

Applications with Inequalities

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CHAPTER 1

Applications with Inequalities

Here you'll learn how to use inequalities to solve real-world problems.

Suppose that a company's budget requires it to spend at least \$20,000 but no more than \$30,000 on training for its employees. The cost of training is the combination of a flat fee of \$5,000 plus \$500 per employee. If the company has m employees, how much is it required to spend per employee? In this Concept, you'll learn how to solve real-world problems such as this one by using inequalities.

Guidance

Inequalities are useful for solving real-world problems. In this Concept, you will see some examples of how to set up and solve real-world problems.

Example A

In order to get a bonus this month, Leon must sell at least 120 newspaper subscriptions. He sold 85 subscriptions in the first three weeks of the month. How many subscriptions must Leon sell in the last week of the month?

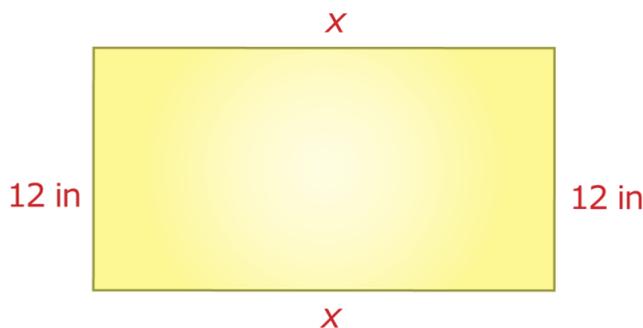
Solution: The number of subscriptions Leon needs is "at least" 120. Choose a variable, such as n , to represent the varying quantity—the number of subscriptions. The inequality that represents the situation is $n + 85 \geq 120$.

Solve by isolating the variable n : $n \geq 35$.

Leon must sell 35 or more subscriptions to receive his bonus.

Example B

The width of a rectangle is 12 inches. What must the length be if the perimeter is at least 180 inches? (Note: Diagram not drawn to scale.)



Solution: The perimeter is the sum of all the sides.

$$12 + 12 + x + x \geq 180$$

Simplify and solve for the variable x :

$$12 + 12 + x + x \geq 180 \rightarrow 24 + 2x \geq 180$$

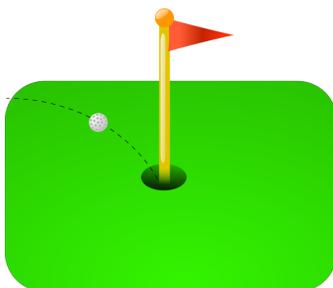
$$2x \geq 156$$

$$x \geq 78$$

The length of the rectangle must be 78 inches or greater.

Example C

The speed of a golf ball in the air is given by the formula $v = -32t + 80$, where t is the time since the ball was hit. When is the ball traveling between 20 ft/sec and 30 ft/sec inclusive?



Solution: We want to find the times when the ball is traveling between 20 ft/sec and 30 ft/sec inclusive. Begin by writing the inequality to represent the unknown values, $20 \leq v \leq 30$.

Replace the velocity formula, $v = -32t + 80$, with the minimum and maximum values.

$$20 \leq -32t + 80 \leq 30$$

Separate the compound inequality and solve each separate inequality.

$$\begin{array}{ccc}
 20 \leq -32t + 80 & & -32t + 80 \leq 30 \\
 32t \leq 60 & \text{and} & 50 \leq 32t \\
 t \leq 1.875 & & 1.56 \leq t
 \end{array}$$

$1.56 \leq t \leq 1.875$. Between 1.56 and 1.875 seconds, the ball is traveling between 20 ft/sec and 30 ft/sec. Inequalities can also be combined with dimensional analysis.

Video Review



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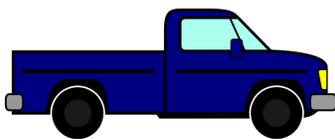
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Guided Practice

William's pick-up truck gets between 18 and 22 miles per gallon of gasoline. His gas tank can hold 15 gallons of gasoline. If he drives at an average speed of 40 miles per hour, how much driving time does he get on a full tank of gas?



