5.3 Slope

Strand:
Linear Relations

Strand:
Analytic Geometry

Student Text Pages
254 to 265

Suggested Timing
80 min

Tools
- grid paper

Related Resources
BLM G10 Grid Paper
BLM A16 My Progress as a Mathematician
BLM 5.3.1 Practice: Slope
BLM A23 News Report Checklist

Mathematical Process Expectations Emphasis

- ☑ Problem Solving
- ☑ Reasoning and Proving
- ☑ Reflecting
- ☐ Selecting Tools and Computational Strategies
- ☐ Connecting
- ☑ Representing
- ☑ Communicating

Specific Expectations

Understanding the Characteristics of Linear Relations

RE2.01 construct tables of values, graphs, and equations, using a variety of tools (e.g., graphing calculators, spreadsheets, graphing software, paper and pencil), to represent linear relations derived from descriptions of realistic situations;

Connecting Various Representations of Linear Relations

RE3.01 determine values of a linear relation by using a table of values, by using the equation of the relation, and by interpolating or extrapolating from the graph of the relation;

Investigating the Properties of Slope

AG2.01 determine, through investigation, various formulas for the slope of a line segment or to determine the slope of a line segment or a line.

Link to Get Ready

The Get Ready segment Ratio and Proportion provides the needed skills for this section. You may wish to have students complete Get Ready questions 4 to 6 before starting this section.

Warm-Up

1. Mental Math: Express in lowest terms.

a) $\frac{8}{6}$ **b)** $\frac{50}{75}$ **c)** $\frac{7}{14}$ **d)** $-\frac{9}{12}$

2. Change to decimal form.

a) $\frac{1}{2}$ **b)** $\frac{3}{8}$ **c)** $\frac{-2}{9}$ **d)** $\frac{-68}{10}$

Warm-Up Answers

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

2. a) 0.5 **b)** 0.375 **c)** $-0.22\overline{2}$ **d)** -6.8

Teaching Suggestions

- For Investigate A, through a class discussion, introduce the concept of steepness, without introducing positive or negative. (5 min)
- Investigate B introduces the concept of slope, one of the most important concepts in understanding relations. Ensure that students understand that graphs are read from left to right and that the slope is the rate of change of the rise (vertical) with respect to the run (horizontal). Negative slope occurs when travelling downward while reading from left to right. Clear, accurate graphs on grid paper allow the students to visualize this abstract concept. You may wish to use **BLM G10 Grid Paper** to support this activity. (15 min)
- Discuss the Examples. (30 min)
- Example 1 illustrates slope in an applied situation, as a rate of change. Note to students that the slope is a decimal value related to a unit change in horizontal distance.

Common Errors

- Some students may reverse the numerator and denominator of slope because they are used to writing x before y.

R$_x$ Have students graph (2, 4) and (7, 5) or any two points one square apart horizontally. Extend the line through the points to illustrate that the slope is constant. Calculate the slope using the given points and repeat using any two points that are more than one square apart horizontally. Illustrate that the slope is a rate of change with respect to x. You may wish to use **BLM G10 Grid Paper**.

Ongoing Assessment

- Communicate Your Understanding questions can be used as quizzes to assess students' Communication skills.)

- Example 2 calculates positive and negative slopes and extends to horizontal and vertical lines. You may wish to provide contextual examples of these. For a horizontal example, plot a graph of the temperature of the interior of an oven (dependent) while it is heating up (time = independent), then reaching its cooking temperature. For a vertical example, plot a graph of volume of gasoline in the gas tank (dependent) versus driving distance (independent) with a stop at the gas station along the way.
- For Example 3, students may have difficulties with where to place the negative sign. With slope, by convention it should be placed in the numerator. Discuss with the students that there is an infinite number of possibilities for point B. The one shown is simply the neighbouring one.
- Discuss the vocabulary (slope, rise, run) before discussing questions from Communicate Your Understanding. (2 min)
- You may wish to use **BLM A16 My Progress as a Mathematician** as a self-assessment for students at any time during this section.
- You may wish to use **BLM 5.3.1 Practice: Slope** for remediation or extra practice.

