Warm Up:

Order the following from least to greatest:
.37, .33, 1/3, .32

$.\overline{3}$

.330 .333

Write the following using interval and set-builder notation:
x>6

$(6,\infty)$ $\{x \mid x>6, x\in\mathbb{R}\}$

1-2 Properties of Real Numbers

Objective

Identify and use properties of real numbers.

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1-2 Properties of Real Numbers

Properties Real Numbers | **Identities and Inverses**

For all real numbers *n*,

WORDS	**Additive Identity Property** The sum of a number and 0, the additive identity, is the original number.
NUMBERS	$3 + 0 = \cancel{0}\ 3$
ALGEBRA	$n + 0 = 0 + n = n$

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1-2 Properties of Real Numbers

Properties Real Numbers | **Identities and Inverses**

For all real numbers *n*,

WORDS	**Multiplicative Identity Property** The product of a number and 1, the multiplicative identity, is the original number.
NUMBERS	$\frac{2}{3} \bullet 1 = \frac{2}{3}$
ALGEBRA	$n \bullet 1 = 1 \bullet n = n$

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1-2 Properties of Real Numbers

Properties Real Numbers **Identities and Inverses**

For all real numbers *n*,

WORDS	**Additive Inverse Property** The sum of a number and its opposite, or additive inverse, is 0.
NUMBERS	$5 + (-5) = 0$
ALGEBRA	$n + (-n) = 0$

$-\frac{4}{3} + \frac{4}{3}$

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1-2 Properties of Real Numbers

Properties Real Numbers **Identities and Inverses**

For all real numbers *n*,

WORDS	**Multiplicative Inverse Property** The product of a nonzero number and its reciprocal, or multiplicative inverse, is 1.
NUMBERS	$\frac{8}{1} \bullet \frac{1}{8} = 1$
ALGEBRA	$n \bullet \frac{1}{n} = 1 \quad (n \neq 0)$

$\frac{3}{4} \cdot \frac{4}{3}$ $\quad -\frac{1}{2} \cdot -\frac{2}{1}$

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Find the additive and multiplicative ~~identity~~ of each number:
inverse

12	3/4	-4
-12	$-\frac{3}{4}$	4
$\frac{1}{12}$	$\frac{4}{3}$	$-\frac{1}{4}$

1-2 Properties of Real Numbers

Properties Real Numbers | **Addition and Multiplication**

For all real numbers *a* and *b*,

WORDS	**Closure Property** The sum or product of any two real numbers is a real number
NUMBERS	$2 + 3 = 5$ $2(3) = 6$
ALGEBRA	$a + b \in \Re$ $ab \in \Re$

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1-2 Properties of Real Numbers

Properties Real Numbers **Addition and Multiplication**

For all real numbers *a* and *b*,

WORDS	**Commutative Property** You can add or multiply real numbers in any order without changing the result.
NUMBERS	$7 + 11 = 11 + 7$ $7(11) = 11(7)$
ALGEBRA	$a + b = b + a$ $ab = ba$

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1-2 Properties of Real Numbers

Properties Real Numbers **Addition and Multiplication**

For all real numbers *a* and *b*, Parantheses

WORDS	**Associative Property** The sum or product of three or more real numbers is the same regardless of the way the numbers are grouped.
NUMBERS	$(5 + 3) + 7 = 5 + (3 + 7)$ $(5 \bullet 3)7 = 5(3 \bullet 7)$
ALGEBRA	$a + (b + c) = a + (b + c)$ $(ab)c = a(bc)$

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1-2 Properties of Real Numbers

Properties Real Numbers **Addition and Multiplication**

For all real numbers *a* and *b*,

WORDS	**Distributive Property** When you multiply a sum by a number, the result is the same whether you add and then multiply or whether you multiply each term by the number and add the products.
NUMBERS	$5(2 + 8) = 5(2) + 5(8)$ $(2 + 8)5 = (2)5 + (8)5$
ALGEBRA	$a(b + c) = ab + ac$ $(b + c)a = ba + ca$

1-2 Properties of Real Numbers

Example 2: Identifying Properties of Real Numbers

Identify the property demonstrated by each question.

A. $2 \bullet 3.9 = 3.9 \bullet 2$

Comm.

B. $3(2\sqrt{8}) = (3 \bullet 2)\sqrt{8}$

Assoc.

