5.6 Use Sinusoidal Functions to Model Periodic Phenomena Not Involving Angles

Student Text Pages
333 to 342

Suggested Timing
60–75 min

Tools
- grid paper
- graphing calculator
- computer with Internet access
- computer with graphing software (optional)

Related Resources
- G–1 Grid Paper
- BLM 5–11 Section 5.6 Practice

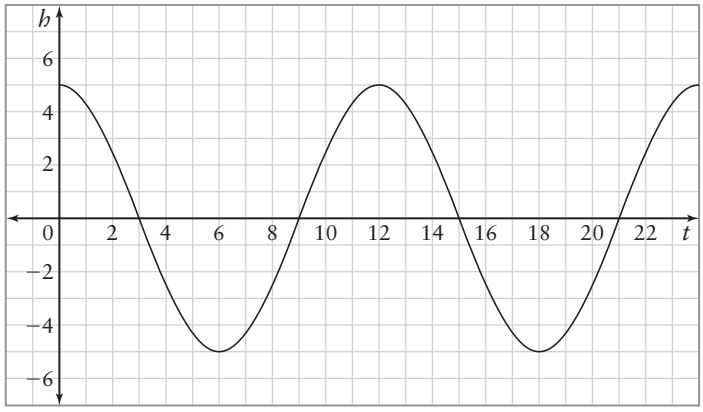
Differentiated Instruction
- Use **Think-Pair-Share** to complete the Investigate, Communicate Your Understanding, and Chapter Problem questions.

Teaching Suggestions

- It is tempting to make use of trigonometric regression in this section. However, the only technology in general use in Ontario schools is the graphing calculator. Its regression function assumes radian measure, which is not used in this course. So, trigonometric regression is left to the Advanced Functions course, after radian measure has been introduced.
- If desired, either *The Geometer's Sketchpad*® or *Fathom*™ dynamic statistical software can be programmed to simulate any kind of curve fitting using sliders. In addition, *Fathom*™ can be programmed to calculate least squares.
- For **Example 1**, consider approaching the physics teacher at your school for a demonstration of the sinusoidal nature of electricity coming out of the wall outlet. It is quick and straightforward to set up an oscilloscope to display the waveform of the actual voltage supplied by Ontario Power Generation.
- For **Example 2**, you can obtain a video clip of time-lapse photography showing the apparent motion of the sun north of the Arctic Circle on a video sharing Web site.
- For **Example 3**, visit the McGraw-Hill Ryerson Web site *www.mcgrawhill.ca/books/functions11* for one example of an online simulation of the predator-prey relationship.

Investigate Answers (page 333)

1.



2. The first high tide will occur at midnight with a height of 5 m.

3. Answers may vary. Sample answer: The first low tide will occur at 6 a.m. with a height of −5 m. The negative answer indicates that the height is 5 m below sea level.

4. The next high tide will be at noon, and the next low tide will be at 6 p.m.

5. The period is 12 h.

6. Answers may vary. Sample answer: A phase shift of 3 h to the left allows for the maximum value of the sine function (with a period of 12 h) to move from 3 a.m. to midnight.

Communicate Your Understanding Responses (page 337)

C1 Answers may vary. Sample answer: The value of a is smaller than the value of c.

C2 Answers may vary. Sample answer: No. For the graph of $y = a\sin[k(x - d)] + c$ to pass through the origin, the phase shift, d, can be a number of values other than zero. For example, the graph for $y = \sin(x - 360°)$ is the same as the graph for $y = \sin x$, and the graph passes through the origin.

C3 Answers may vary. Sample answer: The value of k must be between $\frac{1}{2}$ and 1. Since the period is given by $\frac{360°}{k}$, for $k = 1$ the period is 360°, and for $k = \frac{1}{2}$ the period is 720°. So, the value of k must be between $\frac{1}{2}$ and 1 for the period to be between 360° and 720°.

