LESSON Success for English Language Learners **4-4** Determinants and Cramer's Rule

Steps for Success

Step I Start the lesson by providing students with the following support.

- Discuss the words *diagonal* and *vertical* with students. A diagonal is angle to angle, whereas vertical denotes directly overhead or in an upward and downward plane.
- Discuss the meanings of the vocabulary words *determinant, coefficient matrix,* and *Cramer's Rule* with students. Explain that Cramer's Rule is named after its originator, Gabriel Cramer, a Swiss mathematician who lived from 1704–1752.

Step II Help students understand how to find determinants of 2×2 and 3×3 matrices by following these procedures.

- Point out that finding the determinant of a 2 × 2 matrix involves fewer steps than finding the determinant of a 3 × 3 matrix. Finding the determinant of a 2 × 2 matrix involves subtracting the products of the diagonals. Follow these steps to find the determinant of a 3 × 3 matrix.
 - 1. Multiply each "down" diagonal and add the sums.
 - 2. Multiply each "up" diagonal and add the sums.
 - 3. Calculate the difference of the sums.
- Have students work in small groups of mixed proficiency levels to solve examples of finding determinants of both 2 × 2 and 3 × 3 matrices. Students with a strong grasp of the concept can guide less proficient students in finding the determinants.

Step III Ask English Language Learners to complete the worksheet for this lesson.

• Point out that Example 1A in the student textbook is supported by Problem 1. Point out that the process is different for finding the determinants of 2×2 and 3×3 matrices.

Making Connections

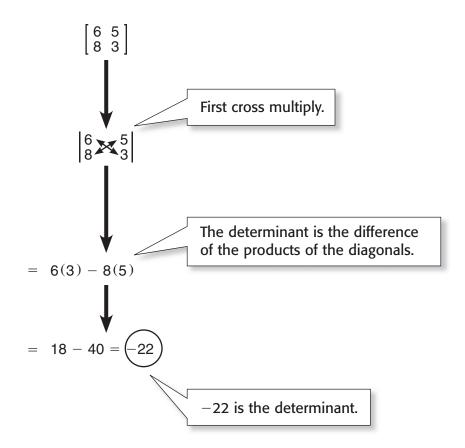
• Discuss the implication of linear models, such as the application of Cramer's Rule, in the natural and social sciences where nonlinear models are approximated by such.

Name	Date	Class

4-4 Determinants and Cramer's Rule

Problem 1

Find the determinant of the matrix.



The determinant is -22.

Think and Discuss

- **1.** Why is it important not to confuse the |A| notation with absolute value notation?
- 2. Why is the determinant a useful measure?

Lesson 4-4

- **1.** If *A* is a matrix it denotes determinant, if *A* is a number it denotes absolute value.
- **2.** Using Cramer's Rule, the determinant can be used to solve systems of equations.

Lesson 4-5

- **1.** If it is not square, then $AA^{-1} \neq A^{-1}A$.
- 2. There is no multiplicative inverse of the matrix.
- **3.** It can be used to solve $A \cdot X = B$, where *A* is a coefficient matrix, *X* is a variable matrix, and *B* is a constant matrix.

Lesson 4-6

- 1. Because they are not coefficients of variables.
- 2. Answers may vary.

CHAPTER 5

Lesson 5-1

- 1. The graph moves right/left.
- 2. The graph moves up/down.
- **3.** The *y*-coordinates of all points on the graph would change sign.

Lesson 5-2

- **1.** Because f(4) = 6.
- **2.** It opens up when a > 0.

Lesson 5-3

- 1. If a point on the graph is reflected across the axis of symmetry, the image is also on the graph.
- 2. Because a quadratic function can go up, then down; a linear function only goes up or down.

Lesson 5-4

- **1.** Because the square root introduces the plus/minus sign.
- **2.** Because you are changing the equation into a square plus a constant term.

Lesson 5-5

- **1.** It is the square root of -1. It is used to work with negative square roots.
- **2.** You could substitute the answer in the original equation.

Lesson 5-6

- **1.** Because the square root is positive.
- **2.** *c* would be 0 and the roots would be 0 and -10.

Lesson 5-7

- **1.** The point (0, 0) involves the least amount of calculation.
- 2. It is dotted because in the problem it is a less than sign, not a less than or equal to sign.

Lesson 5-8

- **1.** The difference between the *x*-values is constant.
- 2. Between 4 and 6 the graph is at 9, goes down, and comes back up to 9. The vertex must be between 4 and 6.
- **3.** It opens up because all the *y*-values are at least 9.

Lesson 5-9

- **1.** Quadrant II, because it corresponds to the point (-9, 1).
- **2.** The additive inverses of 10 and -4i.