

Pure Mathematics 30

**Teacher Notes:
Applications of Sinusoidal
Functions**



September 2004

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Pure Mathematics 30

Applications of Sinusoidal Functions—Teacher Notes

Introduction

This project relates to sunrise/sunset times and allows students to use their knowledge from the Trigonometry unit and the Transformations of Functions unit. The project is designed to be completed in three to five hours of student time. The use of this project is optional; however, if you do choose to use it, you may include it as part of your assessment. Sample solutions for the project questions can be found on the Alberta Learning extranet <https://phoenix.edc.gov.ab.ca>. A hard copy will be mailed to your school in late August. The general scoring guide for the project is the same as the one issued in September 2000.

One of the written-response questions worth 10% on each of the Pure Mathematics 30 November 2004, January 2005, and August 2005 diploma examinations will be related to this project. Students who do not complete the project but who have completed the course will have the knowledge to answer the written-response question; however, students who complete the project will gain experience with the related mathematical skills in another context.

Specific Notes

Teachers may wish to

- inform students that the sunrise/sunset tables were found at <http://aa.usno.navy.mil/AA/data>. Students may wish to access this web site.
- explain that the calculator sinusoidal regression equation is of the form $y = a \sin(bx + c) + d$, rather than $y = a \sin[b(x - c)] + d$ or $y = a \cos[b(x - c)] + d$.
- remind students to use radian mode when graphing trigonometric functions where the independent variable is not an angle given in degrees
- encourage students to link calculators for data transfer, because data takes time to enter
- have all students produce answers rounded to three decimal places so that answers to projects will be consistent with each other and, therefore, easier to mark

Program of Studies

The project relates to mathematics learned in the following units of Pure Mathematics 30.

Trigonometry

- Specific Outcomes**
- 3.1: Distinguish between degree and radian measure, and solve problems using both. [C, CN, E]
- 3.3: Solve first and second degree trigonometric equations over the domain of length $0 \leq \theta < 2\pi$ or the domain $0^\circ \leq \theta < 360^\circ$
- algebraically
 - graphically.
- [PS, T]
- 3.4 Determine the general solutions to trigonometric equations where the domain is the set of real numbers. [PS, T]
- 3.8: Draw (using technology), sketch, and analyze the graphs of sine, cosine, and tangent functions, for
- amplitude, if defined
 - period
 - domain and range
 - asymptotes, if any
 - behaviour under transformations.
- 3.10: Use sine and cosine functions to model and solve problems. [PS,R,V]

Transformations of Functions

- Specific Outcomes**
- 1.1: Describe how various translations of functions affect graphs and their related equations:
- $y = f(x - h)$
 - $y - k = f(x)$.
- [C, T, V]
- 1.2: Describe how various stretches of functions (compressions and expansions) affect graphs and their related equations:
- $y = af(x)$
 - $y = f(kx)$.
- [C, T, V]
- 1.5 Describe and perform single transformations and combinations of transformations on functions and relations. [C, T, V]

Statistics

- Specific Outcome**
- 6.1 Find the population standard deviation of a data set, using technology. [CN, E, T, V]

Mathematical Processes

The seven mathematical processes identified in the *Program of Studies* are addressed in this project in the following manner.

- Communication:** Compare equations found algebraically with those found by using regression methods. Discuss reasonableness of answers.
- Connections:** Relate mathematics to real-life situations and connect different units within Pure Mathematics 30. The study of sunrise/sunset is related to periodic functions.
- Estimation and Mental Mathematics:** Check reasonableness of calculations and claims.
- Problem Solving:** Compare graphs of trigonometric functions and determine the relationship between these functions. Students must apply knowledge of these functions to novel and realistic data.
- Reasoning:** Decide which form of an equation best represents the data.
- Technology:** Use a spreadsheet and/or a graphing calculator to solve and display problems. Create graphs using different lists as data. Perform regression analysis on data to generate equations.
- Visualization:** Visualize the shape of a sinusoidal curve before creating it. Recognize, visually, the type of graphs created by graphing number of daylight hours versus day number.

ICT Program of Studies

C.1—Students will access, use, and communicate information from a variety of technologies.

Specific Outcome 4.2: Select information from appropriate sources, including primary and secondary sources.

C.5—Students will use technology to aid collaboration during inquiry.

Specific Outcome 4.2: Participate in a variety of electronic group formats.

C.6—Students will use technology to investigate and/or solve problems.

Specific Outcomes 4.1: Investigate and solve problems of prediction, calculation, and inference.

4.2: Investigate and solve problems of organization and manipulation of information.

4.3: Manipulate data by using charting and graphing technologies in order to test inferences and probabilities.

4.5: Evaluate the appropriateness of the technology used to investigate or solve a problem.

F.1—Students will demonstrate an understanding of the nature of technology.

Specific Outcomes 4.1: Assess the strengths and weaknesses of computer simulations in relation to real-world problems.

4.2: Solve mathematical and scientific problems by selecting appropriate technology to perform calculations and experiments.

F.2—Students will demonstrate an understanding of the nature of technology.

Specific Outcome 4.1: Use technology outside formal classroom settings.

4.7: Use current, reliable information sources from around the world.

P.2—Students will organize and manipulate data.

Specific Outcome 4.1: Manipulate and present data through the selection of appropriate tools, such as scientific instrumentation, calculators, databases, and/or spreadsheets.