

Key CONCEPTS

To solve a linear system in two variables by elimination,

- clear decimals and fractions, if necessary
- rewrite the equations with like terms in the same column, if necessary
- multiply one or both equations by numbers to obtain two equations in which the coefficients of one variable are the same or opposites
- add or subtract the equations to eliminate a variable, and solve the resulting equation for the remaining variable
- substitute the value from d) into one of the original equations to find the value of the other variable
- check the solution in each of the original equations

Communicate Your Understanding

- Describe how you would solve the linear system $2x + y = 5$ and $3x - 2y = 4$ by elimination.
- Explain why you might need to multiply each equation by a different number when solving a system of equations by elimination.
- State the method you think is best to solve each system—graphing, substitution, or elimination. Explain why you chose each method.

a) $3x - 4y = 17$ b) $y = 5 - 2x$ c) $5y = 11 - 2x$ d) $2x + 3y = 5$
 $5x + 4y = 7$ $y = 2x + 3$ $3x = -y - 3$ $5x + 4y = 16$

Practice

A

1. Solve each system of equations by elimination.

a) $x - y = 3$ b) $x + y = 8$ c) $x + y = 8$ d) $x + 3y = 7$
 $x + y = 7$ $x - y = -2$ $-x + y = 6$ $x + y = 3$

2. Solve each system of equations by elimination. Check each solution.

a) $4a - 3b = -10$ b) $5x + 2y = -11$ c) $4x + 9y = -7$
 $2a + 3b = 22$ $3x + 2y = -9$ $4x + 3y = -13$
d) $2m - 3n = 12$ e) $2p + 3q = -1$ f) $6y - 5x = -7$
 $5m - 3n = 21$ $2p - 3q = -7$ $2y - 5x = -19$

3. Solve each linear system. Check each solution.

a) $4x + 3y = 7$ b) $2a = 3b + 7$ c) $-3 = 2m - 3n$ d) $4c = 3d - 8$
 $2x + 3y - 5 = 0$ $5b = 2a - 9$ $2m + n = -15$ $8 = d - 4c$

4. Determine the values of the constant terms, so that the solution to each system is as shown.

a) $2x - 5y = ?$ b) $x - 6y = ?$
 $3x + 4y = ?$ Solution: (3, 2) $4x + 5y = ?$ Solution: (-2, 3)

5. Solve each system by elimination. Check each solution. If there is not exactly one solution, does the system have no solution or infinitely many solutions?

a) $x + 2y = -3$
 $2x + 3y = -4$

b) $8c - 3d = -10$
 $2c - 5d = 6$

c) $4x + 3y = 15$
 $8x - 9y = 15$

d) $3r + 2s = 5$
 $9r + 6s = 7$

e) $2x - 3y = 2$
 $5x + 6y = 7$

f) $4x - 3y = 5$
 $8x - 6y = 10$

g) $3a + 2b = 16$
 $2a + 3b = 14$

h) $3m + 4n = -1$
 $4m - 5n = -22$

i) $5p + 3q = -19$
 $2p - 5q = 11$

6. Solve by elimination. Check each solution.

a) $38 = 2x - 5y$
 $75 = 7x - 3y$

b) $6x + 5y = 22$
 $3y = 4x + 36$

c) $3a - 7b - 13 = 0$
 $4a - 5b - 13 = 0$

d) $6x - 5y = -3$
 $2y - 9x = -1$

e) $3s + 4 = -4t$
 $7s + 6t + 11 = 0$

f) $3c = 2 - 3d$
 $5c = 3 - 2d$

g) $2d = 10 + 4e$
 $3d = 6e + 15$

h) $10x = 17 - 15y$
 $15x = 25y - 3$

i) $4x - 5 = 2y$
 $1 = 5y - 10x$

7. Solve by elimination.

a) $0.3x - 0.5y = 1.2$
 $0.7x - 0.2y = -0.1$

b) $1.7x + 3.5y = 0.01$
 $0.6x + 1.2y = 0$

c) $0.2x - 0.3y = -0.1$
 $0.5x - 0.4y = 0.8$

d) $0.2x - 0.3y = -0.6$
 $0.5x + 0.2y = 2.3$

e) $4x + 5y = -0.5$
 $3x + 7y = 0.6$

f) $0.5x - 1.3y = 1.23$
 $4x - 2y = 0.6$

8. Solve by elimination.

a) $\frac{x}{3} - \frac{y}{2} = -3$
 $\frac{x}{6} + \frac{y}{5} = 3$

b) $\frac{x}{3} + \frac{y}{4} = 2$
 $\frac{2x}{3} - \frac{y}{2} = 0$

c) $\frac{4a}{3} - \frac{b}{4} = 9$
 $\frac{5a}{6} + b = 1$

d) $x - y = 6$
 $\frac{2x}{3} + \frac{y}{3} = 1$

e) $\frac{x}{3} - \frac{y}{6} = -\frac{2}{3}$
 $\frac{x}{12} - \frac{y}{4} = 1\frac{1}{2}$

f) $\frac{1}{3}m - \frac{1}{6}n = \frac{1}{2}$
 $\frac{m}{5} - \frac{3n}{10} = \frac{1}{2}$

