Chapter 9

9.1 Solving Systems of Linear Equations by Substitution, pages 474 to 479

1. a) $x =$ [illegible] and $y =$ [illegible]
b) $x = -6$ and $y = 18$
c) $x = 12$ and $y = 5$

2. a) $x = 2$ and $y = -2$
b) $j = 2$ and $m = 16$
c) $k = 1.5$ and $n = -1$

3. a) $x = 7$ and $y = -2.9$; Example: Isolating y makes for easier calculations.
b) $x = 21\frac{3}{7}$ and $y = -37\frac{1}{7}$; Example: Isolating y makes for easier calculations.
c) $x = 4$ and $y = 3$; Example: Isolating x makes for easier calculations.

4. a) $x = 12\frac{6}{7}$ and $y = -\frac{5}{7}$
b) $x = -2$ and $y = 8$
c) $x = 17\frac{3}{4}$ and $y = -3\frac{5}{6}$

5. a) $x = 6$ and $y = 2$
b) Example: Helen's method is preferred. Although it requires two steps to isolate the variable x, the solution does not involve operations involving fractions. Jaret's method involves operations on fractions with a denominator of 2.

6. Let x and y be the two numbers. $x + y = 20$ and $2x = 4y + 4$; $x = 14$ and $y = 6$

7. a) approximately (0.3, 3.7)
b) $\left(\frac{1}{3}, 3\frac{2}{3}\right)$
c) The algebraic approach gives exact answers.

8. a), **b)**, and **c)** $x = 6.5$ and $y = 4.5$

d) Example: The method in part b) eliminates the decimals and leaves numbers that are easy to use.

9. 32 m and 50 m

10. Vancouver: 48 cm, Whitehorse: 144 cm

11. 12 days

12. 13 h

13. 7 years

14. Rory: 16 years old,
Rory's grandmother: 74 years old

15. Let b represent the cost of one bush and t represent the cost of one tree, both in dollars.
$40b + 12t = 1484$ and $25b + 18t = 1421$;
One bush costs $23 and one tree costs $47.

16. a) 12 more dimes than quarters; 23 more quarters than nickels

b) Example: The question deals only with the quantity of each type of coin, not the value of the coins.

17. 6 students in each van and 44 students in each bus

18. whole-wheat bread: 28 L; white bread: 40 L

19. a) The answer must be a whole number but the ratio $\frac{7593}{24}$ is not a whole number.

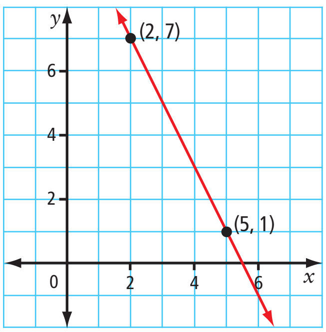
b) In step 2, he needs to multiply the expression $1.00(132 - q)$ by 100 also. Then, it becomes $100(132 - q)$.

c) 73 quarters and 59 loonies

20. a) $x = -1\frac{3}{32}$ and $y = -2\frac{5}{32}$

b) $x = \frac{2}{5}$ and $y = \frac{3}{4}$

21. $m = -2$ and $b = 11$



22. 0.5 km

23. $P = I^2R$

24. Example: Substitution results in the statement $10 = -15$, which is not true. So, the system cannot have a solution.

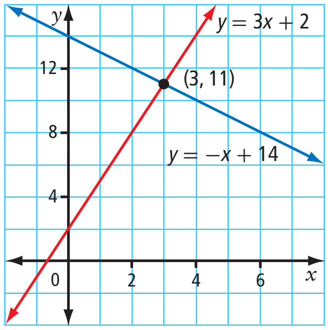
25. Examples:

a) Both methods may use algebra to rearrange an equation. Both methods produce the same solution.

b) Substitution involves working algebraically with equations, variables, and mathematical operations, while solving graphically involves drawing two graphs and finding their point of intersection.

