



Douglas College

Douglas College Learning Centre

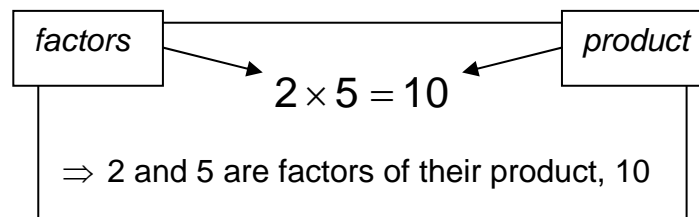
FACTORING, PRIME NUMBERS AND PRIME FACTORIZATION

To use this worksheet you should first be comfortable with basic multiplication and division. If you aren't, please review them with your tutor.

Factoring is an important way to break down numbers into smaller parts. You may not realize it, but factoring is something you often do. For example, when you exchange a dollar for ten dimes or four quarters, you are breaking the dollar down into smaller parts. You're factoring.

Factoring

When you multiply two numbers, the answer that you get is called the *product*. The two numbers that you use to get a product are called *factors* of that product. For example:



Another way to think about a factor is that it can be divided into a number to give you another whole number. For example:

$$\Rightarrow 2 \overline{)10}^5 \Rightarrow 2 \text{ divided into } 10 \text{ yields the whole number } 5$$

$\Rightarrow 2$ is therefore a factor of 10

$$\Rightarrow 5 \overline{)10}^2 \Rightarrow 5 \text{ divided into } 10 \text{ yields the whole number } 2$$

$\Rightarrow 5$ is therefore a factor of 10

If we want to write all the factors of 10, we would get 1,2,5 and 10, because each of these numbers can divide evenly into 10.

Now try to find the factors of some numbers on your own.

Exercise 1: Factors

List the factors of each number. Answers are at the end of the worksheet.

- 1) 8 2) 16 3) 7 4) 24 5) 33 6) 64

Prime Numbers

If a number does not have a factor besides 1 and itself, it is called *prime*. For example, 5 has no factors, whole numbers that can be divided into it evenly, besides 1 and 5. It is therefore prime.

20, on the other hand, has the factors 1, 2, 4, 5, 10 and 20. Because it has factors besides 1 and itself (2, 4, 5 and 10), it is not prime. Numbers that are not prime are called *composite*. 20 is a composite number.

Examples of prime numbers are 2, 3, 5, 7, 11 and 13.

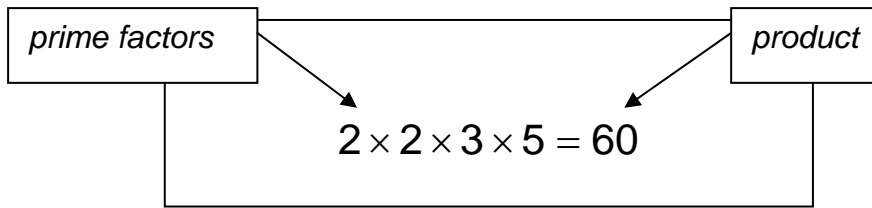
Exercise 2: Prime Numbers

Determine if each number is prime or composite.

- 7) 4 8) 9 9) 11 10) 17 11) 27 12) 89

Prime Factorization

Just as we can break up a number into its factors, we can break up a number into its prime factors. *Prime factors* are prime numbers that, when multiplied together, make up a product. For example:



In the above example, the numbers to the left of the equal sign are all prime. When multiplied together, they equal 60. They are therefore the prime factors of 60. To write 60 in *prime factored form* we would get $2 \times 2 \times 3 \times 5$.

To determine the prime factors of a given number:

Step 1:

Choose the smallest prime number that will divide evenly into the given number and divide.

Step 2:

Repeat Step 1 on the answer until the answer is prime.

Let's try these steps to see if we can use them to determine the prime factors for 60.

Step 1) First we'll choose the smallest prime number that will divide evenly into 60. Because 60 is even, we know that 2 will divide evenly. So,

$$\Rightarrow 2 \overline{)30} \overline{)60}$$

Step 2) Next we'll repeat Step 1 by choosing the smallest prime number that will divide evenly into 30. Because 30 is still even, we know that 2 will divide evenly. So,

$$\Rightarrow 2 \overline{)15} \overline{)30}$$

Step 3) 15 is not prime so we'll repeat Step 1 again by choosing the smallest prime number that will divide evenly into 15. We know that 3 will divide evenly. So,

$$\Rightarrow 3 \overline{)15}^5$$

Step 4) 5 is prime so we've reached the last factor. To check our answer, we can multiply all the prime factors together to see if we get 60:

$$\Rightarrow 2 \times 2 \times 3 \times 5 = 60$$

Now try one on your own. Write 42 in prime factored form.

It's divisible by 2, 3 and 7, so the answer is (drum roll) $2 \times 3 \times 7$.

Exercise 3: Prime Factoring

Convert to prime factored form.

13) 63

14) 210

15) 121

16) 156

17) 128

18) 715

Answers*Exercise 1*

1) (1,2,4,8)

2) (1,2,4,8,16)

3) (1, 7)

4) (1, 2, 3, 4, 6, 8, 12, 24)

5) (1, 3, 11, 33)

6) (1,2,4,8,16,32,64)

Exercise 2

7) composite

8) composite

9) prime

10) prime

11) composite

12) prime

*Exercise 3*13) $3 \times 3 \times 7$ 14) $2 \times 3 \times 5 \times 7$ 15) 11×11 16) $2 \times 2 \times 3 \times 13$ 17) $2 \times 2 \times 2 \times 2 \times 2 \times 2$ 18) $5 \times 11 \times 13$