Number Relationships

What needs to be considered when planning and managing a community garden at a local park?

For example, we would need to consider:

- **how much space we have**
- **what types of plants/vegetation will be planted and how they will be arranged**
- **what fraction of the garden will be allocated to each type of plant**
- **how much sunlight different parts of the garden get**
- **which plants need full sun and which need partial shade**
- **how much water will be needed for the plants to thrive**
- **how many seeds of each type of plant are needed**
- **the costs associated with creating and maintaining the garden**
- **the rate at which the different plants grow**
- **the expected harvest per plant**
- **what fertilizers/pesticides are needed**
- **the cost per square metre for soil and seeds**
- **the cost of tools/equipment needed for the garden**
- **how often the garden needs to be cared for (e.g., weeding, watering, fertilizing)**

Mathology 9 Workbook TOC

Unit 4 Fluency with Rational Numbers

What I Know

Use four digits from 1 to 9 each time. A digit can only be used once. You may use positive and/or negative signs as needed. Explain how you know each expression satisfies the criteria.

- Make two decimals whose product is between –5 and –9.

  For example: 3.8 × (–1.7)

  3.8 is close to 4. –1.7 is close to –1.5.
  4 × (–1.5) = –6.

- Make two fractions whose quotient is a quotient between $\frac{2}{4}$ and $\frac{5}{6}$.

  For example: $\frac{2}{8} \div \frac{3}{9}$

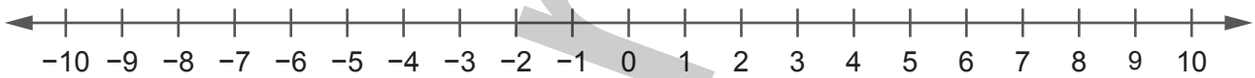
  $\frac{2}{4} = \frac{6}{12}$ and $\frac{5}{6} = \frac{10}{12}$
  When I divide fractions, I can invert and multiply.
  $\frac{2}{8} \times \frac{9}{3} = \frac{18}{24}$, or $\frac{9}{12}$, which is between $\frac{6}{12}$ and $\frac{10}{12}$.

A **quotient** is the answer in a division question. In 6 ÷ 3 = 2, 2 is the quotient.

Checking In

Comparing and Ordering Rational Numbers

1 Identify three rational numbers between each pair of numbers below.
Include at least one fraction or decimal each time. Use the number line if it helps.



a) 2, –1.56

For example: –0.9, 0, 1.56

b) –5.6, –7.25

For example: –5.9, –6.01, –7

c) $-4\frac{1}{3}$, $-2\frac{2}{5}$

For example: –4, $-3\frac{2}{3}$, $-2\frac{4}{5}$

d) $-2\frac{5}{6}$, $1\frac{9}{10}$

For example: $-2\frac{1}{6}$, $-1\frac{1}{6}$, $\frac{1}{2}$

2 Write a one-digit integer in each box to make the statement true.
Identify as many possible answers as you can.

a) $\boxed{8}$.34 > –5.3

And any other positive 1-digit integer, –4, –3, –2, –1, or 0

b) –3.$\boxed{6}$72 < $-3.\overline{6}$

And 7, 8, or 9

c) $-2\frac{2}{3} = \frac{\boxed{-8}}{3}$

d) $\frac{2}{3} > -\frac{2}{\boxed{5}}$

And any other positive 1-digit integer, –4, –5, –6, –7, –8, or –9

3 **TRUE OR FALSE?** When comparing two numbers, the lesser number is *always* closer to zero. Explain.

False. When both numbers are negative, the lesser number is the number farther from zero. When one number is negative and the other is positive, the negative number is always the lesser number, but it may be closer to zero (e.g., –1 is farther from 0 than 0.5, but –1 is the lesser number).

