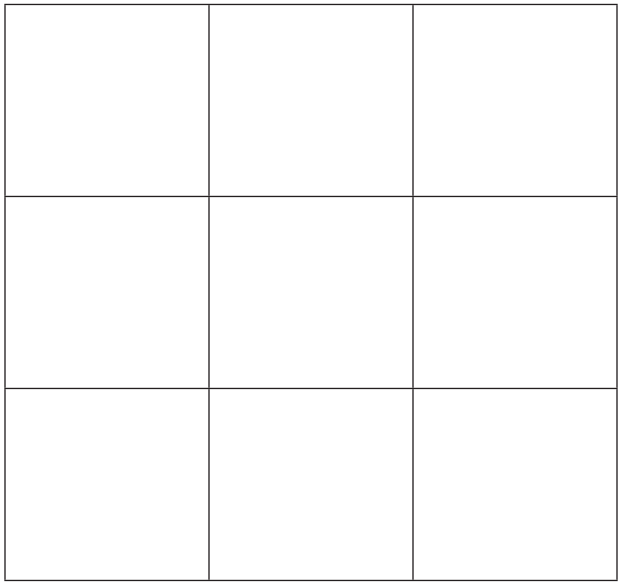
$\sqrt[3]{1}$	$\sqrt[3]{8}$
$\sqrt[3]{27}$	$\sqrt[3]{64}$
$\sqrt[3]{125}$	$\sqrt[3]{216}$
$\sqrt[3]{343}$	$\sqrt[3]{512}$
$\sqrt[3]{729}$	$\sqrt[3]{1{,}000}$

Cube Root Bingo
Playing Cards









Perfect or Not Cards

$\sqrt[3]{10}$	$\sqrt[3]{64}$	$\sqrt[3]{27}$
$\sqrt[3]{25}$	$\sqrt[3]{144}$	$\sqrt[3]{216}$
$\sqrt[3]{30}$	$\sqrt[3]{1{,}000}$	$\sqrt[3]{75}$
$\sqrt[3]{729}$	$\sqrt[3]{343}$	$\sqrt[3]{12}$
$\sqrt[3]{512}$	$\sqrt[3]{18}$	$\sqrt[3]{96}$

Allowance

Part 1: Sasha and his dad make a deal for other tasks Sasha can get an allowance for. Convert each fraction of a dollar to a decimal. Then identify the fraction as terminating or repeating.

Task	Fraction of a Dollar	Decimal Equivalent	Terminating or Repeating Decimal?
take out a garbage bag	$\frac{3}{8}$		
feed the guinea pig a meal	$\frac{5}{13}$		
make the bed	$\frac{1}{2}$		
vacuum one room	$\frac{5}{6}$		
put away one piece of clean laundry	$\frac{3}{4}$		

Part 2: For each number, explain how you know it is a rational number.

1. 124 _____

2. $-0.\overline{235}$ _____

3. –67 _____

4. $1\frac{5}{8}$ _____

5. 19.42 _____

Keep on Converting

Review the example problem. Then convert the fractions to decimals and indicate whether they are terminating or repeating.

Example

Sasha's glad he had practice converting fractions to decimals, because in school the next day he must convert $\frac{11}{20}$ and $-\frac{2}{9}$ to decimals and decide whether they are terminating or repeating. What strategies can he use to convert these fractions? What kind of decimals are they?

Step 1

Determine whether it makes sense to use equivalent fractions or division to convert.

The denominator of $\frac{11}{20}$ is a multiple factor of 100, so it makes sense to use equivalent fractions.

The denominator of $-\frac{2}{9}$ is not a factor of 10, 100, or 1,000, so it makes sense to divide.

Step 2

Convert each fraction to a decimal.

$$\frac{11}{20} = \frac{11 \times 5}{20 \times 5} = \frac{55}{100} = 0.55$$

$$\begin{array}{r} -0.\overline{222} \\ 9\overline{)-2.000} \\ -18 \\ \hline 20 \\ -18 \\ \hline 20 \\ -18 \\ \hline 2 \end{array}$$

Step 3

Describe the decimals as terminating or repeating.

0.55 has exactly two digits to the right of the decimal point. It is a terminating decimal.

$-0.\overline{222}$ has an infinite number of 2s to the right of the decimal point. It is a repeating decimal.

1. $\frac{1}{3} =$ _____ The decimal is terminating/repeating.

2. $-\frac{444}{1{,}000} =$ _____ The decimal is terminating/repeating.

3. $\frac{5}{8} =$ _____ The decimal is terminating/repeating.

4. $-\frac{5}{74} =$ _____ The decimal is terminating/repeating.

Lesson 5 Exit Ticket

Convert each fraction to a decimal and indicate whether it is terminating or repeating. Then explain how you know the numbers are rational.

	Fraction	Decimal Equivalent	Terminating or Repeating Decimal?
1.	$\frac{7}{8}$		
2.	$-\frac{1}{3}$		
3.	$\frac{7}{11}$		
4.	$\frac{3}{5}$		
5.	$-\frac{5}{12}$		

6. How do you know all the decimals above are rational numbers?

Extra Practice: Matching

Match each fraction to the equivalent decimal. Then write each decimal in the appropriate column in the chart and answer the question.

1. $-\frac{2}{3}$

2. $5\frac{1}{4}$

3. $\frac{1}{5}$

4. $-5\frac{3}{5}$

5. $\frac{6}{7}$

6. $-\frac{3}{8}$

7. $5\frac{4}{9}$

0.2

–5.6

5.25

$5.\overline{444}$

–0.375

$-0.\overline{666}$

$0.\overline{857142}$

8.

Terminating Decimals	Repeating Decimals

9. Are all the numbers on this page rational numbers? How do you know?

Rational Game Cards

$\frac{2}{9}$	$\frac{2}{7}$	$\frac{2}{5}$
$\frac{4}{10}$	$\frac{1}{7}$	$\frac{6}{8}$
$\frac{4}{5}$	$\frac{7}{8}$	$\frac{7}{10}$
$\frac{1}{6}$	$\frac{8}{9}$	$\frac{1}{4}$
$\frac{3}{7}$	$\frac{3}{4}$	$\frac{6}{10}$

Dog Park Designs

Part 1: Other people in the community submit designs for the new dog park. Complete the chart to show the exact side length based on each dog park's area. Then state whether the side length is a rational or irrational number. Finally, answer the question.

