

3.6 Order of Operations with Rational Numbers

The order of operations for rational numbers is the same as for integers and fractions. Think BEDMAS to remember the correct order of operations. We use this order of operations to evaluate expressions with more than one operation.

- B** Do the operations in brackets first.
E Next, evaluate any exponents.
D Then, divide and multiply in order from left to right.
M
A Finally, add and subtract in order from left to right.
S

Example 1 Using the Order of Operations with Decimals

Evaluate.

a) $(-2.4) \div 1.2 - 7 \times 0.2$

b) $(-3.4 + 0.6) + 4^2 \times 0.2$

Solution

a) $(-2.4) \div 1.2 - 7 \times 0.2$

$= -2 - 7 \times 0.2$

$= -2 - 1.4$

$= -2 + (-1.4)$

$= -3.4$

Divide first.

Then multiply.

To subtract, add the opposite.

b) $(-3.4 + 0.6) + 4^2 \times 0.2$

$= -2.8 + 4^2 \times 0.2$

$= -2.8 + 16 \times 0.2$

$= -2.8 + 3.2$

$= 0.4$

Brackets first.

Then evaluate the power.

Then multiply.

Add.

Check

1. Evaluate.

a) $3.8 + 0.8 \div (-0.2)$

$= 3.8 + (\quad)$

$= \underline{\hspace{2cm}}$

b) $4.6 - 3^2 + 3.9 \div (-1.3)$

$= 4.6 - \underline{\hspace{1cm}} + 3.9 \div (-1.3)$

$= 4.6 - \underline{\hspace{1cm}} + (\quad)$

$= -4.4 + (\quad)$

$= \underline{\hspace{2cm}}$

Example 2 Using the Order of Operations with Fractions

Evaluate:

a) $\left(\frac{3}{4} - \frac{7}{8}\right) \div \left(-\frac{5}{16}\right)$

b) $\left(-\frac{2}{3}\right) \times \frac{1}{6} + \frac{1}{2}$

Solution

a) $\left(\frac{3}{4} - \frac{7}{8}\right) \div \left(-\frac{5}{16}\right)$

Subtract in the brackets first.

Use a common denominator of 8.

$= \left(\frac{6}{8} - \frac{7}{8}\right) \div \left(-\frac{5}{16}\right)$

$= \left(-\frac{1}{8}\right) \div \left(-\frac{5}{16}\right)$

To divide, multiply by the reciprocal of $-\frac{5}{16}$.

$= \left(-\frac{1}{8}\right) \times \left(-\frac{16}{5}\right)$

Look for common factors.

$= \left(-\frac{1}{8}\right) \times \left(-\frac{16^2}{5}\right)$

Both factors are negative, so the product is positive.

$= \frac{2}{5}$

b) $\left(-\frac{2}{3}\right) \times \frac{1}{6} + \frac{1}{2}$

Multiply first.

$= \left(-\frac{2^1}{3}\right) \times \frac{1}{6^3} + \frac{1}{2}$

Look for common factors.

$= \left(-\frac{1}{9}\right) + \frac{1}{2}$

Add. Use a common denominator of 18.

$= -\frac{2}{18} + \frac{9}{18} = \frac{7}{18}$

Check

1. Evaluate.

a) $\frac{3}{4} - \left(-\frac{2}{3}\right)\left(-\frac{1}{4}\right)$

Multiply first.

$= \frac{3}{4} -$

Look for common factors.

$= \frac{3}{4} -$

$= \frac{3}{4} -$

Subtract. Use a common denominator of 12.

$=$

$=$

$$\text{b) } \left(-\frac{1}{6}\right) \div \frac{1}{5} + \left(-\frac{3}{2}\right)$$

Divide first. Multiply by the reciprocal of ____.

$$= -\frac{1}{6} \times \underline{\hspace{1cm}} + \left(-\frac{3}{2}\right)$$

$$= \underline{\hspace{1cm}} + \left(-\frac{3}{2}\right)$$

$$= \underline{\hspace{1cm}} + \left(-\frac{3}{2}\right)$$

Add. Use a common denominator of ____.

$$= \underline{\hspace{1cm}} + \underline{\hspace{1cm}}$$

$$= \underline{\hspace{1cm}}$$

Example 3 Applying the Order of Operations

The formula $C = (F - 32) \div 1.8$ converts temperatures in degrees Fahrenheit, F , to degrees Celsius, C .

