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**Know that there are numbers that are not rational, and approximate them by rational numbers.**

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Know that numbers that are not rational are called irrationals. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.

**MAFS.8.NS.1.2** ..... 17

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**Domain 2 – Expressions and Equations**..... 21

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**MAFS.8.EE.1.1** ..... 22

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**MAFS.8.EE.1.2** ..... 28

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Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size form measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.

### **Understand the connections between proportional relationships, lines, and linear equations.**

**MAFS.8.EE.2.5** ..... 43

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### **Analyze and solve linear equations and pairs of simultaneous linear equations.**

**MAFS.8.EE.3.7** ..... 64

Solve linear equations in one variable.

- a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form  $x = a$ ,  $a = a$ , or  $a = b$  results (where  $a$  and  $b$  are different numbers).
- b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

**MAFS.8.EE.3.8** ..... 76

Analyze and solve pairs of simultaneous linear equations.

- a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.



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- b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection.
- c. Solve real-world and mathematical problems leading to two linear equations in two variables.

### Domain 3 – Functions..... 86

#### Define, evaluate, and compare functions.

##### MAFS.8.F.1.1 ..... 87

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.

##### MACC.8.F.1.2 ..... 94

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##### MAFS.8.F.1.3 ..... 103

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#### Use functions to model relationships between quantities.

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##### MAFS.8.F.2.5 ..... 118

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**Domain 4 – Geometry**.....127

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**MAFS.8.G.1.1**.....128

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- a. Lines are taken to lines, and line segments to line segments of the same length.
- b. Angles are taken to angles of the same measure.
- c. Parallel lines are taken to parallel lines.

**MAFS.8.G.1.2**.....140

Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.

**MAFS.8.G.1.3**.....146

Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

**MAFS.8.G.1.4**.....159

Understand that a two-dimensional figure is similar to another if the second can be obtained from the first by a sequence of rotations, reflections, translations, and dilations; given two similar two-dimensional figures, describe a sequence that exhibits the similarity between them.

**MAFS.8.G.1.5**.....165

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.

**Understand and apply the Pythagorean Theorem.**

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Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.	
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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.	



# Domain 1

## The Number System

Rational and Irrational Numbers ..... 11

Rational Approximations of Irrational Numbers ..... 17

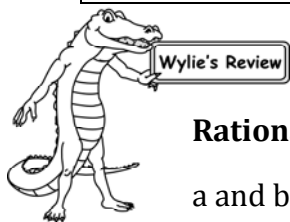




**Know that there are numbers that are not rational, and these are approximated using rational numbers.**

Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers, show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.

Standard



**Rational numbers** are numbers that can be written as the ratio of two integers  $a$  and  $b$ ,  $\frac{a}{b}$ , where  $b \neq 0$ . A rational number can be written as a fraction or as a decimal.

The rational number  $\frac{1}{4}$  means 1 divided by 4 or 0.25. The ratio  $-\frac{2}{3}$  means -2 divided by 3 or -0.666... Remember "... " means the pattern continues forever.

Another way to show that digits repeat is to draw a bar over the digit or series of digits that repeat.

$$0.33... = 0.\overline{3}$$

$$0.3737... = 0.\overline{37}$$

Decimal equivalents of rational numbers either terminate (end) or repeat.

These ratios terminate:  $\frac{1}{2} = 0.5$ ;  $\frac{3}{4} = 0.75$ ;  $-\frac{7}{8} = -0.875$ .

These ratios repeat:  $\frac{1}{3} = 0.33...$ ;  $\frac{5}{6} = 0.833...$ ;  $\frac{5}{9} = 0.\overline{5}$ .

**Example 1:** Give four examples of rational numbers that terminate.

Answers will vary:  $\frac{1}{4} = 0.25$ ;  $-\frac{5}{8} = -0.625$ ;  $\frac{-7}{-100} = 0.07$ ;  $\frac{0}{3} = 0$ .



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**Example 2:** Give four examples of rational numbers that repeat (a digit or sequence of digits).

Answers will vary:  $\frac{1}{9} = 0.\overline{1}$ ;  $\frac{-2}{-7} = 0.\overline{285714}$ ;  $-\frac{5}{3} = -1.\overline{6}$ ;  $\frac{-5}{9} = -0.\overline{5}$ .

---

A convenient rule to use along with a calculator is that the maximum number of digits a rational number can repeat is 1 less than the denominator.

