### Chapter 5 Systems of Equations

#### Section 5.1 Solving Systems by Graphing

**Practice 5.1.1**

1. | Equation 1 | Equation 2 | Comment |
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>x-y=-3</td>
<td>x-2y=-7</td>
<td>Equations to solve</td>
</tr>
<tr>
<td>1-4 = -3</td>
<td>1-2(4) = -7</td>
<td>Substituting for x and y</td>
</tr>
<tr>
<td>-3 = -3</td>
<td>-8 = -8</td>
<td>Simplified</td>
</tr>
</tbody>
</table>

Yes, (1,4) is a solution of both.

2. | Equation 1 | Equation 2 | Comment |
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>3x +y =10</td>
<td>2x -3y=-3</td>
<td>Equations to solve</td>
</tr>
<tr>
<td>3•3+3 =10</td>
<td>2•2-3•3=-3</td>
<td>Substituting for x and y</td>
</tr>
<tr>
<td>9+3 =10</td>
<td>6-9 =-3</td>
<td>Simplified</td>
</tr>
<tr>
<td>12 ≠10</td>
<td>-3 ≠-3</td>
<td>Simplified</td>
</tr>
</tbody>
</table>

No, (3,3) solves only the second equation.

3. | Equation 1 | Equation 2 | Comment |
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>x - y = 1</td>
<td>2x - 3y =1</td>
<td>Equations to solve</td>
</tr>
<tr>
<td>4-3 =1</td>
<td>2•4-3•3 =1</td>
<td>Substituting for x and y</td>
</tr>
<tr>
<td>1 =1</td>
<td>8-9 =1</td>
<td>Simplified</td>
</tr>
<tr>
<td>1 =1</td>
<td>-1 ≠1</td>
<td>Simplified</td>
</tr>
</tbody>
</table>

No, (4,3) solves only the first equation.

4. | Equation 1 | Equation 2 | Comment |
<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2x + y =3</td>
<td>3x - 2y =8</td>
<td>Equations to solve</td>
</tr>
<tr>
<td>2•2+(-1)=3</td>
<td>3•2-2•1=8</td>
<td>Substituting for x and y</td>
</tr>
<tr>
<td>4-1 =3</td>
<td>6+2 =8</td>
<td>Simplified</td>
</tr>
<tr>
<td>3 =3</td>
<td>8 =8</td>
<td>Simplified</td>
</tr>
</tbody>
</table>

Yes, (2,-1) solves both equations.

**Practice 5.1.2**

1. The solution is (0,3).

2. The solution is (2,5).

3. The solution is (3,1).

4. The solution is (3,1).
The solution is (2, -3).

Practice 5.1.3
1. y = larger number; x is smaller
   Equation 1: x - y = 1
   Equation 2: y = 1 + x

   The lines are the same. There are an infinite number of solutions, which we can write as (x, x+1).

2. x = larger then y = smaller number
   Equation 1: x + y = 3
   Equation 2: 2x + 2y = -5

   The lines are parallel. There is no solution.

3. x = larger then y = smaller number.
   Equation 1: x + y = 4
   Equation 2: 2x + 2y = -5

   The solution is (5, -2).

Practice 5.1.4
1. The system is consistent since there is a solution. The lines do not coincide so the equations are independent.

2. The system is consistent since there is a solution. The lines are coincide so the equations are dependent.

3. The system is inconsistent since there is no solution. The lines do not
coincide so the equations are independent.

4. The system is consistent since there is a solution. The lines do not coincide so the equations are independent.

Practice 5.1.5
1. a) Let \( x = \) number of hours; \( y = \) cost
   \[ \text{Equation 1: } y = 20x \]
   \[ \text{Equation 2: } y = 10x + 70 \]

b) The intersection is \((7,140)\). The cost for both options is the same when 7 hours are spent doing inventory. For 7 hours the cost will be $140.

d) If the inventory takes under 7 hours the employee is cheaper. If over 7 hours the temporary worker is cheaper.

2. Let \( x = \) number of days; \( y = \) cost

   \[ \text{Equation 1: } y = 200 + 50x \]
   \[ \text{Equation 2: } y = 350 + 35x \]

   b)

   c) The intersection is \((10,700)\). This means the cost ($700) will be the same for both companies if the backhoe is rented for 10 days.

d) If the backhoe is rented for less than 10 days Company A is cheaper. If rented for more than 10 days, Company B is cheaper.

3. a) $400
   b) If under $400 is borrowed Card 1 is cheaper; if over $400 Card 2 is cheaper.
   c) Card 1 is $3 a month and Card 2 is $4 a month so Card 1 is $1 cheaper.

Exercise Set 5.1
1. | Equation 1 | Equation 2 | Comment |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( x - y = 4 )</td>
<td>( 2x - 2y = 8 )</td>
<td>Equations to solve</td>
</tr>
<tr>
<td>( 4.0 ) = 4</td>
<td>( 8.0 ) = 8</td>
<td>Substituting for ( x ) and ( y )</td>
</tr>
<tr>
<td>( 4 ) = 4</td>
<td>( 8 ) = 8</td>
<td>Simplified</td>
</tr>
</tbody>
</table>

   (4,0) is a solution of both equations.
<table>
<thead>
<tr>
<th>Equation 1</th>
<th>Equation 2</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>x - y = 5</td>
<td>2*2+(-3)=1</td>
<td>Equations to solve</td>
</tr>
<tr>
<td>2+(-3) =5</td>
<td>4+3 =-1</td>
<td>Substituting for x and y</td>
</tr>
<tr>
<td>2+3 =5</td>
<td>7 ≠ -1</td>
<td>Simplified</td>
</tr>
<tr>
<td>5 =5</td>
<td>7 ≠ -1</td>
<td>Simplified</td>
</tr>
</tbody>
</table>

No. (-2,3) solves the first equation, but not the second.

5. (0.5,0.5)

7. There is no solution.

9. (0,1)

11. There are an infinite number of solutions. The lines coincide.

13. Equation 1: x + y = 1  
    Equation 2: 2x + 3y = -3

15. Equation 1: y = 2x + 5  
    Equation 2: 3y - 6x = 15

17. Equation 1: x + y = -6  
    Equation 2 : y = 2x + 9
19. Equation 1: \( x + y = -1 \)
   Equation 2: \( 8 - x = y \)
   The solution is \((-5,-1)\)

21. There is a solution the system is consistent. The lines do not coincide so the equations are independent.

23. There is no solution the system is inconsistent. The lines do not coincide so the equations are independent.

25. a)

27. a)

29. Equation 1: \( y = 250x + 4500 \)
   Equation 2: \( y = 500x + 500 \)
31. a) 20 unit must be sold to break even.
   b) If less than 20 units are sold cost is higher than revenue (the company is losing money). If more than 20 units are sold cost is less than revenue and the company is making money.
   c) For 30 units the cost is $1400 and the revenue is about $1650. The profit is $1650 - $1400 = $250.

33. (-8, -4.5, 0, 1.5)

34. The base is \( x \) and the exponent is 6.

35. Plot (-1,) then go down 5 and to the right 3.

36. \[
\frac{2}{5}(x+5) - \frac{1}{3}(x+2) = \frac{x}{10} + 1
\]
\[
30 \cdot \frac{2}{5}(x+5) - 30 \cdot \frac{1}{3}(x+2) = 30 \cdot \frac{x}{10} + 30 \cdot 1
\]
\[
6 \cdot 2(x+5) - 10(x + 2) = 3x + 30
\]
\[
12(x + 5) - 10x - 20 = 3x + 30
\]
\[
12x + 60 - 10x - 20 = 3x + 30
\]
\[
2x + 40 = 3x + 30
\]
\[
x = 10
\]

37. \[
\frac{2}{3}(x-4)+1 = \frac{1}{2}x + \frac{1}{6}(x-3)
\]
\[
6 \cdot \frac{2}{3}(x-4)+6 = \frac{1}{2}x + \frac{1}{6}(x-3)
\]
\[
2 \cdot 2(x-4) + 6 = 3x + (x-3)
\]
\[
4(x-4) + 6 = 3x + x - 3
\]
\[
4x - 16 + 6 = 4x - 3
\]
\[
4x - 10 = 4x - 3
\]
\[
-10 = -3
\]
This is a contradiction. There is no solution.

