Marcus and Phillip are in the Robotics Club. They are both saving money to buy materials to build a new robot. They plan to save the same amount of money each week.

1. Write a function to represent the time it takes Marcus and Phillip to save money. Define your variables and explain why you chose those variables.

   w = time (in weeks)

   $M(w)$ = amount of money (in dollars) Marcus saves

   $P(w)$ = amount of money (in dollars) Phillip saves

   $M(w) = P(w)$

Marcus decides to open a new bank account. He deposits $25 that he won in a robotics competition. He also plans on depositing $10 a week that he earns from tutoring. Phillip decides he wants to keep his money in a sock drawer. He already has $40 saved from mowing lawns over the summer. He plans to also save $10 a week from his allowance.

2. Write a function to represent the information regarding Marcus and Phillip saving money for new robotics materials.

   $M(w) = 25 + 10w$

   $P(w) = 40 + 10w$

3. Predict when Marcus and Phillip will have the same amount of money saved. Use your functions to help you determine your prediction.

   They will never have the same amount of money saved because Phillip starts with $40 and Marcus starts with $25.

You can prove your prediction by solving and graphing a system of linear equations.

4. Rewrite each function as an equation. Use *x* and *y* for the variables of each function in equation form and define the variables. Then, write a system of linear equations.
   x = time (in weeks)
   y = the amount of money saved (in dollars)
   y = 25 + 10*x*
   y = 40 + 10*x*

5. Analyze each equation.
a. Describe what the slope of each line represents in this problem situation.
    The slope represents the amount of money each person saves each week.

b. How do the slopes compare? Describe what this means in terms of this problem situation.
    The slopes are the same because both people save the same amount of money each week, $10.

c. Describe what the *y*-intercept of each line represents in this problem situation.
    The *y*-intercept represents the initial amount of money each person saved.

d. How do the *y*-intercepts compare? Describe what this means in terms of this problem situation.
    Phillip's y-intercept is greater than Marcus's y-intercept because Phillip started with more money than Marcus.

6. Determine the solution of the system of linear equations algebraically and graphically.

a. Use the substitution method to determine the intersection point.

$y = 25 + 10x$
$y = 40 + 10x$

$$25 + 10x = 40 + 10x$$
$$\underline{-10x \qquad\quad -10x}$$
$$25 \neq 40$$

b. Does your solution make sense? Describe what this means in terms of the problem situation.

No, 25 does not equal 40 so there is NO SOLUTION.

c. Predict what the graph of this system will look like. Explain your reasoning.

The linear equations have the SAME SLOPE, but DIFFERENT Y-INTERCEPTS so they must be PARALLEL.

d. Graph both equations on the coordinate plane provided.
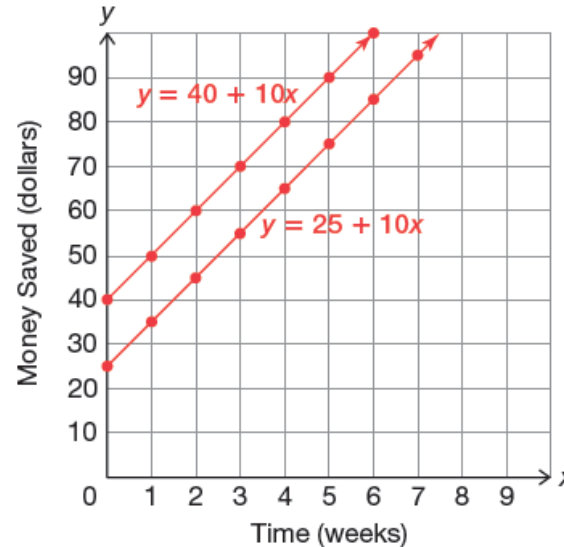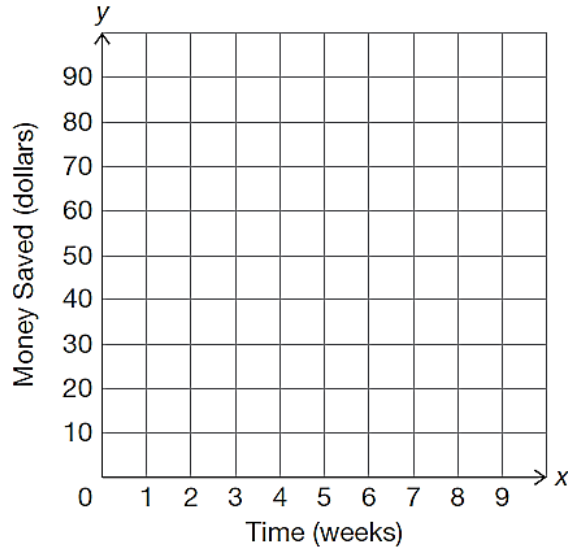
7. Analyze the graph you created.

a. Describe the relationship between the graphs.