26. Example: $y = 3x + 2$ and $x + y = 14$

a) $x = 3$ and $y = 11$



b) Example: The substitution method is simple. For the graphical approach, the second equation needs to be rewritten in $y = mx + b$ form.

9.2 Solving Systems of Linear Equations by Elimination, pages 488 to 491

1. a) $x = 7$ and $y = 3$

b) $x = 9\frac{2}{3}$ and $y = 1\frac{2}{3}$

c) $x = 4$ and $y = 4$

2. a) $-3x + y = 11$ and $x - y = -5$

b) $x - y = -7$ and $2x + y = -8$

c) $x + 3y = 4$ and $x - y = 16$

3. $s + a = 430$ and $10s + 13a = 4804$

a) 168 tickets

b) 262 tickets

4. a) $x = 1$ and $y = 2$

b) $x = 3$ and $y = -1$

c) $x = -5$ and $y = -11$

5. a) $x = 2\frac{4}{7}$ and $y = 1\frac{1}{7}$

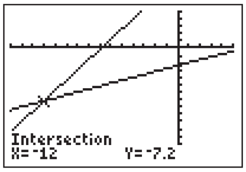
b) $x = 2\frac{8}{15}$ and $y = \frac{11}{45}$

c) $x = 4\frac{1}{2}$ and $y = 1$

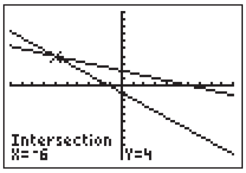
6. The system has no solution. Example: A graph of these equations would result in two parallel lines with no point of intersection.
7. 20 bicycles; 10 tricycles
8. tulip bulbs: \$14; iris bulbs: \$20
9. bagel: \$1.75; juice: \$1.25
10. 175 dogs
11. 40 trucks and 560 passenger vehicles
12. 6.75 km on the flat terrain and 1.8 km on the mountainous terrain
13. 72 min playing basketball and 18 min cycling
14. **a)** Let n represent the number of loads of laundry each sister does per week. Let V represent the number of litres of water used per week. $V = 225n$ and $V = 95n + 260$
    b) 2 loads of laundry
    c) Sharon uses 1800 L and Bev uses 1020 L. So, Sharon uses 780 L more if they both do eight loads of laundry.
15. **a)** $x = -3$ and $y = 2$
    b) $x = 1\frac{7}{25}$ and $y = \frac{56}{75}$
16. \$1750
17. 53.3 L of the 3.25% MF and 6.7 L of the 1% MF
18. $k = 12$
19. $a = -9$ and $b = 9$; There is only one solution. Example: The value of y (which equals a) can be determined from substituting 9 for x in the first equation. The value of b is determined by substituting $x = 9$ and $y = -9$ into the second equation.
20. **a)** Example: $3x + 2y = 10$ and $2x - y = 4$; $x = 2\frac{4}{7}$ and $y = 1\frac{1}{7}$
    b) It is easy to isolate y in the second equation to substitute into the first equation.
    c) Example: Any equations in which none of the coefficients of x or y in either equation is equal to one. When you must divide each term in an equation, you may have to substitute fractional expressions early in the solution.
21. Example: If it is easy to isolate either x or y in either equation without producing fractions, then substitution will be a good method.
    Example: $x + 5y = 7$ and $4x - 3y = -20$
    For any other system, elimination is a better method.

9.3 Solving Problems Using Systems of Linear Equations, pages 498 to 501

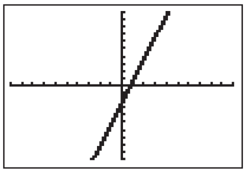
1. **a)** $x = -12$ and $y = -7.2$



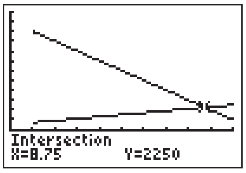
   b) $x = -6$ and $y = 4$



   c) There are an infinite number of solutions.