4 Here are the average monthly low temperatures for seven Canadian cities in December.

City, Province	Temperature (°C)
Toronto, Ontario	1.4
Iqaluit, Nunavut	–17.6
Vancouver, British Columbia	6.2
Winnipeg, Manitoba	–10.3
Halifax, Nova Scotia	–2.9
St. John's, Newfoundland and Labrador	–2.8
Regina, Saskatchewan	–10.1

a) Which city had the warmest average monthly low temperature?

Vancouver

b) Which three cities had the coldest average monthly low temperatures?

Iqaluit, Winnipeg, Regina

c) Which cities had a warmer average monthly low temperature than St. John's?

Vancouver, Toronto

d) Order the average monthly low temperatures from warmest to coldest.

6.2°C, 1.4°C, –2.8°C, –2.9°C, –10.1°C, –10.3°C, –17.6°C

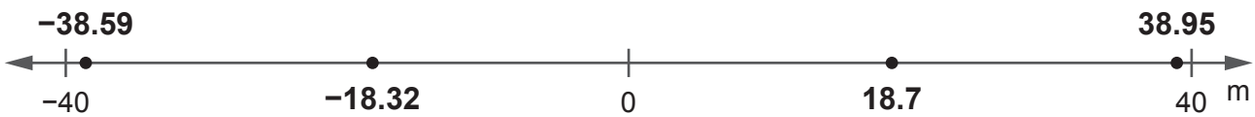
5 Four mountain climbers left base camp to do some exploring. After one hour, Taylor is 38.95 m above base camp, Seline is 18.32 m below base camp, Trey is 38.59 m below base camp, and Aaron is 18.7 m above base camp.

a) Represent each climber's distance from base camp as a rational number.

Taylor: 38.95 m; Seline: –18.32 m; Trey: –38.59 m; Aaron: 18.7 m

b) Place the rational numbers in part a on the number line. What does 0 represent?

0 represents the location of base camp.



c) Who is farthest from base camp? closest to base camp? Explain. **Taylor is farthest; a distance of 38.95 m to the right on the line is greater than a distance of 38.59 m to the left (9 tenths is greater than 5 tenths). Seline is closest; a distance of 18.32 m to the left is less than a distance of 18.7 m to the right (3 tenths is less than 7 tenths).**

6 GAME: Closer to Zero!

If both numbers have the same sign, the fraction is positive. If the signs are different, the fraction is negative. So, you could make $-\frac{7}{4}$ or $-\frac{4}{7}$.

You will need a deck of playing cards with the face cards and 10s removed. Aces are 1.
Black cards are positive and red cards are negative.
Goal: To create the fraction that is closer to zero.

- Place the cards face down in a pile.
- Each of you turn over two cards. Use them to make a fraction that is as close to zero as you can.
- Compare fractions. The player whose fraction is closer to zero takes all four cards.
- Play another round.
- Continue until all cards have been used. The player with more cards wins.

7 Plot these numbers on the open number line.

$-3.59,\ \frac{4}{5},\ -\frac{1}{2},\ -2\frac{5}{6},\ -0.95$

a) Which number(s) is (are) less than –3? **-3.59**

b) Which number(s) is (are) less than –1? **$-0.95, -\frac{1}{2}, \frac{4}{5}$**

c) Identify one rational number between each pair of consecutive numbers plotted on the line.

For example: Between -3.59 and $-2\frac{5}{6}$: -3
Between $-2\frac{5}{6}$ and -0.95: $-2\frac{1}{3}$
Between -0.95 and $-\frac{1}{2}$: -0.7
Between $-\frac{1}{2}$ and $\frac{4}{5}$: 0.52

