5.4 Solve Problems Involving Linear Systems

Strand
Modelling Linear Relations

Student Text Pages
219–225

Suggested Timing
80–160 min

Tools
- graphing calculators
- grid paper

Related Resources
BLM 5.4.1 Practice: Solve Problems Involving Linear Systems
BLM 5.4.2 Achievement Check Rubric
BLM A1 Knowledge/Understanding General Scoring Rubric
BLM A3 Communication General Scoring Rubric
BLM G1 Grid Paper

Specific Expectations

Solving and Interpreting Systems of Linear Equations

In this section, students will

ML3.03 solve problems that arise from realistic situations described in words or represented by given linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method

Link to Get Ready

This section requires students to write equations before solving linear systems. You may wish to have students review the Get Ready segment Translate Words to Algebra, question 7, before proceeding with Section 5.4.

Warm-Up

1. Solve by elimination: $3x + 2y = 17$, $x - y = -6$.

2. Solve by graphing: $x + 2y = 5$, $3x - y = 1$.

3. Solve using a graphing calculator: $y = 21x - 11$, $y = -15x + 16$

4. Solve by substitution: $y = 7x + 1$, $3x - 2y = -13$.

Warm-Up Answers

1. (1, 7)
2. (1, 2)
3. (0.75, 4.75)
4. (1, 8)

Teaching Suggestions

Warm-Up

- Write the Warm-Up questions on the board or on an overhead. Have students complete the questions independently. Then, discuss the solutions as a class. (5–10 min)

Section Opener

- Read the opening paragraph to students and ask if any of them have seen the Snowbirds perform.
- Discuss with the class how the pilots ensure that the planes maintain a safe distance from each other and how they might use linear equations to model manoeuvres.

Investigate

- Circulate while students complete the Investigate and provide help as needed.
- You may wish to have students use **BLM G1 Grid Paper** to solve questions 1 and 2.
- You may wish to have students work with a partner.
- Encourage students who complete the Investigate early to assist others.

Common Errors

- Some students may not use the graphing calculator for the first pair of equations in the Investigate as it is quicker to graph them on grid paper. Similarly, they will prefer to use the graphing calculator for larger numbers.

R_x Be sure to ask students to do the Investigate as it is written so that they can understand the point behind the work.

Ongoing Assessment

- You may wish to assign D1, D2, and D3 as questions to check for communication and understanding. You may wish to use **BLM A1 Knowledge/Understanding General Scoring Rubric** and/or **BLM A3 Communication General Scoring Rubric** to assist you in assessing your students.
- You may wish to use question 3 of Practise the Concepts as a formative assessment.
- You may wish to use question 4 of Apply the Concepts as a formative assessment.

Accommodations

Motor—Have students work with a partner for graphing calculator activities.

- Consolidate students' understanding by discussing their results as a class.
- You may wish to have several students read their answers to question 6 and then discuss preferred methods for solving linear systems.
- Use **BLM 5.4.1 Practice: Solve Problems Involving Linear Systems** for extra practice or remediation.

Investigate Answers (pages 219–220)

1. (4, 13)

2. (1, 100)

3. a) I could not draw a graph with scales where it was easy to read the coordinates of the point of intersection from the graph.

b) Elimination would have been an easier method to use because the y terms have coefficients of $+1$ and -1.

4. a) $y = 3x + 1,\ y = 4x - 3$

$3x + 1 = 4x - 3$

$x = 4$

$y = 13$

b) $y = 3x + 1$

$y = 4x - 3$

$0 = -x + 4$

$x = 4$

$y = 13$

c) All methods give the same answer.

d) Answers will vary. Sample answer: I found the substitution method to be easiest because the y term was already isolated in both equations.

5. a) $x + y = 101,\ 300x - y = 200$

$y = -x + 101$

$300x - (-x + 101) = 200$

$301x = 301$

$x = 1$

$y = 100$

b) $x + y = 101$

$300x - y = 200$

$301x = 301$

$x = 1$

$y = 100$

c) All methods give the same answer.

d) Answers will vary. Sample answer: I found the elimination method to be easiest because the y terms already had opposite coefficients.

6. a) Answers will vary. Sample answer: I would solve by graphing if the numbers were not too large and if I thought I would be able to read the coordinates of the point of intersection from the graph.

b) Answers will vary. Sample answer: I would use substitution when one variable is isolated or it is easy to isolate one variable.

c) Answers will vary. Sample answer: I would use elimination when the coefficients of a term in the two equations have opposite signs.

Examples

- Have students work through the Examples as a class before proceeding to Discuss the Concepts. Alternatively, have students complete the Examples independently or in small groups before reviewing them as a class.
- You might wish to stress with students that, although they can use any of the methods to solve a linear system, often one method is easier or more straightforward than the others.
- For Example 1, point out that both the substitution method and a graphing calculator have been used.
- For Example 2, students are using percent. Remind students that they can clear the decimal values by multiplying the entire equation by 100.

Key Concepts

- Have students recall some of the methods for solving problems they have just worked on. This is an excellent lead in to the Practise the Concepts questions, which require students to choose their own methods for solving.

Discuss the Concepts

- Give the class time to formulate their answers before conducting a discussion.
- You may wish to have students exchange examples and then solve them.

Discuss the Concepts Suggested Answers (page 223)

D1. Answers will vary. Sample answer: I would solve a system by graphing if the numbers were not too large and if I thought I would be able to read the coordinates of the point of intersection from the graph, *for example:* $y = 2x + 1$ *and* $y = -2x + 1$. I would use a graphing calculator when the numbers contain many decimal places, for example: $y = 3.094x + 1.564$, $y = 4.67x - 35.2$.

D2. Answers will vary. Sample answer: I would use substitution when one variable is isolated or it is easy to isolate one of the variables, for example: $y = 7x + 19$, $y = 14x - 6$

D3. Answers will vary. Sample answer: I would use elimination when the coefficients of a term in the two equations have opposite signs, for example: $5y = 8x + 19$, $2y = -9x - 3$

Practise the Concepts (A)

- Encourage students to refer back to the Examples before asking for assistance.
- You may wish to have students work in pairs or small groups.
- The questions allow students to choose among the types of methods they have learned. You may wish to have students solve problems using more than one method.

Apply the Concepts (B)

- Question 8 is an Achievement Check question. It can be used as a diagnostic or formative assessment, or assigned as a small summative assessment piece. You may wish to use **BLM 5.4.2 Achievement Check Rubric** to assist you in assessing your students.
- Question 9 is a Literacy Connect. As a class, discuss some student responses. Literacy Connect questions offer the opportunity to explore literacy issues in the mathematics classroom and within the context of mathematics. This supports general Think Literacy strategies. For more information, visit http://www.edu.gov.on.ca/eng/studentsuccess/thinkliteracy.

Achievement Check Answers (page 224)

8. a) Let x represents the distance driven at 100 km/h; Let y represents the distance driven at 60 km/h.

b) $x + y = 255$

c) Meredith drove 225 km at 100 km/h and 30 km at 60 km/h.

Extend the Concepts (C)

- Assign the Extend the Concepts questions to students who are not being challenged by questions in Apply the Concepts.
- Extend the Concepts questions can be used as a diagnostic assessment for those students considering a university-level course in grade 11.
- Have students doing the Extend the Concepts questions read the MathConnect before they do question 12. You may wish to have students locate Dubai on a map and research its climate.