Substitution Method

Use this method when the coefficient of one of the variables is 1.

$\cancel{x + y = 4}$ $\qquad x = -y + 4$

$2x - y = -1$

$$2(-y+4) - y = -1$$
$$-2y + 8 - y = -1$$
$$\quad -8 \qquad -8$$
$$-3y = -9$$
$$y = 3$$
$$x = -3 + 4 = 1$$

$(1, 3)$

$\cancel{x + y = 3}$ $\qquad y = -x + 3$

$2x + 2y = -4$

$$2x + 2(-x+3) = -4$$
$$2x - 2x + 6 = -4$$
$$6 = -4$$

NO SOLUTION

Substitution Method

$6x + 5y = 1$

$\cancel{x - 3y = 4}$

$x = 3y + 4$

$6(3y + 4) + 5y = 1$

$18y + 24 + 5y = 1$

$23y = -23$

$y = -1$

$x = 3(-1) + 4 = +1$

$(1, -1)$

$y = 1/2x + 4$

$2y = 2x + 8$

$2(\frac{1}{2}x + 4) = 2x + 8$

$x + 8 = 2x + 8$

$0 = x$

$y = \frac{1}{2}(0) + 4 = 4$

$(0, 4)$

Addition/Subtraction Method

Use this method when the coefficient of the like terms are equal. Then add the equations so one of the variables is eliminated.

$$\begin{array}{r} x + y = 5 \\ +\ \ 2x - y = 7 \\ \hline 3x = 12 \\ x = 4 \end{array}$$

$4 + y = 5$

$y = 1$

$(4, 1)$

$$\begin{array}{r} x + 4y = 10 \\ -(x + 2y = 6) \\ \hline 2y = 4 \\ y = 2 \end{array}$$

$x + 2(2) = 6$

$-4 \quad -4$

$x = 2$

$(2, 2)$

Multiplication/ Elimination Method

Multiply one equation by a number(s) so that when you add the equations, the sum will result in eliminating one variable.

$2(4x + y = 6)$

$3x + 2y = 7$

$-(8x + 2y = 12)$

$-5x = -5$

$x = 1$

$4(1) + y = 6$

$y = 2$

$(1, 2)$

$2(3x - 4y = 8)^{3}$ $6x - 8y = 16$

$3(2x + 3y = 9)^{4}$ $-(6x + 9y = 27)$

$-17y = -11$

$y = \frac{11}{17}$

$9x - 12y = 24$

$+ 8x + 12y = 36$

$17x = 60$

$x = \frac{60}{17}$

$3x - 4\left(\frac{11}{17}\right) = 8$

$17 \cdot 3x - \frac{44}{17} \cdot 17 = 8$

$51x - 44 = 136$

$\frac{51x}{51} = \frac{180}{51}$

$x = \frac{60}{17}$

Page 429

EXAMPLE 8 MODELING - *When Are Repair Costs the Same?*

Melinda Melendez needs to purchase a new radiator for her car and have it installed by a mechanic. She is considering two garages: Steve's Repair and Greg's Garage. At Steve's Repair, the parts cost $200 and the labor cost is $50 per hour. At Greg's Garage, the parts cost $375 and the labor cost is $25 per hour. How many hours would the repair need to take for the total cost at each garage to be the same?

$C = 200 + 50h$

$C = 375 + 25h$

$375 + 25h = 200 + 50h$

-200

$175 + 25h = 50h$

$\frac{175}{25} = \frac{25h}{25}$

$7 = h$

EXAMPLE 9 MODELING - *A Mixture Problem*

Pat Kuby, a pharmacist, needs 500 milliliters (mℓ) of a 10% phenobarbital solution. She has only a 5% phenobarbital solution and a 25% phenobarbital solution available. How many milliliters of each solution should she mix to obtain the desired solution?

$.25(f + t = 500)$

$.05f + .25t = .10(500)$ 50

$-\quad .25f + .25t = 125$

$-.20f = -75$

$\frac{-.20f}{-.20} = \frac{-75}{-.20}$

$f = 375$

$t = 125$

$f = 5\%$

$t = 25\%$

Page 432

45. **MODELING** - *Chemical Mixture* Antonio Gonzalez is a chemist and needs 10 liters (ℓ) of a 40% hydrochloric acid solution. He discovers he is out of the 40% hydrochloric acid solution and does not have sufficient time to reorder. He checks his supply shelf and finds he has a large supply of both 25% and 50% hydrochloric acid solutions. He decides to use the 25% and 50% solutions to make 10 ℓ of a 40% solution. How many liters of the 25% solution and of the 50% solution should he mix?

$t = .25$

$f = .50$

$.25(t + f = 10)$

$.25t + .50f = .40(10)$ 4

$-(.25t + .25f = 2.5)$

$\frac{.25f}{.25} = \frac{1.5}{.25}$

$f = 6 \quad t = 4$

46. **MODELING** - *Sets of Dishes* A restaurant manager purchased 100 sets of dishes. One design cost \$30 per set, and another design cost \$40 per set. If the manager spent \$3200 on the dishes, how many sets of each design did she purchase?

$t = 30$

$f = 40$

$30(t + f = 100)$

$30t + 40f = 3200$

$-\ 30t + 30f = 3000$

$10f = 200$

$f = 20 \quad t = 80$

Bobby Llama needs 400 liters of a 60% mustache enhancement solution. He discovers that he only has a 20% solution and a 90% solution available. How many liters of each solution should Bobby mix to obtain the desired solution.