What is 28.4°F in degrees Celsius?

Solution

Substitute $F = 28.4$ in the formula $C = (F - 32) \div 1.8$

$$C = (28.4 - 32) \div 1.8$$

Subtract in the brackets first. Add the **opposite**.

$$= (28.4 + (-32)) \div 1.8$$

$$= (-3.6) \div 1.8$$

Divide.

$$= -2$$

28.4°F is equivalent to -2°C .

Check

1. The expression $F = 32 + 9 \times C \div 5$ converts temperatures in degrees Celsius, C , to degrees Fahrenheit, F .

What is -12.5°C in degrees Fahrenheit?

$$F = 32 + 9 \times (\underline{\hspace{1cm}}) \div 5$$

Multiply first.

$$= \underline{\hspace{2cm}}$$

$$= \underline{\hspace{2cm}}$$

$$= \underline{\hspace{2cm}}$$

-12.5°C is equivalent to $\underline{\hspace{1cm}}^\circ\text{F}$.

Practice

1. In each expression, which operation will you do first?

a) $(-8.6) \times 2.4 - (-6 + 2.5)$

b) $2.5 - 6.4 \times 2.1 + 3.5$

c) $\frac{4}{3} \times \frac{5}{6} + \frac{2}{7} \div \frac{5}{14}$

d) $\frac{5}{3} + \frac{2}{7} \div \left(-\frac{1}{4}\right) - \frac{3}{5}$

2. Evaluate each expression.

a) $(-3.6) \div 1.8 + (1.2 - 1.5)$

= _____

= _____

= _____

b) $\left(-\frac{1}{4}\right) \div \frac{3}{8} + \left(-\frac{1}{2}\right)^2$

= _____

= _____

= _____

= _____

= _____

3. Evaluate each expression.

a) $(5.6 + 4.4) \div (-2.5)$

= _____ $\div (-2.5)$

= _____

c) $9.2 \div 4 - 3.6 \times 2$

= _____

= _____

= _____

b) $(-4.2) + 6 \times (-1.7)$

= $(-4.2) + (\text{_____})$

= _____

d) $7.5 \times [-0.7 + (-0.3) \times 3]$

= _____

= _____

= _____

4. Evaluate each expression.

a) $\frac{1}{5} + \left(-\frac{1}{4}\right) \times \frac{8}{15}$

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

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

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

$=$ _____

$=$ _____

b) $\left(-\frac{7}{4}\right) \div \frac{2}{3} + \frac{1}{4}$

$=$ _____

$=$ _____

$=$ _____

$=$ _____

$=$ _____

c) $\left(\frac{1}{3}\right)^2 \times \frac{3}{2} - \frac{5}{4}$

$=$ _____

$=$ _____

$=$ _____

$=$ _____

$=$ _____

5. A mistake was made in each solution.

Identify the line in which the mistake was made, and give the correct solution.

a) $(-3.2 \div 1.6)^2 - (-4.1)$

$= (-2)^2 - (-4.1)$

$= 4 + (-4.1)$

$= -0.1$

b) $\frac{1}{3} + \frac{4}{3} \times \left(-\frac{1}{2}\right)$

$= \frac{5}{3} \times \left(-\frac{1}{2}\right)$

$= \frac{5 \times (-1)}{3 \times 2}$

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

6. The formula for the area of a trapezoid is $A = h \times (a + b) \div 2$.

In the formula, h is the height and a and b are the lengths of the parallel sides. Find the area of a trapezoid with height 3.5 cm and parallel sides of length 8 cm and 12 cm.

Substitute $h =$ _____, $a =$ _____, and $b =$ _____ in the formula $A = h \times (a + b) \div 2$.

$A =$ _____

$=$ _____

$=$ _____

$=$ _____

The trapezoid has area _____ cm^2 .