Solving Two-Step Equations

Apply the skill to decisions and designs

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

QUICK REVIEW

Undo addition or subtraction on both sides, then undo multiplication or division on both sides. To solve $3x + 4 = 19$, subtract 4 to get $3x = 15$, then divide by 3 to get $x = 5$. Check by substituting into the original equation.

Worked example

Equation: solve $3x + 4 = 19$ and check.

1. Subtract (4) from both sides: $3x + 4 - (4) = 19 - (4)$, so $3x = 15$.
2. Divide by (3): $x = 15 \div (3) = 5$.
3. Check: $3(5) + (4) = 19$.
Answer: $x = 5$.

Practice Problems

Show your thinking.

1. A storage bin holds 10 loose markers and 4 markers per pack. The total is 34. Write an equation for the number of packs and check.

2. A hiker begins 18 m above a marker, then descends 3 m per minute at a steady rate. When is the hiker 3 m below the marker?

3. A mixer makes 1.5 L per batch and spills 1 L total. It has 11 L left after mixing. Recover the number of batches.

4. A trail is 14 km long: one fixed 5 km section and two equal loops. How long is each loop? Is 4 km long enough for each?

5. A club used half its fund and an 8-dollar donation to pay the full 13 cost of a prize. Find the original fund.

6. A runner travels 2.5 m each second. The timer starts with the runner 4 m behind a line. Is the runner 11 m past the line at 5 seconds? Find the exact time.

7. A triangle has perimeter 25 cm. The base is 7 cm and its other sides are equal. Use a two-step equation to find the equal sides.

8. A tank starts with 2 L and fills at three fourths of a liter per minute. When does it reach 14 L? Would a 15-minute timer stop too soon?

9. A sensor converts a signed input to an output by multiplying by -2 and adding 6. Its output is 16. Recover the input and say whether it is below zero.

10. Two teams split a supply equally. One team uses 3 meters and has 10 meters left. Find the length the teams started with altogether.

Answer Key

1. $x = 6$. 6 packs.
2. $x = 7$. After 7 minutes.
3. $x = 8$. 8 batches.
4. $x = \frac{9}{2}$. Each loop is 4.5 km; 4 km is not enough.
5. $x = 10$. The original fund was 10 dollars.
6. $x = 6$. No; the exact time is 6 seconds.
7. $x = 9$. 9 cm each.
8. $x = 16$. 16 minutes; a 15-minute timer stops too soon.
9. $x = -5$. The input is -5, below zero.
10. $x = 26$. 26 m altogether.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Let x count packs. Model: $4x + 10 = 34$.
2. Subtract (10) from both sides: $4x + 10 - (10) = 34 - (10)$, so $4x = 24$.
3. Divide by (4): $x = 24 \div (4) = 6$.
4. Check: $4(6) + (10) = 34$.

Problem 2

1. Let x be minutes. Below the marker is negative: $18 - 3x = -3$.
2. Subtract (18) from both sides: $-3x + 18 - (18) = -3 - (18)$, so $-3x = -21$.
3. Divide by (-3): $x = -21 \div (-3) = 7$.
4. Check: $-3(7) + (18) = -3$.

Problem 3

1. Let x be batches. The model is $\frac{3}{2}x - 1 = 11$.
2. Subtract (-1) from both sides: $\frac{3}{2}x - 1 - (-1) = 11 - (-1)$, so $\frac{3}{2}x = 12$.
3. Divide by $(\frac{3}{2})$: $x = 12 \div (\frac{3}{2}) = 8$.
4. Check: $\frac{3}{2}(8) + (-1) = 11$.

Problem 4

1. Let x be km per loop. Add both loops and the section: $2x + 5 = 14$.
2. Subtract (5) from both sides: $2x + 5 - (5) = 14 - (5)$, so $2x = 9$.
3. Divide by (2): $x = 9 \div (2) = \frac{9}{2}$.
4. Check: $2(\frac{9}{2}) + (5) = 14$.
5. Two 4 km loops and the fixed section total $2(4) + 5 = 13$ km, one km short.

Problem 5

1. Let x be the original fund in dollars. Only half is used, so $\frac{x}{2} + 8 = 13$.
2. Subtract (8) from both sides: $\frac{1}{2}x + 8 - (8) = 13 - (8)$, so $\frac{1}{2}x = 5$.
3. Divide by $(\frac{1}{2})$: $x = 5 \div (\frac{1}{2}) = 10$.
4. Check: $\frac{1}{2}(10) + (8) = 13$.

Problem 6

1. Let x be seconds. At $x = 5$, position is $\frac{5}{2}(5) - 4 = \frac{17}{2}$ m, not 11. Solve $\frac{5}{2}x - 4 = 11$.
2. Subtract (-4) from both sides: $\frac{5}{2}x - 4 - (-4) = 11 - (-4)$, so $\frac{5}{2}x = 15$.
3. Divide by $(\frac{5}{2})$: $x = 15 \div (\frac{5}{2}) = 6$.
4. Check: $\frac{5}{2}(6) + (-4) = 11$.

Problem 7

1. Let x be one equal side in cm. The perimeter is $x + x + 7 = 25$.
2. Subtract (7) from both sides: $2x + 7 - (7) = 25 - (7)$, so $2x = 18$.
3. Divide by (2): $x = 18 \div (2) = 9$.
4. Check: $2(9) + (7) = 25$.

Problem 8

1. Let x count minutes. The target equation is $\frac{3}{4}x + 2 = 14$.
2. Subtract (2) from both sides: $\frac{3}{4}x + 2 - (2) = 14 - (2)$, so $\frac{3}{4}x = 12$.
3. Divide by $(\frac{3}{4})$: $x = 12 \div (\frac{3}{4}) = 16$.
4. Check: $\frac{3}{4}(16) + (2) = 14$.
5. After 15 minutes there are $\frac{3}{4}(15) + 2 = \frac{53}{4}$ L, which is below 14 L.

Problem 9

1. Let x be the signed input. The model is $-2x + 6 = 16$.
2. Subtract (6) from both sides: $-2x + 6 - (6) = 16 - (6)$, so $-2x = 10$.
3. Divide by (-2): $x = 10 \div (-2) = -5$.
4. Check: $-2(-5) + (6) = 16$.

Problem 10

1. Let x be the original total in meters. The team started with half, so $\frac{x}{2} - 3 = 10$.
2. Subtract (-3) from both sides: $\frac{1}{2}x - 3 - (-3) = 10 - (-3)$, so $\frac{1}{2}x = 13$.
3. Divide by $(\frac{1}{2})$: $x = 13 \div (\frac{1}{2}) = 26$.
4. Check: $\frac{1}{2}(26) + (-3) = 10$.

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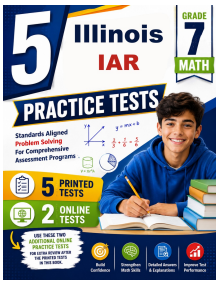

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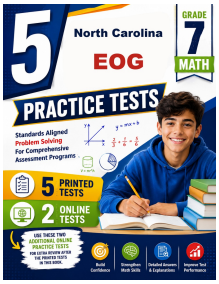

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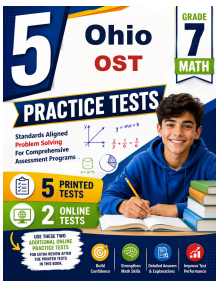

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