WIR Solutions: Sections 3-1, 3-2, and 3-3

This document contains the answers and video solutions to the posed problems. Click the red box to watch the video solution. You can also watch all videos by viewing the Sections 3.1, 3.2, and 3.3 playlist. Closed captions are available for all videos and the speed of the videos may be adjusted inside of "Settings" or the cog in the bottom right corner.

Section 3.1

(1) Sophia is planning a bake sale to raise funds to donate to her favorite charity. She has set a goal to raise at least \$500 (in profit) and hopes that she can even raise more money. She plans to package and sell the muffins and cookies by the dozen. One dozen muffins will sell for a profit of \$12, and one dozen cookies will sell for a profit of \$9. Based on sales from the previous year, she wants to make at least 26 dozen cookies. The cookies require 1 cup of sugar and 1.5 cups of flour per dozen. The muffins require $\dfrac{3}{4}$ cup of sugar and 2 cups of flour per dozen. Sophia has a total of 40 cups of sugar and 67 cups of flour to use for her bake sale. Set up the objective function and the constraints that will determine how many dozens of cookies and muffins Sophia should make to maximize her profits from the bake sale.
Answer: Let x be the number of dozen of cookies made for the bake sale. Let y be the number of dozen muffins made for the bake sale. Let P be the amount of profit made (in dollars).We want to maximize $P = 9x + 12y$ subject to:

$$\begin{cases} x + \frac{3}{4}y \leq 40 \\ \frac{3}{2}x + 2y \leq 67 \\ x \geq 26 \\ y \geq 0 \end{cases}$$

Click here to see video solution to problem #1.

(2) Andrew is a college student who works two jobs on campus. He must work at least 11 hours per week at the library and at least 4 hours per week as a tutor, but he is not allowed to work more than 30 hours per week at both jobs combined. Andrew earns \$15 per hour working at the library and \$20 per hour as a tutor. Because he prefers working at the library, he wants to have at least twice as many hours working at the library as he does working as a tutor. How many hours should Andrew work at each job to maximize the his weekly wages?

Answer: Let x be the number of hours he works at the library. Let y be the number of hours he works as a tutor. Let W be his earned weekly wages (in dollars). We want to maximize $W = 15x + 20y$ subject to:

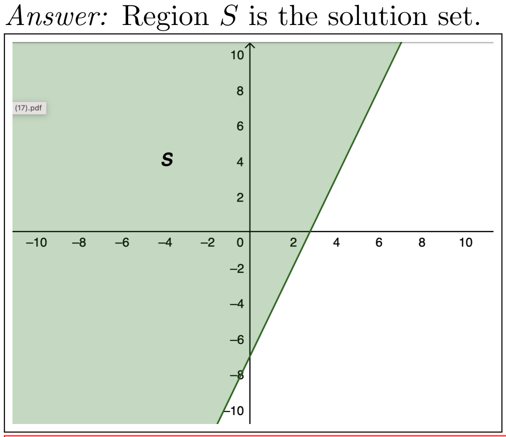
$$\begin{cases} x \geq 11 \\ y \geq 4 \\ x + y \leq 30 \\ x \geq 2y \end{cases}$$

Click here to see video solution to problem #2.

Section 3.2

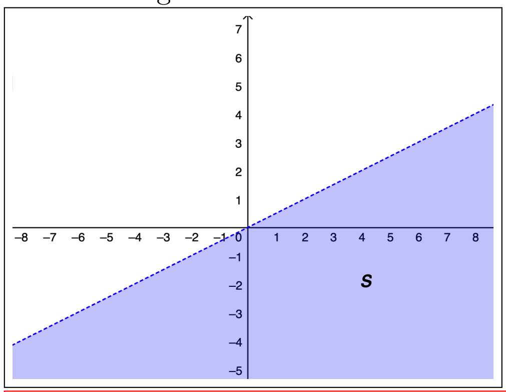
(3) Graph the solution set for $x - 2y > 0$.

