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# Excel Formulas

## Complex Formulas

## Introduction

A simple formula is a mathematical expression with one operator, such as **7+9**. A **complex formula** has more than one mathematical operator, such as **5+2*8**. When there is more than one operation in a formula, the **order of operations** tells your spreadsheet which operation to calculate first. In order to use complex formulas, you will need to understand the order of operations.

### Video: Complex Formulas

Optional: Download our **example file** for this lesson.

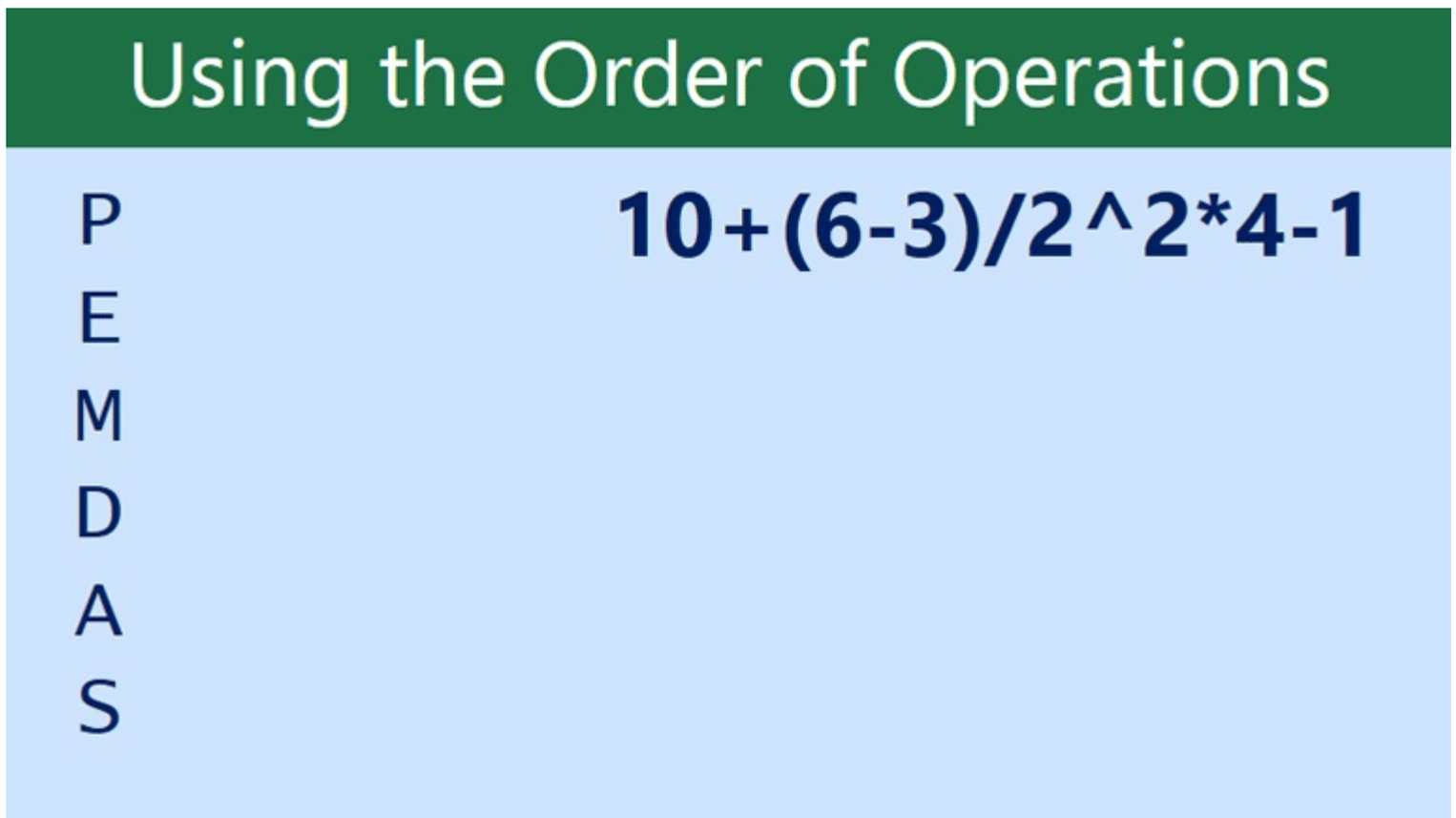
## The order of operations

All spreadsheet programs calculate formulas based on the following **order of operations**:

