

Order of Operations

When a calculation involves many symbols, it is important to know the order to do each step.

This topic is about know how to perform calculations like these:

$$3 + 5 \times 6 \qquad 4 \times 3^2 - 5 \times 2^3 \qquad \frac{6 + 12 \times 3}{2 \times 2^2 - 3}$$

$$(3 - 7)^2 \times 6 \qquad 100 - 3 \times (6 - 2)^2$$

These are usually non calculator questions.

Use **G.E.M.S** to help you remember the order.

Groupings **E**xponents **M**ultiplications and Divisions from left to right **S**ubtractions and Additions from left to right.

Groupings include, brackets, numerator or denominator of a fraction, inside a square root. You can also have groupings within groupings. The inner-most groups are first to be evaluated.

Exponents: In 4^2 The 2 is called the exponent. This is equivalent to $4 \times 4 = 16$. Other words for exponent include power, indices, exponential.

Multiplications and Divisions are carried out from left to right. $3 \times 15 \times 2 \div 6 \div 5$ can be thought of as $3 \times 15 = 45$, then $45 \times 2 = 90$, then $90 \div 6 = 15$, then $15 \div 5 = 3$

Subtractions and Additions are carried out from left to right. $12 - 3 + 6 - 5$ can be thought of as $12 - 3 = 9$, then $9 + 6 = 15$, then $15 - 5 = 10$

Example 1 $3 + 5 \times 6$

Follow the order of GEMS. Multiply before the add.

$$3 + 5 \times 6$$

Multiply before the add

$$3 + 5 \times 6 = 3 + 30 = 33$$

Example 2 $2 + 5^2$

5^2 is an exponent so according to the order of GEMS, we do this before the Addition..

$$2 + 5^2$$

$5^2 = 5 \times 5 = 25$
Exponent before the add

$$2 + 5^2 = 2 + 25 = 27$$

Example 3 $40 + 90 \div 3^2$

Follow the order of GEMS. Exponent first.

$$40 + 90 \div 9$$

Followed by the divide:

$$40 + 10$$

And lastly the add:

$$50$$

You may have seen other ways to remember the order like BIDMAS or BODMAS or PEMDAS. These are also fine to use.

Example 4 $20 - (18 - 16)^3$

Follow the order of GEMS. Groupings first, so do the brackets: $18 - 16 = 2$

$$20 - 2^3$$

Exponential before Subtract $2^3 = 8$

$$20 - 8 = 12$$

Example 5

$$\frac{\sqrt{15 - 6}}{3}$$

$15 - 6$ is within a grouping, so we do that first.

$$\frac{\sqrt{9}}{3}$$

$\sqrt{9}$ counts as an exponential, so do that next. $\sqrt{9} = 3$

$$\frac{3}{3} = 1$$

Working out Exponentials:

$$3^2 = 9$$

'3 squared' means to do 3 times by itself. $3 \times 3 = 9$

$$4^2 = 16$$

$$5^2 = 25$$

$$6^2 = 36$$

$$7^2 = 49$$

$$8^2 = 64$$

$$9^2 = 81$$

$$10^2 = 100$$

$$2^3 = 8$$

'2 cubed' means to do 2 times by itself and by itself again. $2^3 = 2 \times 2 \times 2 = 8$

$$2^3 = 8$$

$$3^3 = 27$$

$$\sqrt{25} = 5$$

'square root of 25' means to find what number times by itself is 25. The answer is 5.