# Section 0.4 Factors

**Contents:**



## THE MULTIPLICATION TABLE

| x | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| **2** | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
| **3** | 3 | 6 | 9 | 12 | 15 | 18 | 21 | 24 | 27 | 30 | 33 | 36 |
| **4** | 4 | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 | 40 | 44 | 48 |
| **5** | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 |
| **6** | 6 | 12 | 18 | 24 | 30 | 36 | 42 | 48 | 54 | 60 | 66 | 72 |
| **7** | 7 | 14 | 21 | 28 | 35 | 42 | 49 | 56 | 63 | 70 | 77 | 84 |
| **8** | 8 | 16 | 24 | 32 | 40 | 48 | 56 | 64 | 72 | 80 | 88 | 96 |
| **9** | 9 | 18 | 27 | 36 | 45 | 54 | 63 | 72 | 81 | 90 | 99 | 108 |
| **10** | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| **11** | 11 | 22 | 33 | 44 | 55 | 66 | 77 | 88 | 99 | 110 | 121 | 132 |
| **12** | 12 | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 |

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## DEFINITIONS: MULTIPLICATION

Product: The **product** of any two numbers is the result (answer) when those two numbers are multiplied together. Since $6 \cdot 5 = 30$, we can say that 30 is the *product* of 6 and 5.

Multiples: The **multiples** of any number, **A**, are all of the products involving **A** and some other whole number. In the multiplication table, the multiples of, say, 3 are those numbers that are found in the column directly below 3 (or the row to the right of 3).

**Example 1:** List the first twelve multiples of 3.

**Answer:** Look at the multiplication table under **3**: 3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36.

Actually, the list of multiples of 3 is not restricted to the multiplication table; any whole number multiplied by 3 results in another multiple of 3.

Consider $2 \cdot 3 = 6$, so 6 is a multiple of 3

$5 \cdot 3 = 15$, so 15 is a multiple of 3

$13 \cdot 3 = 39$, so 39 is a multiple of 3

So really, a multiple of 3 is the *product* of multiplying any *whole* number by 3. The list of multiples of 3 is *infinite*, it goes on forever.

 

**Exercise 1:** Use the multiplication table to list the first twelve multiples of the given number.

a) of 2: ______________________________

b) of 3: ______________________________

c) of 5: ______________________________

d) of 6: ______________________________

e) of 9: ______________________________

f) of 10: ______________________________

Based on what you just wrote, notice that:

i) the multiples of 6 are also found in the lists of multiples of both 2 and 3;

ii) the multiples of 10 end in 0 (have 0 in the units place) and are also found in the lists of multiples of both 2 and 5.

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## FACTORS

**Factors**: Any two whole numbers that *multiply* to get a *product*, n, are called **factors** of that product. We also say that the factors can *divide evenly into* n.

**Example 2:** Since $6 \cdot 7 = 42$, then 6 and 7 are both factors of 42.

**Exercise 2:** Use Example 2 as a guide to complete each of these sentences.

a) Since $4 \cdot 5 = 20$, then ______________________________

b) Since $9 \cdot 4 = 36$, then ______________________________

**Factors Pairs**: Factors can always be written in pairs; since $3 \cdot 5 = 15$, then 3 and 5 are both factors of 15, and we call 3 and 5 a **factor pair** of 15. 1 and 15 form another factor pair of 15, since $1 \cdot 15 = 15$.

**Example 3:** List the *factors* of 24.

**Answer:** Think of 24 as a product of two numbers. (We could use the multiplication table to find most of the products.)

Consider $2 \cdot 12 = 24$,
$3 \cdot 8 = 24$,
$4 \cdot 6 = 24$,
*and even* $1 \cdot 24 = 24$,

so the factors of 24 are 1, 2, 3, 4, 6, 8, 12, and 24.

In finding *all* of the factors of 24 notice that we had a number of factor pairs. Those factor pairs can sometimes be found using a **Factor Pair Table** that looks at possible factors one at a time. Look:

| 24 | |
|---|---|
| / | \ |
| 1 | 24 |
| 2 | 12 |
| 3 | 8 |
| 4 | 6 |

Each of these (pairs) is called a *factor pair*; notice that the list doesn't include 5, because 5 isn't a factor of 24.

