5.3 Solve Linear Systems by Elimination

Strand
Modelling Linear Relations

Student Text Pages
212–218

Suggested Timing
80–160 min

Tools
- graphing calculators
- grid paper

Related Resources
BLM 5.3.1 Practice: Solve Linear Systems by Elimination
BLM G1 Grid Paper

Specific Expectations

Solving and Interpreting Systems of Linear Equations

In this section, students will

ML3.02 solve systems of two linear equations involving two variables with integral coefficients, using the algebraic method of substitution or elimination

Link to Get Ready

This section deals with rearranging formulas and eliminating variables. Students need to be confident with their ability to manipulate expressions and equations. These skills are reviewed in questions 1–4 of the Get Ready.

Warm-Up

1. Find the least common multiple of each pair of numbers.

a) 3 and 5 **b)** 4 and 7
c) 5 and 10 **d)** 2 and 6

2. Add or subtract.

a) $(2x + 3y) + (4x - 3y)$ **b)** $(2x - 3y) - (2x + y)$
c) $(4x - 3y) + (3x + 3y)$ **d)** $(2x - y) - (x - y)$

Warm-Up Answers

1. a) 15 **b)** 28 **c)** 10 **d)** 6

2. a) $6x$ **b)** $-4y$ **c)** $7x$ **d)** x

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

- Discuss the various items one needs to mix or blend in specific proportions. You may wish to speak to the science teacher in the school about the chemicals that are used in grade 9 and 10 chemistry to bring an interdisciplinary connection and to provide additional, relevant examples.

Investigate

- Circulate while students complete the Investigate, and provide help as needed.
- You may wish to have students work with a partner.
- You may wish to have students use **BLM G1 Grid Paper** to graph the equations.
- Encourage students who complete the Investigate early to assist others.
- Consolidate students' understanding by discussing their results.
- Use **BLM 5.3.1 Practice: Solve Linear Systems by Elimination** for extra practice or remediation.

Common Errors

- Some students may not check their solution works in both equations.

R_x Remind students to check their answer in each of the two original equations.

- Some students may find writing the correct equations for the questions difficult.

R_x You may wish to have the first portion posted on the board for students to make sure they are starting off with the correct two equations.

Ongoing Assessment

- You may wish to use question 6 or 8 as a check of students' understanding of the elimination method.

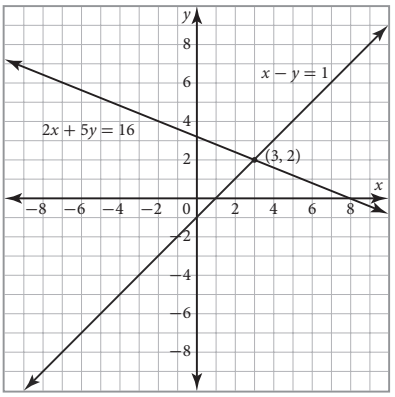
Accommodations

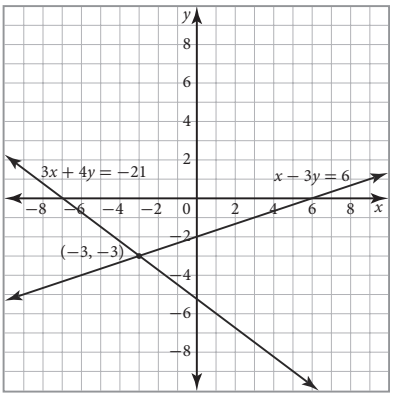
Gifted and Enrichment—Encourage students to think of situations in their own lives that would generate two equations such as the ones in the questions here. Have them create their own questions and answers for the class.