Operations with Positive and Negative Fractions and Decimals

8 Evaluate each expression. Show your thinking.

a) $\frac{3}{4} + \left(-\frac{7}{12}\right) = \frac{9}{12} + \left(-\frac{7}{12}\right)$
$= \frac{2}{12}$, or $\frac{1}{6}$

b) $\left(-2\frac{2}{5}\right) - \left(-4\frac{1}{2}\right) = \left(-2\frac{2}{5}\right) + \left(4\frac{1}{2}\right)$
$= -\frac{12}{5} + \frac{9}{2}$
$= -\frac{24}{10} + \frac{45}{10}$
$= \frac{21}{10}$, or $2\frac{1}{10}$

c) $\frac{14}{3} + \left(-1\frac{1}{2}\right) = \frac{14}{3} + \left(-\frac{3}{2}\right)$
$= \frac{28}{6} + \left(-\frac{9}{6}\right)$
$= \frac{19}{6}$
$= 3\frac{1}{6}$

d) $-5.8 + 3.2 = \mathbf{-5.8 + 3 + 0.2}$
$\mathbf{= -2.8 + 0.2}$
$\mathbf{= -2.6}$

e) $-5.34 + (-4.2) = \mathbf{-5.34 + (-4.20)}$
$\mathbf{= -9.54}$

f) $35.23 - (-34.23) = \mathbf{35.23 + 34.23}$
$\mathbf{= 69.46}$

9 The sum of two rational numbers is $-2\frac{2}{5}$. What could the numbers be?
Show your reasoning.

For example: I chose $-1\frac{4}{5}$ as the first number. To get to -2, I would have to add $-\frac{1}{5}$, and then to get to $-2\frac{2}{5}$, I would add another $-\frac{2}{5}$.
$-\frac{1}{5} + \left(-\frac{2}{5}\right) = -\frac{3}{5}$; the two numbers could be $-1\frac{4}{5}$ and $-\frac{3}{5}$.

10 The difference between two rational numbers is -4.32. What could the numbers be?
Explain your response as if you were helping a friend.

For example: I chose the first number to be -11.5.
Then, $-11.5 - ? = -4.32$.
I can add 4.32 to -11.5 to get the other number: $-11.5 + 4.32 = -7.18$.
So, $-11.5 - (-7.18) = -4.32$.
Two rational numbers with a difference of -4.32 could be -11.5 and -7.18.

11 In the women's 1500-metre race at the 2024 Paris Olympics, Georgia Bell finished only $\frac{5}{100}$ s behind Jessica Hull. What was Georgia Bell's time as a decimal?

Bell finished $\frac{5}{100}$ s behind Hull. $\frac{5}{100}$ as a decimal is 0.05. So, I add 0.05 to Hull's time to get Bell's time: 3:52.56 + 0.05 = 3:52.61.

12 On this number line, the same number is added or subtracted twice to get from -3.4 to -1.75. Identify the number added or subtracted, then use it to record the missing numbers. Explain your thinking.

For example: I determined the distance between -3.4 and -1.75, then divided that distance into 3 parts. $-1.75 - (-3.4) = 1.65$. $1.65 \div 3 = 0.55$. So, to determine the missing numbers, I started at -3.4 and added 0.55 each time.

13 **PUZZLE: Magic Squares!**

In a magic square, the sum of every row, column, and diagonal is the same.

a) In the magic square below, the sum is 7.5. Fill in the missing numbers to complete the magic square.

8.6	**–3.0**	1.9
–4.2	**2.5**	**9.2**
3.1	8.0	**–3.6**

b) Use decimals or fractions to create your own magic square. Be sure to use a mixture of positive and negative fractions or decimals.

14 Evaluate each expression. Show your work.

a) $\frac{2}{5} \times \left(-\frac{1}{3}\right) = \mathbf{-\frac{2}{15}}$

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

$\mathbf{= -\frac{3}{12}}$**, or** $\mathbf{-\frac{1}{4}}$

c) $\left(-3\frac{2}{4}\right) \times \left(-\frac{4}{6}\right)$

For example: I wrote $\mathbf{-3\frac{2}{4}}$ **as** $\mathbf{-\frac{14}{4}}$**.**

$\mathbf{\left(-\frac{14}{4}\right) \times \left(-\frac{4}{6}\right) = \frac{(-14) \times (-4)}{4 \times 6}}$