- 3rds repeat within a maximum of  $(3 - 1)$  or 2 places. 3rds repeat in 1 digit, which is less than 2 digits.
  - 7ths repeat within a maximum of  $(7 - 1)$  or 6 places. 7ths repeat every 6 digits.
  - 9ths repeat within a maximum of  $(9 - 1)$  or 8 places. However, 9ths repeat in 1 digit, which is less than 8 digits.
- 

**Example 3:** Change each of the following rational numbers to a decimal and state if it eventually repeats.

(a)  $\frac{3}{5}$

(b)  $-\frac{4}{3}$

(c)  $\frac{-3}{-8}$

(a)  $\frac{3}{5}$  means 3 divided by 5, which equals 0.6. The decimal terminates.

(b)  $-\frac{4}{3}$  means -4 is divided by 3, which equals -1.333... or  $-1.\overline{3}$ . The decimal repeats.

(c)  $\frac{-3}{-8}$  means -3 divided by -8, which equals 0.375. The decimal terminates.

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When converting a repeating decimal into a fraction or ratio, to eliminate the repeating decimals, use powers of 10 and subtraction.



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To change 1.3333... to a fraction, let  $x = 1.333\dots$ , so  $10x = 13.333\dots$ . Subtract.

$$\begin{array}{r} 10x = 13.33\dots \\ - x = -1.33\dots \\ \hline 9x = 12 \\ x = \frac{12}{9} = \frac{4}{3} \end{array}$$

So, 1.333... equals  $\frac{4}{3}$ .

To change 0.727272... to a fraction, because two digits repeat, multiply the original number by 100 to line up the decimal digits.

Let  $x = 0.72\dots$ , so  $100x = 72.72\dots$ . Subtract.

$$\begin{array}{r} 100x = 72.7272\dots \\ - x = -0.7272\dots \\ \hline 99x = 72 \\ x = \frac{72}{99} = \frac{8}{11} \end{array}$$

So, 0.727272... =  $\frac{8}{11}$ .

---

**Example 4:** Determine the fraction equivalent to each decimal.

- (a) 0.55...      (b) 0.833...      (c)  $2.\bar{3}$

(a) Let  $x = 0.55\dots$ , so  $10x = 5.55\dots$ . Subtract.

$$\begin{array}{r} 10x = 5.5555\dots \\ - x = -0.55\dots \\ \hline 9x = 5 \\ x = \frac{5}{9} \end{array}$$

So, 0.55... =  $\frac{5}{9}$ .



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- (b) Let  $x = 0.833\dots$ . Because not every decimal digit repeats, the number must be multiplied by 100 and by 10 to be able to line up the like decimal digits. So,  $100x = 83.333\dots$  and  $10x = 8.333\dots$ . Subtract.

$$\begin{array}{r} 100x = 83.333\dots \\ - 10x = - 8.333\dots \\ \hline 99x = 75 \\ x = \frac{75}{99} = \frac{5}{6} \end{array}$$

So,  $0.833\dots = \frac{5}{6}$ .

- (c) Let  $x = 2.\bar{3} = 2.333\dots$ , so  $10x = 23.333\dots$ . Subtract.

$$\begin{array}{r} 10x = 23.333\dots \\ - x = - 2.333\dots \\ \hline 9x = 21 \\ x = \frac{21}{9} = \frac{7}{3} \end{array}$$

So,  $2.33\dots = \frac{7}{3}$ .

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**Irrational numbers** are numbers which cannot be written in the form  $\frac{a}{b}$ , where  $a$  and  $b$  are integers and  $b \neq 0$ . In decimal form, irrational numbers do not repeat or terminate.

A few irrational numbers are  $\pi$ ,  $\sqrt{2}$ ,  $\sqrt{3}$ , and  $-\sqrt{10}$ . Using a calculator only the beginning digits can be seen. The number of decimal digits in an irrational number is infinite, as they go on forever and yet never repeat in a pattern of digits.

$$\begin{array}{ll} \pi \approx 3.14159265\dots & \sqrt{3} \approx 1.7320508\dots \\ \sqrt{2} \approx 1.4142135\dots & -\sqrt{10} \approx -3.1622776\dots \end{array}$$

Square root asks, “What number squared is \_\_\_?” or “What number times itself is \_\_\_?”.



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**Domain 1 – The Number System – MAFS.8.NS.1.1**

**Now Try These:**

**For 1-2, Editing Task Choice**

- The rational number  $\frac{4}{9}$  written as a decimal is **0.49**.
  - 0.4
  - $0.\overline{4}$
  - $0.\overline{45}$
- The decimal number  $0.\overline{2}$  written as a ratio is  **$\frac{2}{10}$** .
  - $\frac{1}{5}$
  - $\frac{11}{50}$
  - $\frac{2}{9}$

**For 3-4, Hot Text**

- Complete the table by using the numbers in the box below to show equivalent fractions and decimals.