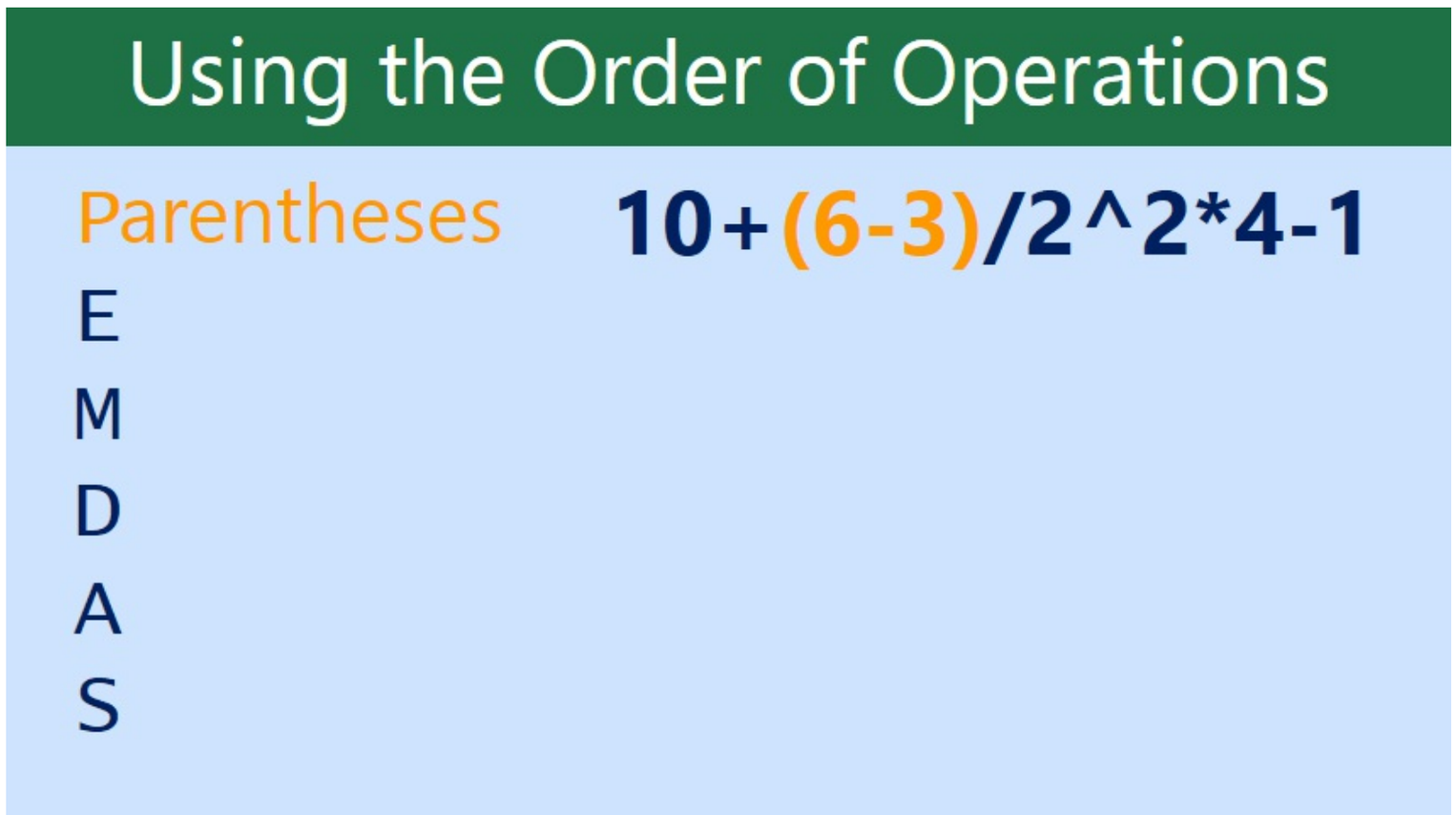
1. Operations enclosed in **parentheses**
2. **Exponential** calculations (3^2, for example)
3. **Multiplication** and **division**, whichever comes first
4. **Addition** and **subtraction**, whichever comes first

A mnemonic that can help you remember the order is **PEMDAS**, or **P**lease **E**xcuse **M**y **D**ear **A**unt **S**ally.

