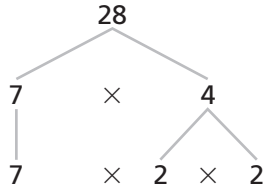
Topic 1: Prime Factorization

for use after ***Bits and Pieces I*** **Investigation 1**

Any composite number can be written as a product using its factors. The **prime factorization** of a number is the product of prime factors equal to that number.

You can use factor trees to find the prime factorization of a number. For example, to make a factor tree for 28, begin by choosing two numbers whose product is 28. Continue dividing each number into two factors until each of the branches ends in a prime number. Below is a sample factor tree for 28.



The prime factorization of 28 is $2 \times 2 \times 7$, or $2^2 \times 7$.

The small raised number in $2^2 \times 7$ is an exponent. An **exponent** tells how many times a factor is multiplied repeatedly. For example, the expression $3^2 \times 5^3$ means $3 \times 3 \times 5 \times 5 \times 5$.

Problem 1.1

A. 1. List all of the factors of 90. Which factors are prime?

2. Which factor pairs could you use to start a factor tree for 90?

3. Make two different factor trees for 90. What do you notice about the prime factorization of each tree?

4. How can you write the prime factorization of 90 using exponents?

B. 1. Are each of the prime factors of a number included in the prime factorization at least once?

2. Does it matter which two factors you choose for the first line of a factor tree?

Exercises

For Exercises 1–9, find the prime factorization of each number.

1. 20 **2.** 36 **3.** 50

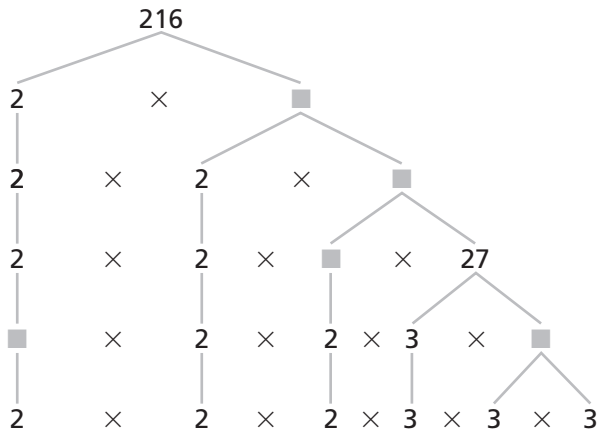
4. 85 **5.** 100 **6.** 189

7. 525 **8.** 639 **9.** 1,000

10. Use exponents to write the prime factorizations you found in Exercises 1–9.

For Exercises 11–12, copy and complete the factor trees.

11.



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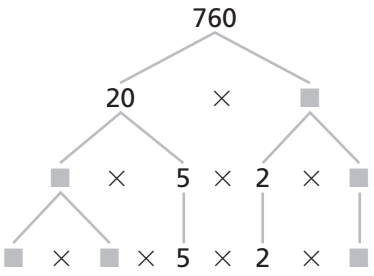


For Exercises 13–16, consider the prime factorization of each of the whole numbers from 2 through 50.

13. Which of the whole numbers from 2 to 25 are prime?

14. Which of the whole numbers from 20 to 30 are the product of exactly three different prime factors?

15. Which of the whole numbers from 30 to 40 have 5 as a prime factor?

16. Which of the whole numbers from 40 to 50 have a prime factorization with only odd prime factors?

17. a. Make three different factor trees for 360.

b. How many different pairs of numbers could you use to start a factor tree for 360?

Topic 1: Prime Factorization

At a Glance

PACING 1 day

Mathematical Goals

- Use a factor tree to find a prime factorization
- Write a prime factorization using exponents

Teaching Guide

Vocabulary

- prime factorization
- exponent

Before beginning Topic 1, review the concepts of prime numbers and factors with students. You can also review the concept of exponents with students. Explain that an expression in the form a^b is called a power; a is the base, and b is the exponent.