2. **a)** $x = 2$ and $y = -6.5$
   b) $m = 12.6$ and $n = 10.4$
   c) $x = \frac{1}{3}$ and $y = -\frac{2}{3}$
3. Calgary: -2.8 °C; Winnipeg: -12.7 °C
4. 6.4%
5. **a)** The equation $C = 0.3m + 16$ represents the total cost, in dollars, of the fundraiser. The equation $C = 0.75m$ represents the income, in dollars, from the sale of the muffins.
   b) 36 muffins
6. approximately 602 h
7. 85 adults and 45 students
8. If Jason drives exactly 520 km, the rental cost is the same for both companies. If he drives less than 520 km, Easy 4 U is cheaper. If he drives more than 520 km, Speed-E-Car is less expensive.

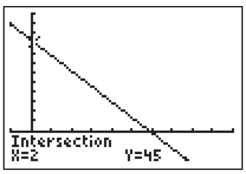
9. a) The population of fish is decreasing by 1000 each year while the number of fish eaten by osprey is increasing by 200 each year.
b) Example: Let F represent the number of fish. Let x represent the year number. $F = -1000x + 11\ 000$ and $F = 200x + 500$
c) 

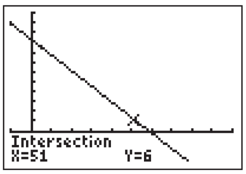
The solution is (8.75, 2250). This point indicates that after 8.75 years, the number of fish in the lake will equal the number of fish that are being eaten by the osprey.
d) Example: As the number of fish decreases, the osprey population will also decrease, because there will not be enough fish to keep feeding the osprey population.

10. Let x represent the depth, in metres, and let y represent the number of minutes the diver can remain at that depth. $60 = 60m + b$ and $90 = 30m + b$; $y = -x + 120$

11. 81.25 min cross-country skiing and 18.75 min playing squash

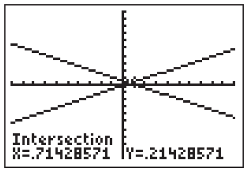
12. 36.75 square units

13. a) The constant in the second equation of the second pair is one larger than the constant of the second equation in the first pair.
b) $x = 2$ and $y = 45$; $x = 51$ and $y = 6$
c) 



d) The large numbers make the graphing difficult for both solving for y and finding a good viewing window. The larger numbers make solving the system algebraically (elimination) tedious.

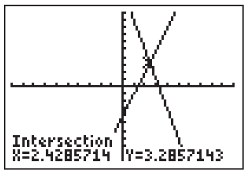
14. a) Example: $3x - y = 5$ and $2x + 7y = 57$ has the solution $x = 4$ and $y = 7$.
b) Example: If it is relatively easy to isolate y in both equations, solving graphically might be preferred. If it is relatively easy to isolate either x or y in only one of the equations, substitution would be recommended. Otherwise, elimination would be preferred.

15. a) Example: $7x - 14y = 2$ and $7x + 14y = 8$ has a solution $x = \frac{5}{7}$ and $y = \frac{3}{14}$.


b) Example: This system is difficult to solve graphically, because isolating y in both equations creates equations with fractions as coefficients and/or constants. The solution can only be approximated from the graphs. Solving by elimination is easy, because the coefficients of x are equal and the coefficients of y add to zero.

Chapter 9 Review, pages 502 to 503

1. a) $x = 3$ and $y = 8$
b) $x = 0$ and $y = -2$
c) $x = \frac{2}{9}$ and $y = -\frac{4}{3}$

2. 

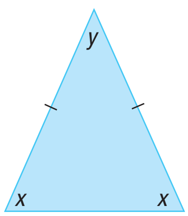
$x = 2\frac{3}{7}$ and $y = 3\frac{2}{7}$; Solving algebraically is preferred, because the solution is exact. Graphical solving gives only an approximate solution.

3. 32 000 km

4. $1.40 for one song and $4.20 for one game

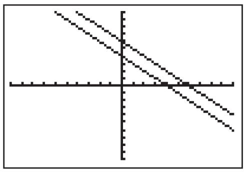
5. a) $x = 4$ and $y = -13$
b) $x = 2\frac{4}{7}$ and $y = 1\frac{1}{7}$
c) $x = \frac{3}{2}$ and $y = 0$

6. Vancouver has 166 wet days and Yellowknife has 119 wet days.

7. 

