Prime Factoring, GCF, and LCM
What is factoring?

Factoring a number involves breaking it down into smaller numbers that can be multiplied together to get the original number.

Example: $4 \times 2 = 8$
Factors of 8 are 4 and 2.

Sometimes, a number can be factored into different combinations.

Example: $2 \times 2 \times 2 = 8$
Factors of 8 are also 2, 2 and 2.
What is a prime number?

A prime number is a whole number that has exactly two factors: 1 and the number itself.

Example: The factors of 2 are 1 and 2. This makes 2 a prime number.

Why is 12 not a prime number?

The number 12 is not a prime number because it has more factors than 1 and itself.
What is a composite number?

A composite number is a number that has two or more factors.

Example: factors of 16 = 1, 2, 4, 8, 16.
16 is a composite number.

What are composite numbers between 1 and 30?

4, 6, 8, 9, 10, 12, 14, 15, 18, 20, 21, 22, 24, 25, 26, 27, 28, 30
What is prime factorization?

Prime factorization breaks down a number’s factors into prime numbers. This can be done using factor trees.

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Once you have a prime number, you stop factoring. No matter how you break up a number, the prime factors will always end up the same.

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The prime factors are:
Use factor trees to break each number into its prime factors.

18
\[ 2 \cdot 3^2 \]

41
\[ 41 \cdot 1 \text{ or } 41 \]

66
\[ 11 \cdot 2 \cdot 3 \cdot 11 \]
Use factor trees to break each number into its prime factors.
What is the greatest common factor?

The greatest common factor of two numbers is the largest factor shared by both. You determine the GCF by calculating all the factors of both numbers and finding the largest one that is a factor of both.

Example: What is the GCF of 44 and 66?

Factors of 44: 1, 2, 4, 11, 22, 44
Factors of 66: 1, 2, 3, 11, 22, 33, 66

The greatest common factor of 44 and 66 is 22.
Find the GCF of the following number pairs.

| Factors of 18: | 1, 2, 3, 6, 9, 18 |
| Factors of 24: | 1, 2, 3, 4, 6, 12, 24 |
| The greatest common factor is: | 6 |

| Factors of 36: | |
| Factors of 54: | |
| The greatest common factor is: | |
You can also find the GCF of two numbers using prime factorization.

Example:

36

= 2, 2, 3, 3

54

= 2, 3, 3, 3

What prime factors do 36 and 54 have in common?

36

= 2, 2, 3, 3

54

= 2, 3, 3, 3

Multiply the common prime factors together to find the GCF.

2 \times 3 \times 3 = 18

The GCF of 36 and 54 is 18.
Find the GCF of the following number pairs using the prime factorization method.

8 and 24

32 and 60
Find the GCF of the following number pairs using the prime factorization method.

45 and 15  
40 and 12
The least common multiple of two numbers is the smallest number (not including 0 or 1) that is a multiple of both. The LCM of two numbers is always larger than either number.

**Example**: What is the LCM of 3 and 4?

Multiples of 3: 3, 6, 9, 12, 15, 18...
Multiples of 4: 4, 8, 12, 16, 20...

The least common multiple of 3 and 4 is 12.
Find the LCM of the following number pairs.

<table>
<thead>
<tr>
<th>Multiples of 2:</th>
<th>2, 4, 6, 8, 10, ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiples of 4:</td>
<td>4</td>
</tr>
<tr>
<td>The LCM of 2 and 4 is:</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multiples of 6:</th>
<th>6, 12, 18, 24, 30, 36, ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiples of 8:</td>
<td>8, 16, 24</td>
</tr>
<tr>
<td>The LCM of 6 and 8 is:</td>
<td>24</td>
</tr>
</tbody>
</table>
Find the LCM of the following number pairs.

| Multiples of 10: |  
|-----------------|---|
| Multiples of 30: |  
| The LCM of 10 and 30 is: | 30  

| Multiples of 8:   |  
|-------------------|---|
| Multiples of 24:  |  
| The LCM of 8 and 24 is: | 24 |
You can also find the LCM of two numbers using the GCF of the numbers.

Example:
Find the LCM of 28 and 35.
Step 1: Find the prime factorization of both numbers.

\[
\begin{align*}
28 & = 2 \cdot 2 \cdot 7 \\
35 & = 5 \cdot 7
\end{align*}
\]

Step 2: Find the GCF

\[
\begin{align*}
28: & \ 2 \cdot 2 \cdot 7 \\
35: & \ 5 \cdot 7
\end{align*}
\]

Step 3: Multiply everything that’s left over to the GCF

\[
7 \cdot 2 \cdot 2 \cdot 5 = 140
\]
Find the LCM of the following number pairs using the GCF method.

32 and 12

32 \div 2 \div 2 \div 2 \div 2
12 \div 2 \div 2

4 \div 2 \div 2 \div 2

GCF = 4

96

20 and 10

20

Whiteboards: Find the LCM of the following number pairs using the GCF method.

8 and 15

\[
\begin{align*}
8 & = 2 \times 2 \\
15 & = 3 \times 5 \\
\end{align*}
\]

\[
2 \times 2 \times 3 \times 5 = 120
\]

15 and 30

30
One last question:

What is the difference between finding the GCF and finding the LCM?

Example:
Find the GCF of 64 and 20

\[ 64 = 2^6 \quad 20 = 2^2 \cdot 5 \]

GCF = 4

Find the LCM of 64 and 20

\[ 64 = 2^6 \quad 20 = 2^2 \cdot 5 \]

LCM = \( 4 \cdot 2^2 \cdot 2 \cdot 5 = 320 \)