$\mathbf{= \frac{56}{24}}$

$\mathbf{= \frac{14}{6}}$**, or** $\mathbf{\frac{7}{3}}$**, or** $\mathbf{2\frac{1}{3}}$

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

For example: I wrote $\mathbf{1\frac{4}{5}}$ **as** $\mathbf{\frac{9}{5}}$**.**

$\mathbf{\frac{9}{5} \div \left(-\frac{3}{4}\right) = \frac{9}{5} \times \left(-\frac{4}{3}\right)}$

$\mathbf{= -\frac{36}{15}}$

$\mathbf{= -2\frac{6}{15}}$**, or** $\mathbf{-2\frac{2}{5}}$

e) 0.4 × 0.8

For example: I know 4 × 8 = 32.
0.4 is close to 0.5 and 0.8 is close to 1.
Since 0.5 × 1 = 0.5, I placed the decimal point before the 3.
0.4 × 0.8 = 0.32

f) 0.42 ÷ (–0.07)

For example: Multiply by 100 to rewrite using whole numbers:
42 ÷ (–7)
42 ÷ 7 = 6, so 42 ÷ (–7) = –6
0.42 ÷ (–0.07) = –6

g) (–25.3)(–4.5)

For example: The product of two negative numbers is positive. So, I multiplied as whole numbers and used estimation to place the decimal point.
25.3 is about 25 and 4.5 is about 5.
25 × 5 = 125
So, (–25.3)(–4.5) = 113.85

$$\begin{array}{r} {\scriptstyle 2\ 1} \\ {\scriptstyle 2\ 1} \\ 253 \\ \times\ 45 \\ \hline 1265 \\ 10120 \\ \hline 11385 \end{array}$$

h) 16.8 ÷ (–1.2)

For example: The quotient will be negative as the numbers have opposite signs.
So, I can divide 16.8 ÷ 1.2, which is equivalent to 168 ÷ 12.
168 ÷ 12 = (120 ÷ 12) + (48 ÷ 12)
= 10 + 4
= 14
So, 16.8 ÷ (–1.2) = –14

15 Without evaluating, identify the expression below that has the same value as $\left(-\frac{2}{5}\right) \div \left(-\frac{3}{4}\right)$?
Explain how you know.

a) $\left(-\frac{2}{5}\right) \times \left(-\frac{3}{4}\right)$ b) $\frac{2}{5} \times \frac{4}{3}$ c) $\left(-\frac{3}{4}\right) \div \left(-\frac{2}{5}\right)$ d) $\frac{2}{5} \div \left(-\frac{3}{4}\right)$

For example: I know the value of $\left(-\frac{2}{5}\right) \div \left(-\frac{3}{4}\right)$ is positive as the fractions have the same sign.
$\left(-\frac{2}{5}\right) \div \left(-\frac{3}{4}\right)$ can be rewritten as $\left(-\frac{2}{5}\right) \times \left(-\frac{4}{3}\right)$, which has a positive product.
Part a does not have the same value because the fractions are the same but the operation is different.
Part b does have the same value because when comparing to the multiplication expression, the fractions are the same but with positive signs, so their product is still positive.
Part c does not have the same value. The fractions are the same as in the original expression, but they are in the opposite order. So, the quotient will be different.
Part d does not have the same value because the fractions have opposite signs, so the value is negative.

16 A scuba diver descends at an average rate of 11.3 m/min.
How many metres below sea level is the scuba diver after 2.5 min?
Show your thinking.

For example: A rational number that represents a descent of 11.3 m/min is –11.3.
An expression that represents the diver's depth after 2.5 min is: –11.3 × 2.5.
The signs are opposite, so the product will be negative. Multiply both numbers by 10 to create an equivalent expression: 113 × 25.

$$\begin{array}{r} {\scriptstyle 1} \\ 113 \\ \times\ 25 \\ \hline 565 \\ 2260 \\ \hline 2825 \end{array}$$

Divide by 10 × 10, or 100.
2825 ÷ 100 = 28.25.
So, –11.3 × 2.5 = –28.25.
The diver is 28.25 m below sea level after 2.5 min.