	Area of Square Dog Park (square yards)	Side Length (yards)	Rational or Irrational?
1.	30		
2.	42		
3.	36		
4.	50		
5.	64		

6. What is the difference between rational numbers and irrational numbers?

Part 2: Write each number in the appropriate side of the diagram.

$-\frac{1}{6}$ 61 $\sqrt{49}$ 61.16 $\sqrt{44}$ $\sqrt[3]{27}$ $\sqrt[3]{25}$

Rational Numbers	Irrational Numbers

Building a Shed

Review the example problem. Then answer the questions.

Example

Valeria decides to build a storage shed at the dog park. The shed is a cube with a volume of **24** cubic yards. How tall is the shed? Is this value a rational or irrational number?

Step 1

The height of the shed is the edge length of a cube. Write an equation to represent the edge length of the cube.

$e = \sqrt[3]{V}$ $e = \sqrt[3]{\mathbf{24}}$

Step 2

Decide whether the volume is a perfect cube number.

You cannot make a cube with exactly **24** linking cubes. There is no number you can raise to the third power and get **24**.

24 is not a perfect cube number.

Step 3

Describe the height of the shed as rational or irrational.

The height is $\sqrt[3]{\mathbf{24}}$, so it is the cube root of a non-perfect cube number and not an irrational number.

1. Valeria changes the shed design to be a cube with a volume of 33 cubic yards.

a. How wide is the shed? The shed is _____ yards wide.

b. Is this value a rational or irrational number? Explain how you know.

_____

_____

2. Valeria changes the shed design to be a cube with a volume of 125 cubic yards.

a. How wide is the shed? The shed is _____ yards wide.

b. Is this value a rational or irrational number? Explain how you know.

_____

_____

Lesson 6 Exit Ticket

Complete the chart to show the exact side length for each dog park's area and state whether the side length is a rational or irrational number. Then answer the questions.

	Area of Square Dog Park (square yards)	**Side Length** (yards)	**Rational or Irrational?**
1.	18		
2.	44		
3.	49		
4.	60		
5.	81		

6. Write each number in the appropriate side of the diagram.

$\sqrt[3]{49}$ 45.54 $\sqrt{72}$ –15 $\sqrt[3]{64}$ $\frac{2}{9}$ $\sqrt{121}$

Rational Numbers	**Irrational Numbers**

7. One of the following numbers is rational, and one is irrational. Which is which, and how do you know?

$\sqrt{27}$ $\sqrt[3]{27}$

The rational number is _____. I know this because _____

_____

_____

The irrational number is _____. I know this because _____

_____

_____

Extra Practice: Irrational Numbers

Part 1: Name three irrational numbers that can be expressed as square roots and three irrational numbers that can be expressed as cube roots.

1. Square roots: _____

_____

2. Cube roots: _____

_____

Part 2: Use words from the word bank to complete the paragraph.

Word Bank

fraction	irrational	non-perfect cubes
non-perfect squares	non-repeating	non-terminating
ratio	repeating	terminating

There are several differences between rational and irrational numbers. A rational number can be written as the _____ of two integers. When a rational number is in decimal form, the decimal either is _____ or _____ .

An _____ number does not have an equivalent _____.

In decimal form an irrational number is _____ and _____.

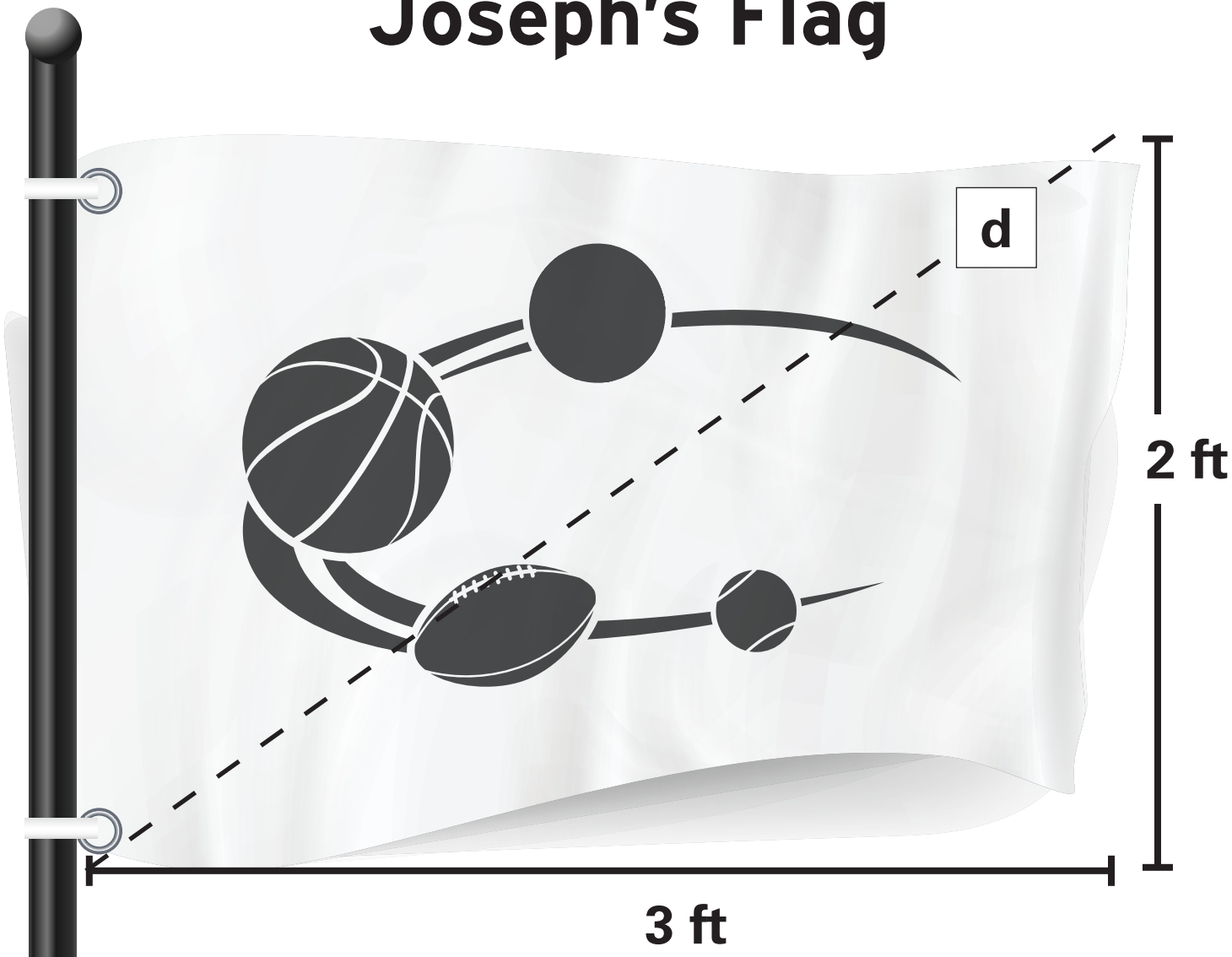
The square roots of _____ and the cube roots of _____ are irrational numbers.

