

Math 9 – Unit 1: Real Numbers

Lesson #4: Order of Operations

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Evaluate the following expression on your own, without anybody's help:

$$\begin{aligned}
 & 2(4-6)^2 - 9 \div (5-2) + 1 \\
 = & 2(-2)^2 - 9 \div (3) + 1 \\
 = & 2(4) - 9 \div (3) + 1 \\
 = & 8 - 3 + 1 = 6
 \end{aligned}$$

-2
-6
6
4
-0.25
-2.6
14

Without order, there is chaos. Math cannot have chaos, so logically there must be an order. The order of operations (sometimes known as BEDMAS) gives the structure or algorithm to solve mathematical questions.

The order is:

Brackets
Exponents
Division
Multiplication
Addition
Subtraction

do these from left to right
do these left to right

The same order MUST be applied when we work with fractions. Let's do some examples:

a) $2 + \frac{4}{5} \times \frac{1}{4}$

$$= 2 + \frac{1}{5}$$

$$= \frac{10}{5} + \frac{1}{5} \quad \text{C.O.} = 5$$

$$= \frac{11}{5}$$

b) $\frac{3}{2} - \frac{7}{5} \div \frac{1}{3} + \frac{3}{2}$

$$= \frac{3}{2} - \frac{7}{5} \times \frac{3}{1} + \frac{3}{2}$$

$$= \frac{3}{2} - \frac{21}{5} + \frac{3}{2} \quad \text{C.O.} = 10$$

$$= \frac{15}{10} - \frac{42}{10} + \frac{15}{10}$$

$$= \frac{-12}{10} = \frac{-6}{5}$$

$$\begin{aligned}
 \text{c) } & \frac{5}{6} + \left(\frac{9}{5} \div \frac{6}{5} \right)^2 - \frac{1}{2} \\
 &= \frac{5}{6} + \left(\frac{9}{5} \times \frac{5}{6} \right)^2 - \frac{1}{2} \\
 &= \frac{5}{6} + \left(\frac{3}{2} \right)^2 - \frac{1}{2} \\
 &= \frac{5}{6} + \frac{9}{4} - \frac{1}{2} \\
 &= \frac{10}{12} + \frac{27}{12} - \frac{6}{12} \\
 &= \frac{31}{12}
 \end{aligned}$$

$$\begin{aligned}
 \text{d) } & \frac{2}{5} \times \frac{3}{5} + \left(\frac{4}{3} + \frac{2}{3} \right) \times \frac{1}{2} \\
 &= \frac{6}{25} + \left(\frac{4}{3} + \frac{6}{3} \right) \times \frac{1}{2} \\
 &= \frac{6}{25} + \frac{10}{3} \times \frac{1}{2} \\
 &= \frac{6}{25} + \frac{5}{3} \\
 &= \frac{6}{25} + \frac{5}{3} \quad \text{c.o.} = 75 \\
 &= \frac{18}{75} + \frac{125}{75} \\
 &= \frac{143}{75}
 \end{aligned}$$

In Math, you are usually given an algebraic expression which you need to use to solve given certain values. When you substitute numbers into letters, always do so with parenthesis ().

Example: Solve the following two expressions given $x = 4$ and $y = -2$.

$$\begin{aligned}
 \text{a) } & 6y - x^2 - y \\
 &= 6(-2) - (4)^2 - (-2) \\
 &= -12 - 16 + 2 \\
 &= -26
 \end{aligned}$$

$$\begin{aligned}
 \text{b) } & (x - y)(x + y) \\
 &= (4 - (-2))(4 + (-2)) \\
 &= (6)(2) \\
 &= 12
 \end{aligned}$$

Application: Jimmy went to Tim Horton's during their "Roll up the Rim" season and won a bike. However, in order to get the bike, he had to answer the following skill testing question: $4 + 4 \div 2 \times (3 + 1)$. Jimmy answered 16. Did he get the bike?

$$\begin{aligned}
 & 4 + 4 \div 2 \times (3 + 1) \\
 &= 4 + 4 \div 2 \times 4 \\
 &= 4 + 2 \times 4 \\
 &= 4 + 8 = 12!!
 \end{aligned}$$

\therefore Jimmy did not get the bike.