5 Trigonometric Functions and Graphs

General Outcome

Develop trigonometric reasoning.

Specific Outcomes

T4 Graph and analyze the trigonometric functions sine, cosine and tangent to solve problems.

T5 Solve, algebraically and graphically, first and second degree trigonometric equations with the domain expressed in degrees and radians.

General Outcome

Develop algebraic and graphical reasoning through the study of relations.

Specific Outcomes

RF2 Demonstrate an understanding of the effects of horizontal and vertical translations on the graphs of functions and their related equations.

RF3 Demonstrate an understanding of the effects of horizontal and vertical stretches on the graphs of functions and their related equations.

RF4 Apply translations and stretches to the graphs and equations of functions.

By the end of this chapter, students will be able to:

Section	Understanding Concepts, Skills, and Processes
5.1	✓ sketch, with or without technology, the graph of $y = \sin x$, $y = \cos x$
	✓ determine the characteristics (amplitude, asymptotes, domain, period, range and zeros) of the graph of $y = \sin x$, $y = \cos x$
	✓ explain how the characteristics of the graph of a trigonometric function relate to the conditions in a problem situation
	✓ solve a problem by analyzing the graph of a trigonometric function
5.2	✓ sketch, without technology, graphs of the form $y = a \sin b(x - c) + d$ or $y = a \cos b(x - c) + d$, using transformations, and explain the strategies
	✓ determine the characteristics (amplitude, asymptotes, domain, period, phase shift, range and zeros) of the graph of a trigonometric function of the form $y = a \sin b(x - c) + d$ or $y = a \cos b(x - c) + d$
	✓ determine the values of a, b, c, and d for functions of the form $y = a \sin b(x - c) + d$ or $y = a \cos b(x - c) + d$ that correspond to a given graph, and write the equation of the function
	✓ determine how varying the value of a, b, c, or d affects the graphs of $y = a \sin b(x - c) + d$ or $y = a \cos b(x - c) + d$
	✓ explain how the characteristics of the graph of a trigonometric function relate to the conditions in a problem situation

Section	Understanding Concepts, Skills, and Processes
5.3	✓ sketch, with or without technology, the graph of $y = \tan x$
	✓ determine the characteristics (amplitude, asymptotes, domain, period, range and zeros) of the graph of $y = \tan x$
	✓ determine a trigonometric function that models a situation to solve a problem
	✓ explain how the characteristics of the graph of a trigonometric function relate to the conditions in a problem situation
	✓ solve a problem by analyzing the graph of a trigonometric function
5.4	✓ determine the values of a, b, c and d for functions of the form $y = a \sin b(x - c) + d$ or $y = a \cos b(x - c) + d$ that correspond to a given graph, and write the equation of the function
	✓ determine a trigonometric function that models a situation to solve a problem
	✓ explain how the characteristics of the graph of a trigonometric function relate to the conditions in a problem situation
	✓ solve a trigonometric equation algebraically
	✓ relate the general solution of a trigonometric equation to the zeros of the corresponding trigonometric function (restricted to sine and cosine functions)
	✓ solve a trigonometric equation graphically

Assessment	Supporting Learning
Assessment *for* Learning	
Method 1: Use the introduction on page 220 in *Pre-Calculus 12* to activate students' prior knowledge about the skills and processes that will be covered in this chapter. **Method 2:** Have students develop a journal entry to explain what they personally know about trigonometry and trigonometric functions.	• Have students update their list of what they need to work on and keep track of the skills and processes that need attention. • Students who require activation of prerequisite skills may wish to complete **BLM 5–1 Chapter 5 Prerequisite Skills**. This material is on the Teacher CD of this Teacher's Resource and mounted on the www.mcgrawhill.ca/school/learningcentres book site.
Assessment *as* Learning	
As students work on each section in Chapter 5, have them keep track of any problems they are having.	• As students complete each section, have them review the list of items they need to work on and check off any that have been handled. • Encourage students to write definitions for the Key Terms in their own words, including reminder tips that may be helpful for review throughout the chapter. • Encourage students to write examples of their own in their notebook or math portfolio. Students should have an example for each method that is covered in the chapter.
Assessment *for* Learning	
BLM 5–1 Chapter 5 Prerequisite Skills This master provides a review of prerequisite skills needed for the chapter.	• Use the Prerequisite Skills BLM to provide additional opportunities for students to demonstrate their readiness for the chapter material. • Have students share their strategies for completing mathematical calculations. • Students who are having difficulty should review angles in standard position and exact trigonometric values for the common angles 0°, 30°, 45°, 60°, and 90°. Drawing a right triangle and labelling the sides may also help students.

