



Concepts and Examples Prime Factorization

Based on power point presentations by Pearson Education, Inc.
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Learning Objective

Carry out prime factorization.

Prime Factorization (1 of 5)

Some Vocabulary

Composite Numbers: Integers divisible evenly by 1 and themselves as well as by other integers.

For example, 6 is divisible evenly by 1 and itself, but it is also divisible evenly by 2 and 3.

Prime Numbers: Integers only divisible evenly by 1 and themselves.

For example, 2, 3, 5, 7, 11, 13, 17, etc. are all prime numbers.

Factor: A factor is a quantity that divides into another quantity without leaving a remainder.

For example, 6 is a factor of 12 because $12 \div 6$ equals 2 with a remainder of 0. On the other hand, 6 is not a factor of 10 because $10 \div 6$ equals 1 with a remainder of 4.

Prime Factorization (2 of 5)

Prime Factorization: The procedure of writing composite numbers as products of their prime factors. This becomes useful when adding and subtracting fractions or simplifying radicals. According to the *Fundamental Theorem of Arithmetic*, any integer greater than 2 is either prime or can be expressed as a product of prime numbers in exactly one unique way.

For example, we can write 2100 as $2 \cdot 2 \cdot 3 \cdot 5 \cdot 5 \cdot 7$.

We use several *Test for Divisibility* to facilitate prime factorization. It states that a number is divisible by

- 2 if the last digit is an even number (0, 2, 4, 6, 8, etc.)
- 3 if the sum of its digits is divisible by 3
- 4 if the last two digits form a number that is divisible by 4
- 5 if the last digit is 0 or 5
- 9 if the sum of its digits is divisible by 9
- 10 if the last digit is 0

Prime Factorization (3 of 5)

Carrying out Prime Factorization

A good way of doing prime factorizations is to use an “upside-down” division symbol. That is, instead of $\sqrt{\quad}$ we use \lrcorner !!!

1. Find the smallest prime factor of a composite number and write it to the left of the “upside-down” division symbol. To the right of the “upside-down” division symbol write the composite number.
2. Underneath the numbers in Step 1, write the result of the division, called the quotient.
3. Continue the processes in Steps 1 and 2 until the quotient is 1. Please note that prime numbers may have to be used several times.

Prime Factorization (4 of 5)

Example 1:

Write the composite number 12 as a product of prime factors.

It looks like 2 is the smallest prime number that divides into 12 because it is an even number.

$$2 \overline{)12}$$

$$2 \overline{)6}$$

$$3 \overline{)3}$$

1

Must check if 2 is a divisor again.

2 is no longer a divisor because the quotient is prime!

We are done with the prime factorization process!

This shows that 12 can be written as a product of prime factors as follows:

$$12 = 2 \cdot 2 \cdot 3$$

Prime Factorization (5. of 5)

Example 2:

Write the composite number 80 as a product of prime factors.

It looks like 2 is the smallest prime number that divides into 80 because it is an even number.

$$2 \overline{)80}$$

$$2 \overline{)40}$$

$$2 \overline{)20}$$

$$2 \overline{)10}$$

$$5 \overline{)5}$$

1

Must check if 2 is a divisor again.

Must check if 2 is a divisor again.

Must check if 2 is a divisor again.

2 is no longer a divisor because the quotient is prime!

We are done with the prime factorization process!

This shows that 80 can be written as a product of prime factors as follows:

$$80 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 5$$