Because 2 is a factor of 10 and $2 \cdot 5 = 10$, 5 is also a factor of 10. The pair 2, 5 is called a **factor pair** of 10.

Key Vocabulary

factor pair, *p. 16*
prime factorization, *p. 16*
factor tree, *p. 16*

EXAMPLE 1 Finding Factor Pairs

The brass section of a marching band has 30 members. The band director arranges the brass section in rows. Each row has the same number of members. How many possible arrangements are there?

Use the factor pairs of 30 to find the number of arrangements.

$30 = 1 \cdot 30$ There could be 1 row of 30 or 30 rows of 1.

$30 = 2 \cdot 15$ There could be 2 rows of 15 or 15 rows of 2.

$30 = 3 \cdot 10$ There could be 3 rows of 10 or 10 rows of 3.

$30 = 5 \cdot 6$ There could be 5 rows of 6 or 6 rows of 5.

$30 = 6 \cdot 5$ The factors 5 and 6 are already listed.

When making an organized list of factor pairs, stop finding pairs when the factors begin to repeat.

There are 8 possible arrangements: 1 row of 30, 30 rows of 1, 2 rows of 15, 15 rows of 2, 3 rows of 10, 10 rows of 3, 5 rows of 6, or 6 rows of 5.

Try It **List the factor pairs of the number.**

1. 18 **2.** 24 **3.** 51

4. **WHAT IF?** The woodwinds section of the marching band has 38 members. Which has more possible arrangements, the brass section or the woodwinds section? Explain.

Remember

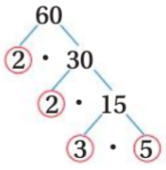
A *prime number* is a whole number greater than 1 with exactly two factors, 1 and itself. A *composite number* is a whole number greater than 1 with factors in addition to 1 and itself.

Key Idea

Prime Factorization

The **prime factorization** of a composite number is the number written as a product of its prime factors.

You can use factor pairs and a **factor tree** to help find the prime factorization of a number. The factor tree is complete when only prime factors appear in the product. A factor tree for 60 is shown.



$60 = 2 \cdot 2 \cdot 3 \cdot 5$, or $2^2 \cdot 3 \cdot 5$

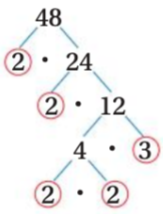
EXAMPLE 2 Writing a Prime Factorization

Write the prime factorization of 48.

Choose any factor pair of 48 to begin the factor tree.

Notice that beginning with different factor pairs results in the same prime factorization. Every composite number has only one prime factorization.

Tree 1



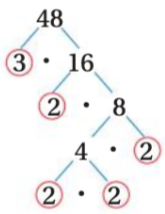
$48 = 2 \cdot 2 \cdot 3 \cdot 2 \cdot 2$

Find a factor pair and draw "branches."

Circle the prime factors as you find them.

Find factors until each branch ends at a prime factor.

Tree 2



$48 = 3 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

The prime factorization of 48 is $2 \cdot 2 \cdot 2 \cdot 2 \cdot 3$, or $2^4 \cdot 3$.

Try It **Write the prime factorization of the number.**

5. 20 **6.** 88 **7.** 90 **8.** 462

Self-Assessment for Concepts & Skills

Solve each exercise. Then rate your understanding of the success criteria in your journal.

WRITING A PRIME FACTORIZATION **Write the prime factorization of the number.**

9. 14 **10.** 86 **11.** 40 **12.** 516

13. **WRITING** Explain the difference between prime numbers and composite numbers.

14. MP **STRUCTURE** Your friend lists the following factor pairs and concludes that there are 6 factor pairs of 12. Explain why your friend is incorrect.

1, 12	2, 6	3, 4
12, 1	6, 2	4, 3

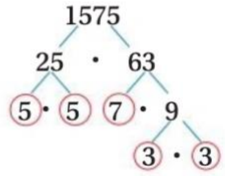
15. **WHICH ONE DOESN'T BELONG?** Which factor pair does *not* belong with the other three? Explain your reasoning.

2, 28	4, 14	6, 9	7, 8

EXAMPLE 3 Using a Prime Factorization

What is the greatest perfect square that is a factor of 1575?

Because 1575 has many factors, it is not efficient to list all of its factors and check for perfect squares. Use a factor tree to write the prime factorization of 1575. Then analyze the prime factors to find perfect square factors.



$$1575 = 3 \cdot 3 \cdot 5 \cdot 5 \cdot 7$$

The prime factorization shows that 1575 has three factors other than 1 that are perfect squares.

$3 \cdot 3 = 9$

$5 \cdot 5 = 25$

$(3 \cdot 5) \cdot (3 \cdot 5) = 15 \cdot 15 = 225$

So, the greatest perfect square that is a factor of 1575 is 225.

Self-Assessment for Problem Solving

Solve each exercise. Then rate your understanding of the success criteria in your journal.

16. A group of 20 friends plays a card game. The game can be played with 2 or more teams of equal size. Each team must have at least 2 members. List the possible numbers and sizes of teams.

17. You arrange 150 chairs in rows for a school play. You want each row to have the same number of chairs. How many possible arrangements are there? Are all of the possible arrangements appropriate for the play? Explain.

18. What is the least perfect square that is a factor of 4536? What is the greatest perfect square that is a factor of 4536?

19. DIG DEEPER! The prime factorization of a number is $2^4 \times 3^4 \times 5^4 \times 7^2$. Is the number a perfect square? Explain your reasoning.