Fraction	Decimal
	0.6
	0.625
	$0.\overline{6}$

$\frac{1}{6}$	$\frac{5}{6}$	$\frac{3}{8}$	$\frac{3}{4}$	$\frac{3}{5}$	$\frac{2}{3}$
---------------	---------------	---------------	---------------	---------------	---------------

- Determine which numbers in the box below are rational or irrational.

RATIONAL	IRRATIONAL

0.2	$\frac{4}{9}$	$\frac{5}{4}$	$\sqrt{4}$	$\sqrt{10}$
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**For 5-12, Equation Editor**

- What is  $-\frac{1}{2}$  written as a decimal?
- What is  $\frac{-7}{-6}$  written as a decimal?
- What is  $\frac{12}{5}$  written as a decimal?
- What is  $0.\overline{37}$  written as a rational number?
- What is  $4.\overline{3}$  written as a rational number?
- What is  $0.0\overline{3}$  written as a rational number?
- What is  $0.58\overline{3}$  written as a rational number?
- What is  $0.4\overline{5}$  written as a rational number?

**For 13-14, Multiselect**

- Select all the irrational numbers.

- $1.\overline{3}$
- $\sqrt{3}$
- $\frac{2}{9}$
- $\sqrt{2}$
- $\pi$



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**Domain 1 – The Number System – MAFS.8.NS.1.1**

14. Select all the rational numbers.

- $\frac{1}{3}$
- $\sqrt{2}$
- $-\frac{1}{2}$
- $\frac{10}{3}$
- $0.\bar{3}$

**For 15-17, Multiple Choice**

15. Which fraction is equivalent to 0.875?

- A.  $\frac{7}{8}$
- B.  $\frac{8}{11}$
- C.  $\frac{8}{9}$
- D.  $\frac{8}{7}$

16. Which number is irrational?

- A.  $\sqrt{64}$
- B.  $\frac{\sqrt{16}}{4}$
- C.  $\frac{\sqrt{20}}{5}$
- D.  $\frac{1}{2}$

17. Which is equivalent to  $\frac{1}{6}$ ?

- A.  $0.0\bar{16}$
- B.  $0.1\bar{6}$
- C.  $0.\bar{16}$
- D.  $0.\bar{61}$

**For 18-19, Matching Item**

18. Determine whether each number is rational or irrational.

Number	Rational	Irrational
$\sqrt{2}$		
$\sqrt{8}$		
$\sqrt{4}$		
$\sqrt{16}$		

19. Determine whether each number is rational or irrational.

Number	Rational	Irrational
$\sqrt{81}$		
$\sqrt{89}$		
$\sqrt{121}$		
$\sqrt{131}$		

**Open Response**

20. Why is the square root of a perfect square always rational?



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Domain 1 – The Number System – MAFS.8.NS.1.1-1.2 – Formative Assessment 1

Know that there are numbers that are not rational,  
and approximate them by rational numbers.

Formative Assessment 1

For 1 – 2, Multiple Choice

1. Which represents an irrational number? MAFS.8.NS.1.1

- A.  $\sqrt{4}$
- B.  $\sqrt{6}$
- C.  $\sqrt{9}$
- D.  $\sqrt{16}$

2. What is the approximate value of  $\sqrt{31}$ ? MAFS.8.NS.1.2

- A. 5
- B. 6
- C. 15
- D. 16

For 3 – 4, Editing Task Choice

3. The rational number equivalent to  $0.\bar{5}$  is " $\frac{6}{11}$ ".

MAFS.8.NS.1.1

- $\frac{5}{7}$
- $\frac{5}{9}$
- $\frac{7}{12}$

4. An irrational number is " $\frac{2}{3}$ ".

MAFS.8.NS.1.1

- $\sqrt{9}$
- $\frac{\sqrt{4}}{\sqrt{9}}$
- $\sqrt{3}$



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**GRID**

5. Select and drag a number to each box to make a correct equation.

3	4	5	16
↓	↓	↓	↓

$$\sqrt{\square^2 - \square^2} = \sqrt{\square} = \square$$

**Equation Editor**

6. What is the approximate value of  $\sqrt{80}$ , to the nearest whole number? MAFS.8.NS.1.2

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**Open Response**

7. Why are the square roots of prime numbers greater than 1 always irrational? MAFS.8.NS.1.2

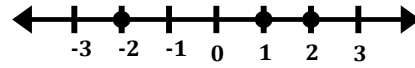
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**For 8 – 9, Hot Text**