This process gives us all of the factors of 24. There are a total of four factor pairs of 24.

**Exercise 3:** Use a factor pair table to find all of the factor pairs of:

a) 30
/ \

b) 36
/ \

Consider this list of factor pairs of 24:

| 24 | |
|---|---|
| / | \ |
| 1 | 24 |
| 2 | 12 |
| 3 | 8 |
| 4 | 6 |
| 6 | 4 |
| 8 | 3 |
| 12 | 2 |
| 24 | 1 |

Are all of these factor pairs necessary? No. There are a lot of duplicate factor pairs in the list shown. The Commutative Property of Multiplication allows us to write, for example, the product $4 \cdot 6$ only once; we don't need to also write it as $6 \cdot 4$.

A better diagram of the factor pairs of 24 might look like this:

| 24 | |
|---|---|
| / | \ |
| 1 | 24 |
| 2 | 12 |
| 3 | 8 |
| 4 | 6 |

In this list, there are no duplicates.

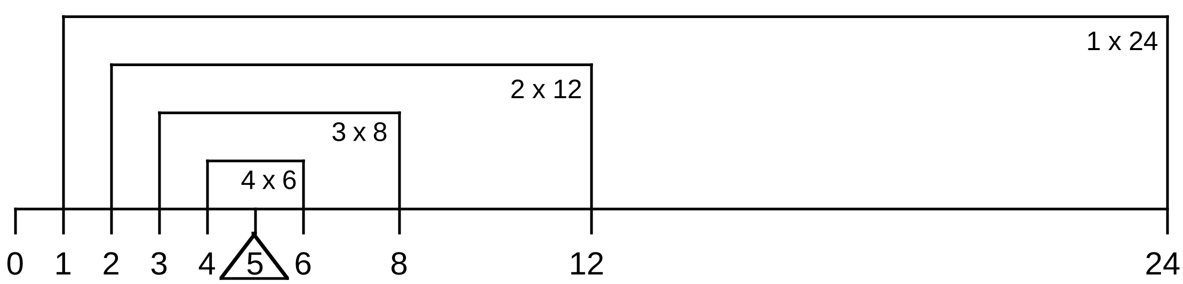
Notice also that the list on the left side is in numerical order. If you do things numerically, then you should find all of the factor pair. Furthermore, there is a "magic number" that tells you when to stop searching for factor pairs; The magic number that tells you when to stop is the square root of the next highest perfect square.

Here's a further explanation of the magic number. Read it carefully.

For example, if you're trying to find all of the factor pairs of 24, the next highest perfect square is 25. Since $\sqrt{25} = 5$, we don't need to go beyond 5 in our search for factor pairs.

For sure, there are factors of 24 beyond 5, such as 8, but this factor is paired with a number less than 5, namely 3.

As the diagram below shows, the magic number isn't in the center of the whole number line from 0 to 24, but it is in the middle of the factor pairs of 24.

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## Primes and Composites

Two important definitions are shown here. Here is the first:

**1.** A whole number is considered to be a **prime number** if it has exactly two *distinct*, *whole number* factors: 1 and itself.

However, 1 is not a prime number because its only two (whole number ) factors, 1 and 1, are not distinct from each other.

**Example 4:** a) Is 7 a prime number? b) Is 12 a prime number?

**Answer:** a) 7 *is* a prime number because the only product to make 7 is $1 \cdot 7$; or we might say, 7 is *prime* because the only numbers that divide evenly into 7 are 1 and 7 ("1 and itself").

b) 12 is *not* a prime number because it has other factors besides just 1 and 12, such as <u>2 and 6</u> and <u>3 and 4</u>.

**Exercise 4:** Answer each based on the definition of a prime number. State why or why not.

a) is 15 a prime number? ______________________________

b) is 13 a prime number? ______________________________

c) is 1 a prime number? ______________________________

**2.** A whole number that has *more* than 2 distinct factors is considered to be a **composite number**. A composite number is any whole number (greater than 1) that is not prime.

**Example 5:** a) Is 17 a composite number? b) Is 12 a composite number?

**Answer:** a) No, because 17 has only two factors it is *prime*, not *composite*.

b) Yes, 12 is a composite number because it is *not* prime; it has *more than two* factors. The factors of 12 are 1, 2, 3, 4, 6, and 12.