38. Let \( c \) = amount in the checking account
\( c + 280 = \text{savings account} \)
\( 1/4(c + 280) = \text{Christmas account} \)
Passbook acct = \( c + (c+280) + 1/4(c+280) \)
Passbook = \( c + c + 280 + 1/4(c+280) \)
Passbook = \( 2c + 280 + 1/4c + 70 \)
Passbook = \( 8/4c + 350 + 1/4c \)
Passbook = \( 9/4c + 350 \)

39. Let \( x \) = amount in 13% account
\( 15000 - x = \text{amount in 5% interest} = \text{principle} \cdot \text{rate} \cdot \text{time} \)
1200 = 0.13x + 0.05(15000-x)
1200 = 0.13x + 750-0.05x
450 = 0.08x
x = $5625 at 13%
15000 - 5625 = $9375 at 5%

40. \[ m = \frac{y_2 - y_1}{x_2 - x_1} \]
   \[ m = \frac{-1-3}{5-2} = -\frac{4}{3} \]

41. \[
\begin{array}{c|c}
  x & f(x) \\
  \hline
  0 & 4 \\
  6 & -2 \\
  8 & -4 \\
\end{array}
\]

Section 5.2 Solving Systems Using Substitution

Practice 5.2.1
1. Equation 1: \( x + y = -5 \)
   Equation 2: \( y = 2x + 1 \)
   \( x + (2x + 1) = -5 \)
   \( 3x + 1 = -5 \)
   \( 3x = -6 \)
   \( x = -2 \)
   Substituting back in to solve for \( y \):
   \( -2 + y = -5 \)
   \( y = -3 \)
   The solution is \((-2,-3)\)

2. Equation 1: \( 2x + y = 9 \)
   Equation 2: \( x = y + 3 \)
   \( 2(y + 3) + y = 9 \)
   \( 2y + 6 + y = 9 \)
   \( 3y + 6 = 9 \)
   \( 3y = 3 \)
   \( y = 1 \)
   Substituting back in to solve for \( x \):
   \( 2x + 1 = 9 \)
   \( 2x = 8 \)
   \( x = 4 \)
   The solution is \((4,1)\)

3. Equation 1: \( 2x + 3y = 7 \)
Equation 2: $x + y = 3$
Solve equation 2 for $x$:
$x = 3 - y$
Now substitute for $x$ in equation 1
$2(3 - y) + 3y = 7$
$6 - 2y + 3y = 7$
$6 + y = 7$
$y = 1$
Substituting back in to solve for $a$:
$2x + 3(1) = 7$
$2x + 3 = 7$
$2x = 4$
$x = 2$
The solution is $(2,1)$.

Practice 5.2.2
1. Equation 1: $3x - 6y = -6$
   Equation 2: $-2x + 5y = 6$
   Solve equation 1 for $x$:
   $3x - 6y = -6$
   $3x = -6 + 6y$
   $x = -2 + 2y$
   Substitute for $x$ in equation 2:
   $-2(-2 + 2y) + 5y = 6$
   $4 - 4y + 5y = 6$
   $y + 4 = 6$
   $y = 2$
   Substitute to solve for $x$:
   $3x - 6(2) = -6$
   $3x - 12 = -6$
   $3x = 6$
   $x = 2$
   The solution is $(2,2)$.

2. Equation 1: $4x + 2y = 6$
   Equation 2: $3x - 5y = -2$
   Solve equation 1 for $y$:
   $4x + 2y = 6$
   $2y = 6 - 4x$
   $y = 3 - 2x$
   Substitute into equation 2:
   $3x - 5(3 - 2x) = -2$
   $3x - 15 + 10x = -2$
   $13x = 13$
   $x = 1$
   Substitute to solve for $y$:
   $4(1) + 2y = 6$
   $4 + 2y = 6$
   $2y = 2$
   $y = 1$
   The solution is $(1,1)$.

3. Equation 1: $2x + 4y = -16$
   Equation 2: $3x + 2y = -8$
   Solve equation 1 for $x$:
   $2x + 4y = -16$
   $x = -8 - 2y$
   Substitute for $x$ in equation 2:
   $3(-8 - 2y) + 2y = -8$
   $-24 + 6y + 2y = -8$
   $-4y - 24 = -8$
   $-4y = 16$
   $y = -4$
   Substitute to solve for $x$:
   $2x + 4(-4) = -16$
   $2x - 16 = -16$
   $2x = 0$
   $x = 0$
   The solution is $(0, -4)$.

Practice 5.2.3
1. Equation 1: $t = p - 250$
   Equation 2: $2t + 3p = 1125$
   $2(p - 250) + 3p = 1125$
   $2p - 500 + 3p = 1125$
   $5p = 1625$
   $p = 325$
   Substitute to solve for $t$:
   $t = 325 - 250 = 75$
   The solution is $(75, 325)$.

2. Equation 1: $w + t = 10$
   Equation 2: $0.05w + 0.25t = 1.50$
   Solve equation 1 for $w$:
   $w + t = 10$
   $w = 10 - t$
   Substitute into equation 2:
   $0.05(10 - t) + 0.25t = 1.50$
   $0.5 - 0.05t + 0.25t = 1.50$
   $0.5 + 0.20t = 1.50$
   $0.20t = 1.00$
   $t = 5$
   Substitute to solve for $w$:
   $w + 5 = 10$
   $w = 5$
   The solution is $(5, 5)$.

Practice 5.2.4
1. Equation 1: $3x + y = 7$
   Equation 2: $-6x - 2y = -14$
   Solve equation 1 for $y$
   $3x + y = 7$
   $y = 7 - 3x$
   Substitute into equation 2:
   $-6x - 2(7 - 3x) = -14$
The equations are dependent so there are an infinite number of solutions. The solutions are the ordered pairs \((x, 7 - 3x)\).

2. Equation 1: \(4x + 2y = 5\)  
   Equation 2: \(2x + y = 1\)  
   Solve equation 2 for \(y\):  
   \[2x + y = 1\]  
   \[y = 1 - 2x\]  
   Substitute into equation 1:  
   \[4x + 2(1 - 2x) = 5\]  
   \[4x + 2 - 4x = 5\]  
   \[2 = 5\]  
   This is a contradiction. There is no solution. The lines are parallel.

3. Equation 1: \(x = 2y + 4\)  
   Equation 2: \(-2x + 4y = -1\)  
   Substitute for \(x\) into equation 2:  
   \[-2(2y + 4) + 4y = -1\]  
   \[-4y - 8 + 4y = -1\]  
   \[-8 = -1\]  
   This is a contradiction. There is no solution. The lines are parallel.

4. Equation 1: \(-3y = 7 - x\)  
   Equation 2: \(-3x + 9y = -21\)  
   Solve equation 1 for \(x\):  
   \[-3y = 7 - x\]  
   \[-7 - 3y = -x\]  
   \[x = 7 + 3y\]  
   Substitute into equation 2:  
   \[-3(7 + 3y) + 9y = -21\]  
   \[-21 - 9y + 9y = -21\]  
   \[-21 = -21\]  
   The equations are dependent so there are an infinite number of solutions.  
   \[-3y = 7 - x\]  
   \[y = -7/3 + x/3\]  
   The solutions are the ordered pairs \((x, -7/3 + x/3)\).

Exercise Set 5.2

1. Equation 1: \(x + y = 9\)  
   Equation 2: \(2x + 3y = 22\)  
   Solve for \(x\) in equation 1:  
   \[x + y = 9\]  
   \[x = 9 - y\]  
   Substitute in equation 2:  
   \[2(9 - y) + 3y = 22\]  
   \[18 - 2y + 3y = 22\]
3. Equation 1: \(6x - 5y = -5\)
Equation 2: \(x - y = -2\)
Solve for \(x\) in equation 2:
\(x - y = -2\)
\(x = -2 + y\)
Substitute in equation 1:
\(6(-2 + y) - 5y = -5\)
\(\Rightarrow -12 + 6y - 5y = -5\)
\(\Rightarrow y - 12 = -5\)
\(\Rightarrow y = 7\)
Substitute to solve for \(x\):
\(x - 7 = -2\)
\(x = 5\)
The solution is (5,7)

5. Equation 1: \(x + y = 1\)
Equation 2: \(2x + 4y = 10\)
Solve for \(x\) in equation 1:
\(x = 1 - y\)
Substitute in equation 2:
\(2(1 - y) + 4y = 10\)
\(\Rightarrow 2 - 2y + 4y = 10\)
\(\Rightarrow 2y + 2 = 10\)
\(\Rightarrow 2y = 8\)
\(\Rightarrow y = 4\)
Substitute to solve for \(x\):
\(x + 4 = 1\)
\(x = -3\)
The solution is (-3,4).

7. Equation 1: \(4x - 2y = 2\)
Equation 2: \(3x + 3y = 15\)
Solve for \(y\) in equation 2:
\(3x + 3y = 15\)
\(\Rightarrow x + y = 5\)
\(\Rightarrow y = 5 - x\)
Substitute in equation 1:
\(4x - 2(5 - x) = 2\)
\(\Rightarrow 4x - 10 + 2x = 2\)
\(\Rightarrow 6x - 10 = 2\)
\(\Rightarrow 6x = 12\)
\(\Rightarrow x = 2\)
Substitute to solve for \(y\):
\(4(2) - 2y = 2\)
\(\Rightarrow 8 - 2y = 2\)
\(\Rightarrow -2y = -6\)

9. Equation 1: \(7x + 3y = 11\)
Equation 2: \(2x - 4y = 8\)
Solve equation for \(x\):
\(2x - 4y = 8\)
\(\Rightarrow 2x = 8 + 4y\)
\(\Rightarrow x = 4 + 2y\)
Substitute in equation 1:
\(7(4 + 2y) + 3y = 11\)
\(\Rightarrow 28 + 14y + 3y = 11\)
\(\Rightarrow 28 + 17y = 11\)
\(\Rightarrow 17y = -17\)
\(\Rightarrow y = -1\)
Substitute to solve for \(x\):
\(7x + 3(-1) = 11\)
\(\Rightarrow 7x - 3 = 11\)
\(\Rightarrow 7x = 14\)
\(\Rightarrow x = 2\)
The solution is (2,-1).