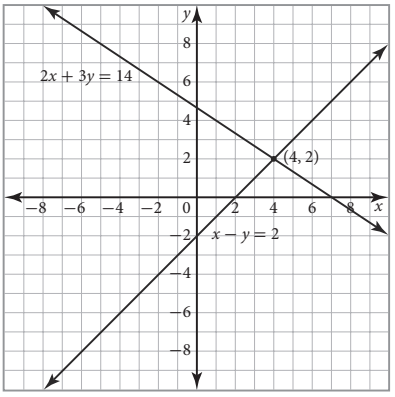
Investigate Answers (pages 212–213)

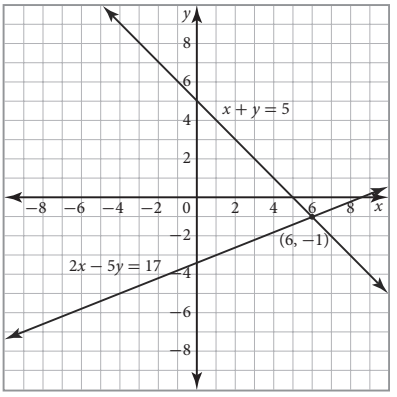
Investigate A

1. b)









2. a) A: $3x + 4y = 17$, B: $4x + y = -15$, C: $3x + 2y = 16$, D: $3x - 4y = 22$

b) In each case, the graph of equation <3> passes through the same point of intersection.

3. a) A: $x + 6y = 15$, B: $2x + 7y = -27$, C: $x + 4y = 12$, D: $x - 6y = 12$

b) In each case, the graph of equation <4> passes through the same point of intersection.

4. Students' results should be the same for the same systems.

5. Students' results should be different for different systems but the observation that the point of intersection did not change when the equations were added or subtracted should be the same.

6. An equation that results from adding or subtracting the equations in a linear system will pass through the same point of intersection as the original equations.

Investigate B

2. a) Answers will vary.

A: $5y = 20x + 15$, B: $10x + 5y = 25$, C: $5y = -5x - 10$, D: $15x - 5y = 5$

b) The lines are the same; the second line lies on top of the first one.

c) The lines are the same; the third line lies on top of the first two.

4. Students' results should be the same for the same equations.

5. Students' results should be different for different equations, but the observation that the line did not change when each term in the equation was multiplied by the same number should be the same.

6. When each term in an equation is multiplied by a constant, the line does not change.

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.
- For Example 1, remind students that writing the equations in a column format will help them add or subtract the equations. The goal is to eliminate one of the variables. Point out that the y terms in the two equations have opposite coefficients: one is $+1$ and the other is -1. When the equations are added, the resulting equation has no y term.
- For Example 2, point out that it is easier to eliminate the y terms because they have opposite coefficients. After working through this example, you may wish to do it again to eliminate the x terms. Remind students of the importance of checking their solutions.
- For Example 3, remind students to explicitly state the variables and what each stands for. They are free to use other letters than x and y, as long as they indicate what the letters mean. Point out that it is easier to eliminate the y terms by multiplying the first equation by 10 for each term, as the numbers will be smaller, but they can multiply the equation by 18 if they wish to eliminate the x terms.

Key Concepts

- Have students refer to Example 3 for a class discussion of the Key Concepts.

Discuss the Concepts

- Have students work in pairs on these two questions and compare their answers. Alternatively, discuss the questions as a class.

Discuss the Concepts Suggested Answers (page 216)

D1. a) To eliminate the x terms, I would subtract because the x terms have the same coefficient, of $+1$.

b) To eliminate the y terms, you would add because the y terms have opposite coefficients, 1 and -1.

c) Yes, because adding or subtracting equations does not change the point of intersection.

D2. The method of substitution requires that one variable be isolated first; the method of elimination requires that variables have the same coefficient.

Practise the Concepts (A)

- Encourage students to refer back to the Examples before asking for assistance.
- If students seem uncertain as to whether or not their answer is correct, have them substitute their solutions into the original equations to check the left side equals the right side.
- For question 1, you may wish to have students circle the variable to be eliminated before using the elimination method to solve the system.
- For questions 3 and 4, have students consider which of the variables it would be more efficient to eliminate before solving the system.

Apply the Concepts (B)

- Have students read the MathConnect before they do question 5. You may wish to have students research the ingredients of various spice blends and report to the class.
- Remind students that they can clear the decimals in their equations by multiplying every term by a power of 10.
- Question 7b) is a Literacy Connect. 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.
- Question 9 links to the Chapter Problem. Remind students to keep the solution to this question handy as the methods they used may help them with the Chapter Problem Wrap-Up. Alternatively, you may wish to use this problem as a formative assessment now, or use all the parts as a summative assessment at the end of the chapter.

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.