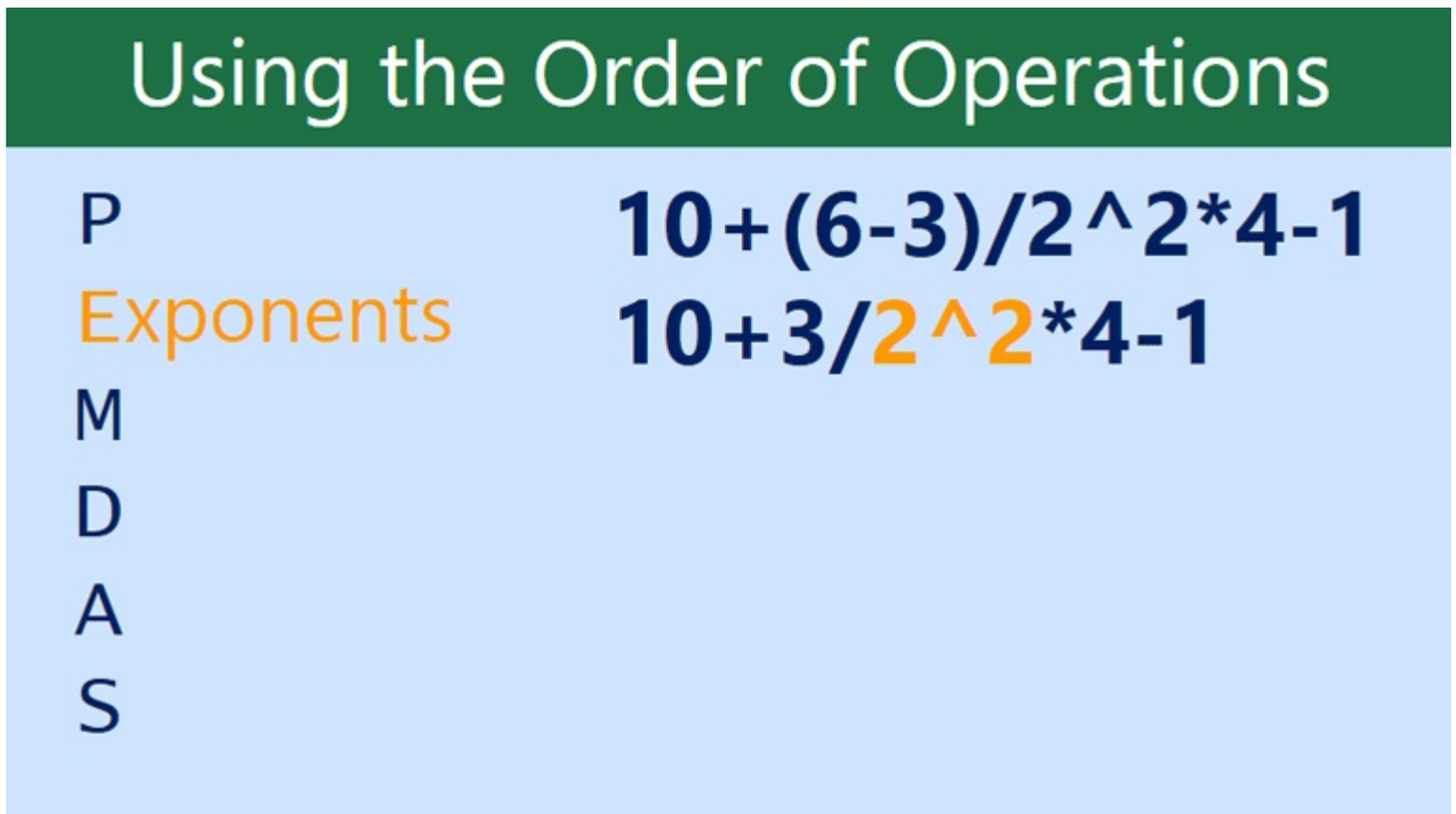
Click the arrows in the slideshow below to learn more about how the order of operations is used to calculate complex formulas.