Chapter 5 Planning Chart

Section/ Suggested Timing	Prerequisite Skills	Materials/Technology	Teacher's Resource Blackline Masters	Exercise Guide	Assessment			Web Link www.mcgrawhill.ca/school/learningcentres
					Assessment *as* Learning	Assessment *for* Learning	Assessment *of* Learning	
Chapter Opener • 30–45 min (TR page 117)			BLM 5–1 Chapter 5 Prerequisite Skills BLM U2–1 Unit 2 Project Checklist					• careers of geologists and related educational programs
5.1 Graphing Sine and Cosine Functions • 135–180 min (TR page 118)	Students should be familiar with • the concepts of pi, radians and degrees, domain and range, *x*- and *y*-intercepts, and maximum and minimum values • trigonometric ratios, sine and cosine in particular • the unit circle • right triangles and the Pythagorean theorem • special triangles • absolute value • solving inequalities	• grid paper • ruler • graphing calculator • protractor • compass • spreadsheet software (optional)	Master 3 Centimetre Grid Paper BLM 5–2 Section 5.1 Extra Practice TM 5–1 How to Do Page 226 Example 2a) Using TI 83/84 TM 5–2 How to Do Page 226 Example 2a) Using TI-Nspire™	**Essential:** #1–10, 12, 14, 18 **Typical:** #1–11, 13, 14, one of 15–17, 18, 19, C1, C3 **Extension/Enrichment:** #6, 10, 20–24, C2, C5	TR pages 119, 123	TR pages 122, 123		
5.2 Transformations of Sinusoidal Functions • 90–135 min (TR page 124)	Students should be familiar with • the concept of a translation • restrictions and set notation	• grid paper • graphing technology • coloured pencils	BLM 5–3 Section 5.2 Extra Practice	**Essential:** #1–6, 11–13, 15–17, 21 **Typical:** #1–7, 12, 14–17, one of 18–22, 26, C1, C2, C4 **Extension/Enrichment:** #5, 12, 14, 19, 23, 25–28, C1, C3, C4	TR pages 125, 129	TR pages 128, 129		
5.3 The Tangent Function • 60–90 min (TR page 130)	Students should be familiar with • trigonometric ratios, tangent in particular • the concept of an asymptote • special triangles	• grid paper • ruler • protractor • compass • graphing technology • spreadsheet software (optional) • coloured pencils (optional)	Master 4 Unit Circle on Grid BLM 5–4 Section 5.3 Extra Practice	**Essential:** #1–5, 7, 8, 10 **Typical:** #1–8, 10, 12, C1, C2 **Extension/Enrichment:** #7, 8, 10, C2	TR pages 131, 133	TR page 133		
5.4 Equations and Graphs of Trigonometric Functions • 90–135 min (TR page 134)	Students should be familiar with • mathematical modelling • solving equations • entering expressions, setting windows, and graphing with a graphing calculator	• marker • ruler • compass • stopwatch • centimetre grid paper • graphing calculator • coloured pencils (optional)	BLM 5–5 Circle With 8 cm Radius on Grid BLM 5–6 Section 5.4 Extra Practice	**Essential:** #1, 5–11, 15–17 **Typical:** #5, 6, 8, 12–15, 17 or 18, 20, C2 **Extension/Enrichment:** #19, 22, 23, C2, C3	TR pages 135, 138	TR pages 137, 138		• tidal power and electricity in Canada • Cassiope, a hybrid satellite project of the Canadian Space Agency
Chapter 5 Review and Practice Test • 90–135 min each (TR page 139)			Master 3 Centimetre Grid Paper BLM 5–2 Section 5.1 Extra Practice BLM 5–3 Section 5.2 Extra Practice BLM 5–4 Section 5.3 Extra Practice BLM 5–6 Section 5.4 Extra Practice BLM 5–7 Chapter 5 Study Guide BLM 5–8 Chapter 5 Test BLM 5–9 Chapter 5 BLM Answers	Have students do at least one question related to any concept, skill, or process that has been giving them trouble. **Chapter 5 Review minimum:** 1–5, 6a), d), 7a), d), 8–12, 14–15, 17, 19–21 Provide students with the number of test questions they can comfortably do in one class. Choose at least one question for each concept, skill, or process. **Chapter 5 Practice Test minimum:** #1–8, 10–12, 15, 17		TR page 139	TR page 139 BLM 5–8 Chapter 5 Test	