11. Equation 1: \(n + d = 25\)
Equation 2: \(0.05n + 0.10d = 2.25\)
Solve equation 1 for \(n\):
\(n + d = 25\)
\(\Rightarrow n = 25 - d\)
Substitute in equation 2:
\(0.05(25 - d) + 0.10d = 2.25\)
\(1.25 -0.05d + 0.10d = 2.25\)
\(0.05d + 1.25 =2.25\)
\(0.05d = 1.00\)
\(\Rightarrow d = 20\)
Substitute to solve for \(n\):
\(n + 20 = 25\)
\(\Rightarrow n = 5\)
The solution is (5,20).

13. Equation 1: \(4x - y = 7\)
Equation 2: \(-4x + y = -7\)
Solve equation 2 for \(y\):
\(-4x + y = -7\)
\(\Rightarrow y = 4x - 7\)
Substitute in equation 1:
\(4x - (4x - 7) = 7\)
\(\Rightarrow 4x - 4x + 7 = 7\)
\(\Rightarrow 7 = 7\)
This is an identity. The equations are dependent so there are an infinite number of solutions.
\(4x - y = 7\)
\(y = 2x - 7\)
The solutions are the ordered pairs...
15. Equation 1: \(3x + y = 7\)
   Equation 2: \(-6x - 2y = 10\)
   Solve equation 1 for \(y\):
   \[3x + y = 7\]
   \[y = 7 - 3x\]
   Substitute in equation 2:
   \[-6x - 2(7 - 3x) = 10\]
   \[-6x - 14 + 6x = 10\]
   \[-14 = 10\]
   This is a contradiction. There are no solutions.

17. Equation 1: \(x + 4y = 3\)
   Equation 2: \(-2x - 8y = -6\)
   Solve equation 1 for \(x\):
   \[x + 4y = 3\]
   \[x = 3 - 4y\]
   Substitute in equation 2:
   \[-2(3 - 4y) - 8y = -6\]
   \[-6 + 8y - 8y = -6\]
   \[-6 = -6\]
   This is an identity. The equations are dependent so there are an infinite number of solutions.
   \[x = \frac{3}{4} - \frac{x}{4}\]
   The solutions are the ordered pairs \((x, \frac{3}{4} - \frac{x}{4})\)

19. Equation 1: \(4x + 2y = 2\)
   Equation 2: \(2x + y = 1\)
   Solve equation 2 for \(y\):
   \[2x + y = 1\]
   \[y = 1 - 2x\]
   Substitute in equation 1:
   \[4x + 2(1 - 2x) = 2\]
   \[4x + 2 - 4x = 2\]
   \[2 = 2\]
   This is an identity.
   The solutions are the ordered pairs \((x, 1 - 2x)\)

21. Find equation 1:
   \[m = \frac{350 - 250}{1 - 0} = \frac{50}{1} = 50\]
   The y intercept is \((0,250)\) so \(b = 250\)
   Equation 1: \(y = 50x + 250\)
   Find equation 2:
   \[m = \frac{750 - 500}{10 - 0} = \frac{250}{10} = 25\]

23. Find equation 1:
   \[m = \frac{313 - 358}{1 - 0} = \frac{-45}{1} = -45\]
   The y intercept is \((0,358)\) so \(b = 358\).
   Equation 2: \(y = -45x + 358\)
   Find equation 2:
   \[m = \frac{327 - 382}{1 - 0} = \frac{-55}{1} = -55\]
   The y intercept is \((0,382)\) so \(b = 382\).

25. \(xy^2 - xy = (-2)(-3)^2 - (-2)(-3)\)
   \[= -2\cdot 9 - 6 = -18 - 6 = -24\]

26. \(f(x) = x - 1\)
   \(f(3) = 3 - 1\)
   \(f(3) = 2\)

27. \(5w - (3w - 3) = 5w - 3w + 3 = 2w + 3\)

29. \(-5 \leq w\)

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CHAPTER 5 SYSTEMS OF EQUATIONS
30. 46 = number of pounds of peanuts
    Value of peanuts = 1.12(46) = 51.52
    40 = number of pounds of cashews
    Value of cashews = (1.12 + 2.65)(40) = 3.77(40) = 150.80
    Value of mix = 51.52 + 150.80
    =$202.32

31. Sweater + tax = 42.60
    Let s = value of sweater
    s + 0.065s = 42.60
    1.065s = 42.60
    s = $40

32. Plot (0,3) then go down 2 and to the right 1.

33. No. An input of 4 gives two output values: 3 and 9

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CHAPTER 5 SYSTEMS OF EQUATIONS
Section 5.3 Using the Addition Method to Solve Systems

Practice 5.3.1

1. Equation 1  \[ 2x - y = -8 \]
   Equation 2  \[ x + y = -1 \]
   Add together \[ 3x = -9 \]
   \[ x = -3 \]
   Substitute to find \( y \): \[ 2(-3) - y = -8 \]
   \[ -6 - y = -8 \]
   \[ -y = -2 \]
   \[ y = 2 \]
   The solution is the ordered pair \((-3, 2)\).

2. Equation 1  \[ 3x + y = 3 \]
   Equation 2  \[ -3x + 2y = 3 \]
   Add together \[ 3y = 6 \]
   \[ y = 2 \]
   Substitute to find \( x \): \[ 3x + 2 = 3 \]
   \[ 3x = 1 \]
   \[ x = \frac{1}{3} \]
   The solution is the ordered pair \((1/3, 2)\).

3. Equation 1  \[ 4x + 3y = 1 \]
   Equation 2  \[ -4x + 2y = -26 \]
   Add together \[ 5y = -25 \]
   \[ y = -5 \]
   Substitute to find \( x \): \[ 4x + 3(-5) = 1 \]
   \[ 4x - 15 = 1 \]
   \[ 4x = 16 \]
   \[ x = 4 \]
   The solution is the ordered pair \((4, -5)\).

Practice 5.3.2

1. Equation 1  \[ x - 4y = 3 \]
   Equation 2  \[ -4x + 2y = -12 \]
   4 times equation 2: \[ 4(x + y) = -1 \cdot 4 \]
   Equation 1  \[ x - 4y = 3 \]
   Equation 2 transformed \[ 4x + 4y = 12 \]
   Add together \[ 5x = 15 \]
   \[ x = 3 \]
   Substitute to solve for \( y \):
   \[ 3 - 4y = 3 \]
   \[ -4y = 0 \]
   \[ y = 0 \]
   The solution is the ordered pair \((3, 0)\).

2. Equation 1  \[ x + 3y = 18 \]
   Equation 2  \[ -5x + y = 6 \]
   5 times equation 1: \[ 5(x + 3y) = 5 \cdot 18 \]
   Equation 1 transformed \[ 5x + 15y = 90 \]
   Equation 2  \[ -5x + y = 6 \]
   Add together \[ 16y = 96 \]
   \[ y = 6 \]
   Substitute to solve for \( x \):
   \[ x + 3(6) = 18 \]
   \[ x + 18 = 18 \]
   \[ x = 0 \]
   The solution is the ordered pair \((0, 6)\).

3. Equation 1  \[ x + 4y = 2 \]
   Equation 2  \[ -2x - 8y = 5 \]
   2 times equation 1: \[ 2(x+4y) = 2 \cdot 2 \]
   Equation 1 transformed \[ 2x+8y = 4 \]
   Equation 2  \[ -2x - 8y = 5 \]
   Add together \[ 0 = 9 \]
   This is a contradiction. The lines are parallel. There is no solution.

4. Equation 1  \[ -6x + 2y = 5 \]
   Equation 2  \[ 12x - 4y = -10 \]
   2 times equation 1: \[ 2(-6x+2y=5) \]
   Equation 1 transformed: \[ -12x + 4y = 10 \]
   Add together \[ 0 = 0 \]
   This is an identity. The equations are dependent so there are an infinite
number of solutions.
12x - 4y = -10
-4y = -10 - 12x
y = 5/2 + 3x
The solutions are the ordered pairs (x, 5/2 + 3x)

Practice 5.3.3
1. Equation 1  y - 1 = 2x
   Equation 2  x + y = 7

   Equation 1 in standard form: 2x - y = -1
   Add together 3x = 6
   x = 2
   Substitute to solve for y: y - 1 = 2•2
   y - 1 = 4
   y = 5
   The solution is the ordered pair (2, 5).

2. Equation 1  x + 2 = -y
   Equation 2  2x - y = -1

   Equation 1 in standard form: x + y = -2
   Add together 2x - y = -1
   3x = -3
   x = -1
   Substitute to solve for y: -1 + 2 = -y
   1 = -y
   y = -1
   The solution is the ordered pair (-1, -1).