Investigate Answers (page 254)

A.

1. middle hill, hill on right, hill on left

2. The steepness of the first hill is $2 \div 8 = 0.25$. The steepness of the second hill is $4 \div 10 = 0.4$. The second hill is steeper, since 0.4 is greater than 0.25.

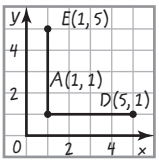
3. Divide the height of the hill by the length of the hill. The greater the result is, the steeper the slope will be.

B.

1. a) The slope is positive because it rises upward, from left to right.
b) rise 3, run 2
c) $\frac{3}{2}$

2. a) The slope is negative because it goes downward, from left to right.
b) rise -2, run 3
c) $-\frac{2}{3}$

3. a)



b) rise 0, run 4
c) slope $= 0 \div 4$
$= 0$
The segment is flat so there is no slope.

4. a) See answer to question 3a).
b) rise 4, run 0
c) slope $= 4 \div 0$; division by 0 is undefined, so, it is not possible to calculate the slope of a vertical line segment.

5. To calculate the slope of a line segment, divide its rise (vertical height) by its run (horizontal distance). If the line segment rises upward, from left to right, then its slope is positive. If it goes downward, from left to right, then its slope is negative. If the line segment is horizontal, then it has a slope of 0, or no slope. If the line segment is vertical, then its slope is undefined.

Communicate Your Understanding Responses (page 258)

C1. Her conclusion is correct but her reasoning is incorrect. It is possible for two points with negative coordinates to form a positive slope. For example, a line segment with endpoints P(1, −8) and Q(4, −1) has a positive slope, even though some of the coordinates are negative. The slope in this graph is negative because it goes downward, from left to right.

C2. a) increase the rise **b)** decrease the run

Accommodations

Visual—Encourage students to draw visual representations of slopes, such as the slope of a roof, in order to visualize the rise and the run, to use to calculate the slope, $m = \frac{\text{rise}}{\text{run}}$.

Perceptual—Have students use visual cues, such as highlighting or colour coding to remember the different forms used to calculate the slope when given two points.

Spatial—Let students work with visual representations of lines with positive, negative, and zero slopes and match them to numerical values.

Language—Give students verbal instructions (for example, down 2, right 3) to find a second point when given a point and a slope of a line, instead of (+3, −2).

ESL—Let students use their translators to understand the meanings of the new words in this section.

Student Success

Question 21 can be turned into a larger investigation involving the entire class. Have students collect data, then analyse the data using a graphing calculator. Have students do an internet search for safety or building code restrictions on the maximum slopes for stairs.

Practise

The Practise questions are straightforward and support the skills learned in the Examples. Some students may have difficulties with negatives.

Connect and Apply

Question 10 may be challenging to some students. With a slope of $\frac{3}{5}$ and a horizontal spacing of 1 m, the height would be $\frac{3}{5}$ m or 0.6 m.

For question 11, students need to review their understanding of percents. Review Get Ready, Percents, or use **BLM 5.3.1 Practice: Slope** as remediation or a skills review. The slope would be $3\% = \frac{3}{100}$.

Question 12 is an excellent real-life job application of slope.

Questions 16 and 17 offer two good examples of the use of slope in architecture. You may wish to use **BLM G10 Grid Paper** for any of these questions.

Extend

Question 18 is an interesting problem as it applies to ski hills, but asks the students to manipulate the slope formula. It is accessible to level 3 and 4 students.

Question 19 involves working with three dimensions and will require students to use the Pythagorean theorem.

Literacy Connections

News Report

Have students look at the section opener picture, and imagine that the headline reads, "Downhill Skier is Top in the Field." Instruct students to write a news report about the photo and the given headline. Remind them to include a link between the photo and the headline. Explain to students that they should try to answer the questions who, what, where, when, why, and how in their news reports. Remind them to write in the third person. You may wish to use **BLM A23 News Report Checklist** to assist you in assessing your students.

Exercise Guide

Category	Question Number
Minimum (essential questions for all students to cover the expectations)	1–9
Typical	1–17
Extension	18–23