8. Which is equivalent to  $0.\overline{583}$ ? MAFS.8.NS.1.1

- $\frac{4}{7}$
- $\frac{5}{9}$
- $\frac{7}{12}$

9. Graph the coordinates  $-2$ ,  $\sqrt{7}$  and  $\sqrt{1}$  on the number line below. MAFS.8.NS.1.2



**Matching Item**

10. Select Rational and Irrational for each number shown. MAFS.8.NS.1.1

Number	Rational	Irrational
$\sqrt{36}$		
$-\sqrt{39}$		
$\sqrt{3^2 + 5^2}$		
$\sqrt{49}$		

**For 11 – 12, Equation Editor**

11. What is  $\frac{5}{12}$  written as a decimal? MAFS.8.NS.1.1

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Domain 1 – The Number System – MAFS.8.NS.1.1-1.2 – Formative Assessment 1**

**12.** What is  $0.8\bar{3}$  written as a rational number?  
MAFS.8.NS.1.1

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**Multiselect**

**13.** Select all of the numbers that are irrational.  
MAFS.8.NS.1.1

- $2.1\bar{6}$
- $\sqrt{2}$
- $\frac{3}{8}$
- $-\frac{8}{3}$
- $\sqrt{15}$
- $\sqrt{1}$

**Multiple Choice**

**14.** Which statement correctly completes the process of finding the equivalent of the repeating decimal  $1.\bar{6}$  to a ratio?  
MAFS.8.NS.1.2

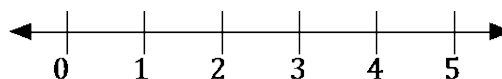
Let  $x = 1.666\dots$  and  $10x = 16.666\dots$   
 $10x - x = 16.666\dots - 1.666\dots$

- A.  $9x = 15$  and  $x = \frac{3}{5}$ .
- B.  $9x = 15$  and  $x = \frac{5}{3}$ .
- C.  $10x = 15$  and  $x = \frac{3}{2}$ .
- D.  $10x = 15$  and  $x = \frac{5}{2}$ .

**GRID**

**15.** Place the following numbers in the proper location on the number line. MAFS.8.NS.1.2

$\sqrt{4}, \sqrt{16}, \sqrt{2}, \sqrt{7}$



**Equation Editor**



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Domain 1 – The Number System – MAFS.8.NS.1.1-1.2 – Formative Assessment 1

16. What is the approximate value of  $\sqrt{77}$ , to the nearest whole number?  
MAFS.8.NS.1.1
- 

**For 17 – 19, Multiple Choice**

17. Which describes the best interval to approximate the value of  $-\sqrt{79}$ ? MAFS.8.NS.1.2

- A. It is a number between -10 and -9.
- B. It is a number between -9 and -8.
- C. It is a number between -8 and -7.
- D. It is a number between -7 and -6.

18. What is the approximate value of  $-\sqrt{57}$ , to the nearest whole number? MAFS.8.NS.1.2

- A. -7
- B. -8
- C. -27
- D. -28

19. Which describes the best interval to approximate the value of  $\sqrt{19}$ ? MAFS.8.NS.1.2

- A. It is a number between 2 and 3.
- B. It is a number between 3 and 4.
- C. It is a number between 4 and 5.
- D. It is a number between 5 and 6.

**Multiselect**

20. Select all of numbers that are rational. MAFS.8.NS.1.1

- $\frac{9}{5}$
- $\frac{-12}{5}$
- $\pi$
- $\frac{-5}{-3}$
- $0.9\overline{16}$
- $-\sqrt{64}$



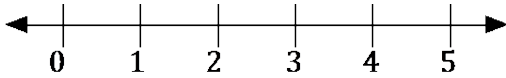


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**GRID**

21. Place the following numbers in the proper location on the number line. MAFS.8.NS.1.2

$$\pi, \sqrt{3}, \sqrt{17}, \sqrt{25}$$



**For 22 – 23, Equation Editor**

22. What is the decimal equivalent of  $\frac{-12}{5}$ ? MAFS.8.NS.1.1

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23. What is  $0.\bar{2}$  written as a rational number? MAFS.8.NS.1.1

---

**Open Response**

24. Explain how to approximate  $\sqrt{3}$  to the nearest whole number. MAFS.8.NS.1.2

---

**Multiselect**

25. Select all of the equations that are correct. MAFS.8.NS.1.2

$\sqrt{1} = 1$

$-\sqrt{4} = -2$

$4^2 = 16$

$\sqrt{4} = 16$

$2^2 = \sqrt{4}$

$\frac{\sqrt{4}}{2} = 1$

$\frac{\sqrt{4}}{\sqrt{16}} = 4$