3. Equation 1  -5 = y - x
   Equation 2  2x - y = -1

   Equation 1 in standard form: x + y = -5
   Add together 2x - y = -1
   3x = -6
   x = -2
   Substitute to solve for y: -5 = y - (-6)
   -5 = y + 6
   y = 11
   The solution is the ordered pair (-6, 11)

Practice 5.3.4
1. Equation 1  4x - 5y = -2
   Equation 2  3x - 2y = -5

   3 times equation 1: 3(4x - 5y) = 3(-2)
   -4 times equation 2: -4(3x - 2y) = -4(-5)
   Equation 1 transformed: 12x - 15y = -6
   Equation 2 transformed: -12x + 8y = 20
   b) 2 times equation 1: 2(4x - 5y) = -2
   -5 times equation 2: -5(3x - 2y) = -5
   Equation 1 transformed: 8x - 10y = -20
   Equation 2 transformed: -15x + 10y = 25

2. Equation 1  6x + 5y = 8
   Equation 2  2x + 8y = 1

   -3 times equation 2: -3(2x + 8y) = -3
   -1
   Equation 1 transformed: 6x - 5y = 8
   Equation 2 transformed: -6x - 24y = -3

   b) -8 times equation 1:
   -8(6x + 5y) = -8•8
   5 times equation 2: 5(2x + 8y) = 5•1
   Equation 1 transformed:
   -48x - 40y = -64
   Equation 2 transformed:
   10x + 40y = 5

Practice 5.3.5
1. Equation 1  4x - 5y = -2
   Equation 2  3x - 2y = -5

   -3 times equation 1: -3(4x - 5y) = -3(-2)
   4 times equation 2: 4(3x - 2y) = 4(-5)
   Equation 1 transformed: -12x + 15y = 6
   Equation 2 transformed: 12x - 8y = -20
   Add together 7y = -14
   y = -2
   Substitute to solve for x:
   4x - 5(-2) = -2
   4x + 10 = -2
   4x = -12

CHAPTER 5 SYSTEMS OF EQUATIONS
x = -3
The solution is the ordered pair (-3,-2).

2.  
Equation 1 6x + 5y = 8
Equation 2 5x + 6y = 14

-6 times equation 1: -6(6x + 5y) = -6•8
5 times equation 2: 5(5x + 6y) = 5•14

Equation 1 transformed: -36x -30y = -48
Equation 2 transformed: 25x + 30y = 70

Add together -11x = 22
x = -2

Substitute to solve for y:
6(-2) + 5y = 8
-12 + 5y = 8
5y = 20
y = 4

The solution is the ordered pair (-2,4).

3.  
Equation 1 6x - 3y = 9
Equation 2 -8x + 4y = -12

4 times equation 1: 4(6x - 3y) = 4•9
3 times equation 2:
3(-8x + 4y) = 3(-12)

Equation 1 transformed: 24x -12y = 36
Equation 2 transformed: -24x + 12y = 36

Add together 0 = 0
This is an identity. The equations are dependent so there are an infinite number of solutions.
6x - 3y = 9
-3y = 9 - 6x
y = -3 + 2x

The solutions are the ordered pairs (x,2x-3)

Practice 5.3.6

1.  
Equation 1 \[ \frac{3}{4}x - \frac{y}{4} = 2 \]
Equation 2 \[ \frac{3}{5}x + \frac{y}{5} = 2 \]

4 times equation 1: \[ 4•\frac{3}{4}x - 4•\frac{y}{4} = 4•2 \]

5 times equation 2: \[ 5•\frac{3}{5}x + 5•\frac{y}{5} = 5•2 \]
Equation 1 transformed: \[ 3x - y = 8 \]
Equation 2 transformed: \[ 3x + y = \]

Add together \[ 6x = 18 \]
\[ x = 3 \]

Substitute to solve for y: \[ \frac{3}{4} \cdot 3 - \frac{y}{4} = 2 \]

\[ \frac{9}{4} - \frac{y}{4} = 2 \]

Multiply by 4 \[ 4\cdot\frac{9}{4} - 4\cdot\frac{y}{4} = 4•2 \]

\[ 9 - y = 8 \]
\[ -y = -1 \]
\[ y = 1 \]

The solution is the ordered pair (3,1).

2.  
Equation 1 \[ \frac{7}{6}x - \frac{5}{6}y = 1 \]
Equation 2 \[ \frac{2}{9}x + \frac{4}{9}y = 2 \]

6 times equation 1: \[ 6\cdot\frac{7}{6}x - 6\cdot\frac{5}{6}y = 6•1 \]
9 times equation 2:
\[ 9\cdot\frac{2}{9}x + 9\cdot\frac{4}{9}y = 9•2 \]

Equation 1 transformed: \[ 7x - 5y = 6 \]
Equation 2 transformed: \[ 2x + 4y = 18 \]

-2 times equation 1: \[ -2(7x - 5y) = - \]

7 times equation 2:
\[ 7\cdot\frac{2}{9}x + 7\cdot\frac{4}{9}y = 7•6 \]

Eq. 1 transformed \[ -14x + 10y = -12 \]
Eq. 2 transformed: \[ 14x + 28y = 126 \]

Add together \[ 38y = 114 \]

Substitute to solve for x:
\[ \frac{7}{6}x = \frac{5}{6} \cdot 3 = 1 \]

\[ 7/6 \cdot x - 15/6 = 1 \]

Times 6: \[ 6\cdot(7/6 \cdot x) - 6\cdot(15/6) = 6\cdot1 \]
\[ 7x - 15 = 6 \]
\[ 7x = 21 \]
\[ x = 3 \]

The solution is the ordered pair (3,3).
3. **Equation 1** \[ \frac{x}{6} + \frac{y}{3} = 3 \]
   **Equation 2** \[ \frac{x}{4} + \frac{y}{2} = 1 \]
   6 times equation 1: \[ 6 \cdot \frac{x}{6} + 6 \cdot \frac{y}{3} = 6 \cdot 3 \]
   4 times equation 2: \[ 4 \cdot \frac{x}{4} + 4 \cdot \frac{y}{2} = 4 \cdot 1 \]
   **Equation 1 transformed:** \[ x + 2y = 18 \]
   **Equation 2 transformed:** \[ x + 2y = 4 \]
   -1 times equation 1: \[ -(x + 2y) = -1 \cdot 18 \]
   **Equation 1 transformed:** \[ -x - 2y = -18 \]
   **Equation 2 transformed:** \[ x + 2y = 4 \]
   Add together \[ 0 = -14 \]
   This is a contradiction. There is no solution.

**Exercise Set 5.3**

1. **Equation 1** \[ x + 2y = 11 \]
   **Equation 2** \[ 3x - 2y = 1 \]
   Add together \[ 4x = 12 \]
   \[ x = 3 \]
   Substitute to solve for y: \[ 3 + 2y = 11 \]
   \[ 2y = 8 \]
   \[ y = 4 \]
   The solution is the ordered pair \((3,4)\).

3. **Equation 1** \[ 4x - 5y = 3 \]
   **Equation 2** \[ -4x + y = -7 \]
   Add together \[ -4y = -4 \]
   \[ y = 1 \]
   Substitute to solve for x: \[ 4x - 5 \cdot 1 = 3 \]
   \[ 4x = 8 \]
   \[ x = 2 \]
   The solution is the ordered pair \((2,1)\).

5. **Equation 1** \[ 3x - y = 3 \]
   **Equation 2** \[ -5x + y = -7 \]
   Add together \[ -2x = -4 \]
   \[ x = 2 \]
   Substitute to solve for y: \[ 3 \cdot 2 - y = 3 \]
   \[ 6 - y = 3 \]
   \[ -y = -3 \]

7. **Equation 1** \[ 4x + y = 7 \]
   **Equation 2** \[ x - 4y = -11 \]
   4 times equation 1: \[ 4(4x + y) = 4 \cdot 7 \]
   **Equation 1 transformed:** \[ 16x + 4y = 28 \]
   **Equation 2** \[ x - 4y = -11 \]
   Add together \[ 17x = 17 \]
   \[ x = 1 \]
   Substitute to solve for y: \[ 4 \cdot 1 + y = 7 \]
   \[ 4 + y = 7 \]
   \[ y = 3 \]
   The solution is the ordered pair \((1,3)\).

9. **Equation 1** \[ -2x + y = -3 \]
   **Equation 2** \[ x - 3y = 14 \]
   2 times equation 2: \[ 2(x - 3y) = 2 \cdot 14 \]
   **Equation 1** \[ -2x + y = -3 \]
   **Equation 2 transformed:** \[ 2x - 6y = 28 \]
   Add together \[ -5y = 25 \]
   \[ y = -5 \]
   Substitute to solve for x: \[ -2x - 5 = -3 \]
   \[ -2x = 2 \]
   \[ x = -1 \]
   The solution is the ordered pair \((-1,-5)\).

11. **Equation 1** \[ 3x - y = 7 \]
    **Equation 2** \[ -9x + 3y = -21 \]
    3 times equation 1: \[ 3(3x - y) = 3 \cdot 7 \]
    **Equation 1 transformed:** \[ 9x - 3y = 21 \]
    **Equation 2** \[ -9x + 3y = -21 \]
    Add together \[ 0 = 0 \]
    This is an identity. The equations represent the same line so there are an infinite number of solutions.
    **Equation:** \[ 3x - y = 7 \]
    **y = 3x - 7**
    The solutions are the ordered pairs \((x,3x-7)\).