17 Write an expression that satisfies the given criteria.
Prove your answer each time by showing the calculations.

a) An addition expression with a sum less than –12.32

For example: –5.32 + (–8.34)
$-5.32 + (-8.34) = -5.32 + (-8) + (-0.34)$
$= -13.32 + (-0.34)$
$= -13.66$
$-13.66 < -12.32$

b) A subtraction expression with a difference between $-1\frac{5}{6}$ and $-1\frac{3}{4}$

For example: $\frac{3}{5} - \left(2\frac{2}{5}\right)$
$\frac{3}{5} - \left(2\frac{2}{5}\right) = \frac{3}{5} - \left(\frac{12}{5}\right)$
$= -\frac{9}{5}$, or $-1\frac{4}{5}$
$-1\frac{5}{6} < -1\frac{4}{5} < -1\frac{3}{4}$

c) A multiplication expression with a product greater than $-7\frac{3}{4}$

For example: $5\frac{1}{4} \times \left(-\frac{2}{5}\right)$

$5\frac{1}{4} \times \left(-\frac{2}{5}\right) = \frac{21}{4} \times \left(-\frac{2}{5}\right)$

$= -\frac{42}{20}$, or $-2\frac{2}{20}$, or $-2\frac{1}{10}$

$-2\frac{1}{10} > -7\frac{3}{4}$

d) A division expression with a quotient between –3.201 and –3.12

For example: I know 64 ÷ 2 = 32, so I wrote (–0.64) ÷ 0.2. I multiplied both numbers by 100 to create an equivalent expression: –64 ÷ 20. The quotient will be negative.

$$20\overline{)64.0}\quad 3.2$$

$$4$$

So, (–0.64) ÷ 0.2 = –3.2

–3.201 < –3.2 < –3.12

18 Without evaluating, identify the expression that has the greatest value. Justify your answer.

a) $-\frac{2}{5} + \left(-\frac{3}{4}\right)$ b) $\frac{2}{5} - \frac{3}{4}$ c) $\left(-\frac{2}{5}\right) \times \left(-\frac{3}{4}\right)$ d) $\left(-\frac{2}{5}\right) \div \left(-\frac{3}{4}\right)$

For example: The expression in part a has a negative value.

The expression in part b also has a negative value because $\frac{3}{4} > \frac{2}{5}$.

The expressions in parts c and d have positive values because the fractions have the same signs.

So, one of these expressions is the greatest.

I can rewrite the expression in part d as a multiplication: $\left(-\frac{2}{5}\right) \times \left(-\frac{4}{3}\right)$.

Comparing with the expression in part c, both expressions have the same first factor.

Since $\frac{4}{3} > \frac{3}{4}$, the product of the factors in part d is greater.

So, the expression in part d has the greatest value.

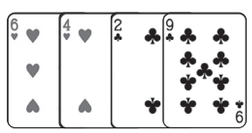
19 **GAME: Zany Zero!**

You will need a deck of playing cards with the face cards and 10s removed. Aces are 1.
Black cards are positive and red cards are negative.

- Decide on the goal of the game: sum/difference/product/quotient as close to or as far from zero as possible.
- Deal four cards to each player.
- Use your cards to make two fractions that will get you as close to your chosen goal as possible.
- The player whose sum/difference/product/quotient is closest to/farthest from zero gets one point.
- Play again. The first player to get five points wins.

Challenge: This time, make two decimals. If you use two cards of the same colour to make a decimal, the decimal is positive. If you use cards of different colours, the decimal is negative.

Example: I could make $\frac{2}{-4}$ and $\frac{-4}{9}$ or $\frac{-4}{-6}$ and $\frac{2}{9}$.



HINT You could use counters as decimal points.