**Exercise 5:** Based on the definition of a composite number:

a) is 16 a composite number? ______________________________

b) is 21 a composite number? ______________________________

c) is 29 a composite number? ______________________________

> Every whole number greater than 1 is either prime or composite (but never both).

Here is the list of prime numbers less than 100.

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97.

Notice that there is only one even number in the whole list; it is the first number, 2. Every other prime number is an odd number. Notice also that there are no prime numbers ending in 5 (except 5 itself).

Also notice that there really is no pattern to the list of primes; in other words, you can't predict what the next prime number is going to be just by looking at the list.

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## RULES OF FACTORS

> **Rule for 1:**
>
> **1** is a factor of every number, and every number is a factor of itself.

**Example 6:** Without trying to find any other factors or factor pairs, list two factors that are *guaranteed*, by Rule 1, for each of these.

a) 13 b) 17 c) 31

1 and 13 1 and 17 1 and 31

**Exercise 6:** Without trying to find any other factors or factor pairs, list two factors that are *guaranteed*, by the Rule For 1, for each of these.

a) 29 b) 41 c) 131

__________ __________ __________

 

## Rule for 2:

**2** is a factor of every *even* number (numbers that end in 0, 2, 4, 6, or 8).

**Exercise 7:** Without trying to find any other factors or factor pairs, determine if 2 is a factor of each. Explain why or why not.

a) 82 ____________________________________

b) 91 ____________________________________

## Rule for 3:

3 is a factor of every number that has this unusual property:

*if the sum of the individual digits is (adds up to) a multiple of 3, then 3 is a factor of that (original) number .*

**Example 7:** Using the Rule for 3, determine if 3 is a factor of the number. (In other words, determine if the number is divisible by 3).

a) 285 b) 671

**Answer:** a) Add the digits: 2 + 8 + 5 = 15; 3 is a factor of 15, so *yes*, 3 is (also) a factor of (the original number) 285.

b) Add the digits: 6 + 7 + 1 = 14; 3 is *not* a factor of 14, so *no*, 3 is *not* a factor of 671.

**Exercise 8:** Use the Rule for 3 to determine if 3 is a factor of the number.

a) 548: ____________________________________

b) 672: ____________________________________

c) 3,582: ____________________________________

d) 25,174: ____________________________________

## Rule for 5:

**5** is a factor of every number that ends in either 5 or 0.

**Exercise 9:** Without trying to find any other factors or factor pairs, determine if 5 is a factor of each. Explain why or why not.

a) 90 ____________________

b) 105 ____________________

c) 608 ____________________

d) 532 ____________________

## Rule for 9:

Just like 3, 9 is a factor of every number that has this unusual property:

*if the sum of the individual digits is (adds up to) a multiple of 9, then 9 is a factor of that (original) number .*

**Example 8:** Determine if 9 is a factor of the number.

a) 675 b) 1,983

**Answer:** a) Add the digits: 6 + 7 + 5 = **18**; 9 is a factor of 18, so *yes*, 9 is (also) a factor of (the original number) 675.

b) Add the digits: 1 + 9 + 8 + 3 = **21**; 9 is *not* a factor of 21, so *no*, 9 is not a factor of 1,983.

**Exercise 10:** Determine if 9 is a factor of the number.

a) 548: ____________________

b) 672: ____________________

c) 3,582: ____________________

d) 35,874: ____________________

e) 46,581: ____________________

**Think about it:** By the way, if we add the digits of a number like 25, we get $2 + 5 = 7$. Does this mean that 7 is a factor of 25?

No – just because the digits add up to 7 doesn't means that 7 is a factor.

The rule for adding digits works only for 3 and for 9.

## Rule for 10:

**10** is a factor of every number that ends in 0.

**Exercise 11:** Without trying to find any other factors or factor pairs, determine if 10 is a factor of each. Explain why or why not.

a) 90 ____________________

b) 1,050 ____________________

c) 605 ____________________

Let's put Rules for 2, 3 and 5 together in the following example.