The graphs are the same distance from each other so they are parallel.

b. Does this linear system have a solution? Explain your reasoning.

No. THE GRAPHS NEVER INTERSECT SO THE LINEAR SYSTEM HAS NO SOLUTION.

8. Was your prediction in Question 3 correct? Explain how you algebraically and graphically proved your prediction.

Yes. The substitution method proved there was no solution because 25 ≠ 40. The graph proved there was no solution because parallel lines never intersect.

11. Phillip and Tonya went on a shopping spree this weekend and spent all their savings except for $40 each. Phillip is still saving $10 a week from his allowance. Tonya now deposits her tips twice a week. On Tuesdays she deposits $4 and on Saturdays she deposits $6. Phillip claims he is still saving more each week than Tonya.

  a. Do you think Phillip's claim is true? Explain your reasoning.
    No. Phillip and Tonya are saving the same amount of money each week. $4 + $6 = $10. They also have the same amount of money left in savings.

  b. How can you prove your prediction?
    By writing a system of linear equations and solving them algebraically and graphically.

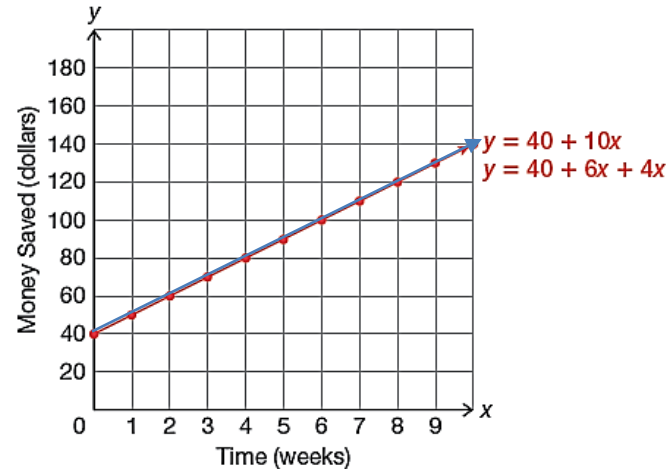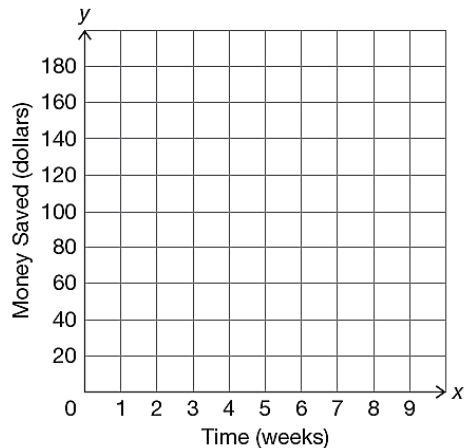12. Prove your prediction algebraically and graphically.
  a. Write **functions** that represent any new information about the way Tonya and Phillip are now saving money. $T(w) = 40 + 6w + 4w$

$$P(w) = 40 + 10w$$

  b. Write a new **linear system** to represent the total amount of money each friend has after a certain amount of time. $y = 40 + 6x + 4x$

$$y = 40 + 10x$$

c. Graph the linear system on the coordinate plane.

13. Analyze the graph.

   a. Describe the relationship between the graphs. What does this mean in terms of this problem situation?

   THE GRAPHS ARE THE SAME. This means that Tonya and Phillip will always have the same amount of money.

   $$40+10x=40+6x+4x$$
   $$40+10x=40+10x$$
   $$40=40$$

   b. Algebraically prove the relationship you stated in part (a).

   c. Does this solution prove the relationship? Explain your reasoning.

   Yes. Determining that 40 = 40 means there are an INFINITE NUMBER OF SOLUTIONS. Therefore, this means the graphs must be the same.

14. Was Phillip's claim that he is still saving more than Tonya a true statement? Explain why or why not.

   No. Phillip is not saving more than Tonya. He is saving the same amount as Tonya.