Applications of Linear Equations II

In this section, equations are used to model real-world situations. You use variables to stand for unknown quantities. When more than one quantity is unknown, an expression can often be written for the second unknown using facts about the problem and the first unknown.

Example: The sum of two consecutive integers is 125. Find the integers.
Answer: This problem has two unknowns that are added together to get 125. Let the smaller unknown be the variable n. The second unknown is one more than n, or $n + 1$. The equation that must be solved is $n + n + 1 = 125$, or $2n + 1 = 125$. Solving, we find that $2n = 124$, or $n = 62$. Since n is the smaller of the two integers and $n + 1$ represents the other integer, the larger integer is 63.

Example: Alison got a check for $580.25 for working 50 hours in a week, but couldn't remember her hourly wage. She knows that she gets time-and-a-half for every hour after 40 hours that she works. What is her hourly wage?
Answer: Let x represent Alison's hourly wage. Then $1.5x$ represents her overtime wage. The related equation is $40x + 10(1.5x) = 580.25$. That is, $40x + 15x = 580.25$, or $55x = 580.25$. Divide to find that her hourly wage is $10.55.

Example: A 15-foot board is cut into 2 pieces such that one piece is twice as long as the other piece. How long is each piece?
Answer: Let y stand for the short piece and $2y$ stand for the long piece. The equation that results from this situation is $y + 2y = 15$, or $3y = 15$. Divide by 3 to find that $y = 5$. When the 15-foot board is cut into 2 pieces, one piece is 5 feet long and the other piece is 10 feet long.

Example: The sum of two integers is 125. Their difference is 31. What are the integers?
Answer: Call the integers a and b. Two statements come from this situation: $a + b = 125$, and $a - b = 31$. To solve this example, find an expression to represent a or b from one of the equations and substitute the expression into the other statement. This will produce a statement with just one variable. Solve the second equation for a by adding b to both sides: $a = 31 + b$ and substitute for a in the first equation. $a + b = 125$ All that remains to be done is to substitute 47 for b

$$\begin{aligned} 31 + b + b &= 125 \\ 31 + 2b &= 125 \\ 2b &= 94 \\ b &= 47 \end{aligned}$$

in either equation to find a. Substitute into the second equation to get $a - 47 = 31$. To solve, add 47 to both sides. $a = 78$.

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