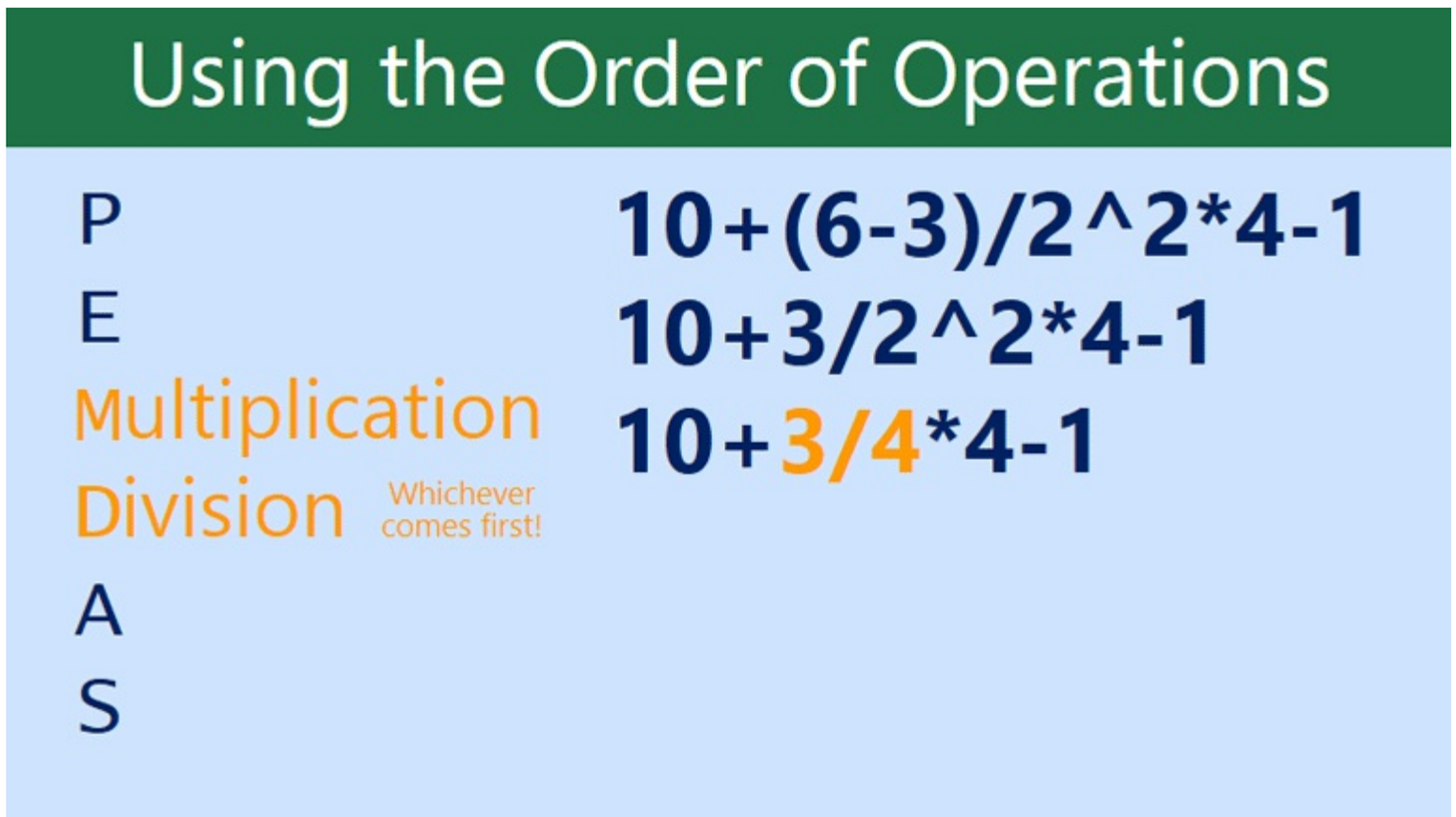

While this formula may look really complicated, we can use the order of operations step by step to find the right answer.




First, we'll start by calculating anything inside the parentheses. In this case, there's only one thing we need to calculate: 6-3=3.

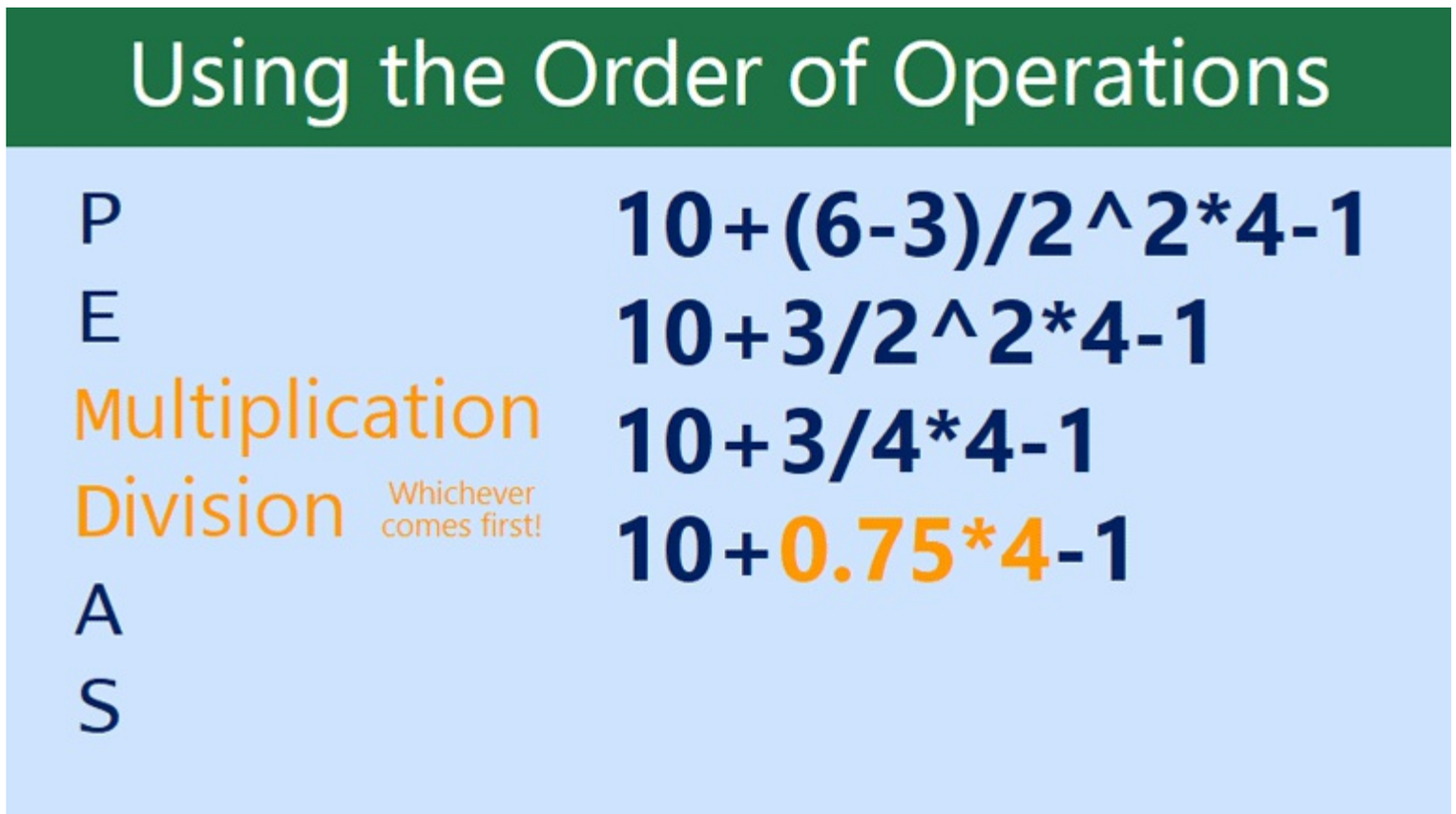



As you can see, the formula already looks a bit simpler. Next, we'll look to see if there are any exponents. There's one: 2^2=4.

