Top of Form

Bottom of Form

**Fractions (Mathisfun)**

*A fraction is a part of a whole*

**Slice a pizza, and we get fractions:**

|  |  |  |
| --- | --- | --- |
| pie 1/2 | pie 1/4 | pie 3/8 |
| 1/2  | 1/4  | 3/8  |
| **(One-Half)** | **(One-Quarter)** | **(Three-Eighths)** |

The top number says how many slices we **have.**
The bottom number says how many equal slices the whole pizza was **cut into**.

**Equivalent Fractions**

Some fractions may look different, but are really the same, for example:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 4/8  | = | 2/4  | = | 1/2  |
| (Four-Eighths) |   | (Two-Quarters) |   | (One-Half) |
| pie 4/8 | = | pie 2/4 | = | pie 1/2 |

It is usually best to show an answer using the simplest fraction ( 1/2 in this case ). That is called ***Simplifying***, or ***Reducing*** the Fraction

**Numerator / Denominator**

We call the top number the **Numerator**, it is the number of parts we have.
We call the bottom number the **Denominator**, it is the number of parts the whole is divided into.

***Numerator*  *and Denominator***

You just have to remember those names! (If you forget just think "Down"-ominator)

**Adding Fractions**

It is easy to add fractions with the **same denominator** (same bottom number):

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1/4  | + | 1/4  | = | 2/4  | = | 1/2  |
| (One-Quarter) |   | (One-Quarter) |   | (Two-Quarters) |   | (One-Half) |
| pie 1/4 | + | pie 1/4 | = | pie 2/4 | = | pie 1/2 |

One-quarter plus one-quarter equals two-quarters, equals one-half

Another example:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 5/8  | + | 1/8  | = | 6/8  | = | 3/4  |
| pie 5/8 | + | pie 1/8 | = | pie 6/8 | = | pie 3/4 |

Five-eighths plus one-eighth equals six-eighths, equals three-quarters

**Adding Fractions with Different Denominators**

But what about when the **denominators** (the bottom numbers) are not the same?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 3/8 | + | 1/4 | = | ? |
| pie 3/8 | + | pie 1/4 | = | pie huh |

Three-eighths plus one-quarter equals ... what?

We must *somehow* make the denominators the same.

In this case it is easy, because we know that 1/4 is the same as 2/8 :

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 3/8  | + | 2/8  | = | 5/8  |
| pie 3/8 | + | pie 2/8 | = | pie 5/8 |

Three-eighths plus two-eighths equals five-eighths

There are two popular methods to **make the denominators the same**:

* [Least Common Denominator](https://www.mathsisfun.com/least-common-denominator.html), or
* [Common Denominator](https://www.mathsisfun.com/numbers/common-denominator.html)

(They both work nicely, use the one you prefer.)

Least Common Denominator

**Least Common Denominator?**

it is the **smallest** of all the common denominators.

**Why?**

Why do we want common denominators?

Because we **can't** add fractions with different denominators:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *1/* **3**  | + | *1/* **6**  | = | ? |
| 1/3 |   | 1/6 |   | pie huh |

Before we can add them we must make the **denominators the same**.

**Finding a Common Denominator**

But what should the new denominator be?

One simple answer is to multiply the current denominators together:

3 × 6 = 18

So instead of having 3 or 6 slices, we will make **both** of them have **18 slices**.

The pizzas now look like this:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *6/* **18**  | + | *3/* **18**  | = | *9/* **18**  |
| 1/3 |   | 1/6 |   | pizza 9/18 |

They now have common denominators (but not the *least* common denominator)

*(Read more about* [*Common Denominators*](https://www.mathsisfun.com/numbers/common-denominator.html)*.)*

**Least Common Denominator**

That is all fine, but 18 is a lot of slices ... can we do it with **fewer slices**?

Here is how to find out:

|  |  |  |  |
| --- | --- | --- | --- |
| *1/* **3**  | List multiples of 3:  |   | 3, 6, 9, 12, 15, 18, 21, ... |
| *1/* **6**  | List multiples of 6:  |   | 6, 12, 18, 24, ... |

Now find the **smallest number** that is the same:

|  |  |  |
| --- | --- | --- |
| multiples of 3:  |   | 3, **6**, 9, 12, 15, 18, 21, ... |
| multiples of 6:  |   | **6**, 12, 18, 24, ... |

The answer is 6, and that is the **Least** Common Denominator.

So let us try using it!