Solution: Use dimensional analysis to get from time per tank to miles per gallon.

$$\frac{t \text{ hour}}{1 \text{ tank}} \times \frac{1 \text{ tank}}{15 \text{ gallons}} \times \frac{40 \text{ miles}}{1 \text{ hour}} = \frac{40 \text{ miles}}{15 \text{ gallon}}$$

Since the truck gets between 18 to 22 miles/gallon, you can write a compound inequality.

$$18 \leq \frac{40t}{15} \leq 22$$

Separate the compound inequality and solve each inequality separately.

$$\begin{array}{l} 18 \leq \frac{40t}{15} \\ 270 \leq 40t \\ 6.75 \leq t \end{array} \qquad \text{and} \qquad \begin{array}{l} \frac{40t}{15} \leq 22 \\ 40t \leq 330 \\ t \leq 8.25 \end{array}$$

Andrew can drive between 6.75 and 8.25 hours on a full tank of gas.

Explore More

For problems 1-5, write the inequality given by the statement. Choose an appropriate letter to describe the unknown quantity.

1. You must be at least 48 inches tall to ride the "Thunderbolt" Rollercoaster.

2. You must be younger than 3 years old to get free admission at the San Diego Zoo.
3. Charlie needs more than \$1,800 to purchase a car.
4. Cheryl can have no more than six pets at her house.
5. The shelter can house no more than 16 rabbits.

6. The width of a rectangle is 16 inches. Its area is greater than 180 square inches.
 - a. Write an inequality to represent this situation.
 - b. Graph the possible lengths of the rectangle.
7. Ninety percent of some number is at most 45.
 - a. Write an inequality to represent the situation.
 - b. Write the solutions as an algebraic sentence.
8. Doubling Martha's jam recipe yields at least 22 pints.
 - a. Write an inequality to represent the situation.
 - b. Write the solutions using interval notation.

For problems 9-15, write the inequality and use it solve the problem.

9. At the San Diego Zoo, you can either pay \$22.75 for the entrance fee or \$71 for the yearly pass, which entitles you to unlimited admission. At most, how many times can you enter the zoo for the \$22.75 entrance fee before spending more than the cost of a yearly membership?
10. Proteek's scores for four tests were 82, 95, 86, and 88. What will he have to score on his last test to average at least 90 for the term?
11. Raul is buying ties and he wants to spend \$200 or less on his purchase. The ties he likes the best cost \$50. How many ties could he purchase?
12. Virena's Scout Troop is trying to raise at least \$650 this spring. How many boxes of cookies must they sell at \$4.50 per box in order to reach their goal?
13. Using the golf ball example, find the times in which the velocity of the ball is between 50 ft/sec and 60 ft/sec .
14. Using the pick-up truck example, suppose William's truck has a dirty air filter, causing the fuel economy to be between 16 and 18 miles per gallon. How many hours can William drive on a full tank of gas using this information?
15. To get a grade of B in her Algebra class, Stacey must have an average grade greater than or equal to 80 and less than 90. She received the grades of 92, 78, and 85 on her first three tests. Between which scores must her grade fall on her last test if she is to receive a grade of B for the class?

Mixed Review

16. Solve the inequality and write its solution in interval notation: $\frac{x+3}{2} < -4$.
17. Graph $2x - 2y = 6$ using its intercepts.
18. Identify the slope and y-intercept of $y + 1 = \frac{2}{5}(x - 5)$.
19. A yardstick casts a one-foot shadow. What is the length of the shadow of a 16-foot tree?
20. George rents videos through a mail-order company. He can get 16 movies each month for \$16.99. Sheri rents videos through instant watch. She pays \$1.99 per movie. When will George pay less than Sheri?
21. Evaluate: $-2\frac{1}{5} \div 1\frac{3}{4}$.
22. Find a line parallel to $y = 5x - 2$ containing (1, 1).