13. **Equation 1** \[ x + 5y = 3 \]
Equation 2  \[2x + 10y = 6\]
-2 times equation 1: \[-2(x + 5y) = -2\cdot3\]

Eq. 1 transformed: \[-2x - 10y = -6\]
Add together \[0 = 0\]
This is an identity and the equations represent the same line so there are an infinite number of solutions.

15. Equation 1  \[2x - 8y = 18\]
Equation 2  \[-4x + y = -21\]
2 times equation 1: \[2(2x - 8y) = 36\]

Eq. 1 transformed: \[4x - 16y = 36\]
Equation 2 \[-4x + y = -21\]
Add together \[-15y = 15\]
Substitute to solve for x:
\[2x - 8(-1) = 18\]
\[2x + 8 = 18\]
\[2x = 10\]
\[x = 5\]
The solution is the ordered pair (5,-1).

17. Equation 1  \[2y = 14 - 3x\]
Equation 2  \[3x - 4y = 8\]

Eq. 1 in standard form: \[-3x- 2y = -14\]
Equation 2 \[3x - 4y = 8\]
Add together \[-6y = -6\]
Substitute to solve for x:
\[2(1) = 14 - 3x\]
\[2 = 14 - 3x\]
\[-12 = -3x\]
\[x = 4\]
The solution is the ordered pair (4,1).

19. Equation 1  \[x = 3 - 2y\]
Equation 2  \[-5x - 10y = -15\]

Eq. 1 in standard form: \[x + 2y = 3\]
5 times equation 1: \[5(x + 2y) = 5\cdot3\]

Eq. 1 transformed: \[5x + 10y = 15\]
Equation 2 \[-5x - 10y = -15\]
Add together \[0 = 0\]
This is an identity. The equations are the same so there are an infinite number of solutions.
x = 3 - 2y
x - 3 = -2y
3/2 - x/2 = y
The solutions are the ordered pairs (x,3/2 - x/2).

21. Equation 1  \[6x - 5y = -3\]
Equation 2  \[9x + 2y = 5\]
2 times equation 1: \[2(6x - 5y) = 2\cdot(-3)\]
5 times equation 2: \[5(9x + 2y) = 5\cdot5\]

Eq 1 transformed: \[12x - 10y = -6\]
Eq. 2 transformed: \[45x+ 10y = 25\]
Add together \[57x = 19\]
Substitute to solve for y:
\[6(1/3) - 5y = -3\]
\[2 - 5y = -3\]
\[-5y = -5\]
y = 1
The solution is the ordered pair (1/3,1).

23. Equation 1  \[3x - 9y = 6\]
Equation 2  \[5x - 15y = 10\]
-5 times eq. 1: \[-5(3x - 9y) = -5\cdot6\]
3 times eq. 2: \[3(5x - 15y) = 3\cdot10\]

Eq 1 transformed: \[-15x + 45y = -30\]
Eq 2 transformed: \[15x - 45 y = 30\]
Add together \[0 = 0\]
This is an identity and the equations represent the same line so there are an infinite number of solutions.
3x - 9y = 6
\[-9y = 6 - 3x\]
y = -2/3 + x/3
The solutions are the ordered pairs (x,-2/3 + x/3).

25. Equation 1  \[6x = 3y + 5\]
Equation 2 \[ 4y = 7 + 8x \]
Eq. 1 in standard form: \[ 6x - 3y = 5 \]
Eq 2 in standard form: \[-8x + 4y = 7 \]
4 times equation 1: \[ 4(6x - 3y) = 4 \cdot 5 \]
3 times equation 2: \[ 3(-8x + 4y) = 3 \cdot 7 \]

3 \cdot 7

Eq 1 transformed: \[ 24x - 12y = 20 \]
Eq 2 transformed: \[ -24x + 12y = \]

Add together \[ 0 \]
This is a contradiction. There is no solution.

27.

Equation 1 \[ 2x - 3y = 5 \]
Equation 2 \[ 3x + 5y = 17 \]
5 times equation 1: \[ 5(2x - 3y) = 5 \cdot 5 \]
3 times eq 2: \[ 3(3x + 5y) = 3 \cdot 17 \]
Eq 1 transformed: \[ 10x - 15y = 25 \]
Eq 2 transformed: \[ 9x + 15y = 51 \]
Add together \[ 19x = 76 \]
\[ x = 4 \]

Substitute to solve for \( y \):
\[ 10 \cdot 4 - 15y = 25 \]
\[ 40 - 15y = 25 \]
\[ -15y = -15 \]
\[ y = 1 \]
The solution is the ordered pair \((4, 1)\).

29.

Equation 1 \[ \frac{x}{2} + \frac{2}{3} y = \frac{7}{5} \]
Equation 2 \[ \frac{x}{2} + \frac{2}{3} y = \frac{1}{3} \]
10 times equation 1:
\[ 10 \cdot \frac{x}{2} + 10 \cdot \frac{2}{3} y = 10 \cdot \frac{7}{5} \]
6 times equation 2:
\[ 6 \cdot \frac{x}{2} - 6 \cdot \frac{2}{3} y = 6 \cdot \frac{1}{3} \]

Equation 1 transformed: \[ 5x + 4y = 14 \]
Equation 2 transformed: \[ 3x - \]
\[ 4y = 2 \]
Add together \[ 8x = 16 \]
\[ x = 2 \]

Substitute to solve for \( y \):
\[ \frac{2}{2} + \frac{2}{5} y = \frac{7}{5} \]
\[ 1 + 2/5 y = 7/5 \]
Multiply by 5: \[ 5 \cdot 1 + 5(2/5 y) = 5(7/5) \]

33.

Equation 1 \[ \frac{5}{4} x - \frac{3}{4} y = 3 \]
Equation 2 \[ \frac{3}{7} x + \frac{5}{7} y = 2 \]
4 times equation 1:
\[ 4 \cdot \frac{5}{4} x - 4 \cdot \frac{3}{4} y = 4 \cdot 3 \]
7 times equation 2:
\[ 7 \cdot \frac{3}{7} x + 7 \cdot \frac{5}{7} y = 7 \cdot 2 \]

Equation 1 transformed: \[ 5x - 3y = 12 \]
Equation 2 transformed: \[ 3x + 5y = 14 \]
5 times equation 1:
\[ 5(5x - 3y) = 5 \cdot 12 \]
3 times equation 2:
\[ 3(3x + 5y) = 3 \cdot 14 \]

Eq 1 transformed: \[ 25x - 15y = 60 \]
Eq 2 transformed: \[ 9x + 15y = 42 \]
Add together \[ 34x = 102 \]
\[ x = 3 \]
Substitute to solve for $y$:

$\frac{3}{7} \cdot (3) + \frac{5}{7} \cdot y = 2$

$\frac{9}{7} + \frac{5}{7} \cdot y = 2$

Multiply by 7:

$\frac{9}{7} \cdot 7 + \frac{5}{7} \cdot y = 7 \cdot 2$

$9 + 5y = 14$

$5y = 5$

$y = 1$

The solution is the ordered pair $(3,1)$.

35. Equation 1

$\frac{x}{4} + \frac{y}{2} = \frac{9}{2}$

Equation 2

$\frac{x}{6} + \frac{y}{3} = 3$

4 times equation 1:

$4 \cdot \frac{x}{4} + 4 \cdot \frac{y}{2} = 4 \cdot \frac{9}{2}$

6 times equation 2:

$6 \cdot \frac{x}{6} + 6 \cdot \frac{y}{3} = 6 \cdot 3$

Equation 1 transformed: $x + 2y = 18$

Equation 2 transformed: $x + 2y = 18$

This is an identity and the equations represent the same line so there are an infinite number of solutions.

37. Equation 1

$\frac{x - y}{4} = -1$

Equation 2

$\frac{3}{4} \cdot x + \frac{y}{2} = 1$

4 times equation 1:

$4 \cdot \frac{x - y}{4} = 4 \cdot (-1)$

4 times equation 2:

$4 \cdot \frac{3}{4} x + 4 \cdot \frac{y}{2} = 4 \cdot 1$

Equation 1 transformed: $x - 2y = -4$

Equation 2 transformed: $3x + 2y = 4$

Add together:

$4x = 0$

$x = 0$

Substitute to solve for $y$:

$\frac{0 - y}{4} = -1$

The solution is the ordered pair $(0,2)$.

39. Equation 1

$x - 8(x + 2) = 3 - x$

$\frac{2}{3} \cdot (-3) - 8(-3 + 2) = 3 - (-3)$

$-2 - 8(-1) = 3 + 3$

$-2 + 8 = 6$

$6 = 6$

This is a solution.

41. $4(x - 3) \geq 8 - x$

$4x - 12 \geq 8 - x$

$5x - 12 \geq 8$

$5x \geq 20$

$x \geq 4$

43. $x$ intercept is $(-6,0)$

$y$ intercept is $(0,-8)$

44. Using $(0,6)$ and $(2,0)$

$m = \frac{6 - 0}{0 - 2} = \frac{6}{-2} = -3$

$y = -3x + 6$ since $(0,6)$ is the $y$ intercept.