The two base angles are each 46.5° and the third angle is 87°.

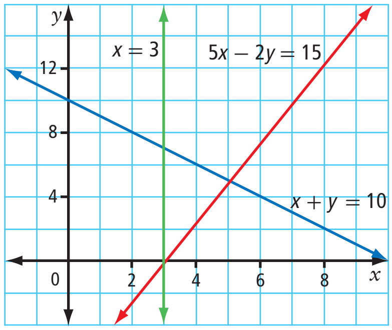
8. Danika ate 121.875 g of grapes and 203.125 g of oranges.
9. washing machine: \$800; shower head: \$25
10. a) \$34 per day; \$0.15 per km
    b) Example: The elimination method is easiest, because graphing and substitution are more complicated due to the coefficients of the variables.
11. a) 19 acres for developed sites and 38 acres for basic sites
    b) 76 developed campsites and 57 basic campsites
12. 1 h 40 min
13. a) no solution



    b) The two lines are parallel, so there is no point of intersection and thus no solution.

Chapter 9 Practice Test, pages 504 to 505

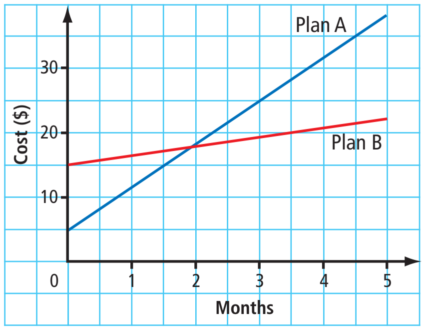
1. D
2. C
3. C
4. C
5. a) $x = 4\frac{1}{4}$ and $y = 5\frac{3}{4}$
   b) $x = -1.5$ and $y = 20.5$
   c) $x = 4.5$ and $y = -3.5$
6. The length is 4 m and the width is 1.4 m.
7. 187.5 g of peanuts and 112.5 g of almonds
8. 17 nickels and 32 quarters
9. The green fee is \$22 per game and the annual fee is \$150.
10. 667 students and 29 teachers
11. a) Edmonton to Saskatoon took approximately 6.21 h. Saskatoon to Regina took approximately 3.64 h.
    b) The distance from Edmonton to Saskatoon is approximately 546.89 km. Example: Multiply the number of hours to drive from Edmonton to Saskatoon (approximately 6.21 h) by the speed (88 km/h) Mallory travelled.
12. a)



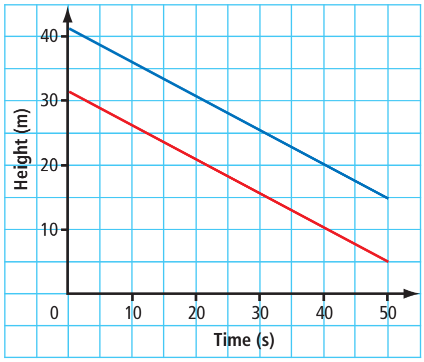
    b) (3, 0), (5, 5), and (3, 7)

Unit 4 Review, pages 507 to 509

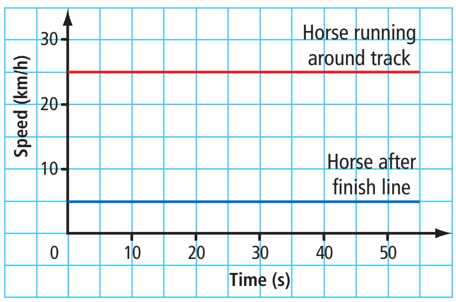
1. a)



   b)



   c)

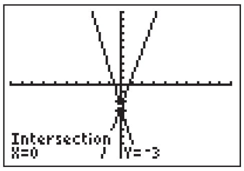


2. i) B **ii)** A **iii)** C

3. a) The point is the solution to the system of linear equations and the point of intersection of the graphs of the two lines.

