

Scouting for Prizes!

Modeling Linear Inequalities

LEARNING GOALS

In this lesson, you will:

- Write and solve inequalities.
- Analyze a graph on a coordinate plane to solve problems involving inequalities.
- Interpret how a negative rate affects how to solve an inequality.

KEY TERM

- solve an inequality

Scouting began in 1907 by a Lieutenant General in the British Army, Robert Baden-Powell, as a way to teach young men and women about different outdoor activities and survival techniques. While he was a military officer, Baden-Powell taught his soldiers how to survive in the wilderness and spent much time on scouting missions in enemy territory. He became a national hero during this time which helped fuel the sales of a book he had written, *Aids to Scouting*. When he returned home many people wanted him to rewrite his book for boys. While his rewritten book, *Scouting for Boys*, contained many of the same ideas about outdoor living, he left out the military aspects of his first book. Boys immediately began forming their own Scout patrols and wrote to Baden-Powell asking for his assistance. The Scouting movement has been growing and changing ever since.

Do you think wilderness survival skills are necessary today? If yes, why do you think we still need these skills? If no, why do you think people still learn them if they are unnecessary?

PROBLEM 1 Popcorn Pays Off



Alan's camping troop is selling popcorn to earn money for an upcoming camping trip. Each camper starts with a credit of \$25 toward his sales, and each box of popcorn sells for \$3.75.

Alan can also earn bonus prizes depending on how much popcorn he sells. The table shows the different prizes for each of the different sales levels. Each troop member can choose any one of the prizes at or below the sales level.

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Sales (dollars)	Gift Cards (2 of each value)	Bonus Prizes
\$250	\$10	
\$350	\$15	
\$450	\$20	
\$600		Cyclone Sprayer
\$650	\$30	
\$850	\$40	
\$1100	\$55	
\$1300	\$75	
\$1500		Choose your prize!
\$1800	\$110	
\$2300	\$150	
\$2500		6% toward college scholarship



1. Write a function, $f(b)$, to show Alan's total sales as a function of the number of boxes of popcorn he sells.

2. Analyze the function you wrote.
 - a. Identify the independent and dependent quantities and their units.

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- b. What is the rate of change and what does it represent in this problem situation?



- c. What is the y -intercept and what does it represent in this problem situation?

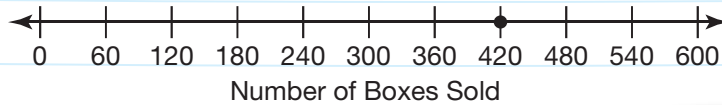
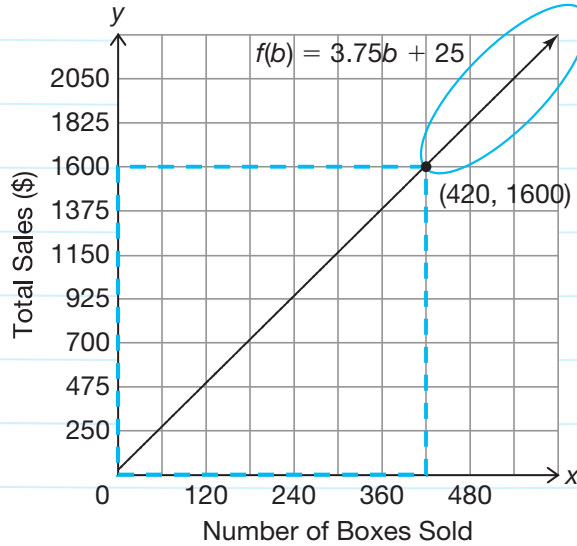




Now, let's analyze your function represented on a graph.

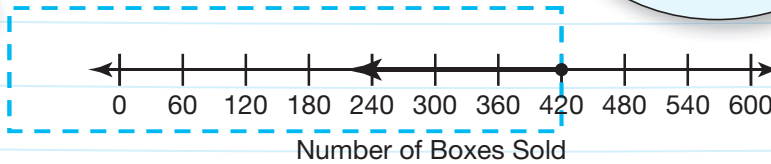
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The graph shown represents the change in the total sales as a function of boxes sold. The oval and box represent the total sales at specific intervals.

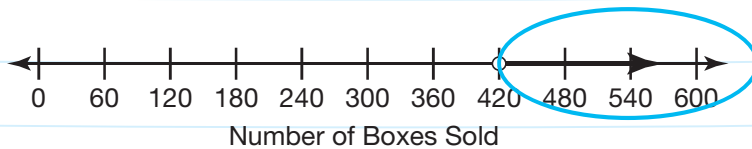


The point at (420, 1600) means that at 420 boxes sold, the total sales is equal to \$1600. This is represented on the number line as a closed point at 420. When $f(b) = 1600$, then $b = 420$.