Answer: Region S is the solution set.



Click here to see video solution to problem #3.

(4) Graph the solution set for $5x - 2y \leq 14$.
Answer: Region S is the solution set.

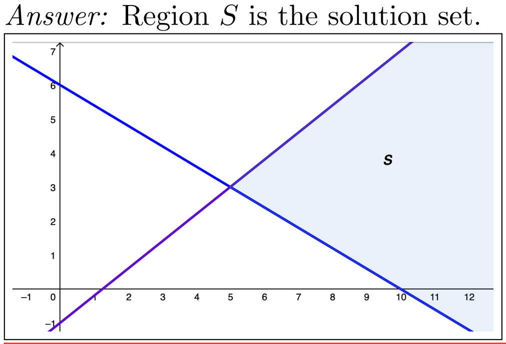


Click here to see video solution to problem #4.

(5) Graph the system of linear inequalities below. Be sure to label the solution set with S.

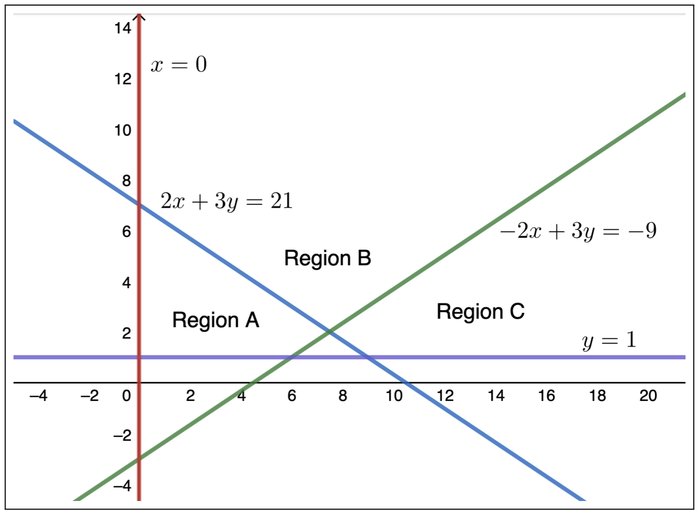
$$\begin{cases} -4x + 5y \geq -5 \\ 3x + 5y \leq 30 \end{cases}$$

Answer: Region S is the solution set.



Click here to see video solution to problem #5.

(6) The lines $l_1; 2x+3y=21, l_2: -2x+3y=-9, l_3: x=0$, and $l_4: y=1$ are graphed below. Write a system of inequalities where Region A is the solution set. Determine if Region A is bounded or unbounded, and then find the corner points of the feasible region. Do the same for Regions B and C.



Answer:

- Region A is a bounded region. The system of linear inequalities for Region A is: $\begin{cases} 2x+3y \le 21 \\ -2x+3y \ge -9 \\ x \ge 0 \\ y \ge 1 \end{cases}$.

  The corner points for Region A are $(0,1),\ (0,7),\ (6,1),\ (7.5,2)$.
  Click here to see video solution for Region A.

- Region B is an unbounded region. The system of linear inequalities for Region B is: $\begin{cases} 2x+3y \ge 21 \\ -2x+3y \ge -9 \\ x \ge 0 \end{cases}$.

  The corner points for Region B are $(0,7),\ (7.5,2)$.
  Click here to see video solution for Region B.