Order of Operations with Rational Numbers

20 Here are the steps a student took to evaluate this expression.

$8.5 - 2.5(2.4 + 2.6)^2$

Step 1	$8.5 - 2.5(5)^2$
Step 2	$8.5 - 2.5(25)$
Step 3	$6(25)$
Step 4	150

Identify the step in which an error occurred. Describe the error.
Correct the error to evaluate the expression.

The student made an error in Step 3. The student subtracted 2.5 from 8.5 but they should have multiplied 2.5 by 25 as multiplication is done before subtraction.
Step 3: $8.5 - 62.5$
Step 4: -54

21 Evaluate each expression.

a) $4.5 - (-2.6) \times 1.5$

$= 4.5 - (-3.9)$
$= 4.5 + 3.9$
$= 8.4$

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

$= \frac{2}{5} + \left(-\frac{3}{20}\right)$
$= \frac{8}{20} + \left(-\frac{3}{20}\right)$
$= \frac{5}{20}$, or $\frac{1}{4}$

c) $(-12.6) \div (-0.3) + 5.5 \div 0.5$

$= 42 + 5.5 \div 0.5$
$= 42 + 11$
$= 53$

d) $\left(-\frac{8}{10}\right) \div \left(-\frac{2}{5}\right) - \left(-\frac{1}{2}\right) \times \frac{3}{5}$

$= \left(-\frac{8}{10}\right) \times \left(-\frac{5}{2}\right) - \left(-\frac{1}{2}\right) \times \frac{3}{5}$
$= \left(\frac{40}{20}\right) - -\frac{3}{10}$
$= 2 + \frac{3}{10}$
$= 2\frac{3}{10}$

e) $(-2.40) \times (-0.11 + 0.61)^3$

$= (-2.40) \times (0.5)^3$
$= (-2.40) \times (0.125)$
I know $0.125 = \frac{1}{8}$.
$\frac{1}{8}$ of $(-2.40) = -0.3$

f) $\frac{4}{5} \times \left(-\frac{2}{3} + \frac{8}{3}\right)^2 - \left(-\frac{3}{5}\right)$

$= \frac{4}{5} \times \left(\frac{6}{3}\right)^2 - \left(-\frac{3}{5}\right)$
$= \frac{4}{5} \times 4 - \left(-\frac{3}{5}\right)$
$= \frac{16}{5} + \frac{3}{5}$
$= \frac{19}{5}$, or $3\frac{4}{5}$

22 This expression has a value of 1.
$\left(\left(-\frac{1}{2} + \left(-\frac{1}{2}\right)\right) \div \left(-\frac{1}{2} + \left(-\frac{1}{2}\right)\right)\right)$
Use $-\frac{1}{2}$ four times and the order of operations to write an expression with each value below.

a) $\frac{1}{4}$

For example:
$\left(\left(-\frac{1}{2}\right)\left(-\frac{1}{2}\right)\right) \div \left(\left(-\frac{1}{2}\right) \div \left(-\frac{1}{2}\right)\right)$
$= \frac{1}{4} \div 1$
$= \frac{1}{4}$

b) 0

For example:
$\left(\left(-\frac{1}{2}\right) - \left(-\frac{1}{2}\right)\right) \times \left(\left(-\frac{1}{2}\right)\left(-\frac{1}{2}\right)\right)$
$= 0 \times \frac{1}{4}$
$= 0$

c) $\frac{3}{4}$

For example:
$\left(\left(-\frac{1}{2}\right) + \left(-\frac{1}{2}\right) + \left(-\frac{1}{2}\right)\right) \times \left(-\frac{1}{2}\right)$
$= \left(-\frac{3}{2}\right)\left(-\frac{1}{2}\right)$
$= \frac{3}{4}$

23 Add brackets or exponents to make each equation true.

a) $14.55 + (-3.54) + (-6.46) \times 2.5 - (-9.4) = -1.05$

For example: I placed brackets around (–3.54) + (–6.46) so it is evaluated first.