Part 3: Circle the irrational numbers.

$\sqrt[3]{125}$ $\sqrt[3]{49}$ $\sqrt{72}$

$\sqrt{48}$ $\sqrt{144}$ $\sqrt[3]{63}$

Joseph's Flag



Irrational Sort

$\sqrt{1}$	$\sqrt[3]{8}$	$\sqrt{27}$	$\sqrt[3]{4}$
$\sqrt{619}$	$\sqrt[3]{765}$	$\sqrt{9}$	$\sqrt[3]{64}$
$\sqrt{125}$	$\sqrt[3]{16}$	773	$\sqrt[3]{542}$
$\sqrt{25}$	$\sqrt[3]{216}$	$\sqrt{343}$	$\sqrt[3]{36}$

Irrational Sort

$\sqrt{81}$	$\sqrt[3]{915}$	$\sqrt{49}$	$\sqrt[3]{512}$
$\sqrt{729}$	$\sqrt[3]{64}$	$\sqrt{353}$	$\sqrt[3]{286}$
$\sqrt{100}$	$\sqrt[3]{1,000}$	$\sqrt{8}$	$\sqrt[3]{121}$
$\sqrt{779}$	$\sqrt[3]{917}$	$\sqrt{144}$	$\sqrt[3]{27}$

Almost Square

Part 1: Complete each sentence. Estimate **to the nearest tenth.**

1. 70 is between the perfect squares 64 and _____ so $\sqrt{70}$ is between 8 and _____. A good estimate of $\sqrt{70}$ is 8.4, because _____

_____.

2. 149 is between the perfect squares _____ and 169, so $\sqrt{149}$ is between _____ and 13. A good estimate of $\sqrt{149}$ is _____, because _____

_____.

3. 222 is between the perfect squares _____ and _____ so $\sqrt{222}$ is between _____ and _____. A good estimate of $\sqrt{222}$ is _____, because _____

_____.

4. 107 is between the perfect squares _____ and _____ so $\sqrt{107}$ is between _____ and _____. A good estimate of $\sqrt{107}$ is _____, because _____

_____.

5. 7 is between the perfect squares _____ and _____ so $\sqrt{7}$ is between _____ and _____. A good estimate of $\sqrt{7}$ is _____, because _____

_____.

Part 2: Choose one of the non-perfect square numbers from Part 1. Use guess and check to estimate the square root to the nearest hundredth.

Was your estimate in Part 1 close to your estimate in Part 2?

_____

_____

Floor Space

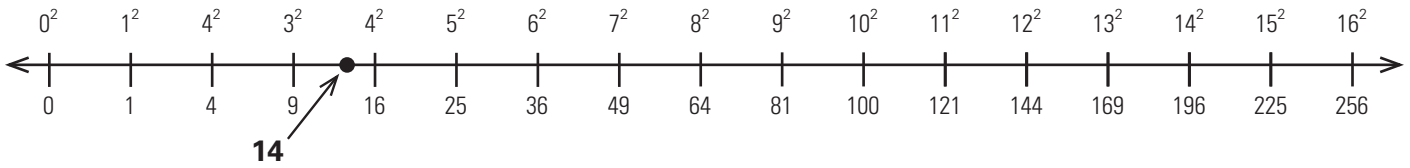
Review the example problem. Then use guess and check to estimate the given square root to the nearest hundredth. Use a **perfect square number line** and show your work.

Example

Ms. Stevens has a square classroom. The floor has an area of **14** square meters, so the side length of the floor is $\sqrt{\mathbf{14}}$ meters. Estimate $\sqrt{\mathbf{14}}$ to the nearest hundredth.

Step 1

Locate **14** between the closest perfect square numbers.



14 is between the perfect squares 9 and 16.

Step 2

Make a first guess to estimate $\sqrt{\mathbf{14}}$. Then check your guess. Is it too high or too low?

14 is closer to 16 than it is to 9. So, $\sqrt{\mathbf{14}}$ is closer to 4 than it is to 3.

First guess: $\sqrt{\mathbf{14}} \approx 3.7$ Check: $3.7^2 = 13.69$

13.69 is less than **14,** so my first guess is too low.

Step 3

Make a second guess to estimate $\sqrt{\mathbf{14}}$. Then check your guess. Is it too high or too low?

Second guess: $\sqrt{\mathbf{14}} \approx 3.8$ Check: $3.8^2 = 14.44$

14.44 is greater than **14,** so my second guess is too high.

Step 4

Make a final estimate to the nearest hundredths place, based on your first two guesses.

$\sqrt{\mathbf{14}}$ is greater than 3.7 but less than 3.8, so my final estimate is between these two numbers: 3.72.

1. $\sqrt{38} \approx$ _____

2. $\sqrt{147} \approx$_____

3. $\sqrt{184} \approx$ _____

4. $\sqrt{117} \approx$ _____

Lesson 7 Exit Ticket

Part 1: Complete each sentence. Estimate to the nearest tenth.

1. 26 is between the perfect squares _____ and _____, so $\sqrt{26}$ is between _____ and _____.

A good estimate of $\sqrt{26}$ is _____, because _____

_____.

2. 201 is between the perfect squares _____ and _____, so $\sqrt{201}$ is between _____

and _____. A good estimate of $\sqrt{201}$ is _____, because _____

_____.

Part 2: Use guess and check to estimate the given square root to the nearest hundredth. Use a **perfect square number line** and show your work.