Applications and Problem Solving

9. Communication State the method you would use to solve each system. Explain why you would choose each method.

a) $y = 6 - 3x$
 $y = 2x + 1$

b) $2x - 5y = -1$
 $3x + 5y = -14$

c) $4x + 3y = 15$
 $x - 2y = 1$

d) $2x - 5y = 1$
 $3x - 2y = -4$

e) $87x + 68y = 99$
 $64x - 55y = 81$

f) $6x = 5y - 1$
 $5x = 4y - 1$

Answers

Chapter 1

Getting Started p. 2

1. 10; The check digit will be 0. **2. a)** 9 **b)** 9 **c)** 2 **d)** 8 **3. a)** No, the check digit should be 6. **b)** Yes, the check digit is correct. **c)** Yes, the check digit is correct. **4.** Answers may vary. 123 456 717; 223 456 740 **5. a)** $10 - m$ **b)** 0 **c)** The check digit is equal to $10 - m$ if $m \neq 0$ and 0 if $m = 0$.

Review of Prerequisite Skills p. 3

1. **a)** $x + 2$ **b)** $2x + 8$ **c)** $3y - 5$ **d)** $-5a + 3$ **e)** $6x + 14$
f) $5z - 8$ **g)** $7t + 41$ **h)** $2x - 9$ **2. a)** $6x$ **b)** $-2c$ **c)** x
d) $3n$ **e)** $x + 2y$ **f)** $3p - r$ **3. a)** 8 **b)** 2 **c)** -6 **d)** -5
4. a) 7 **b)** -3 **c)** 2 **d)** 12 **e)** $-\frac{1}{2}$ **f)** $\frac{3}{2}$ **g)** 4 **h)** -5 **i)** $-\frac{5}{2}$
j) -4 **k)** -1 **l)** 2 **5. a)** $x = 11 - 3y$ **b)** $x = 5y - 8$
c) $x = 2y - 4$ **d)** $x = \frac{5-3y}{2}$ **6. a)** $y = 3 - 2x$
b) $y = x - 2$ **c)** $y = \frac{-1-2x}{4}$ **d)** $y = \frac{3x-4}{2}$
10. a) (3, 1) **b)** (5, -2) **c)** (-1, 6) **d)** (4, 8) **e)** (-4, -5)
f) (2, -1) **11. a)** $9x - 4y + 1$ **b)** $13m^2 - 6m - 19$
c) $-a - 3b - 10$ **d)** $-e - 2$ **12. a)** $x - 8y + 10$
b) $-t^2 - 5t - 11$ **c)** $-9a + 3b + 1$ **d)** $12e - 1$

Section 1.1 pp. 4-5

- 1 Ordered Pairs and One Equation** **1. a)** (1, 13), (24, -10) **b)** (-2, -4), (-12, 0) **c)** (2, 3) **d)** (0.5, -2.5)
2. a) 3, 9, 10, -2 **b)** 2, -9, 11, -2 **c)** -1, 5, 13, 10
d) 5, 3, -4, -7
2 Ordered Pairs and Two Equations **1. a)** (1, 2)
b) (-3, 1) **c)** (2, 3) **d)** (6, -8) **e)** (-2, -5) **f)** (-4, 7)
2. a) (4, -3) **b)** (6, 3) **c)** (-1, 0) **d)** Answers may vary. (0, 0)
3 Problem Solving **1. a)** 55 **b)** 3 days **c)** \$55
2. a) The equations represent the same graph.
b) Answers may vary. (-1, 2), (-2, 3) **3.** The equations represent parallel and distinct lines. The lines never intersect.