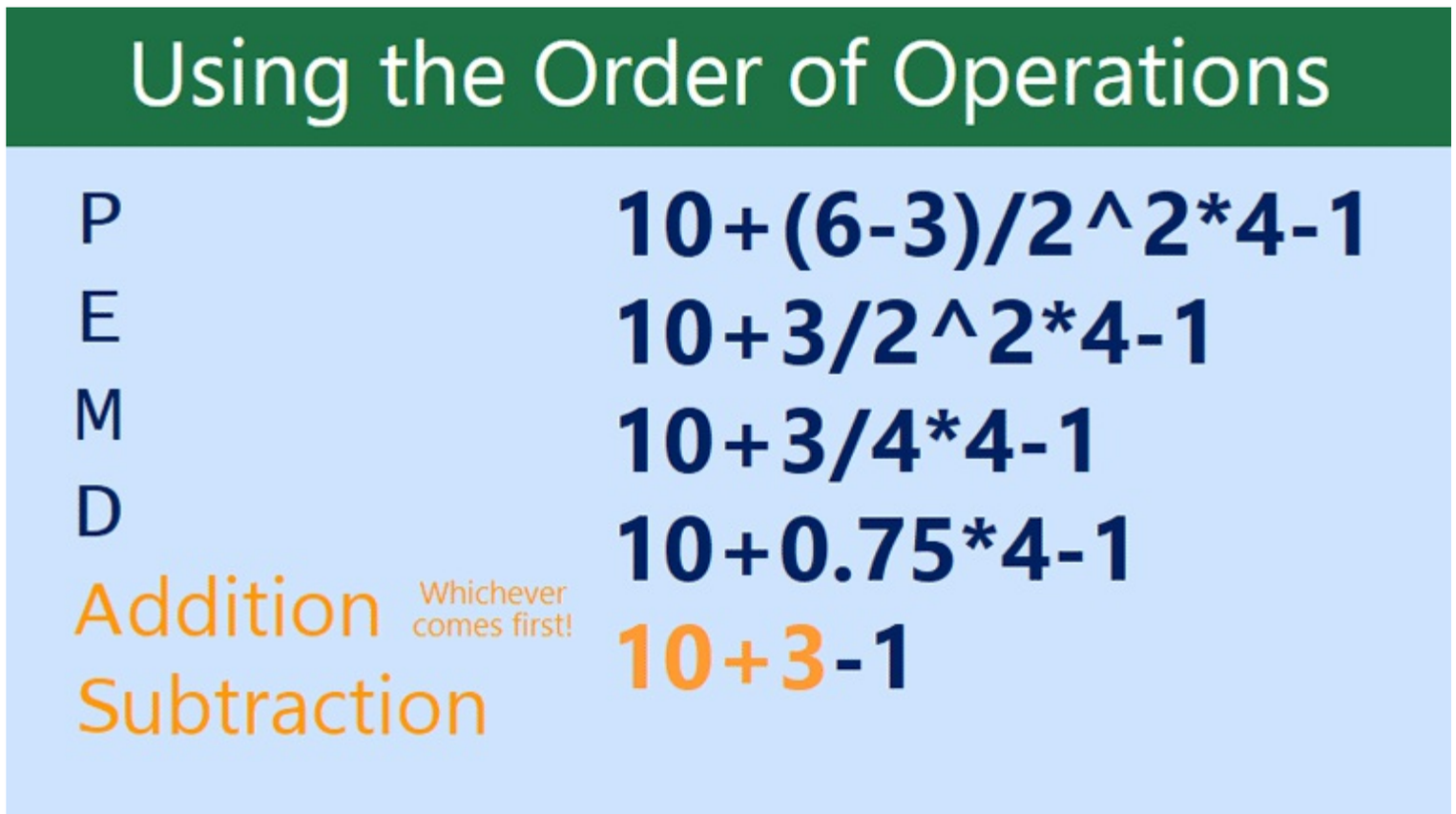



Next, we'll solve any multiplication and division, working from left to right. Because the division operation comes