3. $\sqrt{251} \approx$ _____

4. $\sqrt{98} \approx$ _____

Extra Practice: Estimate Match

Part 1: Match each square root to the most reasonable estimate.

$\sqrt{7}$	13.42
$\sqrt{54}$	9.9
$\sqrt{98}$	2.24
$\sqrt{128}$	7.87
$\sqrt{143}$	2.65
$\sqrt{180}$	15.62
$\sqrt{5}$	11.31
$\sqrt{244}$	6.08
$\sqrt{37}$	11.96
$\sqrt{62}$	7.35

Part 2: Use guess and check to estimate the given square root to the nearest hundredth. Use a **perfect square number line** and show your work.

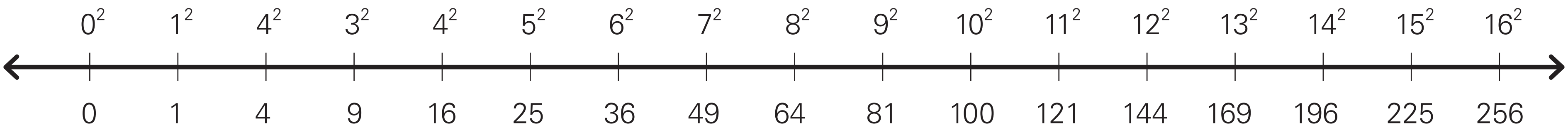
1. $\sqrt{18} \approx$ _____

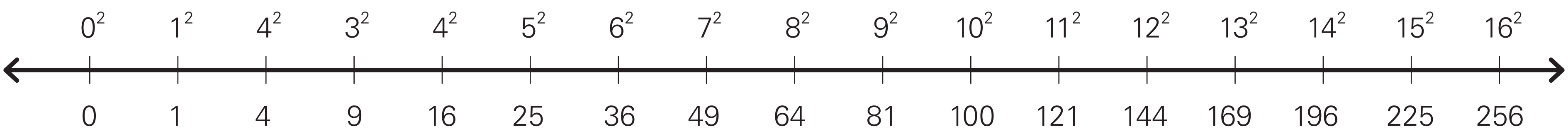
2. $\sqrt{32} \approx$ _____

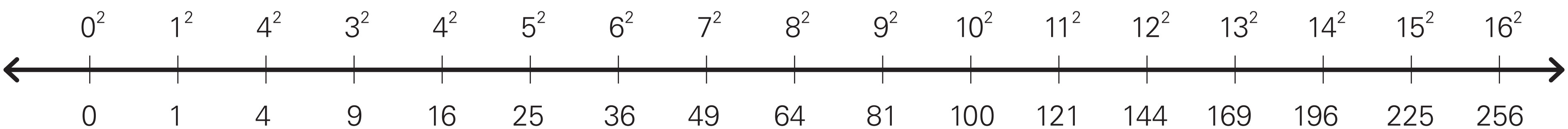
3. $\sqrt{51} \approx$ _____

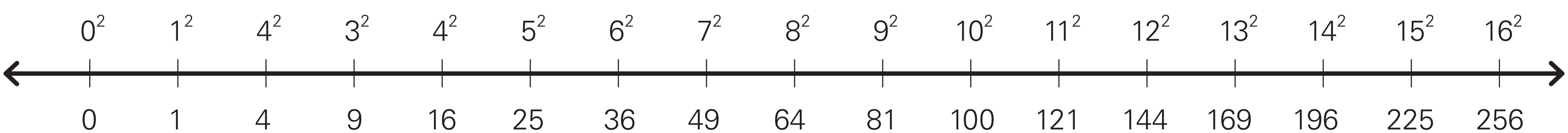
4. $\sqrt{72} \approx$ _____

Perfect Square Number Lines

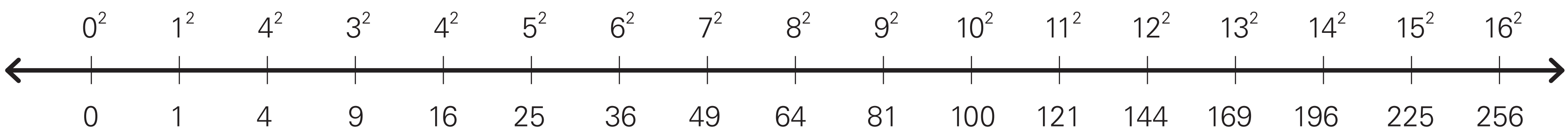


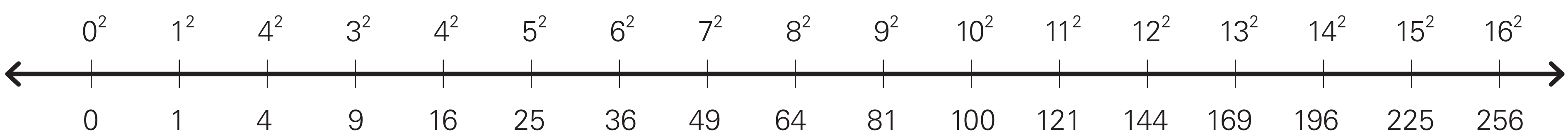


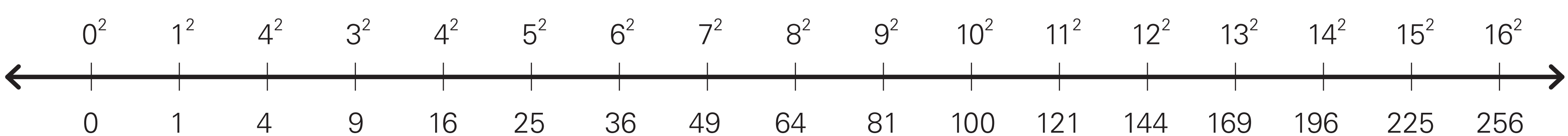


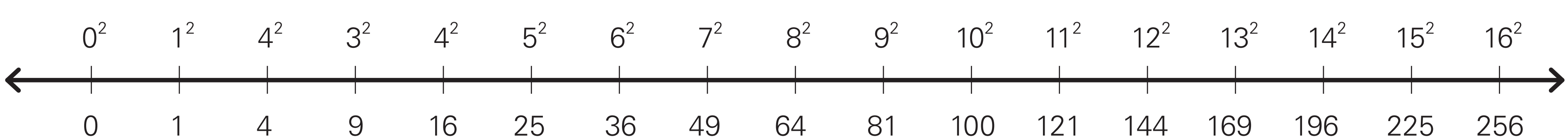


Perfect Square Number Lines









The Order of Things

Complete the chart for Mr. Nielson's The Order of Things question for Monday. Then plot the decimals and Mr. Nielson's numbers on the number line. Write two inequalities comparing Mr. Nielson's numbers—one greatest to least and one least to greatest.