$14.55 + ((-3.54) + (-6.46)) \times 2.5 - (-9.4)$
$= 14.55 + (-10) \times 2.5 - (-9.4)$
$= 14.55 + (-25) - (-9.4)$
$= -10.45 - (-9.4)$
$= -10.45 + 9.4$
$= -1.05$

b) $\left(\frac{8}{10} + \frac{1}{5}\right) \times \left(-\frac{1}{2}\right) \times \frac{4}{5} = \frac{1}{5}$

For example:

I added the exponent 2 to $\left(-\frac{1}{2}\right)$.

$\left(\frac{8}{10} + \frac{1}{5}\right) \times \left(-\frac{1}{2}\right)^2 \times \frac{4}{5}$
$= \left(\frac{8}{10} + \frac{2}{10}\right) \times \left(-\frac{1}{2}\right)^2 \times \frac{4}{5}$
$= 1 \times \left(-\frac{1}{2}\right)^2 \times \frac{4}{5}$
$= 1 \times \frac{1}{4} \times \frac{4}{5}$
$= \frac{1}{5}$

24 You have been hired by a company to create a skill-testing question with fractions or decimals. It must involve at least three operations and require the use of the order of operations.

$(4.2 + 1.8)^2 + 2.5 \times (-2.5)$

a) **−96.25**
b) **−24.85**
c) **42.25**
d) **29.75**

a) Write your question. Show how you would evaluate it.

For example: $(4.2 + 1.8)^2 + 2.5 \times (-2.5)$
$= (6)^2 + 2.5 \times (-2.5)$
$= 36 + 2.5 \times (-2.5)$
$= 36 + (-6.25)$
$= 29.75$

b) Include four multiple choice answers, where one of them is the correct answer. Think about mistakes people might make. Explain your reasoning.

For example:
Answer a: People might square 6, then add 2.5 before multiplying.
Answer b: People might square only the 1.8 and perform operations in given order.
Answer c: People might ignore the negative sign on 2.5.
Answer d: This is the correct answer.

25 **GAME: Zoning in on Zero!**

- Each of you use the numbers −5.4, 0.3, −8, and 2.5, as well as brackets, a combination of operations, and the exponent 2 to create an expression that has a value that is close to zero.
- Show the steps you took to evaluate your expression.
- The player whose value is closer to zero wins.

For example: My expression is $(-8 \times (0.3)^2 - (-5.4)) \div 2.5$
$= (-8 \times (0.09) - (-5.4)) \div 2.5$
$= (-0.72 - (-5.4)) \div 2.5$
$= (-0.72 + 5.4) \div 2.5$
$= 4.68 \div 2.5$
$= 1.872$

26 Use technology to evaluate this expression.
Show the simplified expressions, one step at a time.

$$(-2.38 \times 4.635) + (-0.5)^4 + 1.275 \div 1.25$$

For example:
$-11.0313 + (-0.5)^4 + 1.275 \div 1.25$
$-11.0313 + 0.0625 + 1.275 \div 1.25$
$-11.0313 + 0.0625 + 1.02$
-9.9488
The value of the expression is -9.9488.

27 A bank account has a balance of $125.
Weekly withdrawals of $20 are made for 4 weeks, followed by weekly withdrawals of $25 for 2 weeks.
What is the balance at the end of the 6 weeks if no additional deposits have been made?
Explain your answer.

Week	Withdrawal	Balance
		$125
1	$20	
2	$20	
3	$20	
4	$20	
5	$25	
6	$25	

For example:
Withdrawals are represented by negative integers.
$125 + 4(-20) + 2(-25) = 125 + (-80) + (-50)$
$= 45 + (-50)$
$= -5$
The balance is $-\$5$, meaning that the person withdrew $5 more than they had.

28 An airplane is cruising at an altitude of 8450 m. It begins to descend at 5.5 m/s for 4 min and then descends at 3.4 m/s for 3.5 min. What is the airplane's altitude after the 7.5 min descent?
Write an expression that you could use to solve the problem.
Evaluate the expression to solve the problem.