**Example 9:** Of the first three prime numbers—2, 3 and 5—which of them are factors of the following (use the Rules for 2, 3 and 5)?

a) **42**

(42 is even, so 2 is a factor;
4 + 2 = 6, so 3 is a factor;
42 doesn't end in 0 or 5, so 5 is not a factor)

**2** and **3**

b) **147**

(147 is odd, so 2 is not a factor;
1 + 4 + 7 = 12, a multiple of 3, so 3 is a factor;
147 doesn't end in 0 or 5, so 5 is not a factor)

**3** only

c) **540**

(540 is even, so 2 is a factor;
5 + 4 + 0 = 9, so 3 is a factor;
540 ends in 0, so 5 is a factor)

**2** and **3** and **5**

d) **91**

(91 is odd, so 2 is not a factor;
9 + 1 = 10, *not* a multiple of 3, so 3 is *not* a factor;
91 doesn't end in 0 or 5, so 5 is not a factor)

**none**

**Exercise 12:** Of the first three prime numbers—2, 3 and 5—which of them are factors of the following? If none of them are factors, write *none*.

a) 32 ________
b) 80 ________
c) 127 ________
d) 414 ________

e) 213 ________
f) 169 ________
g) 390 ________
h) 378 ________

i) 175 ________
j) 180 ________
k) 716 ________
l) 135 ________

m) 683 ________
n) 252 ________
o) 459 ________
p) 721 ________

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## Composite Factors

At the beginning of this section we noticed that the multiples of 6 are also multiples of both 2 and 3. What this means is, if 6 is a factor of a number, like 78, then both 2 and 3 are also factors of 78.

Notice that 78 is even, so 2 is a factor, and the sum of its digits is 15, so 3 is also a factor. In this sense, the product of the prime numbers 2 and 3, which is 6, so 6 is a factor of 78 as well.

### Rule for Making Composite Factors:

If two *prime* numbers, P and N, are factors of a larger number L, then the *product* of those prime numbers, **P · N**, is also a factor of L.

This rule is also true when there are more than two *prime* factors.

**Example 10:** Use the Rule for Making Composite Factors to finish each sentence.

a) Since 2 and 7 are both *prime* factors of 98 (and since $2 \cdot 7 = 14$) it must be that 14 is also a factor of 98.

b) Since 3 and 5 are both *prime* factors of 75, it must be that 15 is also a factor of 75. (because $3 \cdot 5 = 15$)

c) Since 2 and 11 are both *prime* factors of 264, it must be that 22 is also a factor of 264.

d) Since 2, 3 and 5 are all *prime* factors of 240, it must be that 30 is also a factor of 240. (because $2 \cdot 3 \cdot 5 = 30$)

**Exercise 13:** Use the Rule for Making Composite Factors to finish each sentence. (Use Example 10 as a guide.)

a) Since 2 and 3 are both prime factors of 96, it must be that ____________________

b) Since 2 and 5 are both prime factors of 130, it must be that ____________________

c) Since 3 and 11 are both prime factors of 231, it must be that ____________________

d) Since 3 and 7 are both prime factors of 462, it must be that ____________________

e) Since 5 and 7 are both prime factors of 665, it must be that ____________________

f) Since 2, 3 and 7 are all prime factors of 924, it must be that ____________________

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## PRIME FACTORIZATION

A **factor diagram** is a visual method used to look at the factors of a number. First let's look at the variety of factors of 24 using a factor diagram:

```
a)     24            b)     24            c)     24            d)     24
      /  \                 /  \                 /  \                 /  \
     1    24              2    12              3    8               4    6
```

To think about this visually, think of the number—24 in this case—as a flower or plant. The lines leading to the factors could be thought of as **roots** growing downward. In this way, we could think of 24 as *growing* from 2 and 12, or *growing* from 3 and 8, or whichever factor pair you choose.

The idea of **factor roots** is also seen in a number like 36, which is a perfect square:

```
   36
  /  \
 6    6
```

As you know, 6 is the square **root** of 36.

> The **prime factorization** of a *composite number* is a *product* of all *prime numbers* (including repetitions) that are *factors* of the original number. (Remember, 1 is not prime.)
>
> The prime factorization of a number is written as a **product** of all such primes.

