Adding and Subtracting Rational Numbers

Apply the skill to decisions and designs

Name _____ **Date** _____ **Score** _____ / 10

QUICK REVIEW

Add numbers with the same sign by adding magnitudes and keeping the sign. With opposite signs, subtract magnitudes and keep the sign of the larger magnitude. $-8+5=-3$. For fractions, first use a common denominator: $-3/10+1/2=1/5$.

Worked example

Evaluate $(-\frac{3}{2})+(\frac{1}{2})$. Show an exact fraction or integer.

1. Use denominator 2: $-\frac{3}{2}=-3/2$ and $\frac{1}{2}=1/2$.
2. Combine the signed numerators: $-3+(1)=-2$.
3. The value is $-2/2=-1$.
Answer: -1.

Practice Problems

Show your thinking.

1. Weather station: a signed model gives $(-\frac{7}{2})+(1)$ meters. Find the signed result and interpret a negative result as below the reference level.

2. Account: plan A changes a balance by $(\frac{5}{3})-(-\frac{9}{4})$ dollars; plan B changes it by $\frac{23}{12}$ dollars. Which leaves a larger balance from the same start, and by how much?

3. Sensor calibration: an unknown first reading combined with (-1) by the operation $+$ gives $-\frac{5}{2}$. Recover the first reading.

4. Temperature: choose x so that $[(4)-(-\frac{4}{3})]+x=\frac{25}{3}$. Determine x and verify the target.

5. Spending plan: the signed change is $(-1)+(\frac{7}{4})$ dollars. Starting at $\frac{43}{4}$ dollars, find the final balance.

6. Height: one day's signed change is $(1)-(-3)$ cm. Find the total change over 3 identical days.

7. Water record: a signed volume change is $(-4)+(\frac{5}{3})$ liters. Compare with a target change of $-\frac{4}{3}$ liters and find the gap.

8. Water level: two readings are 0 and $(3)-(-\frac{3}{4})$ meters. Find the second reading and its distance from zero.

9. Freezer log: plan A changes a balance by $(-\frac{17}{5})+(\frac{11}{6})$ dollars; plan B changes it by $-\frac{107}{30}$ dollars. Which leaves a larger balance from the same start, and by how much?

10. Credit adjustment: choose x so that $[(\frac{19}{8})-(-\frac{7}{12})]+x=\frac{143}{24}$. Determine x and verify the target.

Answer Key

1. $-\frac{5}{2}$ meters; below the reference level.
2. Plan A by 2 dollars.
3. $-\frac{3}{2}$.
4. $x = 3$.
5. $\frac{23}{2}$ dollars.
6. 12 cm.
7. Signed change $-\frac{7}{3}$ liters; 1 liter below target.
8. Reading $\frac{15}{4}$ m; distance $\frac{15}{4}$ m.
9. Plan A by 2 dollars.
10. $x = 3$.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Use denominator 2: $-\frac{7}{2} = -7/2$ and $1 = 2/2$.
2. Combine the signed numerators: $-7 + (2) = -5$.
3. The value is $-5/2 = -\frac{5}{2}$.

Problem 2

1. Use denominator 12: $\frac{5}{3} = 20/12$ and $-\frac{9}{4} = -27/12$.
2. Combine the signed numerators: $20 - (-27) = 47$.
3. The value is $47/12 = \frac{47}{12}$.
4. $\frac{47}{12} - (\frac{23}{12}) = 2$ dollars.

Problem 3

1. Subtract the known addend from the sum.
2. Use denominator 2: $-\frac{5}{2} = -5/2$ and $-1 = -2/2$.
3. $x = (-\frac{5}{2}) - (-1) = -\frac{3}{2}$.
4. Check in the original: $(-\frac{3}{2}) + (-1) = -\frac{5}{2}$.

Problem 4

1. Use denominator 3: $4 = 12/3$ and $-\frac{4}{3} = -4/3$.
2. Combine the signed numerators: $12 - (-4) = 16$.
3. The value is $16/3 = \frac{16}{3}$.
4. $x = \frac{25}{3} - (\frac{16}{3}) = 3$; check $\frac{16}{3} + 3 = \frac{25}{3}$.

Problem 5

1. Use denominator 4: $-1 = -4/4$ and $\frac{7}{4} = 7/4$.
2. Combine the signed numerators: $-4 + (7) = 3$.
3. The value is $3/4 = \frac{3}{4}$.
4. Final $= \frac{43}{4} + (\frac{3}{4}) = \frac{23}{2}$ dollars.

Problem 6

1. Use denominator 1: $1 = 1/1$ and $-3 = -3/1$.
2. Combine the signed numerators: $1 - (-3) = 4$.
3. The value is $4/1 = 4$.
4. Three days: $3(4) = 12$ cm.

Problem 7

1. Use denominator 3: $-4 = -12/3$ and $\frac{5}{3} = 5/3$.
2. Combine the signed numerators: $-12 + (5) = -7$.
3. The value is $-7/3 = -\frac{7}{3}$.
4. Gap: $-\frac{4}{3} - (-\frac{7}{3}) = 1$ liter.

Problem 8

1. Use denominator 4: $3 = 12/4$ and $-\frac{3}{4} = -3/4$.
2. Combine the signed numerators: $12 - (-3) = 15$.
3. The value is $15/4 = \frac{15}{4}$.
4. Distance $= |\frac{15}{4} - 0| = \frac{15}{4}$ m.

Problem 9

1. Use denominator 30: $-\frac{17}{5} = -102/30$ and $\frac{11}{6} = 55/30$.
2. Combine the signed numerators: $-102 + (55) = -47$.
3. The value is $-47/30 = -\frac{47}{30}$.
4. $-\frac{47}{30} - (-\frac{107}{30}) = 2$ dollars.

Problem 10

1. Use denominator 24: $\frac{19}{8} = 57/24$ and $-\frac{7}{12} = -14/24$.
2. Combine the signed numerators: $57 - (-14) = 71$.
3. The value is $71/24 = \frac{71}{24}$.
4. $x = \frac{143}{24} - (\frac{71}{24}) = 3$; check $\frac{71}{24} + 3 = \frac{143}{24}$.

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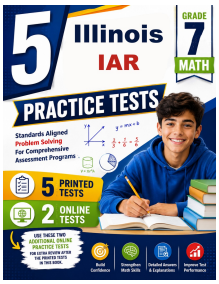

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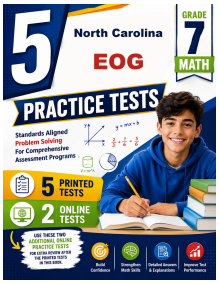

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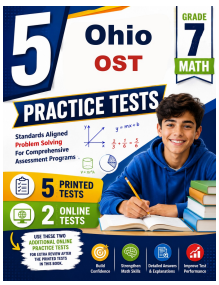

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