45. $m = \frac{-2 - 4}{0 - 3} = \frac{-6}{-3} = 2$

$y = 1x - 2$ since $(0,-2)$ is the $y$ intercept.

46. $m = 1$ since the lines are parallel.

$y = 1x + b$

$2 = 1(4) + b$

$2 = 4 + b$

$b = -2$
y = x - 2

47. Let x = first even integer
x + 2 = second
x + (x + 2) = -14
x + x + 2 = -14
2x + 2 = -14
2x = -16
x = -8
x + 2 = -6

48. Let x = time of first worker
x - 2 = time of second
amount = rate • time
183 = 15x + 19(x - 2)
183 = 15x + 19x - 38
221 = 34x
x = 6.5 hours for the first
x - 2 = 4.5 hours for the second

2. Let n = number of nickels
q = number of quarters
Total value = value of nickels + value of quarters
0.05n = value of nickels
0.25q = value of quarters
Equation 1: 0.05n + 0.25q = 5.00
Equation 2: n + q = 32
Solve for n: n = 32 - q
Substitute into equation 1:
0.05(32 - q) + 0.25q = 5.00
1.6 - 0.05q + 0.25q = 5.00
0.20q = 3.4
q = 17 quarters
32 - 17 = 15 nickels

Section 5.4 Solving Word Problems Using Systems

Practice 5.4.1
1. Let c = number of pounds of chocolate
b = number of pounds of butterscotch
Total value = value of chocolate + value of butterscotch
3.50c = value of chocolate
2.75b = value of butterscotch
Equation 1: 30.50 = 3.50c + 2.75b
Equation 2: b + c = 10
Solve for b: b = 10 - c

Practice 5.4.2
1. Let f = time for first part at 50 mph
s = time for part of trip at 62 mph
distance = rate • time
Equation 1: 50f + 62s = 740
Equation 2: s = f + 2
Substitute into equation 1:
50f + 62(f + 2) = 740
50f + 62f + 124 = 740
112f = 616
f = 5.5 hours
s = 5.5 + 2 = 7.5 hours
62 • 7.5 = 465 miles at 62 mph

2. Let f = time for first part at 240 mph
s = time for part of trip at 200 mph
distance = rate • time
Equation 1: 240f + 200s = 1460
Equation 2: f = s + 1.5
Substitute into equation 1:
240(s + 1.5) + 200s = 1460
240s + 360 + 200s = 1460
440s = 1100
s = 2.5 hours through the turbulence

3. Let s = time traveled at 50 mph
f = time traveled at 60 mph
distance = rate • time
Distances are the same.
Equation 1:  \( 50s = 60f \)
Equation 2:  \( s = f + 1 \)
Substitute in equation 1:
\[
50(f + 1) = 60f
\]
\[
50f + 50 = 60f
\]
f = 5 hours
10 am + 5 hours = 3 pm (before to avoid a crash)
5•60 = 300 miles from station

**Practice 5.4.3**

1. Let \( w \) = speed of wind
   \( p \) = speed of plane
   \( p + w \) = speed with tailwind
   \( p - w \) = speed with headwind
distance = rate \( \times \) time
Equation 1:  \( 3575 = 5.5(p + w) \)
Equation 2:  \( 3575 = 6.5(p - w) \)
Solve equation 1 for \( p \):
\[
3575 = 5.5p + 5.5w
\]
\[
3575 - 5.5w = 5.5p
\]
p = 650 - \( w \)
Substitute into equation 2:
\[
3575 = 6.5[(650 - w) - w]
\]
\[
3575 = 6.5(650 - 2w)
\]
\[
3575 = 4225 - 13w
\]
\[
-650 = -13w
\]
w = 50 mph for the speed of the wind
Substitute in equation 1 to solve for \( p \):
\[
3575 = 5.5(p + 50)
\]
\[
3575 = 5.5p + 275
\]
3300 = 5.5p
p = 600 mph for the speed of the plane

2. Let \( c \) = speed of the current; \( b \) = speed of the boat
Distance = rate \( \times \) time
Distance upstream and downstream are the same.
\( b + c \) = speed downstream
\( b - c \) = speed upstream
Equation 1:  \( 21 = 3(b + c) \)
Equation 2:  \( 21 = 7(b - c) \)
Solve equation 1 for \( b \):
\[
21 = 3b + 3c
\]
\[
21 - 3c = 3b
\]
\[
7 - c = b
\]
Substitute in equation 2:
\[
21 = 7[(7 - c) - c]
\]
\[
21 = 7[7 - 2c]
\]
21 = 49 - 14c
\[
-28 = -14c
\]
c = 2 mph for the speed of the current
Substitute to solve for \( b \):
\[
21 = 3(b + 2)
\]
21 = 3b + 6
15 = 3b
\( b \) = 5 mph for the speed of the boat

**Practice 5.4.4**

1. Let \( s \) = number of sedans painted
   Let \( e \) = number of economy cars
   amount = rate \( \times \) time
Equation 1:  \( 350 = 30s + 20e \)
Equation 2:  \( 100 = 10s + 5e \)
Solve equation 2 for \( e \):
\[
100 = 10s + 5e
\]
\[
20 - 2s = e
\]
Substitute in equation 1:
\[
350 = 30•5 + 20e
\]
\[
350 = 150 + 20e
\]
\[
200 = 20e
\]
e = 10 economy cars

2. Let \( d \) = number of deluxe models
   \( s \) = standard models
Equation 1:  \( 54 = 8d + 3s \)
Equation 2:  \( 19 = 3d + 1s \)
Solve equation 2 for \( s \):
\[
19 - 3d = s
\]
Substitute in equation 1:
\[
54 = 8d + 3(19 - 3d)
\]
\[
54 = 8d + 57 - 9d
\]
\[
-3 = -d
\]
d = 3 deluxe models
Substitute to solve for \( s \):
\[
54 = 8\times3 + 20e
\]
\[
350 = 150 + 20e
\]
\[
200 = 20e
\]
e = 10 economy cars

**Exercise Set 5.4**

1. Let \( a \) = number machine A did
   \( b \) = number machine B did
Equation 1:  \( a = b + 45 \)
Equation 2:  \( a + b = 145 \)
Substitute equation 1 in equation 2:
(b + 45) + b = 145
b + 45 + b = 145
2b + 45 = 145
2b = 100
b = 50 completed by machine A
a = 50 + 45 = 95 completed by machine B

3. Let $s$ = amount in savings; $c$ = amount in checking
   
   Equation 1: $c + s = 3325$
   
   Equation 2: $s = 325 + c$
   
   Substitute equation 2 in equation 1:
   
   $(c + 325) + c = 3325$
   
   $2c + 325 = 3325$
   
   $2c = 100$
   
   $c = 50$
   
   $a = 50 + 45 = 95$
   
   completed by machine B

5. Let $l$ = length; $w$ = width
   
   Equation 1: $2l + 2w = 292$
   
   Equation 2: $l = 3w + 2$
   
   Substitute equation 2 in equation 1:
   
   $2(3w + 2) + 2w = 292$
   
   $6w + 4 + 2w = 292$
   
   $8w + 4 = 292$
   
   $8w = 288$
   
   $w = 36$ feet
   
   $3(36) + 2 = 108 + 2 = 110$ feet

7. Let $o$ = number of $1$ bills; $t$ = number of $20$ bills
   
   $1o = \text{value of } 1 \text{ bill; } 20t = \text{value of } 20 \text{ bills}$
   
   Equation 1: $o + t = 25$
   
   Equation 2: $1o + 20t = 215$
   
   Solve equation 1 for $o$: $o = 25 - t$
   
   Substitute in equation 2:
   
   $1(25 - t) + 20t = 215$
   
   $25 - t + 20t = 215$
   
   $19t = 190$
   
   $t = 10$ $20$ bills
   
   $25 - 10 = 15$ $1$ bills

9. Let $x$ = number of pounds of $6.60$
   
   $y = \text{number of pounds of } 9.50 \text{ coffee}$
   
   value = amount * price per pound
   
   Equation 1: $x + y = 25$
   
   Equation 2: $6.60x + 9.50y = 199.80$
   
   Solve equation 1 for $x$: $x = 25 - y$
   
   Substitute in equation 2:
   
   $6.60(25 - y) + 9.50y = 199.80$
   
   $165 - 6.6y + 9.5y = 199.80$
   
   $2.9y = 34.8$
   
   $y = 12$ pounds of $9.50 \text{ coffee}$
   
   $25 - 12 = 13$ pounds of $6.60 \text{ coffee}$

11. Let $t$ = time of train
   
   $c = \text{time of car}$
   
   distance = rate * time
   
   Equation 1: $110t + 60c = 985$
   
   Equation 2: $t = c + 2$
   
   Substitute equation 2 in equation 1:
   
   $110(c + 2) + 60c = 985$
   
   $110c + 220 + 60c = 985$
   
   $170c + 220 = 985$
   
   $170c = 765$
   
   $c = 4.5$ hours
   
   Car left at 1 pm ($1$ am + 2 hours)
   
   so 4.5 hours later would be 5:30.