For example: 1 min = 60 s
$8450 + (4 \times 60 \times (-5.5)) + (3.5 \times 60 \times (-3.4))$
$= 8450 + (240 \times (-5.5)) + (210 \times (-3.4))$
$= 8450 + (-1320) + (-714)$
$= 6416$
The airplane's altitude after the descent was 6416 m.

Bringing It Together

29 **CHALLENGE:** Use five rational numbers to create an expression whose value is close to the median of the five chosen numbers.

Median: the middle number in an ordered list. For example, the median of 1, 2, 3, 4, 5 is 3.

You can use integers, fractions, mixed numbers, decimals, or a combination of some or all of these.

- Choose five rational numbers.
- Order the numbers from least to greatest. Determine the median of the set of numbers.
- Use all five rational numbers, a combination of operations, brackets, and an exponent to create an expression whose value is close to the median. Show your thinking.

My numbers: **5.5, 1.5, 8.5, 6.2, 7.5**

In ascending order: **1.5, 5.5, 6.2, 7.5, 8.5**

Median: **6.2**

My expression: **$(6.2 - 5.5) \times 8.5 + (1.5)^2 \div 7.5$**

Value of expression: **$(6.2 - 5.5) \times 8.5 + (1.5)^2 \div 7.5$**
$= (0.7) \times 8.5 + (1.5)^2 \div 7.5$
$= (0.7) \times 8.5 + (2.25) \div 7.5$
$= 5.95 + (2.25) \div 7.5$
$= 5.95 + 0.3$
$= 6.25$
6.25 is very close to 6.2.

What I Learned

What strategies from working with whole numbers and integers helped you work with rational numbers? Use examples to help you explain.

For example: To multiply positive and negative decimals, I can multiply each decimal by a multiple of 10, then operate as whole numbers. For example, I can multiply each factor in 2.5 × 3.4 by 10, multiply the whole numbers, then divide the product by 100. I can also use my knowledge of operating with integers to help determine the sign of the product/quotient when multiplying/dividing positive and negative rational numbers. For example, since multiplying two integers with the same sign has a positive product, I know the product of –8.3 × (–3.9) will be positive.

Connecting and Reflecting: Number Relationships

1 A community garden design includes three garden beds of different sizes.
The garden beds have a total area of about 325 m^2.
Each bed is square. What could the dimensions of each bed be, in metres?

For example: The garden beds could have areas of 121 m^2, 144 m^2, and 325 m^2 – 121 m^2 – 144 m^2 ≈ 60 m^2.
Side length of first square garden is: $\sqrt{121\ m^2}$ = 11 m
Side length of second square garden is: $\sqrt{144\ m^2}$ = 12 m
Side length of third square garden is: $\sqrt{60\ m^2}$ ≈ 7.75 m

2 One 4.25 L container of plant food feeds about 163 m^2 of garden area.
If the gardens are "fed" two times per month during the 5-month growing season, how many litres of fertilizer are needed?
How many containers is that?
Note: You will use your answer in questions 3 and 4.

For example: 2 times per month × 5 months = 10 times
1 container covers 163 m^2, so two containers will be needed for each feeding as 2 × 163 m^2 = 326 m^2.
So, one feeding requires 2 × 4.25 L = 8.5 L of fertilizer.
To complete 10 feedings, 8.5 L × 10 = 85 L of fertilizer are needed.
85 L ÷ 4.25 L = 20; 20 containers of fertilizer are needed.

3 One container of fertilizer is mixed with 170.34 L of water.
How much water is needed to feed the plants with fertilizer over the 5-month growing season?

20 × 170.34 L = 3406.8 L
3406.8 L of water are needed.

4 One container of fertilizer costs $11.97, plus tax.
How much will the fertilizer cost for the 5-month growing season?

For example: 20 containers will cost 20 × $11.97 = $239.40, before tax.
In Ontario, there is HST of 13%.
So, the cost of fertilizer, including tax, will be:
$239.40 × 1.13 = $270.52