Section 1.2 pp. 12-14

- Practice** **1. a)** (5, 4) **b)** (-1, 2) **c)** (-3, -5) **d)** (2, -3)
2. a) (-2, 3) **b)** (2, 0) **c)** (2, -3) **d)** (-3, -2)
3. a) (3, -1) **b)** (-1, 6) **c)** (4, -1) **d)** infinitely many solutions **e)** (6, 0) **f)** (-3, 4) **g)** no solution
h) (-2, -1) **i)** (2, -1) **j)** (-3, -2) **k)** (4, 1) **l)** no solution **m)** (5, -1) **n)** infinitely many solutions
o) (-1, -2) **p)** (2, 2) **4. a)** (0.5, 2) **b)** (2, 1.5)
c) (-1, 0.5) **d)** (1.5, -2.5) **5. a)** (1.5, -0.8)
b) (6.7, 1.7) **c)** (3.9, -0.3) **d)** (-2.7, 0.3) **e)** (2.3, 3)
f) (-2.6, 5.1) **6. a)** one solution **b)** no solution
c) infinitely many solutions **d)** one solution **e)** no solution **f)** no solution **7.** Austria: 9, Germany: 16
8. a) (20, 500) **b)** 20 months **c)** Champion **9.** (-6, 3)
10. (2, 4), (-1, -2), (8, -2) **11.** (3, -1), (5, $-\frac{1}{3}$), (4, 0)

12. parallelogram 13. Answers may vary.

- a)** $x + y = 5$ **b)** $2x + 2y = 8$ **c)** $x + 2y = 4$ **14.** Answers may vary. **a)** $x + y = 5$, $x - y = 1$ **b)** $x - y = 1$, $2x - 2y = 2$ **15.** The system has infinitely many solutions: all points on the line $x - 2y + 6 = 0$.
17. a) (-12.5, 9); (48, 24); (-16, -18)

Modelling Math p. 14

- a)** (t, d) = (50, 1000) **b)** 50 **c)** less than 50
d) greater than 50

Career Connection p. 15

- 1.** south: 5000, north: 125 000

Section 1.3 pp. 21-23

- Practice** **1. a)** $x = 8 - 3y$ **b)** $x = -4y - 13$
c) $x = 7y + 7$ **d)** $x = 2y - 1$ **2. a)** $y = 11 - 6x$
b) $y = -5x - 9$ **c)** $y = x + 2$ **d)** $y = 3x + 4$ **3. a)** (2, 2)
b) (-1, 1) **c)** (2, -1) **d)** (-2, -3) **e)** (3, 0) **f)** (3, 2)
g) (4, -5) **h)** (5, 0) **i)** (-2, 3) **j)** (-2, -2) **k)** (-1, 1)
l) (-3, -4) **m)** (1, 0) **n)** (1, 3) **o)** no solution **p)** (3, -1)
q) infinitely many solutions **r)** (-1, -5)
s) no solution **t)** (1, 1) **u)** (-1, 1) **4. a)** $(\frac{1}{2}, -1)$
b) $(\frac{7}{11}, -\frac{1}{11})$ **c)** $(3, -\frac{6}{5})$ **d)** $(1, -\frac{1}{3})$ **e)** $(-1, \frac{2}{7})$

f) $(\frac{4}{3}, \frac{11}{3})$ g) $(-\frac{32}{5}, -\frac{18}{5})$ h) $(-\frac{3}{4}, \frac{1}{2})$ i) $(\frac{1}{7}, -\frac{4}{5})$

Applications and Problem Solving 5. a) (24, -18)

b) (-3, 2) c) $(\frac{3}{2}, 2)$ d) $(-\frac{5}{3}, \frac{1}{6})$ 6. a) Fairweather

Mountain is 3970 m higher than Ishpatina Ridge. Fairweather Mountain is 188 m less than seven time higher than Ishpatina Ridge.

b) Fairweather Mountain: 4663 m, Ishpatina Ridge:

693 m 7. a) The angles are complementary. Six degrees less than $\angle y$ is three times $\angle x$. b) $\angle x = 21^\circ$, $\angle y = 69^\circ$ 8. a) The total number of tickets sold is 550. The total revenue from tickets is \$9184.

b) adult tickets: 323, student tickets: 227 9. (1, 2), (9, -14), (-3, -2) 10. a) (5, 4) b) (4, 5) c) (-1, -5)

d) $(\frac{1}{2}, -\frac{1}{2})$ 11. A = 3, B = 2 12. a) (1, 4, -2)

b) (2, -1, 3) 13. $m = -1$ 14. $n = \frac{1}{2}$

Modelling Math pp. 23

a) $(h, C) = (4, 270)$ b) Quality is cheaper for less than 4 h. ABC is cheaper for more than 4 h.

c) 10 h of work

Section 1.4 pp. 24–25

1 Equivalent Forms 1. Answers may vary. (0, 6), (1, 5), (2, 4) 2. a) $2x + 2y = 12$ b) yes

3. a) $-3x - 3y = -18$ b) yes 4. Yes, they all have the same solution. 5. Answers may vary. a) $2x + 2y = 4$, $-x - y = -2$, $-2x - 2y = -4$ b) $2x - 2y = 8$, $-x + y = -4$, $-2x + 2y = -8$ c) $-2x - y = -7$, $-4x - 2y = -14$, $4x + 2y = 14$ d) $2y = 8x - 6$, $3y = 12x - 9$, $4y = 16x - 12$

2 Equivalent Systems 1. (5, 2) 2. (5, 2)

3. a) $2x - 2y = 6$, $-x - y = -7$ b) (5, 2) 4. They all have the same solution. 5. Answers may vary. $x + y = 3$, $x - y = 1$

3 Adding Equations 1. (2, 1) 2. a) $2x + y$ b) 5

c) $2x + y = 5$ 3. They all pass through (2, 1).