The box represents all the numbers of boxes sold, b , that would earn Alan \$1600 or less. When $f(b) \leq 1600$ then $b \leq 420$.



The oval represents all the numbers of boxes sold, b , that would earn Alan more than \$1600. When $f(b) > 1600$, then $b > 420$.





3. Explain the difference between the open and closed circles on the number lines.

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4. Use the graph to answer each question. Write an equation or inequality statement for each.

a. How many boxes would Alan have to sell to earn at least \$925?

b. How many boxes would Alan have to sell to earn less than \$2050?



c. How many boxes would Alan have to sell to earn exactly \$700?

How does determining the intersection point help you determine your answers?



PROBLEM 2 What's Your Strategy—Your Algebraic Strategy?



Another way to determine the solution set of an inequality is to solve it algebraically. To **solve an inequality** means to determine the values of the variable that make the inequality true. The objective when solving an inequality is similar to the objective when solving an equation: You want to isolate the variable on one side of the inequality symbol.

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In order to earn two \$55 gift cards, Alan's total sales, $f(b)$, needs to be at least \$1100. You can set up an inequality and solve it to determine the number of boxes Alan needs to sell.

$$f(b) \geq 1100$$

$$3.75b + 25 \geq 1100$$

Solve the inequality in the same way you would solve an equation.

$$3.75b + 25 \geq 1100$$

$$3.75b + 25 - 25 \geq 1100 - 25$$

$$3.75b \geq 1075$$

$$\frac{3.75b}{3.75} \geq \frac{1075}{3.75}$$

$$b \geq 286.66 \dots$$

Alan needs to sell at least 287 boxes of popcorn to earn two \$55 gift cards.

1. Why was the answer rounded to 287?



2. Write and solve an inequality for each. Show your work.
 - a. What is the greatest number of boxes Alan could sell and still not have enough to earn the Cyclone Sprayer?



- b. At least how many boxes would Alan have to sell to be able to choose his own prize?

PROBLEM 3 Reversing the Sign



Alan's camping troop hikes down from their campsite at an elevation of 4800 feet to the bottom of the mountain. They hike down at a rate of 20 feet per minute.

1. Write a function, $h(m)$, to show the troop's elevation as a function of time in minutes.

2. Analyze the function.
 - a. Identify the independent and dependent quantities and their units.

 - b. Identify the rate of change and explain what it means in terms of this problem situation.

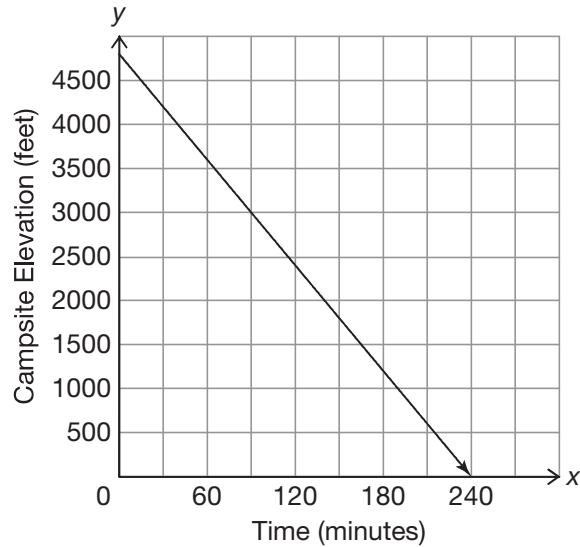
 - c. Identify the y -intercept and explain what it means in terms of this problem situation.

- d. What is the x -intercept and explain what it means in terms of this problem situation?





- Label the function on the coordinate plane.



- Use the graph to determine how many minutes passed if the troop is below 3200 feet. Draw an oval on the graph to represent this part of the function and write the corresponding inequality statement.
- Write and solve an inequality to verify the solution set you interpreted from the graph.



- Compare and contrast your solution sets using the graph and the function. What do you notice?



7. Complete the table by writing the corresponding inequality statement that represents the number of minutes for each height.

$h(m)$	m
$h(m) > 3200$	
$h(m) \geq 3200$	
$h(m) = 3200$	
$h(m) < 3200$	
$h(m) \leq 3200$	

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- a. Compare each row in the table shown. What do you notice about the inequality signs?



- b. Explain your answer from part (a). Use what you know about solving inequalities when you have to multiply or divide by a negative number.

Talk the Talk



1. Explain the differences when you solved inequalities involving the function $f(b) = 3.75b + 25$ and the function $h(m) = -20m + 4800$.

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2. Solve each inequality and then graph the solution on the number line.

a. $-\frac{2}{3}x \geq 7$



b. $32 > 23 - x$



c. $2(x + 6) < 10$



Be prepared to share your solutions and methods.