Mr. Nielson's Number	Decimal Equivalent or Estimate
$2\frac{2}{3}$	
$\sqrt{8}$	
2.6	
$2\frac{7}{10}$	
2.78	

Mr. Nielson's numbers, greatest to least: _____

Mr. Nielson's numbers, least to greatest: _____

Tuesday's Numbers

Review the example problem. Then order the numbers given on the number line and write a comparison statement.

Example

Tuesday's The Order of Things question is a breeze for Janine, but it has her friend Phoebe stumped. The first two numbers are $\mathbf{2\frac{1}{2}}$ and $\sqrt{\mathbf{7}}$. Which number has the least value?

Step 1

Convert rational numbers to decimal form.

$\mathbf{2\frac{1}{2}}$ is a rational number. $\mathbf{2\frac{1}{2}} = 2\frac{5}{8} = 2.5$

Step 2

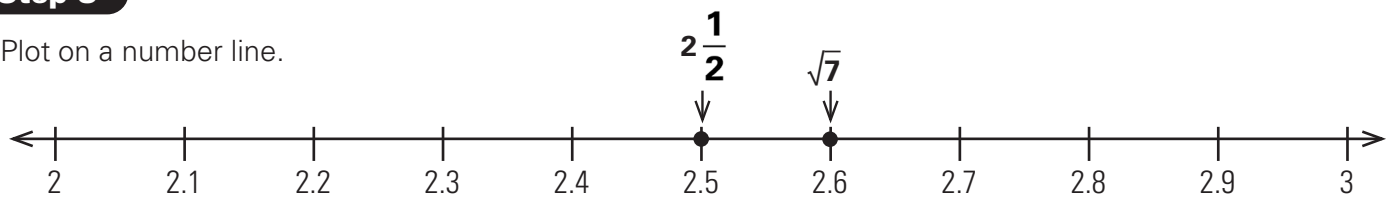
Estimate irrational numbers to the nearest tenth.

$\sqrt{\mathbf{7}}$ is an irrational number.

7 is about halfway between the perfect cubes 4 and 9, but a little closer to 9. So, $\sqrt{\mathbf{7}}$ is a little more than halfway between 2 and 3. $\sqrt{7} \approx 2.6$

Step 3

Plot on a number line.

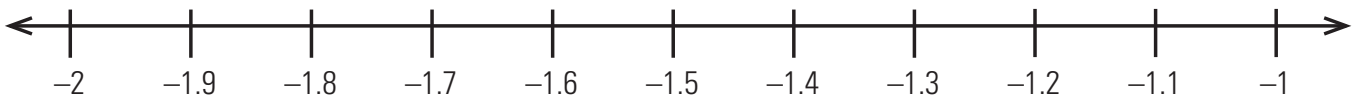


Step 4

Write a comparison statement using a greater than symbol.

$\sqrt{\mathbf{7}} > \mathbf{2\frac{1}{2}}$ The number with the least value is $\mathbf{2\frac{1}{2}}$.

1. Tuesday's other numbers are $-\sqrt{3}$, $-1\frac{8}{9}$, and $-1.\overline{7}$. Calculate equivalent decimals and show your work. Then order Tuesday's numbers on the number line.



2. Write a comparison statement with greater than symbols to order the three numbers.

Lesson 8 Exit Ticket

On Wednesday Mr. Nielson lists these numbers below for his students to order.

1. Complete the chart by finding the decimal equivalent or estimate. Write rational numbers to the *nearest tenth* and irrational numbers to the *nearest hundredth.*

Mr. Nielson's Numbers	Decimal Equivalent or Estimate
$\sqrt{32}$	
$5\frac{5}{6}$	
5.85	
$\sqrt[3]{216}$	
$5\frac{3}{4}$	

2. Write a comparison statement with greater than symbols to order the decimals.

3. Plot the numbers from the chart on the number line.

4. Write a comparison statement with greater than symbols to order the numbers from the final round of the activity.

Extra Practice: Order by Color

Part 1: Find the decimal equivalent of each number. Shade the box of the greatest number orange, the next greatest number yellow, the next greatest number green, and the least number blue.

