

Lesson 4 – Sec. 7.5: Solving Systems by Elimination

Use **elimination** when no coefficients (the number in front of the variable) are 1.

Example 1: Solve this linear system:

$$\begin{aligned} \textcircled{1} \quad & 3x + 2y = 2 \\ \textcircled{2} \quad & 4x - 2y = 5 \end{aligned}$$

Which terms can we eliminate by *adding* equations together?

$$2y + (-2y) = 0$$

$$\begin{array}{r} 3x + 2y = 2 \\ + \quad 4x - 2y = 5 \\ \hline 7x \quad \quad = 7 \\ \frac{7x}{7} \quad \quad = \frac{7}{7} \\ x = 1 \end{array}$$

Solve for y:

$$\begin{aligned} 3x + 2y &= 2 \\ 3(1) + 2y &= 2 \\ -3 + 2y &= 2 \\ -3 \quad \quad -3 \\ \hline 2y &= -1 \\ \frac{2y}{2} &= \frac{-1}{2} \\ y &= -\frac{1}{2} \end{aligned}$$

Check:

$$P(1, -\frac{1}{2})$$

* use other equation.

$$\begin{aligned} 4(1) - 2(-\frac{1}{2}) &= 5 \\ 4 + 1 &= 5 \quad 5 = 5 \checkmark \end{aligned}$$

Example 2: Solve this linear system:

$$\begin{aligned} 3[4x + 3y = 15] &= 12x + 9y = 45 \\ 8x - 9y &= 15 \end{aligned}$$

$$\begin{array}{r} 12x + 9y = 45 \\ + \quad 8x - 9y = 15 \\ \hline 20x \quad \quad = 60 \\ \frac{20x}{20} \quad \quad = \frac{60}{20} \end{array}$$

$$x = 3$$

$$\begin{aligned} 4x + 3y &= 15 \\ 4(3) + 3y &= 15 \\ 12 + 3y &= 15 \\ -12 \quad \quad -12 \\ \hline 3y &= 3 \quad y = 1 \end{aligned}$$

$$P(3, 1)$$

$$\text{check: } 8x - 9y = 15$$

$$\begin{aligned} 8(3) - 9(1) &= 15 \\ 24 - 9 &= 15 \\ 15 &= 15 \checkmark \end{aligned}$$

Example 3: Solve this linear system:

$$3x - 4y = 7$$

$$5x - 6y = 8$$

$$\begin{array}{l} 5 [3x - 4y = 7] \\ -3 [5x - 6y = 8] \end{array} \quad \left. \vphantom{\begin{array}{l} 5 [3x - 4y = 7] \\ -3 [5x - 6y = 8] \end{array}} \right\} \rightarrow \begin{array}{r} 15x - 20y = 35 \\ + \quad \underline{-15x + 18y = -24} \\ -2y = 11 \end{array}$$

$$3x - 4\left(-\frac{11}{2}\right) = 7$$

$$y = -\frac{11}{2}$$

$$\begin{array}{r} 3x + 22 = 7 \\ -22 \quad -22 \end{array}$$

$$\begin{array}{r} 3x = -15 \\ x = -5 \end{array}$$

$$P\left(-5, -\frac{11}{2}\right)$$

$$\begin{array}{l} \text{check: } 5(-5) - 6\left(-\frac{11}{2}\right) = 8 \\ -25 + 33 = 8 \\ 8 = 8 \checkmark \end{array}$$

Example 4: Solve this linear system:

$$\begin{array}{l} \left[\frac{2}{3}x - \frac{1}{2}y = 4 \right] \times 6 \\ \left[\frac{1}{2}x + \frac{1}{4}y = \frac{5}{2} \right] \times 4 \end{array}$$

$$4x - 3y = 24$$

$$-2[2x + y = 10]$$

* clear fractions by multiplying by LCD.

$$(6)\frac{2}{3}x - (6)\frac{1}{2}y = 4(6)$$

$$\begin{array}{r} 4x - 3y = 24 \\ + \quad \underline{-4x - 2y = -20} \end{array}$$

$$\begin{array}{r} -5y = 4 \\ y = -\frac{4}{5} \end{array}$$

$$(5)2x + \left(-\frac{4}{5}\right) = 10(5)$$

$$\begin{array}{r} 10x - 4 = 50 \\ +4 \quad +4 \end{array}$$

$$10x = 54$$

$$x = \frac{54}{10} = \frac{27}{5}$$

$$P\left(\frac{27}{5}, -\frac{4}{5}\right)$$