3.4 Determine the Equation of a Line

Strand
Modelling Linear Relations

Student Text Pages
128–137

Suggested Timing
150–225 min

Tools
- calculators
- graphing calculators
- grid paper
- rulers
- toothpicks

Related Resources
BLM 3.4.1 Practice: Determine the Equation of a Line
BLM A3 Communication General Scoring Rubric
BLM G1 Grid Paper
BLM G4 Four-Quadrant Grids

Specific Expectations

Graphing and Writing Equations of Lines

In this section, students will

ML2.06 determine the equation of a line, given its graph, the slope and *y*-intercept, the slope and a point on the line, or two points on the line

Link to Get Ready

This section again requires students to have the ability to solve problems involving integers. Questions 4 and 5 of the Get Ready review some skills involving integers. Evaluating simple expressions by substituting values for a variable is covered in questions 7 and 8 of the Get Ready.

Warm-Up

1. Solve.

a) $-4 - 9$ **b)** $14 - (-6)$

c) $5 - (-3)$ **d)** $-7 - 4$

2. Solve for x.

a) $x + 9 = 4$ **b)** $4x = 18$

c) $3x - 9 = 0$ **d)** $-\frac{1}{2}x + 4 = 10$

Warm-Up Answers

1. a) -13 **b)** 20 **c)** 8 **d)** -11

2. a) $x = -5$ **b)** $x = 4.5$ **c)** $x = 3$ **d)** $x = -12$

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

- Ask students whether they are earning money from a part-time job and saving for any goals, such as buying a car or paying for their post-secondary education. Discuss how savings can be modelled using a linear relation when the rate of change is consistent from one period to the next. All linear relations can be expressed as an equation between two variables.

Investigate

- Distribute toothpicks and instruct students to follow the instructions as they are laid out in the student text.
- Use **BLM G1 Grid Paper** and/or **BLM G4 Four-Quadrant Grid** for Method 1 of the Investigate.
- Ask students to record their results and look for a pattern so that they can predict future results without constructing additional triangles.
- Have students construct the triangles to confirm their predictions.

Common Errors

- Some students may have difficulty interpreting the Apply the Concepts (B) questions and identifying the relevant information.

R_x Work through sample word problems as a class using an overhead, or use **BLM 3.4.1 Practice: Determine the Equation of a Line** as remediation or extra practice.

Ongoing Assessment

Assess students' ability to communicate mathematically and to justify their thinking. You may wish to use or adapt **BLM A3 Communication General Scoring Rubric** to assist you in assessing your students.

For Example 2, assess students' ability to link the slope and the *y*-intercept with the derivation of the equation.

Parts of each question in Practise the Concepts (A), except question 7, can be used as formative assessment of MLR 2.06.

Use the Extend the Concepts (C) questions to assess strong students' problem-solving processes and ability to determine the equations of lines using a variety of methods.

Accommodations

Gifted and Enrichment—Have students read through the material independently and then move on to the Examples on their own. Encourage these students to help others. Assign the Extend the Concepts (C) questions to these students.

Motor—Have students work with a partner for the Investigate. Substitute items that are easier to pick up and handle than toothpicks (e.g., straws). Not all parts of every question need be assigned to each student.

Perceptual—Provide a blank table of values, especially for determining the rate of change. Encourage students to use graphing technology to provide support for students while they answer questions.

- Work through both options for displaying data (paper and pencil, and graphing calculator).
- Use **BLM 3.4.1 Practice: Determine the Equation of a Line** for extra practice or remediation.

Investigate Answers (pages 128–129)

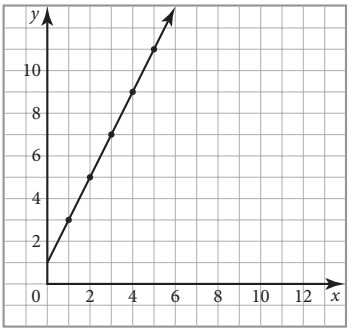
2. b)–c)

Number of Triangles	Total Number of Toothpicks
1	3
2	5
3	7
4	9
5	11

3. The relationship between the number of triangles and the total number of toothpicks can be modelled with a linear relation because the rate of change in the values in the toothpick column is constant.

Method 1: Use Paper and Pencil

1.



2. The slope of the line is 2.

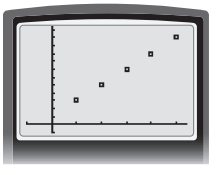
3. The *y*-intercept is 1.

4. $y = 2x + 1$

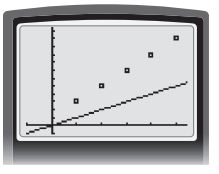
5. To make 5500 triangles, you would need 11001 toothpicks.

Method 2: Use a Graphing Calculator

1.



2.



3. The line needs to be steeper and raised; $y = 2x + 1$

4. To make 5500 triangles, you would need 11001 toothpicks.

Examples

- Work through each Example as a class, and emphasize the importance of substituting the correct numbers for *m* and *b*.
- Read the MathConnect aloud to the class and ensure that students understand how to recognize and interpret a scale break.
- Example 2 shows students how to follow a logical sequence for determining the equation of line given the slope and a point on the line. Work through this Example emphasizing the process of how to work from what is known (the slope and a point) to what is unknown (the *y*-intercept) and the equation.

- Working through a second example that includes a point with a negative x-coordinate may be helpful to students' understanding.
- Ensure that students have read Example 3 thoroughly and understand the context for the question. Explain how the two given points are derived and what units of measure are being used. Students need to understand how the slope is determined and how the substitution of the slope and coordinate is performed. It may be necessary to provide another example.

Key Concepts

- Read the Key Concepts as a class to guide students into the Discuss the Concepts questions.

Discuss the Concepts

- You may wish to have students answer these questions as a class, in small groups, or with a partner. For the latter two options, discuss their results as a class.
- Most students should not have trouble answering question D1.
- Question D2 provides an opportunity for students to explain their reasoning in support of their answer and to consider the merits of the answers of others if the question is discussed in a group setting. Students could be required to verify their opinion by demonstrating a solution.
- Question D3 can be conducted as a class activity. Have students use paper and pencil or graphing technology to demonstrate why the question is possible.

Discuss the Concepts Suggested Answers (page 133)

D1. The slope and y-intercept are needed to write the equation of any straight line.

D2. To find the equation of a line, use algebraic substitution or apply slope pattern to the given point to determine the y-intercept.

D3. It is possible to find the equation of a line that joins two points if one of the points is an x-intercept and the second is a y-intercept. The x- and y-intercepts are two points and only two points are needed.

Practise the Concepts (A)

- Encourage students to refer back to the Examples before asking for assistance.
- Encourage students to use graphing technology to assist in solving or confirming the answers.
- Work through part a) of all the questions and display the solutions on the board or on an overhead as models to help students to complete the other parts of each question.

Apply the Concepts (B)

- Apply the Concepts questions require that students carefully read and interpret each of the word problems. Provide additional guidance and/or remediation, as required. You may wish to use **BLM 3.4.1 Practice: Determine the Equation of a Line** for remediation or extra practice.
- While there isn't a specific Literacy Connect here, the entire section involves literacy skills as students read and interpret questions and gather relevant information.
- Remind students that they need to identify key pieces of information within each question before attempting to answer the entire question.

- It may be beneficial to answer part a) of some of the questions to help students complete all the questions in the section.
- Refer students to the MathConnect. If possible, have a pedometer available for students to examine to add additional context to question 8.

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.