We want both fractions to have 6 slices:

* When we multiply top and bottom of *1/* **3** by 2 we get *2* /**6**
* *1/* **6** already has a denominator of 6

And our question now looks like:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *2*/**6**  | + | *1* /**6**  | = | *3/* **6**  |   |   |
| 2/6 |   | 1/6 |   | 3/6 |   | empty |

One last step is to [simplify the fraction](https://www.mathsisfun.com/simplifying-fractions.html) (if possible). In this case 3/6 is simpler as 1/2:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *2* /**6**  | + | *1/* **6**  | = | *3/* **6**  | = | *1/* **2**  |
| 2/6 |   | 1/6 |   | 3/6 |   | 3/6 |

And that is what the Least Common Denominator is all about.

It lets us add (or subtract) fractions using the least number of slices.

**Multiplying Fractions**

**There are 3 simple steps to multiply fractions**

1. Multiply the top numbers (the *numerators*).

2. Multiply the bottom numbers (the *denominators*).

3. [Simplify](https://www.mathsisfun.com/simplifying-fractions.html) the fraction if needed.

**Example:**

***1/* 2 × *2/* 5**

**Step 1**. Multiply the top numbers:

***1****/* 2  × ***2****/* 5   =  ***1 × 2*     =  *2***

**Step 2**. Multiply the bottom numbers:

*1/* **2**  × *2/* **5**   **2 × 5**   =  **10**

**Step 3**. [Simplify the fraction](https://www.mathsisfun.com/simplifying-fractions.html):

*2/* **10** = *1/* **5**

**With Pizza**

Here you can see it with pizza ...



Do you see that half of two-fifths is two-tenths?
Do you also see that two-tenths is simpler as one-fifth?

**Another Example:**

***1/* 3 × *9*/16**

**Step 1**. Multiply the top numbers:

*1*/3  × *9*/16   =  *1 × 9*     =  *9*

**Step 2**. Multiply the bottom numbers:

*1/* 3  × *9*/16   =  3 × 16   =  48

**Step 3**. Simplify the fraction:

*9*/48 = *3*/16

(This time we simplified by dividing both top and bottom by 3)

**Fractions and Whole Numbers**

## Fractions and Whole Numbers

What about multiplying fractions **and** whole numbers?

**Make the whole number a fraction, by putting it over 1.**

Example: 5 is also 5/1

Then continue as before.

### Example:

### 2 /**3**  ×  5

Make **5** into **5 /1 :**

**2 /3  × 5 /1**

Now just go ahead as normal.

Multiply tops and bottoms:

2/3  × 5/1   =  2 × 5**= 10** and 3 x 1 = 3 so    10/3

The fraction is already as simple as it can be.

Answer = 10/**3**

Or you can just think of the whole number as being a "top" number:

### Example:

### 3 × 2/****9****

Multiply tops and bottoms:

3   × 2 = 6; 1 x 9 =  9  so 6/9

Simplify:

6/9 =2/3

**Multiplying Mixed Numbers**

What is 1 11**2** × 2 11**5** ?

### Step, by step it is:

Convert Mixed to Improper Fractions:

1 11**2** = 2/2 + ½ or 3/2

2 1/5 = 10/5 + 1/5 or 11/5

[Multiply the fractions](https://www.mathsisfun.com/fractions_multiplication.html) (multiply the top numbers, multiply bottom numbers):

3/2 x 11/5 = 33/10

Convert to a mixed number

33/10 = 3 3/10

If you are clever you can do it all in one line like this:

1 ½ x 2 1/5 = 3/2 x 11/5

## One More Example: What is 3 ¼ x 3 1/3

Convert Mixed to Improper Fractions:

3 ¼ = 13/4

3 1/3 = 10/3

Multiply

13/4 x 10/3 = 130/12

Convert to a mixed number:

10 2/12

And [simplify](https://www.mathsisfun.com/simplifying-fractions.html):

10 1/6

**Dividing with Fractions**

|  |
| --- |
| Step 1. Turn the second fraction *(the one you want to divide by)* upside down (this is now a [reciprocal](http://www.mathsisfun.com/reciprocal-fraction.html)). Step 2. [Multiply](http://www.mathsisfun.com/fractions_multiplication.html) the first fraction by that reciprocalStep 3. [Simplify](http://www.mathsisfun.com/simplifying-fractions.html) the fraction (if needed) |

**1/2 ÷ 1/6**

Step 1. Turn the second fraction upside down (it becomes a **reciprocal**):

1/6 becomes 6/1

Step 2. Multiply the first fraction by that **reciprocal**:

*(multiply tops ...) (... multiply bottoms)*

½ x 6/1   =  1 × 6 and **2 × 1**   =  6/2

 Step 3. Simplify the fraction:

6/2 = 3