Sect 4.6 - Order of Operations

Objective a: Applying the order of operations to decimals.

Recall the order of operations:

Order of Operations

1) Parentheses - Do operations inside of Parentheses ( ), [ ], { }, | |
2) Exponents including square roots.
3) Multiplication or Division as they appear from left to right.
4) Addition or Subtraction as they appear from left to right.

Simplify the following:

Ex. 1 $4.8 \bullet 1.6 \div 0.8 \bullet 0.4$

Solution:

Since there are no parentheses or exponents, we start with step #3, multiply or divide as they appear from left to right:

$4.8 \bullet 1.6 \div 0.8 \bullet 0.4$ (#3-multiplication)

$= 7.68 \div 0.8 \bullet 0.4$ (#3-division)

$= 9.6 \bullet 0.4$ (#3-multiplication)

$= 3.84.$

Ex. 2 $5.1 - 3.4 \div 1.7 + (\sqrt{25} - 3.5)^2$

Solution:

$5.1 - 3.4 \div 1.7 + (\sqrt{25} - 3.5)^2$ (#1-parentheses, #2-expon.)

$5.1 - 3.4 \div 1.7 + (5 - 3.5)^2$ (#1-parentheses, #4-subtraction)

$= 5.1 - 3.4 \div 1.7 + (1.5)^2$ (#2-exponents)

$= 5.1 - 3.4 \div 1.7 + 2.25$ (#3-division)

$= 5.1 - 2 + 2.25$ (#4-subtraction)

$= 3.1 + 2.25$ (#4-addition)

$= 5.35$

Ex. 3 $0.3[7(1.2)^2 - \sqrt{0.49}\,(10)] \div 0.2 - 0.72 \div 0.3$

Solution:

$0.3[7(1.2)^2 - \sqrt{0.49}\,(10)] \div 0.2 - 0.72 \div 0.3$ (#1-parent., #2-exp.)

$= 0.3[7(1.44) - (0.7)(10)] \div 0.2 - 0.72 \div 0.3$ (#1- parent., #3-mult.)

$= 0.3[10.08 - (0.7)(10)] \div 0.2 - 0.72 \div 0.3$ (#1- parent., #3-mult.)

$= 0.3[10.08 - 7] \div 0.2 - 0.72 \div 0.3$ (#1-parentheses, #4-sub.)

$= 0.3[3.08] \div 0.2 - 0.72 \div 0.3$ (#3-multiplication)

$= 0.924 \div 0.2 - 0.72 \div 0.3$ (#3-division)

$= 4.62 - 0.72 \div 0.3$ (#3-division)

$= 4.62 - 2.4$ (#4-subtraction)

$= 2.22$

Ex. 4 $1 + 3^2 - (3.9 - 3.6 \div 3)^2 + (1.21)^1$

Solution:

$1 + 3^2 - (3.9 - 3.6 \div 3)^2 + (1.21)^1$ (#1-parentheses, #3-div.)

$= 1 + 3^2 - (3.9 - 1.2)^2 + (1.21)^1$ (#1-parentheses, #4-sub.)

$= 1 + 3^2 - (2.7)^2 + (1.21)^1$ (#2-exponents)

$= 1 + 3^2 - (2.7)^2 + (1.21)^1$ (#2-exponents)

$= 1 + 9 - (2.7)^2 + (1.21)^1$ (#2-exponents)

$= 1 + 9 - 7.29 + (1.21)^1$ (#2-exponents)

$= 1 + 9 - 7.29 + 1.21$ (#4-addition)

$= 10 - 7.29 + 1.21$ (#4-subtraction)

$= 2.71 + 1.21$ (#4-addition)

$= 3.92$

Objective b: Calculations with Decimals and Fractions.

Simplify the following:

Ex. 5 $(0.1)^3 \div (\{3.1 - \frac{12}{5}\}^2 - \frac{1}{8} \div 0.5) + \frac{5}{16}$

Solution:

In this problem, we have both fractions and decimals. Let's see if the fractions convert to nice, terminating decimals:

$\frac{12}{5} = 2.4$ $\frac{1}{8} = 0.125$ $\frac{5}{16} = 0.3125$

Since we get nice, terminating decimals, we will do this as a decimal problem:

$(0.1)^3 \div (\{3.1 - \frac{12}{5}\}^2 - \frac{1}{8} \div 0.5) + \frac{5}{16}$

$= (0.1)^3 \div (\{3.1 - 2.4\}^2 - 0.125 \div 0.5) + 0.3125$
(#1-parentheses, #1-parentheses, #4-subtraction)

$= (0.1)^3 \div (\{0.7\}^2 - 0.125 \div 0.5) + 0.3125$ (#1-parent., #2-exp.)

