Topic B
Multi-Step Equations and Their Solutions

Topic B extends student understanding of solving equations in one variable to include more complex linear equations. Students build on their experiences solving equations with if–then moves in topic A to now solve equations by using the properties of equality. They then focus on using the structure of a linear equation to determine its number of solutions.

In the first lesson, the terms *linear expression* and *linear equation* are introduced, and students identify equations as linear or nonlinear. Students write an equation with a variable on both sides to represent an angle relationship. After attempting to solve the equation, students are introduced to the properties of equality. They apply the properties of equality to solve equations by starting with equations that have integer coefficients and then transitioning to equations that have rational coefficients. Students use this new knowledge about solving equations to write and solve equations from geometric diagrams.

Students discover that there are equations for which any value of the variable makes the equation true, so these equations have infinitely many solutions. By comparing a group of equations that have one solution with a group of equations that have infinitely many solutions, students begin to recognize that the equations with infinitely many solutions have equivalent expressions on both sides of the equation.

Students then consider equations that have no solution. After applying properties of equality to solve these equations, students notice that these equations are false. Students solve a variety of equations that have only one solution, infinitely many solutions, or no solution. They use the relationships between the linear terms and constant terms in the expressions on each side of an equation to distinguish between equations with only one solution, infinitely many solutions, and no solution. Then students use this new knowledge about the structure of linear equations to write equations that have specified numbers of solutions.

In the last lesson of the topic, students encounter real-world problems. They represent situations by writing an equation and solve it by using a strategy of their choice. Because the problems may have only one solution, infinitely many solutions, or no solution, students recontextualize their results to ensure that they make sense in the situations.

Choose values for a and b to create an equation with the given number of solutions. Write the completed equation.

$$2(4x - 3) = ax + b$$

a. Only one solution

   Sample: $8x - 6 = 9x + 12$

b. Infinitely many solutions

   $8x - 6 = 8x - 6$

c. No solution

   Sample: $8x - 6 = 8x + 3$