Before Problem 1.1, ask:

- *What is the definition of a prime number?*
- *Is 1 considered a prime number?*
- *How can you find the factors of a number?*
- *How can you use exponents to rewrite the expression $5 \times 5 \times 5$? the expression $2 \times 2 \times 5 \times 5 \times 5$?*

During Problem 1.1, you may want to review divisibility rules to help the students find factors. Ask:

- *How do you know if a number is divisible by 2? by 3? by 5?*
- *How do you know if an number is divisible by 6? by 10?*

After Problem 1.1B, explain to students that the prime factorization of a number is unique. Students may be unsure about the order in which they should write the numbers in a prime factorization. Explain that the prime factors are usually written with primes listed in increasing order. Point out to students that the order of the prime factors does not change the prime factorization, because multiplication is commutative. Remind students to include repeated prime factors in a prime factorization, or to use exponent notation.

Homework Check

When reviewing Exercise 17, ask:

- *Is there a factor pair that cannot be used to start a factor tree?*
- *Does the factor pair you choose to start a factor tree matter? Will you always get the same result?*

Assignment Guide for Topic 1

Core 1–17

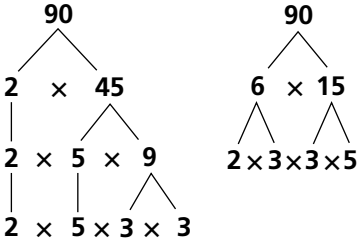
Answers to Topic 1

Problem 1.1

A. 1. Factors of 90: 1, 2, 3, 5, 6, 9, 10, 15, 18, 30, 45, 90
Prime factors of 90: 2, 3, 5

2. 2 and 45, 3 and 30, 5 and 18, 6 and 15, 9 and 10

3. Answers may vary. Sample:



4. $2 \times 3^2 \times 5$

B. 1. yes

2. no

Exercises

1. $2 \times 2 \times 5$

2. $2 \times 2 \times 3 \times 3$

3. $2 \times 5 \times 5$

4. 5×17

5. $2 \times 2 \times 5 \times 5$

6. $3 \times 3 \times 3 \times 7$

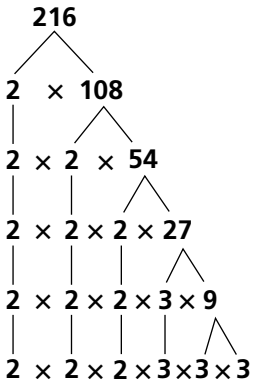
7. $3 \times 5 \times 5 \times 7$

8. $3 \times 3 \times 71$

9. $2 \times 2 \times 2 \times 5 \times 5 \times 5$

10. $2^2 \times 5$, $2^2 \times 3^2$, 2×5^2, 5×17, $2^2 \times 5^2$, $3^3 \times 7$, $3 \times 5^2 \times 7$, $3^2 \times 71$, $2^3 \times 5^3$

11.



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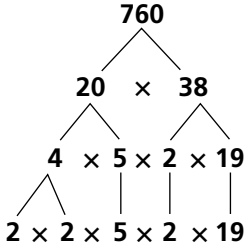


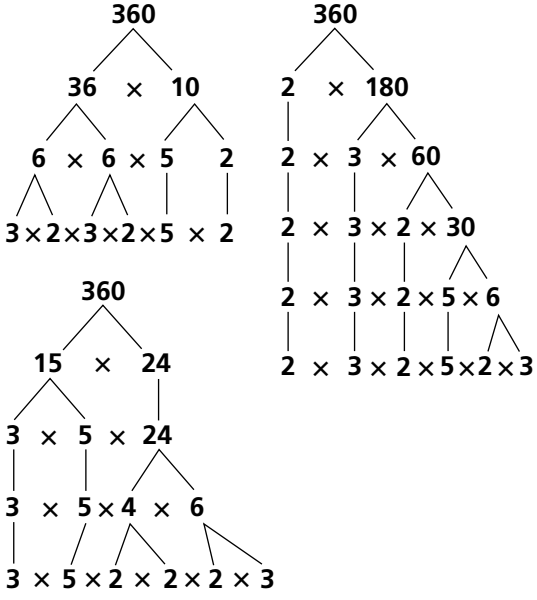
13. 2, 3, 5, 7, 11, 13, 17, 19, 23

14. 21, 22, 26

15. 30, 35, 40

16. 41, 43, 45, 47, 49

17. a. Answers may vary. Sample:



b. 11