13. Let $f$ = time of 10 mph bike
   
   $s = \text{time of 7 mph}$
   
   distance = rate * time
distance of fast - distance of slow =

   Equation 1: $10f - 7s = 17$
   
   Equation 2: $f = s + 0.5$ where 0.5 represents half an hour later.
   
   Substitute equation 2 in equation 1:
   
   $10(s + 0.5) - 7s = 17$
   
   $10s + 5 - 7s = 17$
   
   $3s = 12$
   
   $s = 4$ hours
   
   $8:30 = 4$ hours = 12:30 pm

15. $p$ = speed of plane; $w$ = speed of wind
   
   $p + w = \text{speed with tailwind}$
   
   $p - w = \text{speed with headwind}$
   
   Equation 1: $1050 = 3(p + w)$
   
   Equation 2: $1050 = 3.5(p - w)$
   
   Solve equation 1 for $p$:
   
   $1050 = 3p + 3w$
   
   $1050 - 3w = 3p$
   
   $350 - w = p$
   
   Substitute into equation 2:
   
   $1050 = 3.5[(350 - w) - w]$
   
   $1050 = 3.5(350 - 2w)$
   
   $1050 = 1225 - 7w$
   
   $-175 = -7w$
   
   $w = 25$ mph for speed of the wind
   
   Substitute to solve for $p$:
   
   $1050 = 3(p + 25)$
   
   $1050 = 3p + 75$
   
   $975 = 3p$
p = 325 mph for the plane’s air speed

17. Let n = number of novels
m = number of magazines

amount = rate • time
Equation 1: \[ 480 = 30n + 4m \]
Equation 2: \[ 95 = 5n + 1m \]

Solve equation 2 for m: \[ 95 - 5n = m \]
Substitute in equation 1:
\[ 480 = 30n + 4(95-5n) \]
\[ 480 = 30n + 380 - 20n \]
\[ 100 = 10n \]
\[ n = 10 \text{ novels} \]

Substitute to solve for m:
\[ 480 = 30\cdot 10 + 4m \]
\[ 480 = 300 + 4m \]
\[ 180 = 4m \]
\[ m = 45 \text{ magazines} \]

19. Commutative property of multiplication

20. \[ x \geq -7 \]

21. \[ \frac{2}{3}x - 5(x + 1) > \frac{3x}{2} \]
\[ 6\cdot \frac{2}{3}x - 6\cdot 5(x + 1) > 6\cdot \frac{3x}{2} \]
\[ 2(2x) - 30(x + 1) > 3(3x) \]
\[ 4x - 30x - 30 > 9x \]
\[ -26x - 30 > 9x \]
\[ -35x > 30 \]
\[ x < -30/35 \]
\[ x < -6/7 \]

22. Let w = width: length = 4w (since width is 1/4 length)
Perimeter = 2l + 2w
\[ 2(4w) + 2(w) = 130 \]

23. Let t = time riding home
distance = rate • time
The distances are equal.
4:45 - 4:25 = 20 minutes = 1/3 hour
12(1/3) = 17t
\[ 4 = 17t \]
\[ t = \frac{4}{17} \text{ hour} ----> \frac{4}{17}\cdot 60 = 24 \text{ minutes} \approx 14 \text{ minutes} \]
4:45 + 14 minutes = 4:59 or one minute before 5 pm.

24. Line 1 \[ m = \frac{4-3}{0-1} = \frac{1}{-1} = -1 \]
Line 2 \[ m = \frac{3\cdot(-2)}{5\cdot0} = \frac{3\cdot-2}{5} = \frac{-6}{5} = -1 \]
Slopes have opposite signs and are reciprocals. Lines are perpendicular.

25. Domain = \{3, 5\} Range = \{-2, -1, 0, 2\}

Chapter 5 Review Exercises

1.  Yes, (2,0) solves this system.
2.  (1,1)
3. \((x, 3x-2)\)

4. \((4, -2)\)

5. No solution

6. There is a solution the system is consistent. The lines are not the same so the equations are independent.

7. There is no solution so the system is inconsistent. The lines are not the same so the equations are independent.

8. a) Let \(x\) = time in minutes since leak started
   \(y\) = number of gallons of water moved (in and out of the ship)
   \(y = 150(x - 5)\) water moved out of ship
   Equation 1: \(y = 150x - 750\)
   Equation 2: \(y = 100x\) water moved into the ship
   b) This occurs 15 minutes after the leak has started. The amount of water coming in and out of the ship is the same - 1500 gallons

9. a) Let \(x\) = number of hours; \(y\) = cost
   Equation 1: \(y = 60 + 40x\)
   Equation 2: \(y = 55x + 15\)
   b)
c) When the job requires 3 hours the cost ($180) is the same for both companies.
d) For jobs less than 3 hours Penny’s plumbing is cheapest. For jobs over 3 hours Highland is cheapest.

10. Equation 1: \[5x - 3y = -5\]
    Equation 2: \[7x + y = 19\]
    Solve equation 2 for \(y\): \(y = 19 - 7x\)
    Substitute in equation 1:
    \[5x - 3(19 - 7x) = -5\]
    \[5x - 57 + 21x = -5\]
    \[26x = 52\]
    \[x = 2\]
    Substitute to solve for \(y\):
    \[5(2) - 3y = -5\]
    \[10 - 3y = -5\]
    \[-3y = -15\]
    \[y = 5\]
    The solution is the ordered pair \((2, 5)\).

11. Equation 1: \[-2x + y = 2\]
    Equation 2: \[y = 3x\]
    Substitute equation 2 in equation 1:
    \[-2x + (3x) = 2\]
    \[-2x + 3x = 2\]
    \[x = 2\]
    Substitute to solve for \(y\):
    \[y = 3(2)\]
    \[y = 6\]
    The solution is the ordered pair \((2, 6)\).

12. Equation 1: \[3 = 5y - 2x\]
    Equation 2: \[7 = -6x + 15y\]
    Eq 1 in standard form: \[-2x + 5y = 3\]

13. Equation 1: \[5 + 5y = -4x\]
    Equation 2: \[8x + 6 = -10y\]
    Eq 1 in standard form: \[4x + 5y = -5\]
    Eq 2 in standard form: \[8x + 10y = 6\]
    -2 times eq 1: \[-2(4x + 5y) = -2(-5)\]
    \[-8x - 10y = -10\]
    Add
    There is no solution. The lines are parallel.

14. Plan A slope = \[\frac{55 - 40}{30 - 0} = \frac{15}{30} = \frac{1}{2} = 0.5\]
    The y intercept is \((0, 40)\) so \(b = 40\)
    Equation 1: \[y = 0.5x + 40\]
    Plan B slope = \[\frac{46 - 32}{30 - 10} = \frac{14}{20} = \frac{7}{10} = 0.7\]
    \[y = 0.7x + b\]
    \[32 = 0.7(10) + b\]
    \[32 = 7 + b\]
    \[b = 25\]
    Equation 2: \[y = 0.7x + 25\]
    Substitute equation 1 in equation 2:
    \[0.5x + 40 = 0.7x + 25\]
    \[15 = 0.2x\]
    \[x = 75\] minutes of use results in the same cost for both plans - \$77.50

15. Equation 1: \[3x + y = 4\]
    Equation 2: \[x - y = 8\]
    Add together \[4x = 12\]
    \[x = 3\]
    Substitute to solve for \(y\): \[3(3) + y = 4\]
    \[9 + y = 4\]
    \[y = -5\]
    The solution is the ordered pair \((3, -5)\).

16. Equation 1: \[x + 2y = 3\]
    Equation 2: \[-x - 5y = 12\]
    Add together \[-3y = 15\]
3

y = -5
Substitute to solve for x: x + 2(-5) =

3
x - 10 = 3
x = 13
The solution is the ordered pair (13,-5).

17. Equation 1: 2x - y = 3
   Equation 2: x + 2y = -11
2 times equation 1: 2(2x - y) = 2•3

4x - 2y = 6
x + 2y = -11 Equation 2
5x = -5 Add together
x = -1
Substitute to solve for y: 2(-1) - y =

3
-2 - y = 3
-y = 5
y = -5
The solution is the ordered pair (-1,-5).

18. Equation 1: 8x - 3y = 31
   Equation 2: 2x + y = -1
3 times equation 2: 3(2x + y) = 3(-1)

6x + 3y = -3
8x - 3y = 31 Equation 2
14x = 28 Add
together
x = 2
Substitute to solve for y: 2(2) + y =

-1
4 + y = -1
y = -5
The solution is the ordered pair (2,-5).

19. Equation 1: 8x = y + 17
   Equation 2: x + y = 1
   Equation 1 in standard form:
   8x - y = 17
   \[ \frac{x + y}{9x} = \frac{1}{18} \] Add together
x = 2
Substitute to solve for y: 8(2) = y +
17

16 = y + 17
y = -1
The solution is the ordered pair (2,-1).

