For questions 10 to 13, write a linear system to model each situation. Solve the related problem. Indicate whether your solution is exact or approximate.

10. The area of Stanley Park in Vancouver is 391 hectares. The forested area is 141 hectares more than the rest of the park. What is the area of each part of the park?

11. In the American Hockey League, a team gets 2 points for a win and 1 point for an overtime loss. In the 2008–2009 regular season, the Manitoba Moose had 107 points. They had 43 more wins than overtime losses. How many wins and how many overtime losses did the team have?

12. Annika's class raised $800 by selling $5 and $10 movie gift cards. The class sold a total of 115 gift cards. How many of each type of card did the class sell?

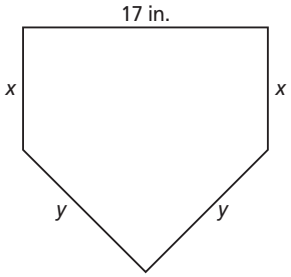
13. A group of adults and students went on a field trip to the Royal Tyrell Museum, near Drumheller, Alberta. The total admission fee was $152. There were 13 more students than adults. How many adults and how many students went on the field trip?

14. **a)** Write a linear system to model this situation: A box of 36 golf balls has a mass of 1806 g. When 12 balls are removed, the mass is 1254 g.

b) Use a graph to solve this problem: What is the mass of the box and the mass of one golf ball?

c) Why was it difficult to determine a solution?

15. The home plate in a baseball diamond is a pentagon with perimeter 58 in. Each shorter side, x, is $3\frac{1}{2}$ in. less than each longer side, y. What are the values of x and y?



16. **a)** Solve this linear system by graphing.

$2x + 7y = 3$

$4x + 3y = 7$

b) Why is the solution approximate?

C

17. Emma solved a linear system by graphing. She first determined the intercepts of each line.

Equation	x-intercept	y-intercept
1	5	5
2	4	6

a) Write a linear system that Emma could have solved. Explain your work.

b) Draw the graphs to determine the solution.

18. One equation of a linear system is $y = 2x + 1$. The solution of the linear system is in the third quadrant. What might the second equation be? Explain how you determined the equation.

19. **a)** Suppose you want to solve this linear system by graphing. How do you know that the lines are perpendicular?

$2x + 3y = -5$

$\frac{x}{2} - \frac{y}{3} = 2$

b) Create another linear system where the lines are perpendicular. Explain what you did.

Reflect

When you solve a linear system graphically, how can you determine whether the solution is approximate or exact?

Exercises

A

4. Use substitution to solve each linear system.

a) $y = 9 - x$
$2x + 3y = 11$

b) $x = y - 1$
$3x - y = 11$

c) $x = 7 + y$
$2x + y = -10$

d) $3x + y = 7$
$y = x + 3$

5. Solve each linear system.

a) $2x + 3y = 11$
$4x - y = -13$

b) $4x + y = -5$
$2x + 3y = 5$

c) $x + 2y = 13$
$2x - 3y = -9$

d) $3x + y = 7$
$5x + 2y = 13$

B

6. **a)** In each linear system, identify two like terms and say how they are related.

i) $2x - 3y = 2$
$4x - 4y = 2$

ii) $40x + 10y = 10$
$3x + 5y = 5$

iii) $-3x + 6y = 9$
$5x - 2y = -7$

iv) $-3x + 4y = 6$
$9x + 3y = 27$

b) Solve each linear system in part a.

7. **a)** Suppose you wanted to solve a linear system in the fewest steps. Which of these systems would you choose? Why?

i) $x - y = -5$
$x = -1$

ii) $x - y = -5$
$-x - y = 3$

iii) $2x - 3y = 7$
$x - 2y = 3$

b) Solve each linear system in part a. Explain what you did.

8. **a)** For each equation, identify a number you could multiply each term by to ensure that the equation has only integer coefficients and constants. Explain why you chose that number. Create an equivalent linear system.

$\frac{x}{3} - \frac{y}{2} = 2$
$\frac{5x}{6} + \frac{3y}{4} = 1$

b) Verify that both linear systems in part a have the same solution.

