Solving Multi-Step Problems with Rational Numbers

Explore ideas and representations

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. A club has 30 dollars, buys 4 passes at $7/2$ dollars each, and gets a 2 dollar refund. Write one expression and find the balance.

2. A probe starts at $-5/2$ m relative to the surface. It rises $3/4$ m per second for 6 seconds, then sinks $1/2$ m. Write one expression for its final position.

3. Three teammates share the cost of two packs at $11/2$ dollars each and one delivery charge of $5/2$ dollars. Write one expression for each share and evaluate.

4. A sled starts at the $-3/2$ m mark and advances $5/4$ m four times. A marker stays at $-1/2$ m. Write one expression for how far right of the marker the sled finishes.

5. From $15/2$ L of juice, set aside $3/2$ L. Use $2/3$ of the rest for samples. Write one expression for the amount used in samples.

6. A player earns $5/2$ points on each of 4 turns and loses $3/2$ on each of 2 turns. Write one expression for the average change per turn, counting all turns.

7. A baker makes three batches, each with $5/4$ cups of oats and $1/2$ cup of seeds. One batch gets an extra $1/4$ cup of oats. Write one expression for all the cups mixed.

8. A thermometer reads $-9/4$ degrees C. Calibration subtracts a bias of $-3/4$ degree. The corrected reading then rises $5/4$ degrees per hour for two hours. Write one expression for the final corrected reading.

Answer Key

1. $30 - 4(\frac{7}{2}) + 2 = 18$ dollars.
2. $-\frac{5}{2} + 6(\frac{3}{4}) - \frac{1}{2} = \frac{3}{2}$ m. It ends above the surface.
3. $\frac{2(\frac{11}{2})+\frac{5}{2}}{3} = \frac{9}{2}$ dollars.
4. $[-\frac{3}{2} + 4(\frac{5}{4})] - (-\frac{1}{2}) = 4$ m.
5. $\frac{2}{3}(\frac{15}{2} - \frac{3}{2}) = 4$ L.
6. $\frac{4(\frac{5}{2})-2(\frac{3}{2})}{4+2} = \frac{7}{6}$ points per turn.
7. $3(\frac{5}{4} + \frac{1}{2}) + \frac{1}{4} = \frac{11}{2}$ cups.
8. $-\frac{9}{4} - (-\frac{3}{4}) + 2(\frac{5}{4}) = 1$ degrees C.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Subtract all 4 purchases and add the refund. Use $30 - 4(\frac{7}{2}) + 2$.
2. The passes cost $4(\frac{7}{2}) = 14$ dollars.
3. Evaluate $30 - 14 + 2 = 18$ dollars.

Problem 2

1. The rise is positive and the final drop is negative. Use $-\frac{5}{2} + 6(\frac{3}{4}) - \frac{1}{2}$.
2. The rise over 6 seconds is $6(\frac{3}{4}) = \frac{9}{2}$ m.
3. Evaluate $-\frac{5}{2} + \frac{9}{2} - \frac{1}{2} = \frac{3}{2}$ m.
4. It ends above the surface.

Problem 3

1. Include the delivery once, then divide the entire bill among 3 people. Use $\frac{2(\frac{11}{2})+\frac{5}{2}}{3}$.
2. The bill is $11 + \frac{5}{2} = \frac{27}{2}$ dollars.
3. Evaluate $\frac{27}{2} \div 3 = \frac{9}{2}$ dollars.

Problem 4

1. Subtract the marker position from the final sled position. Use $[-\frac{3}{2} + 4(\frac{5}{4})] - (-\frac{1}{2})$.
2. The sled advances $4(\frac{5}{4}) = 5$ m, reaching $-\frac{3}{2} + 5 = \frac{7}{2}$ m.
3. Evaluate $\frac{7}{2} - (-\frac{1}{2}) = 4$ m.

Problem 5

1. Apply the fraction only to what remains after setting the reserve aside. Use $\frac{2}{3}(\frac{15}{2} - \frac{3}{2})$.
2. The amount left after the reserve is $\frac{15}{2} - \frac{3}{2} = 6$ L.
3. Evaluate $\frac{2}{3}(6) = 4$ L.

Problem 6

1. Divide the net gain by all 6 turns. Use $\frac{4(\frac{5}{2})-2(\frac{3}{2})}{4+2}$.
2. The gains total $4(\frac{5}{2}) = 10$ and the losses total $2(\frac{3}{2}) = 3$.
3. Evaluate $\frac{10-3}{6} = \frac{7}{6}$ points per turn.

Problem 7

1. Group the oats and seeds per batch, then add the extra oats just once. Use $3(\frac{5}{4} + \frac{1}{2}) + \frac{1}{4}$.
2. A regular batch uses $\frac{5}{4} + \frac{1}{2} = \frac{7}{4}$ cups.
3. Evaluate $3(\frac{7}{4}) + \frac{1}{4} = \frac{11}{2}$ cups.

Problem 8

1. Subtract the signed bias, then add both hourly increases. Use $-\frac{9}{4} - (-\frac{3}{4}) + 2(\frac{5}{4})$.
2. The two hourly increases total $2(\frac{5}{4}) = \frac{5}{2}$ degrees.
3. Evaluate $-\frac{9}{4} + \frac{3}{4} + \frac{5}{2} = 1$ degrees C.

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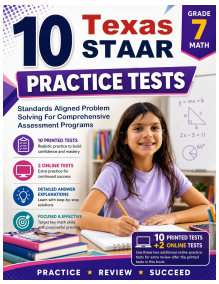

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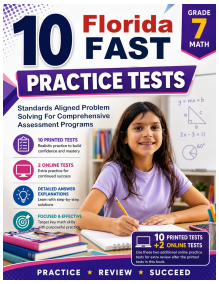

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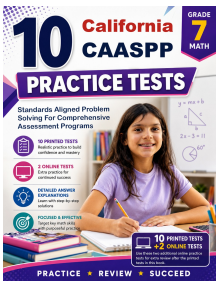

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