1. The decimal equivalent of $\boxed{1\frac{9}{20}}$ is _____.

2. The decimal equivalent of $\boxed{\sqrt[3]{1}}$ to the nearest tenth is _____.

3. The decimal equivalent of $\boxed{1\frac{5}{11}}$ is _____.

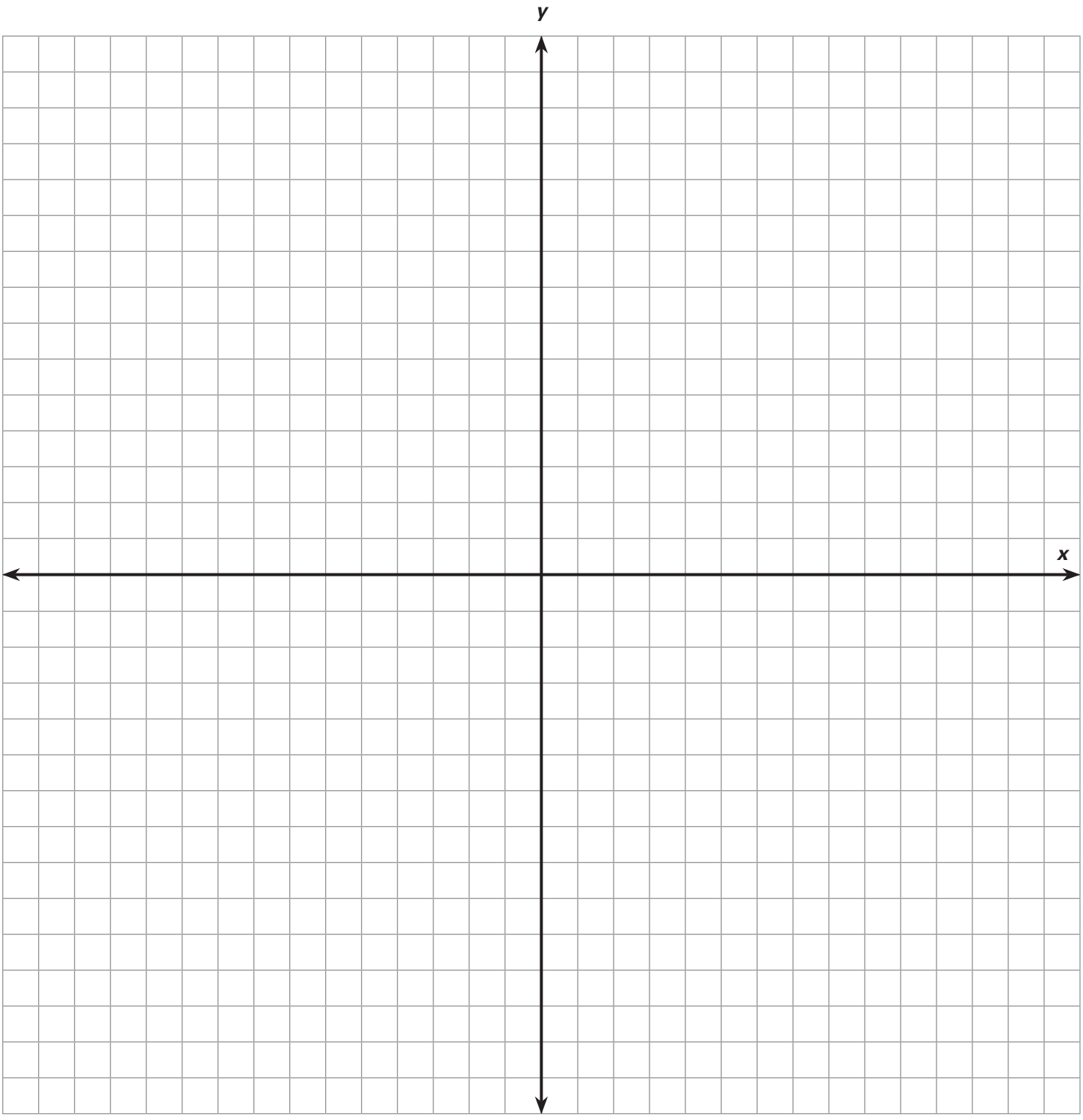
4. The decimal equivalent of $\boxed{\sqrt{2}}$ to the nearest tenth is _____.

Part 2: Plot the boxed numbers from Part 1 on the number line. Then write two inequalities to show how the numbers compare.

