Solving Multi-Step Problems with Rational Numbers

Spot mistakes, reason, and work backward

Name _____ **Date** _____ **Score** _____ / 8

QUICK REVIEW

Write one expression for the quantity requested. Use signs for gains and losses, and group amounts that must be combined before multiplying or dividing. For example, dividing a net change of $-6+2$ among 4 stages gives $(-6+2)/4=-1$ per stage.

Worked example

A machine drops $3/2$ m on each of two moves, then rises $1/4$ m. Write one expression for the net change.

1. The two drops are negative changes. Use $2(-\frac{3}{2})+\frac{1}{4}$.
2. Together the drops give $2(-\frac{3}{2})=-3$ m.
3. Evaluate $-3+\frac{1}{4}=-\frac{11}{4}$ m.
Answer: $2(-\frac{3}{2})+\frac{1}{4}=-\frac{11}{4}$ m.

Practice Problems

Show your thinking.

1. An account ends at 11 dollars after paying for 3 tickets at $5/2$ dollars each and receiving a $1/2$ dollar credit. Write one expression to recover the starting balance.

2. Two parcels weigh $9/4$ kg each and use one shared $1/2$ kg carton. A student writes $2(9/4+1/2)$. Give one correct expression, the total, and the error.

3. A probe starts at $-7/2$ m, descends the same distance four times, then rises $1/2$ m to finish at -8 m. Write one expression for the positive distance of each descent.

4. A score starts at -4 points, receives three penalties of $5/4$ points, then has one penalty canceled. A student subtracts four penalties. Write one correct expression and find the score.

5. After trimming $7/4$ m from a rope, a loop uses $3/5$ of the remaining length. The loop is $9/2$ m long. Write one expression for the original rope length.

6. From 9 L, a worker sets aside $3/2$ L once, then fills six $5/6$ L jars. Sam subtracts both amounts once per jar. Write one expression for the unused, unreserved liquid.

7. After a $7/4$ dollar fee was taken from a rebate, four teammates each received $13/8$ dollars. Write one expression for the original rebate.

8. Two trails start at elevation 0 m. Trail A drops $3/4$ m on each of four sections and then climbs $3/2$ m. Trail B ends at -1 m. A sign says A ends higher. Write one expression for A minus B and check the sign.

Answer Key

1. $11 - \frac{1}{2} + 3(\frac{5}{2}) = 18$ dollars.
2. $2(\frac{9}{4}) + \frac{1}{2} = 5$ kg. The proposed expression counts the carton twice.
3. $\frac{-\frac{7}{2}+\frac{1}{2}-(-8)}{4} = \frac{5}{4}$ m.
4. $-4 + 3(-\frac{5}{4}) - (-\frac{5}{4}) = -\frac{13}{2}$ points.
5. $\frac{9}{2} \div \frac{3}{5} + \frac{7}{4} = \frac{37}{4}$ m.
6. $9 - \frac{3}{2} - 6(\frac{5}{6}) = \frac{5}{2}$ L.
7. $4(\frac{13}{8}) + \frac{7}{4} = \frac{33}{4}$ dollars.
8. $[4(-\frac{3}{4}) + \frac{3}{2}] - (-1) = -\frac{1}{2}$ m. The difference is negative; the sign is wrong.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Work backward: undo the credit, then restore all three ticket payments. Use $11 - \frac{1}{2} + 3(\frac{5}{2})$.
2. The ticket payments total $3(\frac{5}{2}) = \frac{15}{2}$ dollars.
3. Evaluate $11 - \frac{1}{2} + \frac{15}{2} = 18$ dollars.

Problem 2

1. Only the parcel weight repeats; the carton is added once. Use $2(\frac{9}{4}) + \frac{1}{2}$.
2. The two parcels weigh $2(\frac{9}{4}) = \frac{9}{2}$ kg before packing.
3. Evaluate $\frac{9}{2} + \frac{1}{2} = 5$ kg.
4. The proposed expression counts the carton twice.

Problem 3

1. Subtract the end position from the position it would reach with only the rise, then split the total descent into 4 equal parts. Use $\frac{-\frac{7}{2}+\frac{1}{2}-(-8)}{4}$.
2. Without any descents it would reach $-\frac{7}{2} + \frac{1}{2} = -3$ m, which is $-3 - (-8) = 5$ m above the end.
3. Evaluate $5 \div 4 = \frac{5}{4}$ m.

Problem 4

1. A penalty is negative; canceling it means subtracting that negative change. Use $-4 + 3(-\frac{5}{4}) - (-\frac{5}{4})$.
2. The three penalties contribute $3(-\frac{5}{4}) = -\frac{15}{4}$.
3. Evaluate $-4 - \frac{15}{4} + \frac{5}{4} = -\frac{13}{2}$ points.

Problem 5

1. Undo the fraction first, then add back the trimmed piece. Use $\frac{9}{2} \div \frac{3}{5} + \frac{7}{4}$.
2. Before making the loop there was $\frac{9}{2} \div \frac{3}{5} = \frac{15}{2}$ m.
3. Evaluate $\frac{15}{2} + \frac{7}{4} = \frac{37}{4}$ m.

Problem 6

1. The reserve is a one-time subtraction; only the jar volume repeats. Use $9 - \frac{3}{2} - 6(\frac{5}{6})$.
2. The jars use $6(\frac{5}{6}) = 5$ L.
3. Evaluate $9 - \frac{3}{2} - 5 = \frac{5}{2}$ L.

Problem 7

1. Recombine all four shares, then restore the fee. Use $4(\frac{13}{8}) + \frac{7}{4}$.
2. The shares total $4(\frac{13}{8}) = \frac{13}{2}$ dollars.
3. Evaluate $\frac{13}{2} + \frac{7}{4} = \frac{33}{4}$ dollars.

Problem 8

1. Use signed changes to find the A elevation, then subtract the B elevation. Use $[4(-\frac{3}{4}) + \frac{3}{2}] - (-1)$.
2. Trail A ends at $-3 + \frac{3}{2} = -\frac{3}{2}$ m.
3. Evaluate $-\frac{3}{2} - (-1) = -\frac{1}{2}$ m.
4. The difference is negative; the sign is wrong.

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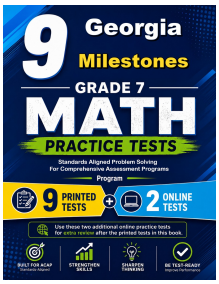

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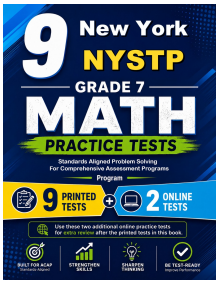

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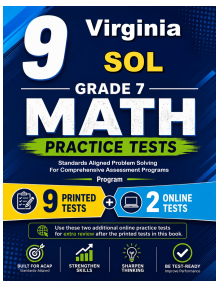

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