**Example 11:** Find the prime factorization of each of these.

a) 6 b) 14 c) 15

**Answer:** a) 6: $6 = 2 \cdot 3$. That's right! That's all there is to it.

b) The prime factorization of 14 is $2 \cdot 7$; so we could say $14 = 2 \cdot 7$

c) The prime factorization of 15 is $5 \cdot 3$; so we could say $15 = 5 \cdot 3$

**Exercise 14:** Write the prime factorization of the following.

a) 21 = ______________ b) 22 = ______________

c) 35 = ______________ d) 77 = ______________

If a composite number has more than two prime number factors, then we may need to do a little more work within the factor diagram.

**Example 12:** Find the prime factorization of 30

**Answer:** We'll use a factor diagram to first find *any* two factors of 30. We'll **box or circle** any primes that appear to indicate that the "branch" can't be factored further.

(Prime numbers can be considered the **fruit** of the roots.)

However, if we arrive at any *composite* numbers, we must factor them further to continue our search for prime factors.

Here are <u>three</u> different "paths" to find the prime factors of 30:

| i) | ii) | iii) |
|---|---|---|
| 30 | 30 | 30 |
| / \ | / \ | / \ |
| $\boxed{5}$ 6 | $\boxed{2}$ 15 | $\boxed{3}$ 10 |
| / \ | / \ | / \ |
| $\boxed{2}$ $\boxed{3}$ | $\boxed{3}$ $\boxed{5}$ | $\boxed{2}$ $\boxed{5}$ |
| So, **30 = <u>5 · 2 · 3</u>** | **30 = <u>2 · 3 · 5</u>** | **30 = <u>3 · 2 · 5</u>** |

Notice that the result (the prime factorization) is the same no matter which factor path you choose to make.

**<u>Exercise 15:</u>** Find the prime factorization of the following. Use a factor diagram and put a box around any prime factor.

a) **42** b) **70**

The prime factorization of 42 is: ________ The prime factorization of 70 is: ________

**Example 13:** Find the prime factorization of 24.

**Answer:** This time you will see only one path, but you should know that this is not the only path. Any (correct) path you choose will give the same result.

**Try two different paths yourself:**

i) Our path: ii) Your 1st path iii) Your 2nd path

$$\begin{array}{ccccccc} & & & \mathbf{24} & & & \\ & & / & & \backslash & & \\ & 4 & & & & 6 & \\ / & & \backslash & & / & & \backslash \\ \boxed{2} & & \boxed{2} & & \boxed{3} & & \boxed{2} \end{array}$$

So, the prime factorization of 24 is $\mathbf{2 \cdot 2 \cdot 2 \cdot 3}$

Notice this time we have repeated prime factors, and we must list them all in writing the prime factorization. We can write the answer as:

$\mathbf{2 \cdot 2 \cdot 2 \cdot 3}$ or as $\mathbf{2^3 \cdot 3}$

(without exponents) or as (with exponents)

**Exercise 16:** Find the prime factorization of the following using a factor diagram. Write your answer *two* ways: with and without exponents, as shown in the previous example.

**Be sure to show the factor diagram and circle the prime factors as they appear.**

a) 12 b) 50

The prime factorization of 12 is:

or as

(without exponents) or as (with exponents)

The prime factorization of 50 is:

or as

 

c) 36

The prime factorization of 36 is:

____________ or as ____________

d) 27

The prime factorization of 27 is:

____________ or as ____________

e) 48

The prime factorization of 48 is:

____________ or as ____________

f) 72

The prime factorization of 72 is:

____________ or as ____________

**Example 14:** Find the prime factorization of 280.

**Answer:** When a number is rather large, don't be intimidated by it; identify at least one number (prime *or* composite) that is a factor and begin the process. The other factors will quickly become smaller and easier to work with.

We can use the rules of factors to help us decide on a way to get started.

(i) Since the number is even, 2 is a *prime* factor of 280;

(ii) Since the number ends in 0, 5 is also a *prime* factor of 280. This means that

(iii) 10 must also be a *composite* factor of 280.

Using a little <u>thinking</u> allows us to find the best way to proceed:

```
              280            (We're using 10 as a good factor to start with.)
            /       \
        10            28
      /    \        /    \
    [2]    [5]     4     [7]
                 /   \
               [2]   [2]
```

So, the prime factorization of 280 is **$2 \cdot 2 \cdot 2 \cdot 5 \cdot 7$** or as **$2^3 \cdot 5 \cdot 7$**.