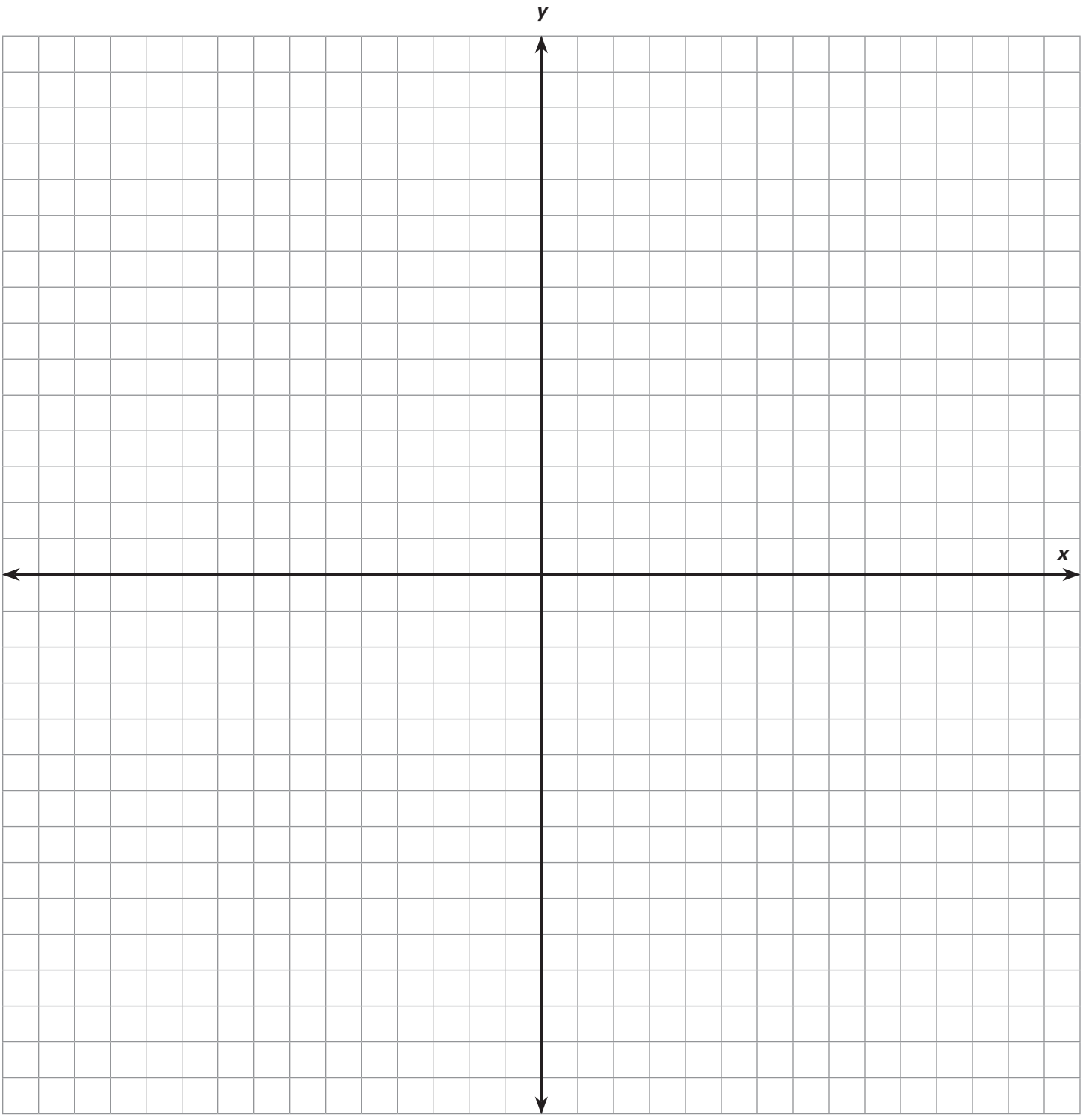
Boxed numbers, greatest to least: _____

Boxed numbers, least to greatest: _____

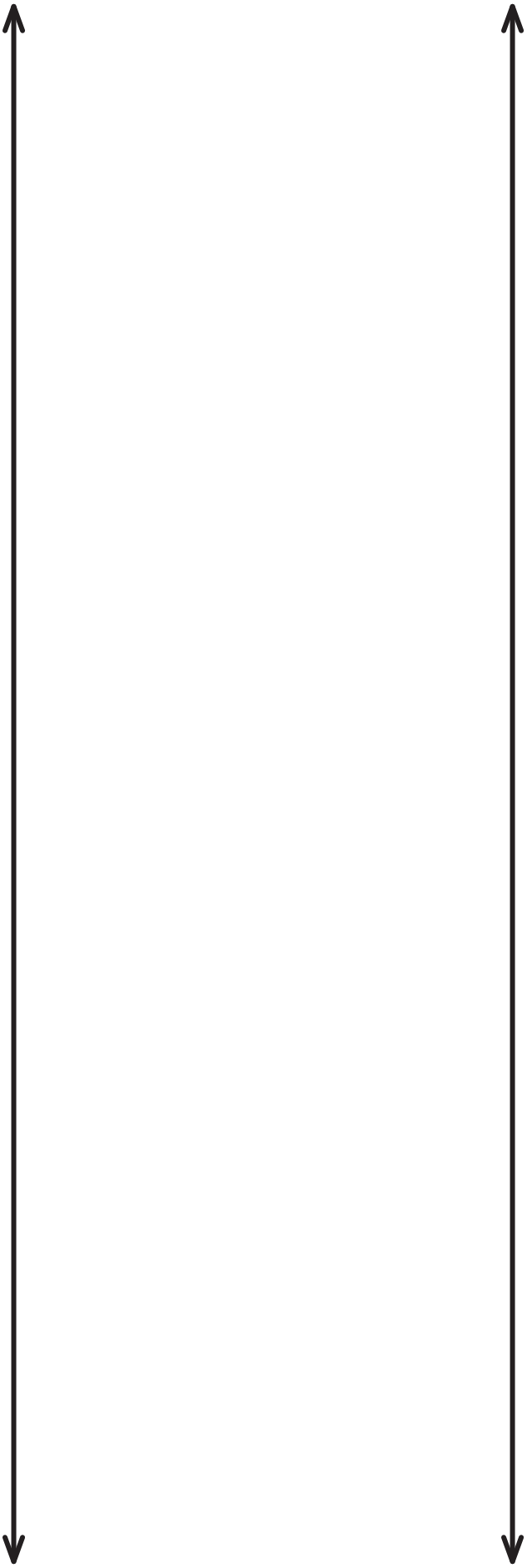
Coordinate Plane



Coordinate Plane

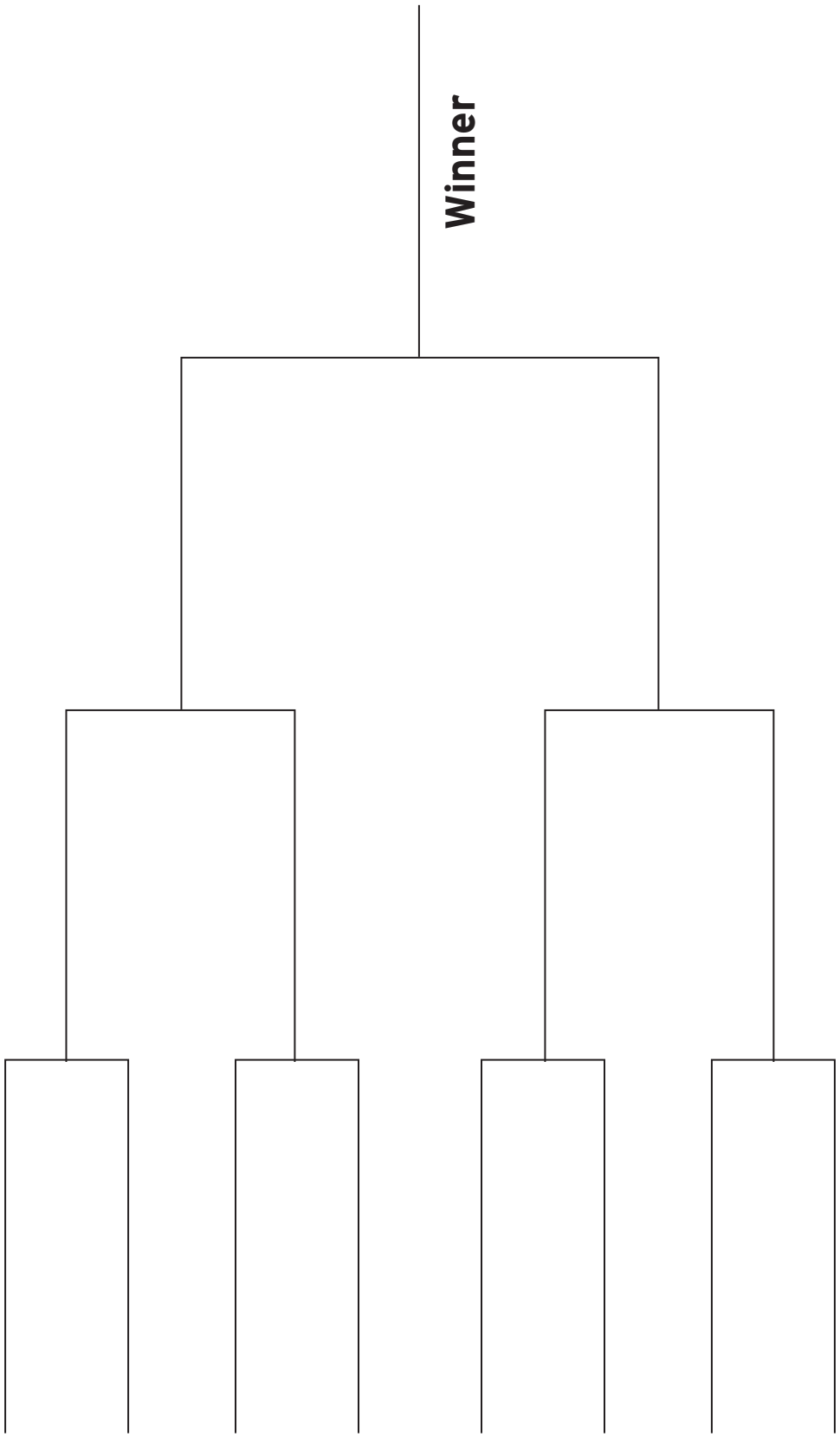


Open Number Lines



Open Number Lines

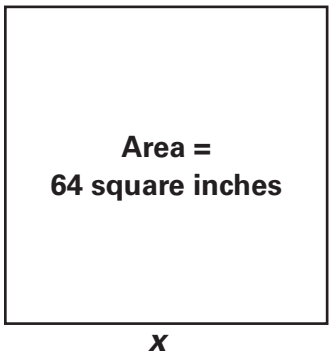
The Great Eight



Assessment

Unit 1 Assessment

1. Complete the equations to model the square. Then record the value of x.



$x^2 =$ _____

$x = \sqrt{\quad}$ _____

$x =$ _____

What is the side length of the square? _____

2. Simplify each expression, if possible. Leave square roots of non-perfect squares in radical form.

$\sqrt{150} =$ _____ $\sqrt{144} =$ _____ $\sqrt{256} =$ _____ $\sqrt{237} =$ _____

3. Angela has a cube-shaped box of beads. One edge of the box is 4 inches. Write an equation with an exponent to model the volume of the box.

Equation: _____

The volume of the box is _____ cubic inches.

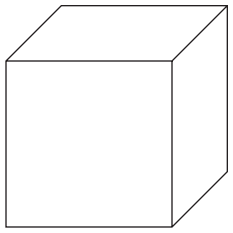
4. Simplify each expression, if possible. Leave cube roots of non-perfect cubes in radical form.

$\sqrt[3]{864} =$ _____ $\sqrt[3]{200} =$ _____ $\sqrt[3]{1} =$ _____ $\sqrt[3]{216} =$ _____

5. Label the edge of the cube. Then complete the equation.

V = 1,331 cubic inches.

$\sqrt[3]{1{,}331}$ = _____



Height: _____ in.

Width: _____ in.

Length: _____ in.

6. Find the decimal form of $6\frac{3}{8}$. Show your work.

$6\frac{3}{8}$ = _____

Is this a terminating or repeating decimal? _____

7. Find the decimal form of $\frac{7}{11}$. Show your work.

$\frac{7}{11}$ = _____

Is this a terminating or repeating decimal? _____

8. Write each of the following numbers in the appropriate column of the diagram:

$\sqrt[3]{46}$ 46.26 $\sqrt{26}$ –26 $\sqrt[3]{64}$ $4\frac{5}{6}$ $\sqrt{64}$

Rational Numbers	**Irrational Numbers**

9. Use the guess and check strategy to estimate $\sqrt{40}$ to the nearest hundredth. Show your work. Be sure to explain how to use perfect squares to estimate.

$\sqrt{40} \approx$ _____

10. Leo paints miniature figures. The chart shows the heights of figures he has painted.

a. Write the decimal equivalent or estimate in the chart.

Figure	Height (inches)	Decimal Equivalent or Estimate
The Silent Rogue	$1\frac{1}{6}$	
The Frozen Dragon	$\sqrt{3}$	
The Red Knight	$\sqrt[3]{3}$	