$= (0.1)^3 \div (0.49 - 0.125 \div 0.5) + 0.3125$ (#1-parent., #3-division)

$= (0.1)^3 \div (0.49 - 0.25) + 0.3125$ (#1-parent., #4-subtraction)

$= (0.1)^3 \div (0.24) + 0.3125$ (#2-exponents)

$= 0.001 \div (0.24) + 0.3125$ (#3-division)

$= 0.00\overline{416} + 0.3125$ (#4-addition)

$= 0.3\overline{16}$

Ex. 6 $(2.5)^2 - \left(\frac{5}{6} \div 0.75\right) - \sqrt{0.09}\left(2\frac{5}{14} - 2.2\right) \bullet 100$

Solution:

In this problem, we have both fractions and decimals. Let's see if the fractions convert to nice, terminating decimals:

$\frac{5}{6} = 0.833333...$ $\frac{5}{14} = 0.35714285714...$

Since we do not get nice, terminating decimals, we will do this as a fraction problem:

$2.5 = 2\frac{5}{10} = 2\frac{1}{2}$, $0.75 = \frac{75}{100} = \frac{3}{4}$, $\sqrt{0.09} = \sqrt{\frac{9}{100}}$, $2.2 = 2\frac{2}{10} = 2\frac{1}{5}$

So, $(2.5)^2 - \left(\frac{5}{6} \div 0.75\right) - \sqrt{0.09}\left(2\frac{5}{14} - 2.2\right) \bullet 100$

$= \left(2\frac{1}{2}\right)^2 - \left(\frac{5}{6} \div \frac{3}{4}\right) - \sqrt{\frac{9}{100}}\left(2\frac{5}{14} - 2\frac{1}{5}\right) \bullet 100$ (invert and multiply)

$= \left(2\frac{1}{2}\right)^2 - \left(\frac{5}{6} \bullet \frac{4}{3}\right) - \sqrt{\frac{9}{100}}\left(2\frac{5}{14} - 2\frac{1}{5}\right) \bullet 100$ (#1-parent., #3-mult.)

$= \left(2\frac{1}{2}\right)^2 - \frac{10}{9} - \sqrt{\frac{9}{100}}\left(2\frac{5}{14} - 2\frac{1}{5}\right) \bullet 100$ (L.C.D. = 70, build fractions)

$= \left(2\frac{1}{2}\right)^2 - \frac{10}{9} - \sqrt{\frac{9}{100}}\left(2\frac{5 \bullet 5}{14 \bullet 5} - 2\frac{1 \bullet 14}{5 \bullet 14}\right) \bullet 100$ (multiply)

$= \left(2\frac{1}{2}\right)^2 - \frac{10}{9} - \sqrt{\frac{9}{100}}\left(2\frac{25}{70} - 2\frac{14}{70}\right) \bullet 100$ (#1-parent., #4-sub.)

$= \left(2\frac{1}{2}\right)^2 - \frac{10}{9} - \sqrt{\frac{9}{100}}\left(\frac{11}{70}\right) \bullet 100$ (change into an improper fraction)

$= \left(\frac{5}{2}\right)^2 - \frac{10}{9} - \sqrt{\frac{9}{100}}\left(\frac{11}{70}\right) \bullet 100$ (#2-exponents)

$= \frac{25}{4} - \frac{10}{9} - \frac{3}{10}\left(\frac{11}{70}\right)\bullet 100$ (change into an improper fraction)

$= \frac{25}{4} - \frac{10}{9} - \frac{3}{10}\left(\frac{11}{70}\right)\bullet \frac{100}{1}$ (#3-multiplication)

$= \frac{25}{4} - \frac{10}{9} - \frac{33}{7}$ (L.C.D. = 252, build fraction)

$= \frac{25\bullet 63}{4\bullet 63} - \frac{10\bullet 28}{9\bullet 28} - \frac{33\bullet 36}{7\bullet 36}$ (multiply)

$= \frac{1575}{252} - \frac{280}{252} - \frac{1188}{252}$ (#4-subtraction)

$= \frac{1295}{252} - \frac{1188}{252}$ (#4-subtraction)

$= \frac{107}{252}$

Since $252 = 4\bullet 9\bullet 7 = 2^2\bullet 3^2\bullet 7$ and 107 is not divisible by 2, 3, or 7, our answer is reduced to lowest terms. So, the answer is $\frac{107}{252}$.

