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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 1

The Number System

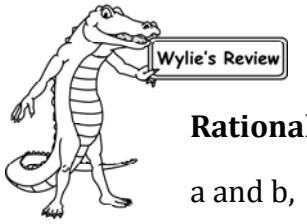
Everglades K-12 Publishing's Mathematics Florida Standards Grade 8
Domain 1 – The Number System – MAFS.8.NS.1.1

Domain → **Rational and Irrational Numbers** ← Standard Coding

Title → **Rational and Irrational Numbers**

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

Standard → 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.



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.

$0.33\ldots = 0.\overline{3}$ $\qquad$ $0.3737\ldots = 0.\overline{37}$

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

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

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

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.

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

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

$$\begin{aligned} 10x &= 13.33\ldots \\ -x &= -1.33\ldots \\ \hline 9x &= 12 \end{aligned}$$

$$x = \frac{12}{9} = \frac{4}{3}$$

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…, so 100x = 72.72… . Subtract.

$$\begin{aligned} 100x &= 72.7272\ldots \\ -x &= -0.7272\ldots \\ \hline 99x &= 72 \end{aligned}$$

$$x = \frac{72}{99} = \frac{8}{11}$$

So, 0.727272… = $\frac{8}{11}$.

Example 4: Determine the fraction equivalent to each decimal.

(a) 0.55… (b) 0.833… (c) $2.\overline{3}$

(a) Let x = 0.55…, so 10x = 5.55… . Subtract.

$$\begin{aligned} 10x &= 5.5555\ldots \\ -x &= -0.55\ldots \\ \hline 9x &= 5 \end{aligned}$$

$$x = \frac{5}{9}$$

So, 0.55… = $\frac{5}{9}$.

(b) Let x = 0.833… . 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… and 10x = 8.333… . Subtract.

$$\begin{aligned} 100x &= 83.333\ldots \\ -\ 10x &= -\ 8.333\ldots \\ \hline 99x &= 75 \end{aligned}$$

$$x = \frac{75}{90} = \frac{5}{6}$$

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

(c) Let $x = 2.\overline{3} = 2.33\ldots$, so $10x = 23.3\ldots$. Subtract.

$$\begin{aligned} 10x &= 23.333\ldots \\ -\ x &= -\ 2.333\ldots \\ \hline 9x &= 21 \end{aligned}$$

$$x = \frac{21}{9} = \frac{7}{3}$$

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

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 π, $\sqrt{2}$, $\sqrt{3}$, 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.

$\pi \approx 3.14159265\ldots$ $\qquad$ $\sqrt{3} \approx 1.7320508\ldots$

$\sqrt{2} \approx 1.4142135\ldots$ $\qquad$ $-\sqrt{10} \approx -3.1622776\ldots$

Square root asks**, "**What number squared is __?" or "What number times itself is__?".

Now Try These:

For 1-2, Editing Task Choice

1. The rational number $\frac{4}{9}$ written as a decimal is **0.49**.

- 0.4
- $0.\overline{4}$
- $0.\overline{45}$

2. The decimal number $0.\overline{2}$ written as a ratio is $\frac{\mathbf{2}}{\mathbf{10}}$.

- $\frac{1}{5}$
- $\frac{11}{50}$
- $\frac{2}{9}$

For 3-4, Hot Text

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

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

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

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

RATIONAL	IRRATIONAL

0.2	$\frac{4}{9}$	$\frac{5}{4}$	$\sqrt{4}$	$\sqrt{10}$

For 5-12, Equation Editor

5. What is $-\frac{1}{2}$ written as a decimal?

6. What is $\frac{-7}{-6}$ written as a decimal?

7. What is $\frac{12}{5}$ written as a decimal?

8. What is $0.\overline{37}$ written as a rational number?

9. What is $4.\overline{3}$ written as a rational number?

10. What is $0.0\overline{3}$ written as a rational number?

11. What is $0.58\overline{3}$ written as a rational number?

12. What is $0.\overline{45}$ written as a rational number?

For 13-14, Multiselect

13. Select all the irrational numbers.

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

14. Select all the rational numbers.

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

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. $0.01\overline{6}$

B. $0.1\overline{6}$

C. $0.\overline{16}$

D. $0.\overline{61}$

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?

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 $0.\overline{5}$ 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

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

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

_____

Open Response

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

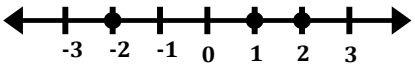
_____

For 8 – 9, Hot Text

8. Which is equivalent to $0.58\overline{3}$? 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

_____

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

_____

Multiselect

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

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

Multiple Choice

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

Let x = 1.666… and 10x = 16.666…
10x – x = 16.666… – 1.666…

A. 9x = 15 and x = $\frac{3}{5}$.

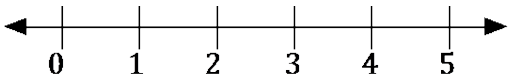
B. 9x = 15 and x = $\frac{5}{3}$.

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

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

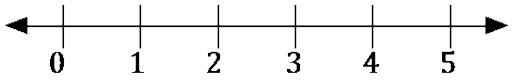
20. Select all of numbers that are rational. MAFS.8.NS.1.1

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

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

_____

23. What is $0.\overline{2}$ 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

- ☐ $\sqrt{1}=1$
- ☐ $-\sqrt{4}=-2$
- ☐ $4^2=16$
- ☐ $\sqrt{4}=16$
- ☐ $2^2=\sqrt{4}$
- ☐ $\frac{\sqrt{4}}{2}=1$
- ☐ $\frac{\sqrt{4}}{\sqrt{16}}=4$