9. **a)** For each equation, choose a divisor. Create an equivalent linear system by dividing each term in the equation by that divisor.
$2x + 2y = -4$
$-12x + 4y = -24$

b) Show that both linear systems in part a have the same solution.

For questions 10 to 18, write a linear system to model each situation. Solve the linear system to solve the related problem.

10. A study recorded the reactions of 186 polar bears as they were approached by a tundra buggy. Some bears did not appear to respond, while others responded by sitting, standing, walking away, or running away. There were 94 more bears that did not respond than did respond. How many bears responded and how many bears did not respond?

11. Louise purchased a Métis flag whose length was 90 cm longer than its width. The perimeter of the flag was 540 cm. What are the dimensions of the flag?

12. Forty-five high school students and adults were surveyed about their use of the internet. Thirty-one people reported a heavy use of the internet. This was 80% of the high school students and 60% of the adults. How many students and how many adults were in the study?

13. Many researchers, such as those at the Canadian Fossil Discovery Centre at Morden, Manitoba, involve students to help unearth fossil remains of 80 million-year-old reptiles. Forty-seven students are searching for fossils in 11 groups of 4 or 5. How many groups of 4 and how many groups of 5 are searching?

14. An art gallery has a collection of 85 Northwest Coast masks of people and animals. Sixty percent of the people masks and 40% of the animal masks are made of yellow cedar. The total number of yellow cedar masks is 38. How many people masks and how many animal masks are there?

15. Sam scored 80% on part A of a math test and 92% on part B of the math test. His total mark for the test was 63. The total mark possible for the test was 75. How many marks is each part worth?

16. Five thousand dollars was invested in two savings bonds for one year. One bond earned interest at an annual rate of 2.5%. The other bond earned 3.75% per year. The total interest earned was $162.50. How much money was invested in each bond?

17. Tess has a part-time job at an ice-cream store. On Saturday, she sold 76 single-scoop cones and 49 double-scoop cones for a total revenue of $474.25. On Sunday, Tess sold 54 single-scoop cones and 37 double-scoop cones for a total revenue of $346.25. What is the cost of each cone?

18. Joel has a part-time job that pays him $40 per weekend. Sue has a part-time job that paid a starting bonus of $150, then $30 per weekend. For how many weekends would Joel have to work before he earns the same amount as Sue? Justify your answer.

19. Solve each linear system.

a) $\frac{1}{2}x + \frac{2}{3}y = 1$

$\frac{1}{4}x - \frac{1}{3}y = \frac{5}{2}$

b) $\frac{3}{4}x + \frac{1}{2}y = -\frac{7}{12}$

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

c) $\frac{1}{3}x - \frac{3}{8}y = 1$

$-\frac{1}{4}x - \frac{1}{8}y = \frac{3}{2}$

d) $\frac{7}{4}x + \frac{4}{3}y = 3$

$\frac{1}{2}x - \frac{5}{6}y = 2$

20. This linear system was used to solve a problem about the cost of buying reams of printer paper and ink cartridges for a school computer lab:

$7.50r + 45c = 375$

$r - c = 15$

a) Create a situation that can be modelled using the linear system. Write a related problem.

b) Solve the system and the problem.

21. Create a situation that can be modelled by this linear system. Write a related problem. Solve the system and the problem.

$2x + 4y = 98$

$x + y = 27$

22. **a)** Write a linear system that is equivalent to this system. Explain what you did.

$2x - y = -4$

$3x + 2y = 1$

b) Solve each linear system. How do your solutions show that the systems are equivalent?

C

23. One weekend, members of a cycling club rode on the KVR trail (Kettle Valley Railway) uphill from Penticton in Okanagan, B.C. The uphill climb reduced the cyclists' usual average speed by 6 km/h and they took 4 h to get to Chute Lake. On the return trip, the downhill ride increased the cyclists' usual average speed by 4 km/h. The return trip took 2 h.

a) What is the usual average speed?

b) What is the distance from Penticton to Chute Lake?

