ORDER OF OPERATIONS

Some equations can have many different answers if the operations (e.g. adding, subtracting, multiplying, dividing, etc.) are calculated in different orders. For example, to answer an equation like:

\[ 3 \times 4 + 8 \div 2 \]

You might multiply, add then divide:

Step 1) \[ 3 \times 4 = 12, \text{ making the original equation } 12 + 8 \div 2 \]
Step 2) \[ 12 + 8 = 20, \text{ making the original equation } 20 \div 2 \]
Step 3) \[ 20 \div 2 = 10 \]

You might add, multiply then divide:

Step 1) \[ 4 + 8 = 12, \text{ making the original equation } 3 \times 12 \div 2 \]
Step 2) \[ 3 \times 12 = 36, \text{ making the original equation } 36 \div 2 \]
Step 3) \[ 36 \div 2 = 18 \]

You might divide, add then multiply:

Step 1) \[ 8 \div 2 = 4, \text{ making the original equation } 3 \times 4 + 4 \]
Step 2) \[ 4 + 4 = 8, \text{ making the original equation } 3 \times 8 \]
Step 3) \[ 3 \times 8 = 24 \]

As you can see, without a rule to dictate the order of operations, it would be possible to get many different answers from one equation. The term Order of Operations therefore refers to a specific order that you should always use when calculating the operations in any mathematical equation so that you always get the same answer.
The Rule for Order of Operations

Step 1: Brackets.
Calculate the operations that have been grouped by brackets.

Step 2: Exponents.
Calculate all the exponents.

Step 3: Multiply and Divide.
Calculate both multiplication and division from left to right.

Step 4: Add and Subtract.
Calculate addition and subtraction from left to right.

A useful acronym, or memory aid, that will help you to remember this order is BEDMAS:

- Brackets
- Exponents
- Division
- Multiplication
- Addition
- Subtraction

Now let’s try it! Before we had the equation $3 \times 4 + 8 \div 2$. Following BEDMAS, we know that division and multiplication come before addition. If we do the division and multiplication from left to right, we arrive at the following order of operations:

Step 1) We multiply:
$3 \times 4 = 12$, making the original equation $12 + 8 \div 2$

Step 2) Then we divide:
$8 \div 2 = 4$, making the original equation $12 + 4$

Step 3) Lastly, we add:
$12 + 4 = 16$

Let’s try a harder one. Use the correct order of operations and try to get the right answer.

$(3 + 2) \times 4 + 3^2$
Order of Operations MA1.30

Now check your calculations.

Step 1) First, we need to calculate what is inside the brackets:
3 + 2 = 5, making the original equation 5 × 4 + 3²

Step 2) Then we calculate the exponent:
3² = 9, making the original equation 5 × 4 + 9

Step 3) Then we multiply:
5 × 4 = 20, making the original equation 20 + 9

Step 4) And lastly, we add:
20 + 9 = 29

After some practice, you'll be able to calculate much harder equations. Good work!

Exercise

For each problem, write the correct order of operations and then do the calculations.

1) 25 − 3 × 7 + 4

2) 49 ) 7 × (2³ + 7) × 2

3) 25 ) (2 + 3) × 2²

4) 8 × (3 − 1)³ - 3 × (7 − 3)²
Answers

1) Multiply, subtract then add to get 8.

2) Inside the brackets, calculate the exponent then add. Then divide and multiply twice to get 270.

3) Add what’s in the brackets, calculate the exponent, and then divide and multiply to get 20.

4) Subtract what’s in both brackets. Calculate the exponents, then multiply, and then subtract to get 16.