4. They are equivalent systems. They have the same solution. 5. They are equivalent systems. They have the same solution.

Section 1.5 pp. 30–33

Practice 1. a) (5, 2) b) (3, 5) c) (1, 7) d) (1, 2)

2. a) (2, 6) b) (-1, -3) c) (-4, 1) d) (3, -2) e) (-2, 1)

f) (5, 3) 3. a) (1, 1) b) (2, -1) c) (-6, -3) d) (-2, 0)

4. a) -4, 17 b) -20, 7 5. a) (1, -2) b) (-2, -2)

c) (3, 1) d) no solution e) (1, 0) f) infinitely many solutions g) (4, 2) h) (-3, 2) i) (-2, -3) 6. a) (9, -4)

b) (-3, 8) c) (2, -1) d) $(\frac{1}{3}, 1)$ e) $(-2, \frac{1}{2})$ f) $(\frac{5}{9}, \frac{1}{9})$

g) infinitely many solutions h) $(\frac{4}{5}, \frac{3}{5})$ i) no solution

7. a) (-1, -3) b) (-0.2, 0.1) c) (4, 3) d) (3, 4)

e) (-0.5, 0.3) f) (-0.4, -1.1) 8. a) (6, 10) b) (3, 4)

c) (6, -4) d) (3, -3) e) (-6, -8) f) (1, -1)

Applications and Problem Solving 9. Answers may vary. a) substitution b) elimination

c) substitution d) elimination e) elimination

f) elimination 10. a) There are 10 provinces. Three times the number of names with First Nations

origins is equal to twice the number of names with other origins. b) 4 11. ham: \$5, roast beef: \$6

12. a) (-1, -3) b) (1, 6) c) (-2, 3) d) (2, 1)

13. a) $x = a$, $y = -b$ b) $x = 3a$, $y = -b$ 14. (3, 2),

(-2, 4), (0, -2) 15. $a = -2$, $b = 3$ 16. (4, 6) 17. a) 10

b) 6 18. a) -2 b) 3 19. (2, 5) 20. Answers may

vary. $2x + 3y = -3$, $x - 2y = 16$ 21. Answers may

vary. a) $2x + 3y = 19$, $-2x + 3y = 11$ b) $3x + 2y = 2$,

$4x + 5y = 19$ c) $2x + 3y = 0$, $-3x - 6y = 1$

Technology Extension pp. 34–35

1 Solving Systems Using a Graphing Calculator

Program 1. b) Each of the following systems has $AE - BD = 0$. In the system $ax + by = c$,

$kax + kby = kc$, one equation is a multiple of the other. Thus, there are infinitely many solutions.

$CE - BF = ckb - bkc = 0$. In the system $ax + by = c$,

$ax + by = d$, the lines are parallel and distinct when $c \neq d$. There is no solution, and

$CE - BF = cb - bd = b(c - d) \neq 0$, since $c \neq d$.

2. a) (-1, -2) b) (7, 10) c) infinitely many solutions

d) no solution

2 Solving Systems Using Preprogrammed

Calculators 1. a) (2, 4) b) (2, -3) c) $(\frac{1}{2}, -1)$

2. a) infinitely many solutions b) no solution

Section 1.6 pp. 36–37

1 Expressions in Two Variables 1. a) $x + y$

b) $x - y$ c) $5y - x$ d) $6x + 2y$ 2. a) $x - y$ b) $x + y$

3. a) $x + 7y$ b) $x + 15y$ 4. a) $x + y$ b) $10x$ c) $5y$

d) $10x + 5y$ 5. a) $x + y$ b) $0.07x$ c) $0.06y$

d) $0.07x + 0.06y$

2 Equations in Two Variables 1. a) $x + y = 8$

b) $x - y = 5$ c) $y = 3x + 1$ d) $y = 2x - 1$

2. a) $l + w = 40$ b) $2b + 3t = 61$

3 Systems of Equations 1. a) $x + y = 7$, $x - y = 3$

b) $y = 2x$, $y = x - 4$ 2. a) $x + y = 256$ b) $5x + 2y = 767$

3. a) $p + r = 295$, $p = r + 11$ b) $l = w + 6$, $l + w = 46$