Topic (Chapter)
Lesson (Sections)

[1.1] Operations on Real Numbers

Add, Subtract, Multiply, & Divide

Rational # or Irrational #
Fractions
decimal: repeats / terminates
π $\sqrt{75}$ $\sqrt[3]{50}$ $\sqrt{2}$

Rational # $\overset{+}{*}\overset{-}{\div}$ Rational # = Rational #

Rational # + or − Irrational # = Irrational #

Rational # * Irrational # = Irrational #
Except if the rational # is zero.

Irrational # + or − Irrational # = Irrational #
Except if you subtract the SAME irr. #.

Irrational # $\overset{*}{\div}$ Irrational # = Irrational #

Except if the #'s are the same

$\frac{\sqrt{10}}{\sqrt{10}} = 1$

$\sqrt{10} \cdot \sqrt{10} = \sqrt{100} = 10$

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

p 8 ; 9 (#6-31) ace

CONCEPT SUMMARY Operations on Real Numbers

WORDS	The sum of two rational numbers is always rational. The product of two rational numbers is always rational.	The sum of a rational number and an irrational number is always irrational. The product of a nonzero rational number and an irrational number is always irrational.
NUMBERS	Sums: $\frac{2}{9}+\frac{4}{6}=\frac{32}{36}$ Products: $\frac{2}{9}\cdot\frac{4}{6}=\frac{8}{54}$	Sums: $\sqrt{3}+\frac{1}{3}=\frac{3\sqrt{3}+1}{3}$ Products: $\sqrt{3}\cdot\frac{1}{3}=\frac{\sqrt{3}}{3}$
ALGEBRA	Sums: $\frac{a}{b}+\frac{c}{d}=\frac{ad+cb}{bd}$ Products: $\frac{a}{b}\cdot\frac{c}{d}=\frac{ac}{bd}$	Sums: $\frac{a}{b}+c\neq\frac{p}{q}$, when c is irrational Products: $\frac{a}{b}\cdot c\neq\frac{p}{q}$, when c is irrational

Do You UNDERSTAND?

1. **ESSENTIAL QUESTION** How can you classify the results of operations on real numbers?

2. **Communicate Precisely** Explain why the sum of a rational number and an irrational number is always irrational. MP.6

3. **Vocabulary** Are the rational numbers a *subset* of the *set* of all real numbers? Are the rational numbers a *subset* of the irrational numbers? Explain?

4. **Error Analysis** Jacinta says that the product of a rational number and an irrational number is always irrational. Explain her error. MP.3

5. **Reason** Let $D = \{-2, -1, 0, 1, 2\}$. Is D a subset of itself? Explain. MP.2

Do You KNOW HOW?

Determine whether set B is a subset of set A.

6. $A = \{0, 1, 2, 3, 4\}$
   $B = \{1, 2\}$

7. $A = \{2, 3, 5, 7, 11\}$
   $B = \{3, 5, 7, 9, 11\}$

Order each set of numbers from least to greatest.

8. $\sqrt{200}$, 14, $\frac{41}{3}$

9. $\frac{2}{3}$, $\sqrt{\frac{9}{16}}$, 0.6

10. The park shown is in the shape of a square. Is the perimeter rational or irrational?

PRACTICE & PROBLEM SOLVING

Scan for Multimedia

Practice Tutorial

Additional Exercises Available Online

UNDERSTAND

11. Reason Identify each solution as rational or irrational. MP.2

a. $\frac{4}{7} + \frac{-1}{3}$

b. $\sqrt{4} \cdot \frac{2}{5}$

12. Higher Order Thinking Is the product of two irrational numbers always an irrational number? Explain.

13. Error Analysis Describe and correct the error a student made when ordering numbers from least to greatest. MP.3

$\sqrt{144}, \frac{234}{3}, 68.12$

$\sqrt{144} = 72$

$\frac{234}{3} = 78$

$68.12, \sqrt{144}, \frac{234}{3}$ ✗

14. Mathematical Connections The bulletin board is in the shape of a square. Find two rational numbers that are within $\frac{1}{8}$ in. of the actual side length.

Construct Arguments Tell whether each statement is *always true*, *sometimes true*, or *never true*. Explain. MP.3

a. An integer is a whole number.

b. A natural number is a rational number.

c. An irrational number is an integer.

PRACTICE

List all subsets of the real numbers from the list below that each number belongs to. SEE EXAMPLE 1

- real numbers
- irrational numbers
- rational numbers
- integers
- whole numbers

16. 10.5

17. $\frac{4}{7}$

18. 6

19. 0

20. $\sqrt{2}$

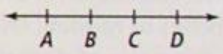
21. -29

Order the numbers shown from least to greatest. SEE EXAMPLE 2

22. $3.5, \frac{10}{3}, \sqrt{14}$

23. $\frac{1}{3}, 0.1\overline{6}, \sqrt{\frac{1}{4}}$

Match each number to the letter that represents its position on the number line. SEE EXAMPLE 2



24. $-\sqrt{120}$

25. $-\sqrt{\frac{400}{4}}$

26. $-\frac{23}{2}$

27. -11.75

Determine whether each sum, difference, product, or quotient represents a rational number or an irrational number. Explain how you know without simplifying. SEE EXAMPLES 3 AND 4

28. $\frac{6}{23} - \frac{\sqrt{2}}{2}$

29. $\frac{6}{23} - \frac{15}{127}$

30. $\frac{6}{23} \div \frac{15}{127}$

31. $\frac{6}{23} \div \frac{\sqrt{2}}{2}$

32. Is the difference of two rational numbers always a rational number? Explain. SEE EXAMPLE 3

33. Is the quotient of a rational number and an irrational number always irrational? Explain. SEE EXAMPLE 4