3.3 Properties of Slopes of Lines

Strand
Modelling Linear Relations

Student Text Pages
118–127

Suggested Timing
75–150 min

Tools
- calculators
- computers
- *The Geometer's Sketchpad®*
- graphing calculators
- grid paper
- rulers

Related Resources
BLM 3.3.1 Practice: Properties of Slopes of Lines
BLM G1 Grid Paper
BLM T1 *The Geometer's Sketchpad®* 4

Specific Expectations

Graphing and Writing Equations of Lines

In this section, students will

ML2.04 identify, through investigation, properties of the slopes of lines and line segments (e.g., direction, positive or negative rate of change, steepness, parallelism), using graphing technology to facilitate investigations, where appropriate

Link to Get Ready

The slope of a line is often expressed as either a fraction or a decimal. Facility with the conversion from fraction to decimal, and vice versa, is reviewed in question 3 of the Get Ready. Generally, a fraction is most often expressed in lowest terms. Question 2 of the Get Ready reviews this skill.

Warm-Up

1. Convert to a decimal or a fraction.

a) $\frac{1}{2}$ **b)** 0.75 **c)** $3\frac{1}{10}$ **d)** -2.25 **e)** $\frac{7}{4}$ **f)** -1.9

2. Express each fraction in lowest terms.

a) $\frac{6}{8}$ **b)** $-\frac{9}{3}$ **c)** $\frac{4}{12}$ **d)** $\frac{6}{10}$ **e)** $-\frac{6}{4}$ **f)** $-\frac{12}{8}$

3. Describe the pattern.

a) $-5, -2, 1, 4$ **b)** $-1, 2, 5, 8$ **c)** $10, 13, 16, 19$ **d)** $6, 1, -4, -9$

Warm-Up Answers

1. a) 0.5 **b)** $\frac{3}{4}$ **c)** 3.1 **d)** $-2\frac{1}{4}$ **e)** $1\frac{3}{4}$ **f)** $-1\frac{9}{10}$

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

d) $\frac{3}{5}$ **e)** $-\frac{3}{2}$ (or $-1\frac{1}{2}$) **f)** $-\frac{3}{2}$ (or $-1\frac{1}{2}$)

3. a) Each term is 3 greater than the one before it.
b) Each term is 3 greater than the one before it.
c) Each term is 3 greater than the one before it.
d) Each term is 5 less than the one before it.

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

- Have students look at the photo in the Section Opener. Ask them if they have ever seen or been inside a yurt.
- Discuss the characteristics of a yurt with respect to the slopes of the lines that are visible in the photo.
- Read the Section Opener and have students brainstorm other examples of slopes similar to the roof of the yurt or of a house (e.g., ramps).

Common Errors

- Some students may not follow the instructions for using a graphing calculator in Investigate 1 and Method 2 exactly as listed.

R_x Emphasize the importance of following the instructions carefully and of not skipping steps. Demonstrate how an answer can be changed if a step is missed.

Ongoing Assessment

- Assess students' ability to identify the properties of the slopes of lines. Students can demonstrate the properties physically or on paper.
- Assess students' ability to generate a line parallel to the lines in Example 2.
- Assess students' understanding of steepness and a zero slope.
- Questions 11 and 12 can be used as a formative assessment of student progress thus far in the chapter.
- Provide students with feedback on their answers to the Extend the Concepts (C) questions, but do not use these when evaluating students.

Accommodations

ESL—Some students may struggle with interpreting the Chapter Problem. A thorough reading through of the problem or a discussion to set up the context can be helpful.

Motor/Perceptual—Have students observe the Investigate activities rather than perform them to learn the concepts. To accommodate specific student needs, discuss items in varying-sized groups. Encourage students to use graphing technology to assist in their working through of problems or for confirming answers generated by other means.

Perceptual—Some students will need more time to complete the investigation. Some students can strengthen their understanding of the properties of slopes by physically demonstrating them.