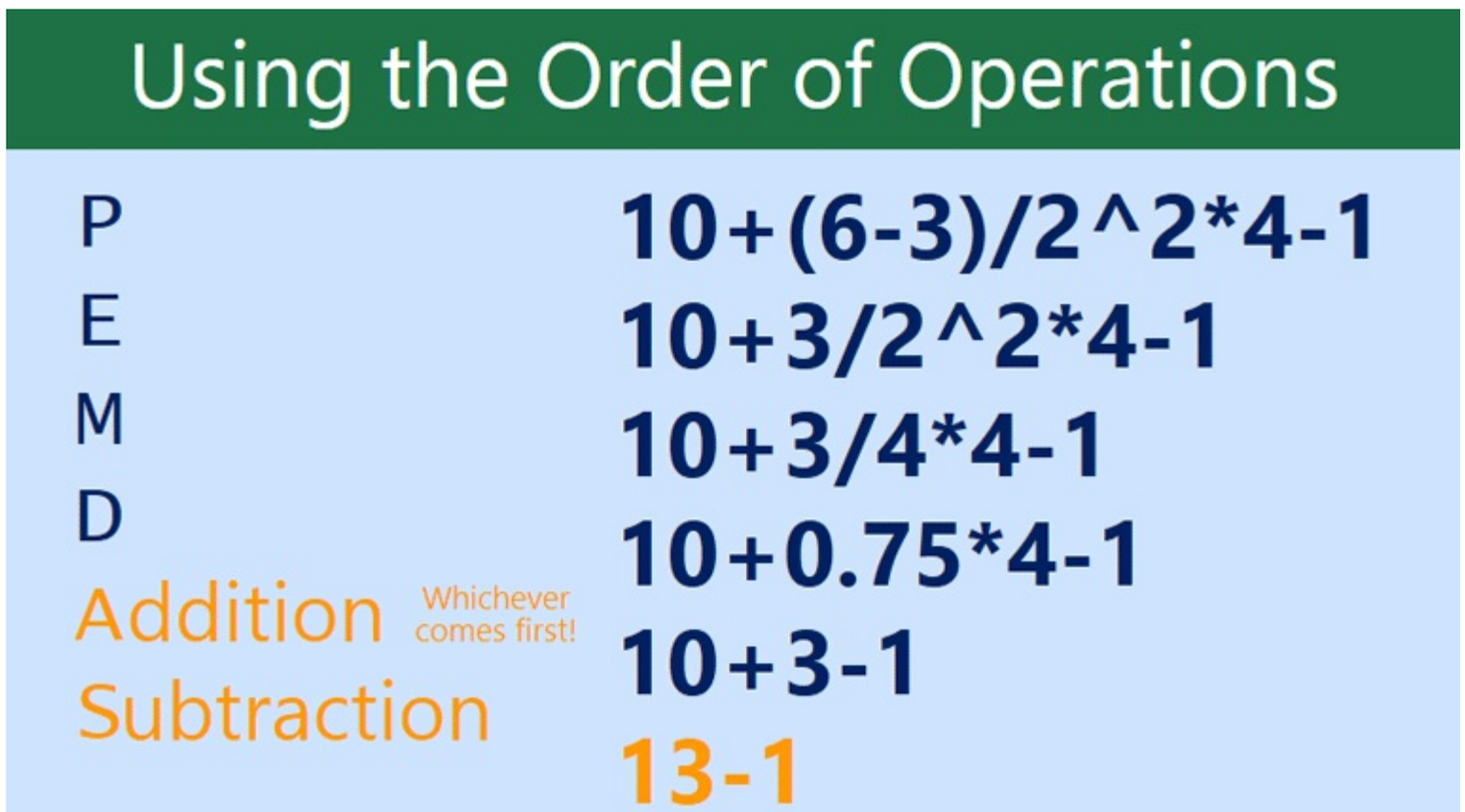
before the multiplication, it is calculated first: 3/4=0.75.

