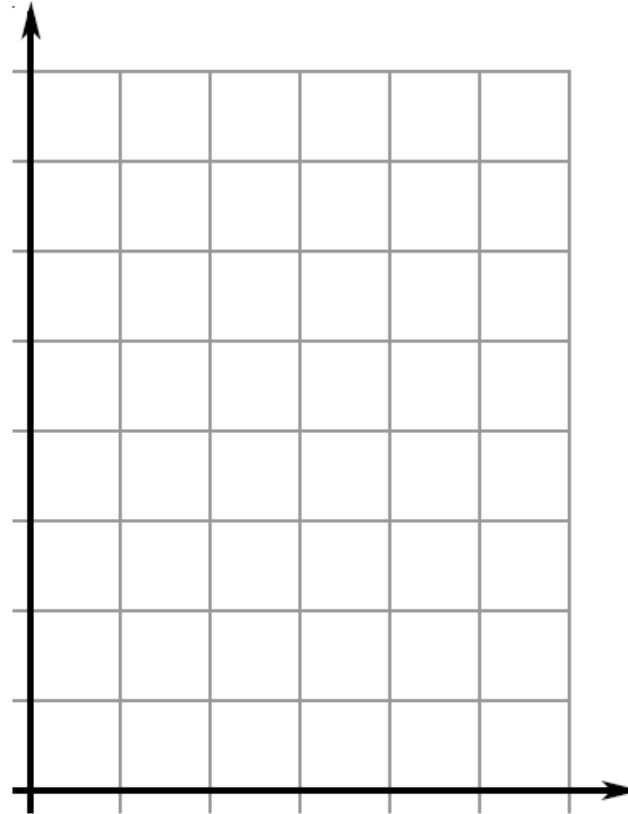


Bellringer

Diego works at a warehouse that ships two types of packages, a red package weighing 4 pounds and a blue package weighing 6 pounds. Diego shipped a total of 40 packages weighing 180 pounds.

2. Graph the system of linear equations.
3. How many red and blue packages were in the shipment?



8.2 Solving Systems by Substitution

8.EE.8b

Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection.

8.EE.8c

Solve real-world and mathematical problems leading to two linear equations in two variables

Vocabulary

- Substitution Method - used to solve systems of linear equations by solving an equation for one variable and then substituting the resulting expression for that variable into the other equation

Solving Using Substitution Method:

- Step 1: Solve 1 equation for one of its variables
- Step 2: Substitute the expression from Step 1 into the other equation and solve for the variable
- Step 3: Substitute value from Step 2 into other equation and solve for variable
- Step 4: Write answer as ordered pair
- Step 5: Check solution by plugging into both equations and checking for true statements
- Step 6: Interpret solution if necessary (for real-world problems)

ADDITIONAL EXAMPLE 1

Solve the system of linear equations by substitution. Check your answer.

$$\begin{cases} 2x + y = 5 \\ -3x + 2y = 17 \end{cases}$$

$$\begin{array}{r} 2x + y = 5 \\ \underline{-2x} \quad \underline{-2x} \end{array}$$

$$y = -2x + 5$$

$$-3x + 2(-2x + 5) = 17$$

$$-3x + -4x + 10 = 17$$

$$\begin{array}{r} -7x + 10 = 17 \\ \underline{-10} \quad \underline{-10} \end{array}$$

$$\begin{array}{r} -7x = 7 \\ \underline{-7} \quad \underline{-7} \end{array}$$

$$x = -1$$

$$\begin{array}{l} y = -2(-1) + 5 \\ y = 2 + 5 \\ \boxed{y = 7} \end{array}$$

$$(-1, 7)$$

$$2(-1) + 7 = 5$$

$$-2 + 7 = 5$$

$$5 = 5 \checkmark$$

$$-3(-1) + 2(7) = 17$$

$$3 + 14 = 17$$

$$17 = 17 \checkmark$$

YOUR TURN

Solve each system of linear equations by substitution.

$$4. \begin{cases} 3x + y = 11 \\ -2x + y = 1 \end{cases} \quad (2, 5)$$

$$\begin{array}{r} -2x + y = 1 \\ \underline{+2x} \quad \underline{+2x} \\ y = 2x + 1 \end{array}$$

$$\begin{array}{l} 3(2) + 5 = 11 \\ 6 + 5 = 11 \\ 11 = 11 \checkmark \end{array}$$

$$3x + 2x + 1 = 11$$

$$\begin{array}{r} 5x + y = 11 \\ \underline{-1} \quad \underline{-1} \\ 4x = 10 \end{array}$$

$$\begin{array}{r} 4x = 10 \\ \underline{4} \quad \underline{4} \\ x = 2.5 \end{array}$$

$$y = 2(2) + 1$$

$$y = 4 + 1$$

$$\boxed{y = 5}$$

$$\begin{array}{l} -2(2) + 5 = 1 \\ -4 + 5 = 1 \\ 1 = 1 \checkmark \end{array}$$

$$5. \begin{cases} 2x - 3y = -24 \\ x + 6y = 18 \end{cases} \quad (-6, 4)$$

$$\begin{array}{r} x + 6y = 18 \\ \underline{-6y} \quad \underline{-6y} \\ x = -6y + 18 \end{array}$$

$$x = -6y + 18$$

$$2(-6y + 18) - 3y = -24$$

$$-12y + 36 - 3y = -24$$

$$\begin{array}{r} -15y + 36 = -24 \\ \underline{-36} \quad \underline{-36} \\ -15y = -60 \end{array}$$