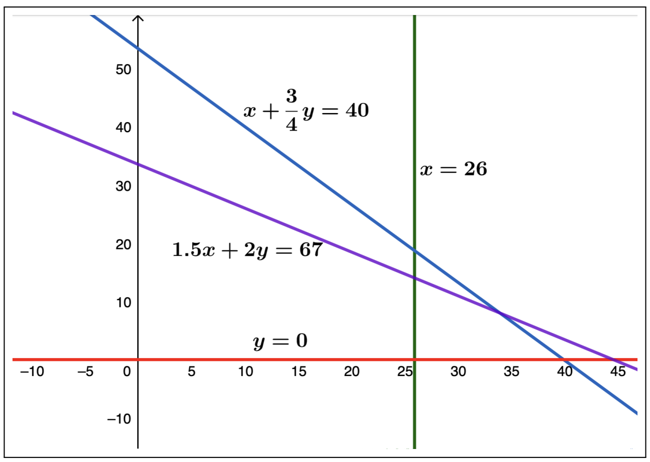
- Region C is an unbounded region. The system of linear inequalities for Region C is: $\begin{cases} 2x+3y \ge 21 \\ -2x+3y \le -9 \\ y \ge 1 \end{cases}$.

  The corner points for Region C are $(9,1),\ (7.5,2)$.
  Click here to see video solution for Region C.

Section 3.3

(7) Use the graph below to solve the problem set up in #1 from Section 3.1 above. First find the feasible region and then find the maximum profit Sophia can make. Recall that x was the number of dozen of cookies made for the bake sale; y was the number of dozen muffins made for the bake sale; and P was the amount of profit made (in dollars). We want to maximize

$$P = 9x + 12y \text{ subject to: } \begin{cases} x + \frac{3}{4}y \leq 40 \\ \frac{3}{2}x + 2y \leq 67 \\ x \geq 26 \\ y \geq 0 \end{cases}$$

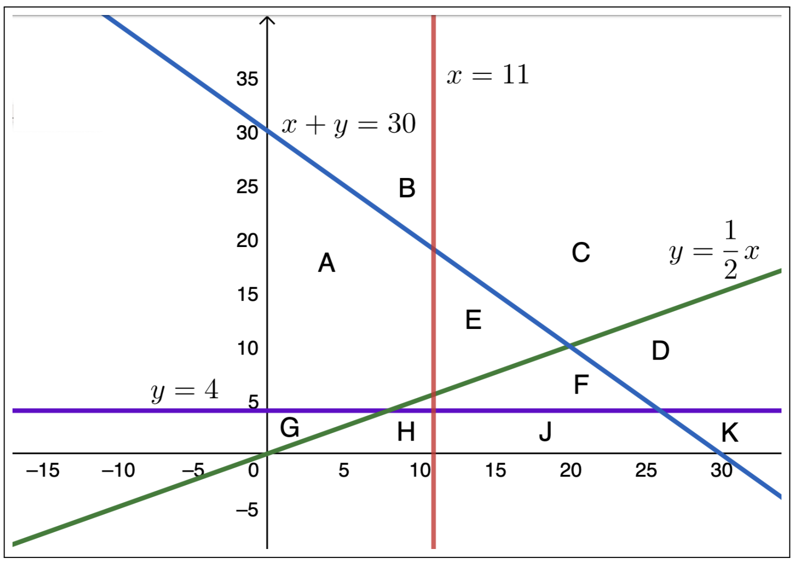


Answer: Sophia can make 26 dozen cookies and 14 dozen muffins, or 30 dozen cookies and 11 dozen muffins, or 34 dozen cookies and 8 dozen muffins to obtain a maximum profit of \$402. Note, she would not reach her goal of at least \$500 is profit.

Click here to see video solution to problem #7.

(8) Use the graph below to solve the problem set up in #2 from Section 3.1 above. Determine which of the regions below is the feasible region and then find Andrew's maximum weekly wages. Recall that x was the number of hours he works at the library; y was the number of hours he works as a tutor; and W was his earned weekly wages (in dollars). We want to maximize $W = 15x + 20y$

subject to: $\begin{cases} x \geq 11 \\ y \geq 4 \\ x + y \leq 30 \\ x \geq 2y \end{cases}$



Answer: Region F is the feasible region for this problem. Andrew can earn a maximum of \$500 by working 20 hours at the library and 10 hours as a tutor.
Click here to see video solution to problem #8.