The Rugged Ranger	$1\frac{1}{4}$	

b. Plot the heights on the number line.

Unit 1 Cumulative Review

1. Rick drives his car for $\frac{1}{4}$ of an hour and goes $10\frac{1}{2}$ miles. What is the unit rate of speed?

Rick drives _____ miles per hour.

2. Expand the expression.

$5(2x - 3) =$ _____

3. Layla earns $9 per hour and gets a $28 bonus. How many hours will she need to work to make at least $100? Write an inequality using the variable *h,* then solve the problem.

Inequality: _____

Layla needs to work _____ hours.

4. Solve.

$-12 - 6 =$ _____

5. Verify the proportionality of the ratios using cross multiplication.

$\frac{9}{24} = \frac{21}{56}$ _____

Are the ratios proportional? _____

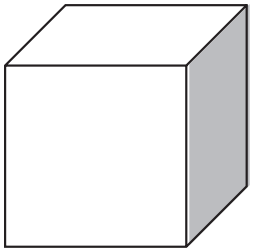
6. Kendrick earns $8.50 per hour for babysitting two children. Write and solve an equation to show how much money Kendrick needs to babysit to earn $51.

Equation: _____

$x =$ _____

Kendrick needs to babysit for _____ hours.

7. The cube-shaped box below has an edge length of 7 centimeters.



7 centimeters

What is the volume of the box? _____

8. Simplify the expression.

$-12 \div 6 =$ _____

9. A grocery store makes a display each week with bags of apples. The table shows the number of bags and the number of apples in the display each week.

Number of Bags ***(x)***	**Number of Apples** ***(y)***
23	184
24	192
25	200
26	208

Write an equation in the form of $y = mx$ to represent the proportional relationship between x and y.

_____

10. Estimate to the nearest tenth.

$\sqrt{8} \approx$ _____

11. Multiply.

$(-3)(-8) =$ _____

12. Amaria likes to download her favorite music. Yesterday she downloaded 112 songs. Today she downloads more songs. Now, Amaria has a total of 121 downloaded songs. Write and solve an equation to find out how many songs Amaria downloaded today.

Amaria downloaded _____ songs today.

13. Solve. Show your work.

$$660 = 60(x + 6)$$

$x =$ _____

14. Emilio's car can travel 34 miles per gallon. Complete the table to show how many miles the car can travel on the given number of gallons.

Gallons of Gasoline	Miles
10	
11	
12	
13	

15. Rowan eats lunch at a restaurant. Her meal costs $12.50. She leaves a 20% tip. What is the total cost of her meal?

Rowan's total meal costs _____ dollars.