Common Errors

- Students have difficulty determining appropriate Window settings when the period is very short, such as when modelling AC electricity, or very long, such as when modelling the mutation of Earth's axis of rotation.

R_x Have students begin by setting the variables for the horizontal axis from minus one period to plus one period. This will produce a recognizable graph, which can then be adjusted as desired.

Practise, Connect and Apply, Extend

- **Question 2** reinforces the concept that either a sine or a cosine function can be used to model a periodic process.
- **Question 7** allows students to reason through questions related to modelling the voltage of AC current. They will use connecting skills from previous mathematical knowledge to represent a model of the voltage with a transformed sine function. They will also select tools to graph the voltage function and use their communicating skills to explain what the ticks on the axes mean.
- For **question 12**, visit the McGraw-Hill Ryerson Web site *www.mcgrawhill.ca/books/functions11* for a predator-prey simulation.
- **Question 14** gives students the opportunity to select tools and use connecting skills to represent the given data in the form of a graph. From the graph and the given table, students will use reasoning skills to construct a model to represent the number of daylight hours. After graphing the model on the same set of axes as the data, they will use their communicating skills to comment on the fit and to predict the number of hours of daylight on January 31.
- Use **BLM 5–11 Section 5.6 Practice** for remediation or extra practice.

Mathematical Process Expectations

The table shows questions that provide good opportunities for students to use the mathematical processes.

Process Expectation	Selected Questions
Problem Solving	5, 6, 18–21
Reasoning and Proving	1–21
Reflecting	5, 6, 10–13, 17, 20, 21
Selecting Tools and Computational Strategies	3–9, 11–16, 18–21
Connecting	1–21
Representing	1–9, 11–16, 18–21
Communicating	3, 7–9, 11, 12, 14, 15, 17, 20, 21

Use Technology

Student Text Page
343

Suggested Timing
15–20 min

Tools
- TI-Nspire™ CAS graphing calculator

Create a Scatter Plot and a Function Using a TI-Nspire™ CAS Graphing Calculator

Teaching Suggestions

- If a class set of calculators is not available, consider using a single calculator connected to a projector, or the emulator in the TI-Nspire™ CAS Computer Software Teacher Edition to demonstrate the activity. If an interactive whiteboard is available, have students take turns performing the required steps.

Chapter 5 Review

Student Text Pages
344 to 345

Suggested Timing
60–75 min

Tools
- grid paper
- graphing calculator
- computer with graphing software (optional)

Related Resources
- G–1 Grid Paper
- BLM 5–12 Chapter 5 Review

Ongoing Assessment

- Upon completing the Chapter Review, students can also answer questions such as the following:
  - *Did you work by yourself or with others?*
  - *What questions did you find easy? difficult? Why?*
  - *How often did you have to check the related Example in the text to help you with the questions? For which questions?*

Using the Review

Each question reviews different skills and concepts. Students might work independently to complete the Review, then work in pairs to compare solutions. Alternatively, the Review could be assigned for reinforcing skills and concepts in preparation for the Practice Test. Provide an opportunity for students to discuss any questions containing strategies or features they find difficult.

Consider making technology available to students to check their answers. If you have arranged for home access to *The Geometer's Sketchpad*®, students can quickly check their answers.

After students have completed the Review, encourage them to make a list of questions that caused them difficulty, and include the related sections and teaching examples. They can use this to focus their studying for a final test on the chapter's content.

Study Guide

Use the following study guide to direct students who have difficulty with specific questions to appropriate examples to review.

Question	Section(s)	Refer to
1	5.1	Examples 1 and 2 (pages 286–287)
2	5.1	Example 3 (pages 288–289)
3	5.2	Investigate A (pages 294–295)
4	5.2	Investigate C (page 298)
5	5.3	Examples 1 to 3 (pages 306–308)
6	5.4	Example 1 (pages 313–314)
7	5.5	Examples 1 and 2 (pages 324–325)
8	5.5	Example 3 (pages 325–327)
9	5.6	Examples 1 and 2 (pages 334–335)