Solving Linear Equations in One Variable

Linear Equations: Model Constraints and Targets

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

QUICK REVIEW

Translate a situation into equal expressions before solving. A fixed charge plus a unit rate is $rx + b$; a perimeter includes all side lengths. State what the variable measures, solve using balanced operations, and check the result in the context. If an answer represents a count, require a nonnegative integer. Give money exactly to cents when needed, rather than rounding intermediate calculations.

Worked example

A rental costs $\$5$ plus $\$4$ per hour. The bill is $\$29$. Find the hours h.

1. Let h be the number of rental hours. The fixed fee plus hourly charge gives $4h + 5 = 29$ dollars.

2. Collecting variable terms on the left and constants on the right gives $(4 - 0)h = 29 - (5)$, or $4h = 24$.

3. Divide by 4: $h = 6$ hours. In the reduced equation, both sides equal 29, confirming the solution.

Answer: $h = 6$ hours.

Practice Problems

Show your thinking.

1. A club has $\$18$ and gains $\$6$ per sale. How many sales s bring its balance to $\$72$?

2. Three equal notebooks and a $\$2$ folder cost $\$17$. Find notebook price p in dollars.

3. A rectangle has width w and length $w + 3$ centimeters. Its perimeter is 34 centimeters. Find w.

4. Two consecutive integers total 45. Find the smaller integer n.

5. Plan A costs $\$8$ plus $\$3$ per hour; plan B costs $\$2$ plus $\$5$ per hour. When are costs equal?

6. A 20% discount leaves a price of $\$36$. Find the original dollar price p.

7. A temperature conversion is $F = \frac{9}{5}C + 32$. Find C when $F = 68$.

8. A ribbon is cut into 4 equal pieces after 6 centimeters are removed. Each piece is 9 centimeters. Find original length L.

9. Pool A has 40 liters and gains 2 liters per minute. Pool B has 16 liters and gains 5 per minute. Find the equal-volume time.

10. Design a fixed fee for a service charging $\$3$ per visit so 5 visits cost $\$22$.

Answer Key

1. $s = 9$ sales.
2. $p = 5$ dollars per notebook.
3. $w = 7$ centimeters.
4. $n = 22$.
5. $h = 3$ hours. Both plans cost $\$17$.
6. $p = 45$ dollars.
7. $C = 20$ degrees Celsius.
8. $L = 42$ centimeters.
9. $t = 8$ minutes. Both contain 56 liters.
10. Fixed fee $\$7$; $C = 3v + 7$.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Let s count sales. Starting money plus sale income gives $6s + 18 = 72$; the solution must be a nonnegative whole number.

2. Collecting variable terms on the left and constants on the right gives $(6 - 0)s = 72 - (18)$, or $6s = 54$.

3. Divide by 6: $s = 9$ sales. In the reduced equation, both sides equal 72, confirming the solution.

Problem 2

1. Let p be the price of one notebook. Three notebooks cost $3p$, so the total-price equation is $3p + 2 = 17$.

2. Collecting variable terms on the left and constants on the right gives $(3 - 0)p = 17 - (2)$, or $3p = 15$.

3. Divide by 3: $p = 5$ dollars per notebook. In the reduced equation, both sides equal 17, confirming the solution.

Problem 3

1. The perimeter is $2w + 2(w + 3) = 34$. Distribute and combine: $2w + 2w + 6 = 34$, so $4w + 6 = 34$.

2. Collecting variable terms on the left and constants on the right gives $(4 - 0)w = 34 - (6)$, or $4w = 28$.

3. Divide by 4: $w = 7$ centimeters. In the reduced equation, both sides equal 34, confirming the solution.

Problem 4

1. Consecutive integers are n and $n + 1$. Their sum gives $n + (n + 1) = 45$, which simplifies to $2n + 1 = 45$.

2. Collecting variable terms on the left and constants on the right gives $(2 - 0)n = 45 - (1)$, or $2n = 44$.

3. Divide by 2: $n = 22$. In the reduced equation, both sides equal 45, confirming the solution.

Problem 5

1. Let h be the common number of hours. Equal cost requires $3h + 8 = 5h + 2$, with both expressions measured in dollars.

2. Collecting variable terms on the left and constants on the right gives $(3 - 5)h = 2 - (8)$, or $-2h = -6$.

3. Divide by -2: $h = 3$ hours. In the reduced equation, both sides equal 17, confirming the solution. Both plans cost $\$17$.

Problem 6

1. After a 20% reduction, the retained fraction is $1 - 0.20 = 0.80 = \frac{4}{5}$. Thus the price equation is $\frac{4}{5}p = 36$.

2. Collecting variable terms on the left and constants on the right gives $(\frac{4}{5} - 0)p = 36 - (0)$, or $\frac{4}{5}p = 36$.

3. Divide by $\frac{4}{5}$: $p = 45$ dollars. In the reduced equation, both sides equal 36, confirming the solution.

Problem 7

1. Insert the Fahrenheit reading into the conversion: $\frac{9}{5}C + 32 = 68$. The unknown is the Celsius temperature, not the Fahrenheit output.

2. Collecting variable terms on the left and constants on the right gives $(\frac{9}{5} - 0)C = 68 - (32)$, or $\frac{9}{5}C = 36$.

3. Divide by $\frac{9}{5}$: $C = 20$ degrees Celsius. In the reduced equation, both sides equal 68, confirming the solution.

Problem 8

1. The remaining length is $L - 6$. Four pieces of length 9 use $4(9) = 36$ centimeters, giving $L - 6 = 36$.

2. Collecting variable terms on the left and constants on the right gives $(1 - 0)L = 36 - (-6)$, or $1L = 42$.

3. Divide by 1: $L = 42$ centimeters. In the reduced equation, both sides equal 36, confirming the solution.

Problem 9

1. Let t be elapsed minutes. The two volumes are $2t + 40$ and $5t + 16$ liters, so equality requires $2t + 40 = 5t + 16$.

2. Collecting variable terms on the left and constants on the right gives $(2 - 5)t = 16 - (40)$, or $-3t = -24$.

3. Divide by -3: $t = 8$ minutes. In the reduced equation, both sides equal 56, confirming the solution. Both contain 56 liters.

Problem 10

1. Let b be the fixed fee. Five visits at 3 dollars each plus that fee must total 22, so $3(5) + b = 22$.

2. Calculate $15 + b = 22$. Subtract 15 from both sides to obtain $b = 7$ dollars, giving the model $C = 3v + 7$.

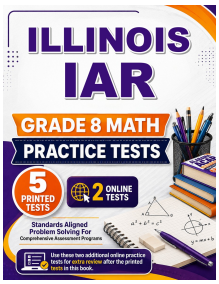
3. Check the design at five visits: $C = 3(5) + 7 = 15 + 7 = 22$. The nonnegative fee satisfies the target exactly without rounding.

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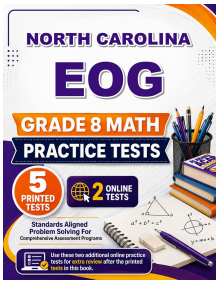
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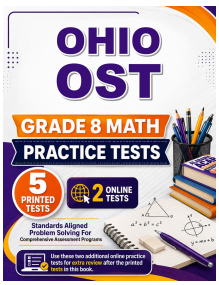
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