1-2 Properties of Real Numbers

Check It Out! Example 2

Identify the property demonstrated by each equation.

2a. $9\sqrt{2} = (\sqrt{2})9$

Comm.

2b. $9(12\pi) = (9 \bullet 12)\pi$

Assoc.

1-2 Properties of Real Numbers

Example 4A: Classifying Statements as Sometimes, Always, or Never True

Classifying each statement as sometimes, always, or never true. Give examples or properties to support your answers.

$a \bullet b = a$, where $b = 3$

$a \cdot 3 = a$

$0 \cdot 3 = 0$ ✓

$\cancel{2 \cdot 3 = 2}$

1-2 Properties of Real Numbers

Example 4B: Classifying Statements as Sometimes, Always, or Never True

Classifying each statement as sometimes, always, or never true. Give examples or properties to support your answers.

$3(a + 1) = 3a + 3$

$3a + 3 = 3a + 3$

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Write your own equation and decide if it is always, sometimes, or never true. Justify your answer.

Then, classify your partner's equation and justify your answer.

1-3 Square Roots

Objectives

Estimate square roots.

Simplify, add, subtract, multiply, and divide square roots.

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1-3 Square Roots

Vocabulary

radical symbol
radicand
principal root
rationalize the denominator
like radical terms

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1-3 Square Roots

The side length of a square is the square root of its area. This relationship is shown by a **radical symbol** ($\sqrt{\ }$). The number or expression under the radical symbol is called the **radicand**. The radical symbol indicates only the positive square root of a number, called the **principal root**. To indicate both the positive and negative square roots of a number, use the plus or minus sign ($\pm$).

1-3 Square Roots

Numbers such as 25 that have integer square roots are called *perfect squares.* Square roots of integers that are not perfect squares are irrational numbers. You can estimate the value of these square roots by comparing them with perfect squares. For example, $\sqrt{5}$ lies between $\sqrt{4}$ and $\sqrt{9}$, so it lies between 2 and 3.

1-3 Square Roots

Properties of Square Roots

For $a \geq 0$ and $b > 0$,

WORDS	NUMBERS	ALGEBRA
Product Property of Square Roots		
The square root of a product is equal to the product of the square roots of the factors.	$\sqrt{12} = \sqrt{4 \cdot 3} = \sqrt{4} \cdot \sqrt{3} = 2\sqrt{3}$ $\sqrt{8} \cdot \sqrt{2} = \sqrt{8 \cdot 2} = \sqrt{16} = 4$	$\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$ $\sqrt{a} \cdot \sqrt{b} = \sqrt{ab}$
Quotient Property of Square Roots		
The square root of a quotient is equal to the quotient of the square roots of the dividend and the divisor.	$\sqrt{\frac{25}{16}} = \frac{\sqrt{25}}{\sqrt{16}} = \frac{5}{4}$ $\frac{\sqrt{18}}{\sqrt{2}} = \sqrt{\frac{18}{2}} = \sqrt{9} = 3$	$\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$ $\frac{\sqrt{a}}{\sqrt{b}} = \sqrt{\frac{a}{b}}$

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More often than not you will be given a square root that does not have a "nice" answer. As mathematicians we like our work to be as exact as possible so estimating on a calculator can become pointless and menial because it makes our work less exact. This is where these properties come in to play. By simplifying the number under the radical symbol into multiplication or division with a perfect square we can end up with much more precise answers.

1-3 Square Roots

Example 2: Simplifying Square–Root Expressions

Simplify each expression.

A. $\sqrt{32}$

$\sqrt{16 \cdot 2}$

$\sqrt{16} \cdot \sqrt{2} = 4\sqrt{2}$

B. $\sqrt{\frac{25}{36}}$

$\frac{\sqrt{25}}{\sqrt{36}} = \frac{5}{6}$

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1-3 Square Roots

Example 2: Simplifying Square–Root Expressions

Simplify each expression.

C. $\sqrt{3} \cdot \sqrt{12}$

$= \sqrt{3 \cdot 12}$

$= \sqrt{36} = 6$

D. $\frac{\sqrt{500}}{\sqrt{5}}$

$\sqrt{\frac{500}{5}} = \sqrt{100} = 10$

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Now attempt these with your partner. Give them a "mean" square root and have them apply these properties to get the most precise simplified answer.

Homework

p. 16 #15-23,35-40

p. 24 #18-26