- 

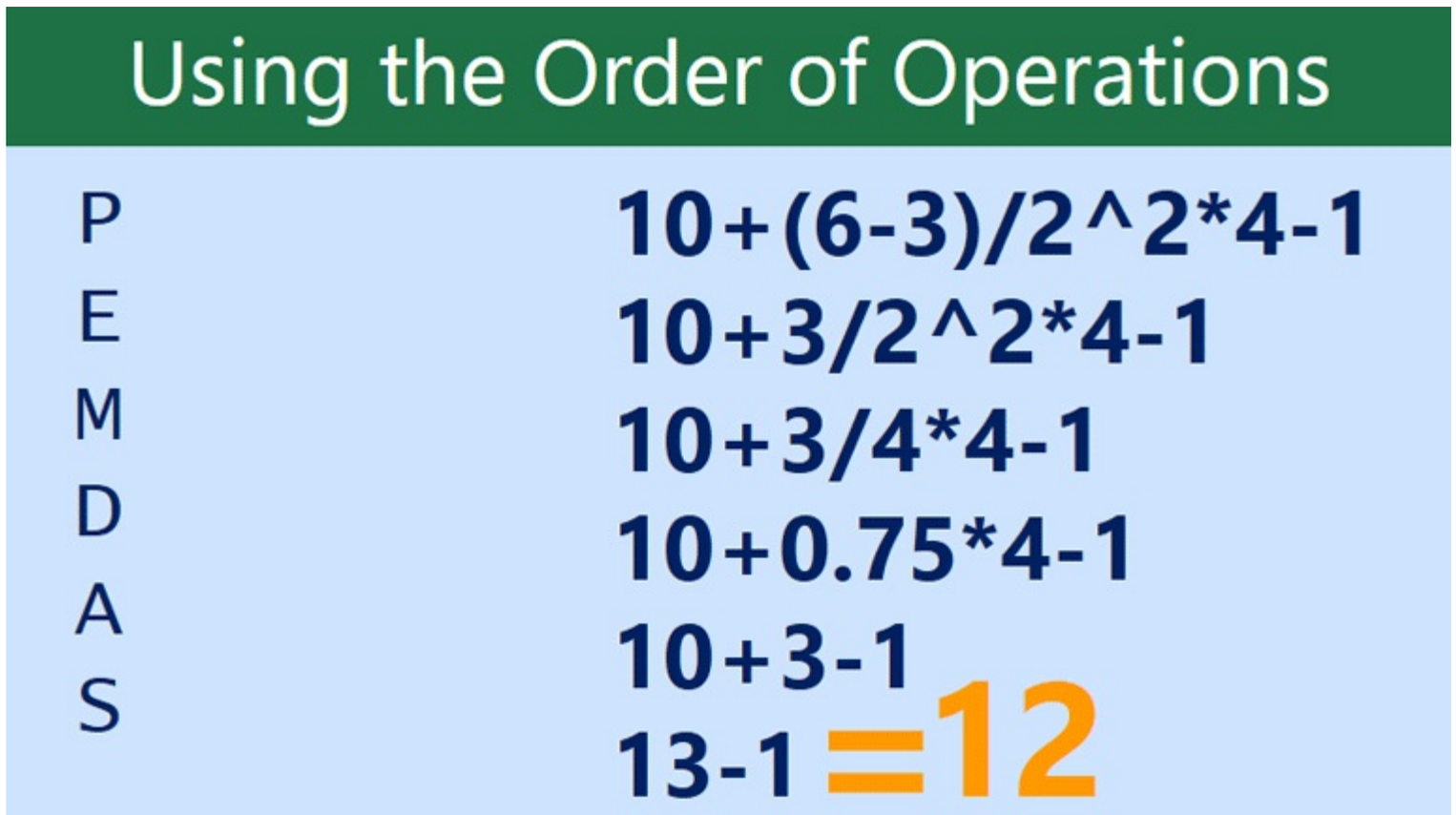

Now, we'll calculate our remaining multiplication operation: 0.75*4=3.

- 


Next, we'll calculate any addition or subtraction, again working from left to right. Addition comes first: 10+3=13.

- 

Finally, we have one remaining subtraction operation: 13-1=12.

- 


And now we have our answer: 12. This is the exact same result you would get if you entered the formula into a spreadsheet.

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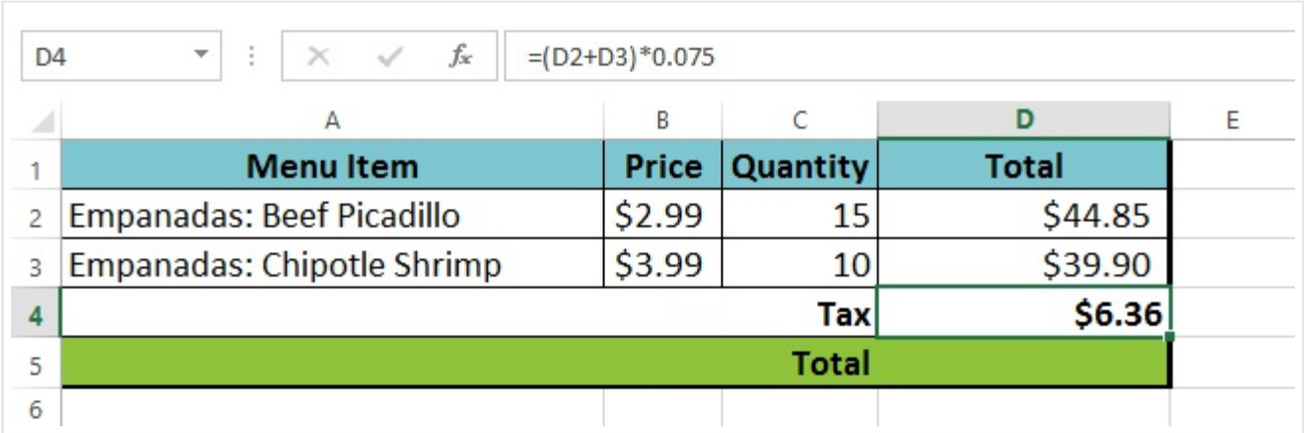
## Creating complex formulas

In the example below, we'll demonstrate a complex formula using the order of operations. Here, we want to calculate the cost of **sales tax** for a catering invoice. To do this, we'll write our formula as **=(D2+D3)*0.075** in cell **D4**. This formula will add the prices of our items together and then multiply that value by the 7.5% tax rate (which is written as 0.075) to calculate the cost of sales tax.

The spreadsheet then follows the order of operations and first adds the values inside the parentheses: **(44.85+39.90) = $84.75**. Then it multiplies that value by the tax rate: **$84.75*0.075**. The result will show that the sales tax is **$6.36**.




It is especially important to enter complex formulas with the correct order of operations. Otherwise, the spreadsheet will not calculate the results accurately. In our example, if the **parentheses** are not included, the multiplication is calculated first and the result is incorrect. Parentheses are the best way to define which calculations will be performed first in a formula.