20. Equation 1: 2y = 17 - x
    Equation 2: 5x - 8 = y
Eq 1 in standard form: x + 2y = 17
Eq 2 in standard form: 5x - y = 8
2 times equation 2: 2(5x - y) = 2•8
10x - 2y = 16
\[ \frac{x + 2y = 17}{11x = 33} \] Add together
x = 3
Substitute to solve for y: 2y = 17 - 3
2y = 14
y = 7
The solution is the ordered pair (3,7).

21. Equation 1: 12x + 3y = 15
    Equation 2: -5x + 2y = -3
-2 times eq 1: -2(12x + 3y) = -2(15)
3 times eq 2: 3(-5x + 2y) = 3(-3)
Eq 1 transformed: -24x + 6y = -30
Eq 2 transformed: -15x + 6y = -9
Add together -39x = -39
x = 1
Substitute to solve for y:
12(1) + 3y = 15
12 + 3y = 15
3y = 3
y = 1
The solution is the ordered pair (1,1).

22. Equation 1: 9x - 2y = 20
    Equation 2: 5x + 3y = 7
3 times equation 1: 3(9x - 2y) = 3•20
2 times equation 2: 2(5x + 3y) = 2•7
Eq 1 transformed: 27x - 6y = 60
Eq 2 transformed: 10x + 6y = 14
Add together \[ \frac{37x = 74}{x = 2} \]
Substitute to solve for y:
9(2) - 2y = 20
18 - 2y = 20
-2y = 2
y = -1
The solution is the ordered pair (2,-1).

23. Equation 1: 1/2 x - y = -4
Equation 2: \[ x + \frac{1}{3} y = -1 \]

2 times equation 1: \[ 2(\frac{1}{2} x - y) = 2(-4) \]

3 times equation 2: \[ 3(x + \frac{1}{3} y) = 3(-1) \]

Equation 1 transformed: \[ x - 2y = -8 \]
Equation 2 transformed: \[ 3x + y = -3 \]

2 times equation 2: \[ 2(3x + y) = 2(-3) \]

\[ 6x + 2y = -6 \]
\[ x - 2y = -8 \] Equation 1
\[ 7x = -14 \] Add
together
\[ x = -2 \]
Substitute to solve for y:
\[ 1/2(-2) - y = -4 \]
\[ -1 - y = -4 \]
\[ -y = -3 \]
\[ y = 3 \]
The solution is the ordered pair (-2, 3).

24. Equation 1: \[ \frac{1}{6} x + y = -1 \]
Equation 2: \[ 2x - \frac{1}{2} y = 13 \]
6 times eq 1: \[ 6(\frac{1}{6} x + y) = 6(-1) \]
2 times eq 2: \[ 2(2x - \frac{1}{2} y) = 2\cdot13 \]

Equation 1 transformed: \[ x + 6y = -6 \]
Equation 2 transformed: \[ 4x - y = 26 \]
6 times equation 2: \[ 6(4x - y) = \]

\[ 24x - 6y = 156 \]
\[ x + 6y = -6 \] Equation 2
\[ 25x = 150 \] Add
together
\[ x = 6 \]
Substitute to solve for y:
\[ 1/6(6) + y = -1 \]
\[ 1 + y = -1 \]
\[ y = -2 \]
The solution is the ordered pair (6, -2).

25. Let q = quarters; d = dimes
value of quarters = 0.25q
value of dimes= 0.10d
Equation 1: \[ q + d = 23 \]
Equation 2: \[ 0.25q + 0.10d = 5.00 \]

Solve equation 1 for q: \[ q = 23 - d \]
Substitute in equation 2:
\[ 0.25(23 - d) + 0.10d = 5.00 \]
\[ 5.75 - 0.25d + 0.10d = 5.00 \]
\[ -0.15d = -0.75 \]
\[ d = 5 \text{ dimes} \]

26. Let w = speed of wind
p=air speed of plane
p + w = plane speed with tailwind
p - w = plane speed with headwind
distance = rate • time
1600 = 2(p + w)
1600 = 2.5(p - w)
1600 = 2p + 2w
1600 = 2.5p - 2.5w
Solve equation 1 for p:
1600 - 2w = 2p
p = 800 - w
Substitute in equation 2:
1600 = 2.5(800-w) - 2.5w
1600 = 2000 - 2.5w - 2.5w
-400 = -5w
w = 80 mph for the wind speed
Substitute to solve for p:
1600 = 2(p + 80)
1600 = 2p + 160
1440 = 2p
p = 720 mph for the plane’s air speed

27. Let x = amount of HiPro; y = amount of HiFat
Eq 1: \[ 0.02x + 0.08y = 8 \text{ grams fat} \]
Eq 2: \[ 0.40x + 0.30y = 95 \text{ grams protein} \]

-20 times equation 1:
-20(0.02x+0.08y) = -20(8)
-0.40x - 1.6y = -160
\[ \frac{0.40x + 0.30y = 95}{-1.3y = -65} \] Equation 2
y = 50 grams of HiFat
Substitute to solve for x:
0.02x +0.08(50)=8
0.02x + 4 = 8
0.02x = 4
x = 200 grams of HiPro

CHAPTER 5 SYSTEMS OF EQUATIONS

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<td>2(-3)+(-1)=-5</td>
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<td>-5 = -5</td>
<td>2 = 2</td>
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(-3,-1) solves both equations.

2. (-1,-2)

![Graph of equations](image)

3. There is a solution so the system is consistent. The lines are not the same so the system is independent.

4. a) Let \( x \) = time in hours since speedboat left.
   \( y \) = distance from marina
   Eq 1: \( y = 50x \) for the speed boat
   Eq 2: \( y = 60(x - 0.25) \) for the police boat
   b) The intersection is (1.5,75). The police boat catches the speedboat 1.5 hours after it left the marina. At that time the boats are 75 miles from the marina.

5. Equation 1: \( 2x - 4y = 14 \)
   Equation 2: \( x - y = 6 \)
   Solve equation 2 for \( x: x = 6 + y \)
   Substitute in eq 2: \( 2(6 + y) - 4y = 14 \)
12 + 2y - 4y = 14
-2y = 2
y = -1
Substitute to find x: x - (-1) = 6
x + 1 = 6
x = 5
The solution is the ordered pair (5, -1).

6. Equation 1: 8x - y = 0
   Equation 2: -2x + y = 6
   Add together 6x = 6
   x = 1
   Substitute to solve for y: 8x - y = 0
   8 - y = 0
   y = 8
   The solution is the ordered pair (1, 8)

7. Equation 1: 20y = 8 + 6x
   Equation 2: 3x + 4 = 10y
   Eq 1 in standard form: -6x + 20y = 8
   Eq 2 in standard form: 3x - 10y = -4
   2 times equation 2: 2(3x - 10y) = 2(-4)
   6x - 20y = -8
   -6x + 20y = 8
   Add together
   The lines are the same. Solve for y in one of the equations: 20y = 8 + 6x
   y = 0.4 + 0.3x
   The solutions are the ordered pairs (x, 0.4 + 0.3x).

8. Equation 1: 2x + y = 5
   Equation 2: 2y = -4x + 8
   Solve equation 1 for y: y = 5 - 2x
   Substitute in equation 2:
   2(5 - 2x) = -4x + 8
   10 - 4x = -4x + 8
   2 = 0
   This is a contradiction. There is no solution since the lines are parallel.

9. Equation 1: -5x + 2y = -9
   Equation 2: -3x - 3y = 3
   Solve equation 2 for x: -3x = 3 + 3y
   x = -1 - y
   Substitute in equation 1:
   -5(-1 - y) + 2y = -9
   5 + 5y + 2y = -9
   7y = -14
   y = -2
   Substitute to solve for x:
   -5x + 2(-2) = -9
   -5x - 4 = -9
   -5x = -5
   x = 1
   The solution is the ordered pair (1, -2).

10. Equation 1: 1/5 x + y = -4
    Equation 2: x - 2/3 y = 14
    5 times eq 1: 5(1/5 x + y) = 5(-4)
    3 times eq 2: 3(x - 2/3 y) = 3(14)
    Eq 1 transformed: x + 5y = -20
    Eq 2 transformed: 3x - 2y = 42
    Solve equation 1 for x: x = -20 - 5y
    Substitute in equation 2:
    3(-20 - 5y) - 2y = 42
    -60 - 15y - 2y = 42
    -17y = 102
    y = -6
    Substitute to solve for x:
    x - 2/3(-6) = 14
    x + 4 = 14
    x = 10
    The solution is the ordered pair (10, -6).

11. Let x = speed of boat in still water.
    c = speed of current
    x + c = speed going downstream
    x - c = speed going upstream
    distance = rate • time
    Equation 1: 10 = 2.5(x + c)
    Equation 2: 10 = 4(x - c)
    Solve equation 1 for x:
    10 = 2.5x + 2.5c
    10 - 2.5c = 2.5x
    x = 4 - c
    Substitute in equation 2:
    10 = 4((4 - c) - c)
    10 = 4(4 - 2c)
    10 = 16 - 8c
    -6 = -8c
    c = 0.75 mph for the current speed of the current.