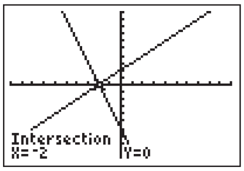
b) The point is the y-intercept of the graph of $y = -x + 3$, but the point is not on the graph of $y = \frac{3}{2}x + 2$.

4. a)



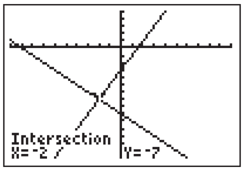
(0, −3)

b)



(−2, 0)

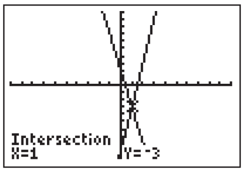
c)



(−2, −7)

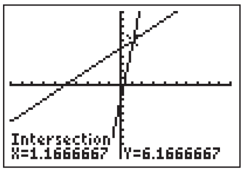
5. D

6. a)



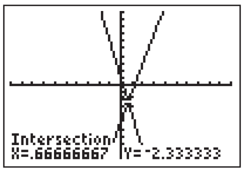
(1, −3)

b)



(1.2, 6.2)

c)



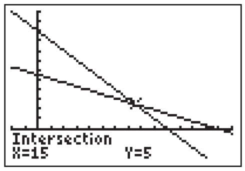
(0.7, −2.3)

7. This point indicates that if she rented a car for 7 days, the cost of renting from each company would be $580.

8. a) Let d represent the number of dimes. Let q represent the number of quarters. $d + q = 20$ and $0.10d + 0.25q = 2.75$

b) $d + q = 20$ written as a function is $q(d) = 20 - d$.
Domain: $\{d \mid 0 \leq d \leq 20, d \in W\}$
Range: $\{q \mid 0 \leq q \leq 20, q \in W\}$
$0.10d + 0.25q = 2.75$ written as a function is $q(d) = -0.4d + 11$ or $q(d) = -\frac{2}{5}d + 11$.
Domain: {0, 5, 10, 15, 20, 25}
Range: {1, 3, 5, 7, 9, 11}

c)



15 dimes and 5 quarters

9. a) one solution

b) no solution

c) infinite number of solutions

10. Let a represent the number of assists. Let g represent the number of goals. $a + 2g = 23$ and $2g = a + 1$

11. a) Example: Use the substitution method, because the first equation is already solved for y.

b) Example: Use the elimination method, because substitution would involve rational expressions.

c) Example: Use the elimination method, because multiplying the first equation by 2 and adding the two equations would eliminate y.

d) Example: Use the substitution method, because it is easy to isolate x in the first equation.

12. a) $x = -1$ and $y = 5$

b) $x = 2$ and $y = 1$

c) $x = 2$ and $y = -1$

13. a) $x = 5$ and $y = 3$. Example: Use the elimination method, because adding the two equations eliminates y.

b) $x = 0$ and $y = -2$. Example: Use the elimination method, because multiplying the second equation by −3 and adding the two equations eliminates y.

c) $x = -2$ and $y = 1$. Example: Use the elimination method, because substitution would involve equations with fractions as coefficients and/or constants.

14. a) Let p represent their paddling speed, in kilometres per hour. Let c represent the speed of the current, in kilometres per hour.
$\frac{1}{3}(p + c) = 3$ and $\frac{3}{5}(p - c) = 3$

b) Their paddling speed was 7 km/h and the speed of the current was 2 km/h.

Unit 4 Test, pages 510 to 511

1. A
2. C
3. A
4. D
5. 10
6. 38
7. $x = 4$ and $y = -6$. Example: I used the elimination method, because after multiplying the first equation by 6 and the second equation by 12 to make integral coefficients, adding the two equations will eliminate y.
8. a) Let r represent the cost of one red bead.
Let g represent the cost of one green bead.
$25r + 15g = 2.75$ and $7r + 13g = 1.65$
b) red bead: \$0.05, green bead: \$0.10
c) \$1.00
9. 56 km/h