**Exercise 17:** Find the prime factorization of the following.

a) **100**

The prime factorization of 100 is:

or as

b) **260**

The prime factorization of 260 is:

or as

c) **600**

The prime factorization of 600 is:

or as

d) **420**

The prime factorization of 420 is:

or as

e) **504**

The prime factorization of 504 is:

or as

f) **1,540**

The prime factorization of 1,540 is:

or as

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# Answers to each Exercise

## Section 0.4

**Exercise 1**

a) Multiples of 2: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24

b) Multiples of 3: 3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36

c) Multiples of 5: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

d) Multiples of 6: 6, 12, 18, 24, 30, 36, 42, 48, 54, 60, 66, 72

e) Multiples of 9: 9, 18, 27, 36, 45, 54, 63, 72, 81, 90, 99, 108

f) Multiples of 10: 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120

**Exercise 2**

a) ....4 and 5 are both factors of 20.

b) ....9 and 4 are both factors of 36.

**Exercise 3**

a)

```
  30
 /  \
1   30
2   15
3   10
5    6
```

b)

```
  36
 /  \
1   36
2   18
3   12
4    9
6    6
```

**Exercise 4**

a) No, because 15 has other factors besides 1 and 15: 3 and 5 are also factors of 15.

b) Yes, because the only factors of 13 are 1 and 13.

c) No, because the only factors of 1 are 1 and 1, and these are not distinct values.

**Exercise 5**

a) Yes, because 16 has other factors besides 1 and 16, including 2, 4 and 8.

b) Yes, because 21 has other factors besides 1 and 21, including 3 and 7.

c) No, because the only factors of 29 are 1 and 29; 29 is a prime number.

**Exercise 6**

a) 1 and 29 are guaranteed factors of 29.

b) 1 and 41 are guaranteed factors of 41.

c) 1 and 131 are guaranteed factors of 131.

**Exercise 7**

a) 2 is a factor of 82 because 82 is an even number; 2 is a factor of every even number.

b) 2 is not a factor of 91 because it isn't an even number. 2 is never a factor of an odd number.

**Exercise 8**

a) Since 5 + 4 + 8 = 17, and since 3 **isn't** a factor of 17, 3 **isn't** a factor of 548.

b) Since 6 + 7 + 2 = 15, and since 3 **is** a factor of 15, 3 **is** a factor of 672.

c) Since 3 + 5 + 8 + 2 = 18, and since 3 **is** a factor of 18, 3 **is** a factor of 3,582.

d) Since 2 + 5 + 1 + 7 + 4 = 19, so 3 **isn't** a factor of 25,174.

**Exercise 9**

a) 5 is a factor of 90 because 90 ends in 0; 5 is a factor of every number that ends in 0 (where 0 is in the ones place).
b) 5 is a factor of 105 because 105 ends in 5; 5 is a factor of every number that ends in 5 (5 is in the ones place).
c) 5 is not a factor of 608 because 608 does not end in a 0 or 5. Even though 608 has a 0 in it, the 0 is not in the ones place.
d) 5 is not a factor of 532 because 532 does not end in a 0 or 5.

**Exercise 10**

a) Since 5 + 4 + 8 = 17, and since 9 **isn't** a factor of 17, 9 **isn't** a factor of 548.
b) Since 6 + 7 + 2 = 15, and since 9 **isn't** a factor of 15, 9 **isn't** a factor of 672.
c) Since 3 + 5 + 8 + 2 = 18, and since 9 **is** a factor of 18, 9 **is** a factor of 3,582.
d) Since 3 + 5 + 8 + 7 + 4 = 27, and 9 **is** a factor of 27, so 9 **is** a factor of 35,874.
e) Since 4 + 6 + 5 + 8 + 1 = 24, so 9 **isn't** a factor of 46,581.

**Exercise 11**

a) 10 is a factor of 90 because 90 ends in 0;
b) 10 is a factor of 1,050 because 1,050 ends in 0;
c) 10 is *not* a factor of 605 because 605 doesn't end in 0; 5 is a factor of 605, but 10 is not.