$$\begin{array}{r} -15y = -60 \\ \underline{-15} \quad \underline{-15} \\ y = 4 \end{array}$$

$$\begin{array}{l} x = -6(4) + 18 \\ x = -24 + 18 \end{array}$$

$$\boxed{x = -6}$$

$$2(-6) - 3(4) = -24$$

$$-12 - 12 = -24$$

$$-24 = -24 \checkmark$$

$$-6 + 6(4) = 18$$

$$-6 + 24 = 18$$

$$18 = 18 \checkmark$$

$$6. \begin{cases} x - 2y = 5 \\ 3x - 5y = 8 \end{cases} \quad (-9, -7)$$

$$\begin{array}{r} x - 2y = 5 \\ \underline{+2y} \quad \underline{+2y} \\ x = 2y + 5 \end{array}$$

$$x = 2y + 5$$

$$3(2y + 5) - 5y = 8$$

$$6y + 15 - 5y = 8$$

$$\begin{array}{r} y + 15 = 8 \\ \underline{-15} \quad \underline{-15} \\ y = -7 \end{array}$$

$$\boxed{y = -7}$$

$$x = 2(-7) + 5$$

$$x = -14 + 5$$

$$\boxed{x = -9}$$

$$-9 + 2(-7) = 5$$

$$-9 + 14 = 5$$

$$5 = 5 \checkmark$$

$$3(-9) + 5(-7) = 8$$

$$-27 + 35 = 8$$

$$8 = 8 \checkmark$$

Guided Practice

Solve each system of linear equations by substitution. (Example 1)

$$1. \begin{cases} 3x - 2y = 9 \\ y = 2x - 7 \end{cases} \quad (5, 3)$$

$$3x + -2(2x + -7) = 9$$

$$3x + -4x + 14 = 9$$

$$-1x + 14 = 9$$

$$\quad \quad \quad \underline{-14 \quad -14}$$

$$\underline{-1x} = \underline{-5}$$

$$\quad \quad \quad \underline{-1 \quad -1}$$

$$\boxed{x = 5}$$

$$y = 2(5) + -7$$

$$y = 10 + -7$$

$$\boxed{y = 3}$$

$$3(5) + 2(3) = 9$$

$$15 + -6 = 9$$

$$9 = 9 \checkmark$$

$$3 = 2(5) - 7$$

$$3 = 10 - 7$$

$$3 = 3 \checkmark$$

$$2. \begin{cases} y = x - 4 \\ 2x + y = 5 \end{cases} \quad (3, -1)$$

$$2x + x + -4 = 5$$

$$3x + -4 = 5$$

$$\quad \quad \quad \underline{+4 \quad +4}$$

$$\underline{3x} = \underline{9}$$

$$\quad \quad \quad \underline{3 \quad 3}$$

$$\boxed{x = 3}$$

$$y = 3 - 4$$

$$\boxed{y = -1}$$

$$-1 = 3 - 4$$

$$-1 = -1 \checkmark$$

$$2(3) + -1 = 5$$

$$6 + -1 = 5$$

$$5 = 5 \checkmark$$

$$3. \begin{cases} x+4y=6 \\ y=-x+3 \end{cases} \quad (2,1)$$

$$X+4(-x+3)=6$$

$$X-4x+12=6$$

$$-3x+12=6$$

$$\underline{-12} \quad \underline{-12}$$

$$\frac{-3x}{-3} = \frac{-6}{-3}$$

$$\boxed{X=2}$$

$$y=-2+3$$

$$\boxed{y=1}$$

$$2+4(1)=6$$

$$2+4=6$$

$$6=6 \checkmark$$

$$1=-2+3$$

$$1=1 \checkmark$$

$$4. \begin{cases} x+2y=6 \\ x-y=3 \end{cases} \quad (4,1)$$

$$X+2y=6$$

$$-\underline{2y} \quad -\underline{2y}$$

$$X=-2y+6$$

$$-2y+6+y=3$$

$$-3y+6=3$$

$$\underline{6} \quad \underline{-6}$$

$$\frac{-3y}{-3} = \frac{-3}{-3}$$

$$\boxed{y=1}$$

$$X=-2(1)+6$$

$$X=-2+6$$

$$\boxed{X=4}$$

$$4+2(1)=6$$

$$4+2=6$$

$$6=6 \checkmark$$

$$4-1=3$$

$$3=3 \checkmark$$

9. Adult tickets to Space City amusement park cost x dollars. Children's tickets cost y dollars. The Henson family bought 3 adult and 1 child tickets for \$163. The Garcia family bought 2 adult and 3 child tickets for \$174. (Example 3)

- a. Write equations to represent the Hensons' cost and the Garcias' cost.

Hensons' cost:

$$3x + y = 163$$

Garcias' cost:

$$2x + 3y = 174$$

- b. Solve the system.

adult ticket price: \$45

child ticket price: \$28

$$\begin{array}{r} 3x + y = 163 \\ -3x \quad -3x \\ \hline y = -3x + 163 \end{array}$$

$$\begin{array}{r} 2x + 3(-3x + 163) = 174 \\ 2x - 9x + 489 = 174 \\ -7x + 489 = 174 \\ \quad -489 \quad -489 \\ \hline -7x = -315 \\ \quad -7 \quad -7 \quad \boxed{x = 45} \end{array}$$

$$\begin{array}{r} y = -3(45) + 163 \\ y = -135 + 163 \\ \boxed{y = 28} \end{array}$$