

1.4 Order of Operations with Rational Numbers

Name: _____

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Learning Goals: *I will learn to*

- use order of operations to solve problems involving rational numbers

Order of Operations	
B E DM AS	(), [], { } Parentheses, Brackets, Braces
	x^a , $\sqrt{\quad}$ Exponents, Radicals
	\times , \div Multiplication, Division (from left to right)
	$+$, $-$ Addition, Subtraction (from left to right)

include things inside

Explore and Analyze

In Canada, contestants need to answer a skill testing question in order to collect their prize. For some reason, these skill testing questions are almost always math questions! Why do calculations with three or more operations need to be done in a specific order?

1. Answer the following question using the order of operations.

B E DM AS

$$\begin{aligned}
 & 2 + 8 \times (5 - 2^2) \div 2 - 6 \\
 & = 2 + 8 \times (5 - 4) \div 2 - 6 \\
 & = 2 + 8 \times 1 \div 2 - 6 \\
 & = 2 + 8 \div 2 - 6 \\
 & = 2 + 4 - 6 \\
 & = 6 - 6 \\
 & = 0
 \end{aligned}$$

2. Will you get the same answer if you ignore the order of operations, and just solve #1 by making each calculation from left to right as you encounter it?

No → changing the order of the calculations changes the result

$$\sqrt{\frac{9}{4}} = \frac{\sqrt{9}}{\sqrt{4}} = \frac{3}{2}$$

Example 1: Order of operations With Rational Numbers

Calculate.

$$\begin{aligned}
 \text{a) } & 12 \div 4 \times \sqrt{\frac{3}{4} + 1\frac{1}{2}} + \left(\frac{5}{8} - \frac{1}{16}\right) - 1\frac{3}{8} \\
 & = 12 \div 4 \times \sqrt{\frac{3}{4} + \frac{6}{4}} + \left(\frac{10}{16} - \frac{1}{16}\right) - 1\frac{3}{8} \\
 & = 12 \div 4 \times \sqrt{\frac{9}{4}} + \left(\frac{9}{16}\right) - \frac{11}{8} \\
 & = 12 \div 4 \times \frac{3}{2} + \frac{9}{16} - \frac{11}{8} \\
 & = \frac{3}{1} \times \frac{3}{2} + \frac{9}{16} - \frac{11}{8} \\
 & = \frac{9 \times 8}{2 \times 8} + \frac{9}{16} - \frac{11}{8} \\
 & = \frac{72}{16} + \frac{9}{16} - \frac{11 \times 2}{8 \times 2} \\
 & = \frac{81}{16} - \frac{22}{16} \\
 & = \frac{59}{16} \\
 & = \boxed{3\frac{11}{16}}
 \end{aligned}$$

$$\begin{aligned}
 \text{b) } & -0.7 + [2.2(1.58 - 3.12)] + \sqrt{12.5 + (-3.5)} \\
 & = -0.7 + [2.2 \times (-1.54)] + \sqrt{9} \\
 & = -0.7 + [-3.388] + \sqrt{9} \\
 & = -0.7 - 3.388 + 3 \\
 & = -4.088 + 3 \\
 & = \boxed{-1.088}
 \end{aligned}$$

Show You Know

Calculate.

$$\begin{aligned} \text{a) } & 15 \div (-2.5) + \sqrt{6.25} - 3^2 \\ & = \underline{15 \div (-2.5)} + \underline{2.5} - 9 \\ & = \underline{-6} + \underline{2.5} - 9 \\ & = -3.5 - 9 \\ & = \boxed{-12.5} \end{aligned}$$

$$\begin{aligned} \text{b) } & \left[1\frac{1}{2} + \left(\frac{3}{4} - \frac{1}{2} \right) - \sqrt{\frac{1}{4}} \right] \times 4 \\ & = \left[\frac{3}{2} + \left(\frac{3}{4} - \frac{2}{4} \right) - \sqrt{\frac{1}{4}} \right] \times 4 \\ & = \left[\frac{3}{2} + \frac{1}{4} - \sqrt{\frac{1}{4}} \right] \times 4 \\ & = \left[\frac{3^{x2}}{2^{x2}} + \frac{1}{4} - \frac{1^{x2}}{2^{x2}} \right] \times 4 \\ & = \left[\frac{6}{4} + \frac{1}{4} - \frac{2}{4} \right] \times 4 \\ & = \left[\frac{7}{4} - \frac{2}{4} \right] \times 4 \\ & = \frac{5}{4} \times \frac{4}{1} \\ & = \frac{5}{1} = \boxed{5} \end{aligned}$$