Objective c: Applications

Solve the following:

Ex. 7 A developer purchased 409.84 acres of land and plans to divide it into a 52-acre recreational park and lots of $\frac{8}{11}$ of an acre each. If 12 acres will be reserved for roads and utilities, how many lots can be formed from the land?

Solution:

To begin, we must exclude the land that s being used for roads, utilities and the recreational park. The remaining land will be split into lots of $\frac{8}{11}$ acres each:

$(409.84 - 52 - 12) \div \frac{8}{11}$ (#1-parenthesis, #4-subtraction)

$= (345.84) \div \frac{8}{11}$ (write 345.62 as an improper fraction)

$= \frac{34584}{100} \div \frac{8}{11}$ (invert and multiply)

$= \frac{34584}{100}\bullet \frac{11}{8}$ (reduce)

$= \frac{4323\bullet 8}{100}\bullet \frac{11}{8\bullet 1} = \frac{4323}{100}\bullet \frac{11}{1}$ (multiply and then divide)

$= \frac{47553}{100} = 475.53$

The developer can form 475 complete lots.

Ex. 8 At the department store, Leroy purchased four boxes of cat food priced at $5.78 per box, six t-shirts for $4.95 each, and two pairs of shoes for $19.48. If the sale tax was $5.58, how much change did he get if he gave the cashier a hundred dollar bill?

Solution:

First, multiply the quantity times the price for each item he bought:

4(5.78) = 23.12 6(4.95) = 29.70 2(19.48) = 38.96

Add these amounts and the sales tax:

23.12 + 29.70 + 38.96 + 5.58 = 97.36

Now, subtract this from 100:

100 – 97.36 = 2.64

He received $2.64 in change.

Ex. 9 The monthly rainfall amounts for a six-month period of time were 1.34", 2.07", 4.56", 2.03", 0.29", and 1.34". Find the average rainfall per month (round the nearest hundredth).

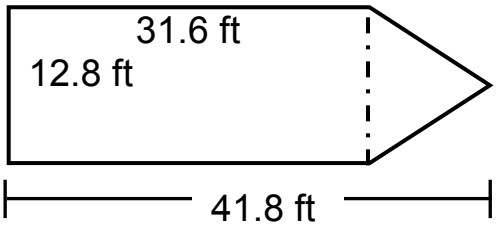
Solution:

To find the average, we add the numbers and then divide by the number of numbers: (1.34 + 2.07 + 4.56 + 2.03 + 0.29 + 1.34) ÷ 6

= 11.63 ÷ 6 = 1.938333... ≈ 1.94"

The average rainfall was 1.94" per month.

Ex. 10 Find the area of the following:

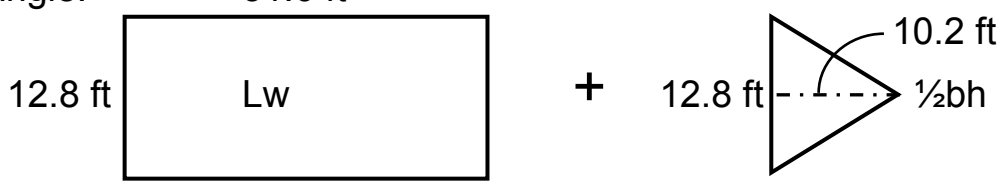


Solution:

Since the triangle is turned on its side, the height of the triangle is the total length of the figure minus the length of the rectangle:

41.8 ft – 31.6 ft = 10.2 ft

The area of the figure is the area of a rectangle plus the area of the triangle:



A = 31.6(12.8) + ½(12.8)(10.2) = 404.48 + 65.28 = 469.76

The area is 469.76 ft^2.