Investigate

- Define and discuss parallel and perpendicular lines with students.
- Have students read through the Investigate before they begin the activity so that they are familiar with the tasks required. Ask students to pose any questions they may have before beginning.
- Instruct students to follow the directions in the Investigate text exactly. You may wish to have students use **BLM T1 *The Geometer's Sketchpad*® 4** to assist them with this acitvity.
- After students have completed the Investigate, conduct a class discussion on the properties of slope.
- Use **BLM 3.3.1 Practice: Properties of Slopes of Lines** for extra practice or remediation.

Investigate Answers (pages 118–122)

Method 1: Use *The Geometer's Sketchpad*®

11. They are equal. Slope is a ratio of the rise (vertical distance) and the run (horizontal distance) between two points.

12. The slope becomes steeper. The length of AB stays the same while the length of BC increases.

13. The slope becomes increasingly negative. The length of AB stays the same while the length of BC increases.

14. Make it horizontal. The length of BC is zero.

Method 2: Use a Graphing Calculator

2. The line becomes less steep.

3. y can equal any number. The coefficient of x is zero.

4. The coefficient of x must be negative. All lines with a positive slope have a positive coefficient of x. All lines with a negative slope have a negative coefficient of x.

5. a) slope $= \frac{1}{2}$, y-intercept $= 0$.

b) All lines are the same slope.

c) No, the lines never cross.

d) Parallel lines (have the same slope).

Examples

- Discuss possible reasons for needing to know about slope with students. Ask them to brainstorm examples.
- Discuss the meaning of the word *steep* with students.
- Review the concepts of rise, run, and the calculation of slope as a ratio of the two.
- Discuss positive and negative slopes. Ask students whether, in Example 1, there is any practical difference between the two (there is not).
- Point out to students that, in general, measures in feet and inches are not calculator-friendly because there are 12 in./ft, not 10 (see the MathConnect on page 122 of the student text). Explain that converting from feet and inches to inches makes these measures easier to work with.
- Have students read through Example 2 on their own. Most students should be familiar with parallel lines. Highlight for students the concept that parallel lines have the same slope.

Key Concepts

- Demonstrate or have students demonstrate, using a metre stick or your/their arms, the properties of the slopes included in the Key Concepts.

Discuss the Concepts

- The questions can be discussed as a class, in smaller groups, or one-on-one.
- Encourage students to make a sketch to support their argument or help them to formulate answers to the questions. Have students take a few minutes to formulate answers before the discussion commences.

Discuss the Concepts Suggested Answers (page 123)

D1. With a positive slope, the line on the graph goes up and to the right. With a negative slope, the line goes down and to the right.

D2. The greater the coefficient of x, the steeper the line.

D3. The y-intercept does not relate to the steepness of a line.

Practise the Concepts (A)

- Encourage students to refer back to the Examples before asking for assistance.
- Not all parts of all questions need to be assigned to every student.
- Questions 1 and 2 can be completed orally as a class or in small groups.
- Have students check their answers to the question in this section with each other.

Apply the Concepts (B)

- Discuss why the tables in question 8a) will produce parallel lines and the tables in question 8b) will not.
- Question 9 can be completed on the board and discussed with the class.
- Question 10 is a Chapter Problem. Discuss how students should proceed with the Chapter Problem. Ensure students' facility with working with percent. Review the concept if necessary. Suggest that students keep the solution to this question handy as it may help them with the Chapter Problem Wrap-Up.
- Question 11 involves the paying back of a loan. The resulting graph is a downward sloping line. A negative slope results because Dylan owes 50 fewer dollars with each passing week. Her debt is declining. You may wish to use **BLM G1 Grid Paper** for this activity.
- Question 11e) 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.

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.
- Perpendicularity is not mentioned in the curriculum, however it would benefit students wishing to advance to a university-level course in grade 11 to be familiar with the nature of the relationship of slopes of perpendicular lines.