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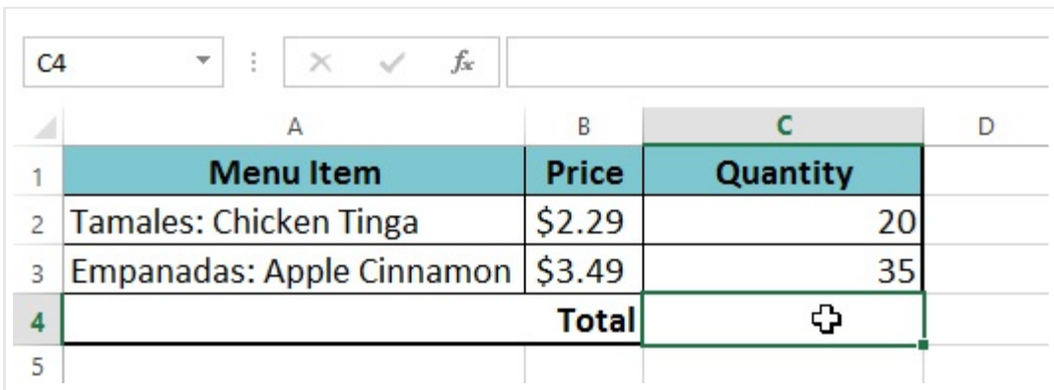
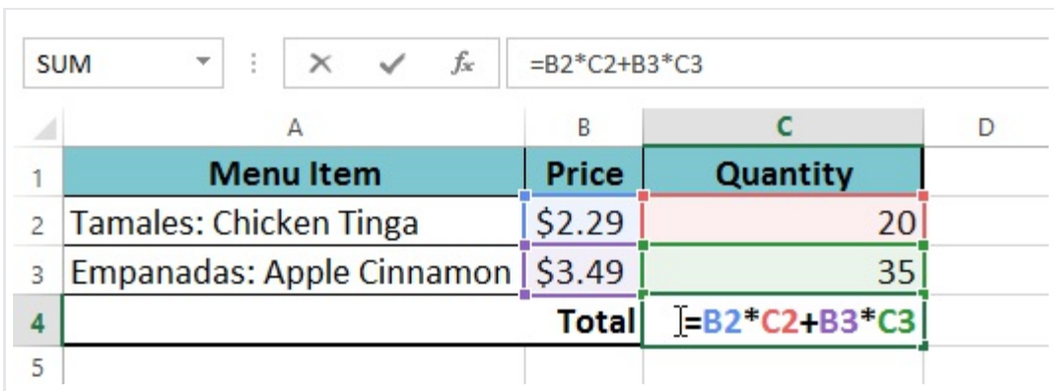
## To create a complex formula using the order of operations:

In our example below, we will use **cell references** along with **numerical values** to create a complex formula that will calculate the **total cost** for a catering invoice. The formula will calculate the cost for each menu item and add those values together.

1. Select the **cell** that will contain the formula. In our example, we'll select cell **C4**.

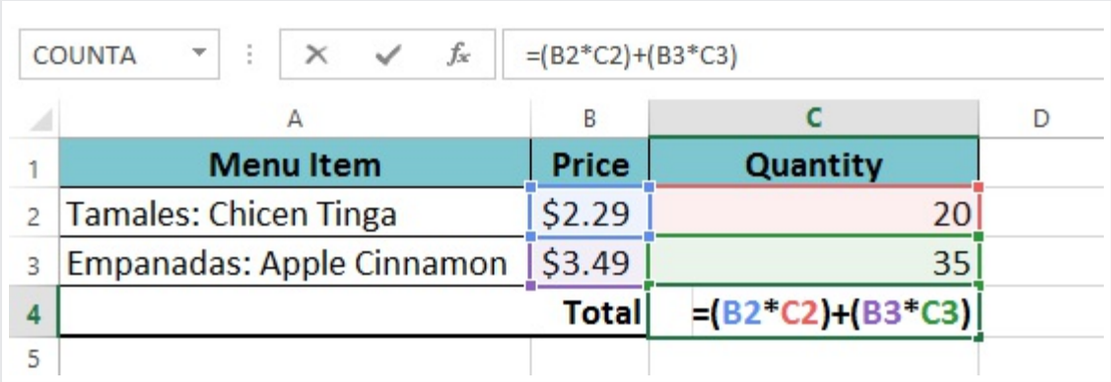



2. Enter your **formula**. In our example, we'll type **=B2*C2+B3*C3**. This formula will follow the order of operations, first performing multiplication: **2.29*20 = 45.80** and **3.49*35 = 122.15**. Then it will add those values together to calculate the total: **45.80+122.15**.




3. Double-check your formula for accuracy, then press **Enter** on your keyboard. The formula will **calculate** and display the **result**. In our example, the result shows that the total cost for the order is **$167.95**.

You can add **parentheses** to any equation to make it easier to read. While it won't change the result of the formula in this example, we could enclose the multiplication operations within parentheses to clarify that they will be calculated before the addition.




Your spreadsheet **will not always tell you** if your formula contains an error, so it's up to you to check all of your formulas. To learn how to do this, check out the **Double-Check Your Formulas** lesson.

TRY THIS!

## Challenge!

1. Open an existing Excel workbook. If you want, you can use the **example file** for this lesson.
2. Create a complex formula that will perform addition before multiplication. If you are using the example, create a formula in cell **D6** that first **adds** the values of cells **D3**, **D4**, and **D5** and then **multiplies** their total by **0.075**. Hint: You'll need to think about the order of operations for this to work correctly.

Previous: Simple Formulas

Next: Relative and Absolute Cell References

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