**Exercise 12**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| a) | 2 only | b) | 2 and 5 | c) | none of these | d) | 2 and 3 |
| e) | 3 only | f) | none of these | g) | 2, 3 and 5 | h) | 2 and 3 |
| i) | 5 only | j) | 2, 3 and 5 | k) | 2 only | l) | 3 and 5 |
| m) | none of these | n) | 2 and 3 | o) | 3 only | p) | none of these |

**Exercise 13**

a) .... 6 is also a factor of 96. b) .... 10 is also a factor of 130.
c) .... 33 is also a factor of 231. d) .... 21 is also a factor of 462.
e) .... 35 is also a factor of 665. f) .... 42 is also a factor of 924.

**Exercise 14**

a) $21 = 3 \cdot 7$ b) $22 = 2 \cdot 11$ c) $35 = 5 \cdot 7$ d) $77 = 7 \cdot 11$

**Exercise 15**

a) $42 = 2 \cdot 3 \cdot 7$ b) $70 = 2 \cdot 5 \cdot 7$

**Exercise 16**

a) $12 = 2 \cdot 2 \cdot 3$ or $12 = 2^2 \cdot 3$ b) $50 = 2 \cdot 5 \cdot 5$ or $50 = 2 \cdot 5^2$
c) $36 = 2 \cdot 2 \cdot 3 \cdot 3$ or $36 = 2^2 \cdot 3^2$ d) $27 = 3 \cdot 3 \cdot 3$ or $27 = 3^3$
e) $48 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3$ or $48 = 2^4 \cdot 3$
f) $72 = 2 \cdot 2 \cdot 2 \cdot 3 \cdot 3$ or $72 = 2^3 \cdot 3^2$

**Exercise 17**

a) $100 = 2 \cdot 2 \cdot 5 \cdot 5$ or $100 = 2^2 \cdot 5^2$
b) $260 = 2 \cdot 2 \cdot 5 \cdot 13$ or $260 = 2^2 \cdot 5 \cdot 13$
c) $600 = 2 \cdot 2 \cdot 2 \cdot 3 \cdot 5 \cdot 5$ or $600 = 2^3 \cdot 3 \cdot 5^2$
d) $420 = 2 \cdot 2 \cdot 3 \cdot 5 \cdot 7$ or $420 = 2^2 \cdot 3 \cdot 5 \cdot 7$
e) $504 = 2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 \cdot 7$ or $504 = 2^3 \cdot 3^2 \cdot 7$
f) $1540 = 2 \cdot 2 \cdot 5 \cdot 7 \cdot 11$ or $1540 = 2^2 \cdot 5 \cdot 7 \cdot 11$

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## Section 0.4 Focus Exercises

**1.** Use the multiplication table to list the first eight multiples of the given number.

a) of 4: ______________________________________

b) of 7: ______________________________________

**2.** Use a factor pair table to find all of the factor pairs of:

a) 32
/ \

b) 40
/ \

**3.** Based on the definitions of a prime and composite numbers, decide whether each is **prime**, **composite**, or **neither**.

a) 14 ____________ b) 23 ____________

c) 27 ____________ d) 33 ____________

e) 31 ____________ f) 1 ____________

**4.** Of the first three prime numbers—2, 3 and 5—which of them are factors of the following (use the Rule For 2, 3 and 5)?

a) 32 b) 80 c) 127 d) 414

_______ _______ _______ _______

**5.** Use the Rule for Making Composite Factors to finish each sentence. (Use Example 10 as a guide.)

a) Since 5 and 11 are both prime factors of 605, it must be that

________________

________________

b) Since 2, 3 and 5 are all prime factors of 870, it must be that

________________

________________

 

**6.** Find the prime factorization of the following using a factor diagram. Write your answer *two* ways: with and without exponents, as shown in the previous example.

Be sure to show the factor diagram and circle (or box) the prime factors as they appear.

a) **18**

The prime factorization of 18 is:

or as

(without exponents) or as (with exponents)

b) **63**

The prime factorization of 63 is:

or as

c) **135**

The prime factorization of 135 is:

or as

d) **216**

The prime factorization of 216 is:

or as

e) **720**

The prime factorization of 720 is:

or as

f) **1,050**

The prime factorization of 1,050 is:

or as

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