12. Solve each linear system. Explain what you did for part a.

a) $\frac{a}{2} + \frac{b}{3} = 1$

$\frac{a}{4} - \frac{2b}{3} = -1$

b) $\frac{x}{2} + \frac{y}{2} = 7$

$3x + 2y = 48$

c) $0.03x + 0.15y = 0.027$

$-0.5x - 0.5y = 0.05$

d) $-1.5x + 2.5y = 0.5$

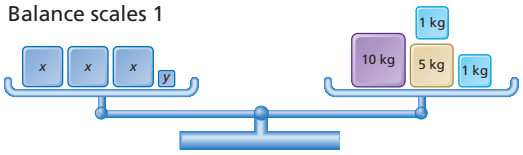
$2x + y = 1.5$

13. The 2008–09 Edmonton Oilers had 25 players, 17 of whom were over 6 ft. tall. Seven-ninths of the Canadian players were over 6 ft. tall. Three-sevenths of the foreign players were over 6 ft. tall. How many players were Canadian and how many were foreign?

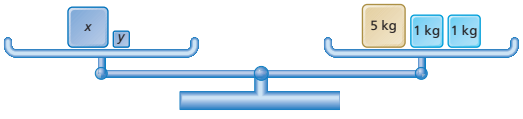
14. Melody surveyed the 76 grade 10 students in her school to find out who played games online. One-quarter of the girls and $\frac{3}{4}$ of the boys said they played online games with someone over the weekend. Thirty-nine students played online games that weekend. How many girls and how many boys did Melody survey?

15. **a)** Which linear system is modelled by these two balance scales?

Balance scales 1



Balance scales 2



b) From Balance scales 1, suppose you remove mass x and mass y from the left side and 7 kg from the right side. How do you know that the scales will still be balanced?

c) How does this process help you determine the value of x and the value of y?

d) How is this process related to the elimination strategy for solving a linear system?

16. To visit the Manitoba Children's Museum in Winnipeg:

- One adult and 3 children pay $27.75.
- Two adults and 2 children pay $27.50.

Which ticket is more expensive? Justify your answer.

17. A co-op that sells organic food made 25 kg of soup mix by combining green peas that cost $5/kg with red lentils that cost $6.50/kg. This mixture costs $140. What was the mass of peas and the mass of lentils in the mixture?

18. This linear system models a problem about a pentagon.

$3x + 2y = 21$

$x - y = 2$

What might the problem be? Solve the problem you suggest.

19. **a)** Write a problem that can be modelled by this linear system. Explain how you created the problem.

$3x + y = 17$

$x + y = 7$

b) Solve the problem you created.

20. Suppose you want to eliminate one variable in the linear system below by adding.

a) What are two different ways to eliminate a variable?

$3x + 4y = 29$

$2x - 5y = -19$

b) Solve the system using the two ways you described in part a.

21. This table shows the numbers of males and females in a study of colour blindness.

	Female	Male	Total
Colour blind	2	12	14
Not colour blind	98	88	186
Total	100	100	200

a) Use the data in the table to create a situation that can be modelled by a linear system.
b) Pose and solve a related problem.

C

22. Cam invested in a stock and a bond for one year. At the end of the year, the stock had lost 10.5% and the bond had gained 3.5%. The total loss for both investments was $84. If Cam had invested the bond amount into the stock and the stock amount into the bond, he would have lost only $14. How much money did Cam invest in the stock and in the bond?

23. In the equation $2x + 5y = 8$, the difference in consecutive coefficients and constant term is 3.
a) Write another equation whose coefficients and constant differ by 3. Solve the linear system formed by these equations.
b) Write, then solve two different systems of linear equations for which the coefficients and constant term in each equation differ by 3.
c) Compare your solutions in parts a and b.
d) Use algebra to verify that when the coefficients and constant term in the linear equations differ by a constant in this way, then the solution of the linear system will always be the same.

24. A farmer in Saskatchewan harvested 1 section (which is 640 acres) of wheat and 2 sections of barley. The total yield of grain for both areas was 99 840 bushels. The wheat sold for $6.35/bushel and the barley sold for $2.70/bushel. The farmer received $363 008 for both crops.
a) What was the yield of each section in bushels/acre?
b) Some farmers use hectares instead of acres or sections to measure area. One acre is 0.4047 ha. Would you have to write and solve a different linear system to determine the yield in bushels/hectare? Explain.

Reflect

You have used graphing, substitution, and elimination to solve a linear system. For each strategy, give an example of a linear system that you think would be best solved using that strategy. Justify your choices.