Grade 12
Pre-Calculus Mathematics
Achievement Test

Booklet 1

January 2016

Manitoba

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After the administration of this test, print copies of this resource will be available for purchase from the Manitoba Learning Resource Centre (formerly the Manitoba Text Book Bureau). Order online at <www.mtbb.mb.ca>.

This resource will also be available on the Manitoba Education and Advanced Learning website at <www.edu.gov.mb.ca/k12/assess/archives/index.html>.

Websites are subject to change without notice.

Disponible en français.

Available in alternate formats upon request.

Grade 12 Pre-Calculus Mathematics Achievement Test

DESCRIPTION

Time: 3 hours

Numbers and Marks by Question Type

	Selected Response	Constructed Response	Marks
Booklet 1*	–	13	29
Booklet 2	8	24	63
Total	8	37	**92**

* The first 4 questions in *Booklet 1* require a calculator. 
You will have access to your calculator for the first 45 minutes of the test.

GENERAL DIRECTIONS

- Read all instructions carefully.
- The perforated *Formula Sheet* and the *Terminology Sheet* can be removed from the test booklet. No marks will be given for work done on these pages.
- The blank pages at the back of each booklet may be used as scrap paper, but must **not** be removed from the test booklet. No marks will be given for work done on these pages.
- Note that diagrams and graphs provided in the test booklets may not be drawn to scale.
- After 45 minutes, put away your calculator. Even though you may not have finished *Booklet 1*, *Booklet 2* will be distributed at this time. You may choose to continue working on *Booklet 1* or start working on *Booklet 2*, but you will no longer have access to your calculator.

Instructions

- There are 13 questions worth a total of 29 marks.
- Calculators (scientific or graphing) are allowed for the first 45 minutes of the test.
- A calculator icon  appears next to the questions that require a calculator.
- Write each solution in the space provided.
- For full marks, your answers must show all pertinent diagrams, calculations, and explanations.
- Graphing calculator solutions must include an explanation of how your final answer is obtained.
- Your solutions should be neat, organized, and clear.
- Some answers are to be given as decimal values. Rounding too early in your solution may result in an inaccurate final answer for which full marks will not be given.
- Express your answers as exact values or correct to the nearest thousandth (3 decimal places) unless instructed otherwise.

Formula Sheet

$s = \theta r$

$\sin^2\theta + \cos^2\theta = 1$

$\tan^2\theta + 1 = \sec^2\theta$

$1 + \cot^2\theta = \csc^2\theta$

$\sin(\alpha - \beta) = \sin\alpha\cos\beta - \cos\alpha\sin\beta$

$\cos(\alpha - \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$

$\tan(\alpha - \beta) = \dfrac{\tan\alpha - \tan\beta}{1 + \tan\alpha\tan\beta}$

$\sin(\alpha + \beta) = \sin\alpha\cos\beta + \cos\alpha\sin\beta$

$\cos(\alpha + \beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta$

$\tan(\alpha + \beta) = \dfrac{\tan\alpha + \tan\beta}{1 - \tan\alpha\tan\beta}$

$\sin 2\alpha = 2\sin\alpha\cos\alpha$

$\cos 2\alpha = \cos^2\alpha - \sin^2\alpha$

$\cos 2\alpha = 1 - 2\sin^2\alpha$

$\cos 2\alpha = 2\cos^2\alpha - 1$

$\tan 2\alpha = \dfrac{2\tan\alpha}{1 - \tan^2\alpha}$

$\log_a(MN) = \log_a M + \log_a N$

$\log_a\left(\dfrac{M}{N}\right) = \log_a M - \log_a N$

$\log_a(M^n) = n\log_a M$

$P(n,r)$ or ${}_nP_r = \dfrac{n!}{(n-r)!}$

$C(n,r)$ or ${}_nC_r = \dfrac{n!}{r!(n-r)!}$

$t_{k+1} = {}_nC_k a^{n-k}b^k$

For $ax^2 + bx + c = 0$,

$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Terminology Sheet

Some questions may contain directing words such as *explain*, *identify*, and *justify*. These words are defined below.

Evaluate: Find the numerical value.

Explain: Use words to provide the cause of or reason for the response, or to render the response more clear and understandable.

Sketch the graph: Provide a detailed drawing with key features of the graph that includes a minimum of 2 coordinate points.

Identify/Indicate: Recognize and select the answer by stating or circling it.

Justify: Show reasons for or give facts that support a position by using mathematical computations, words, and/or diagrams.

Solve: Give a solution for a problem or determine the value(s) of a variable.

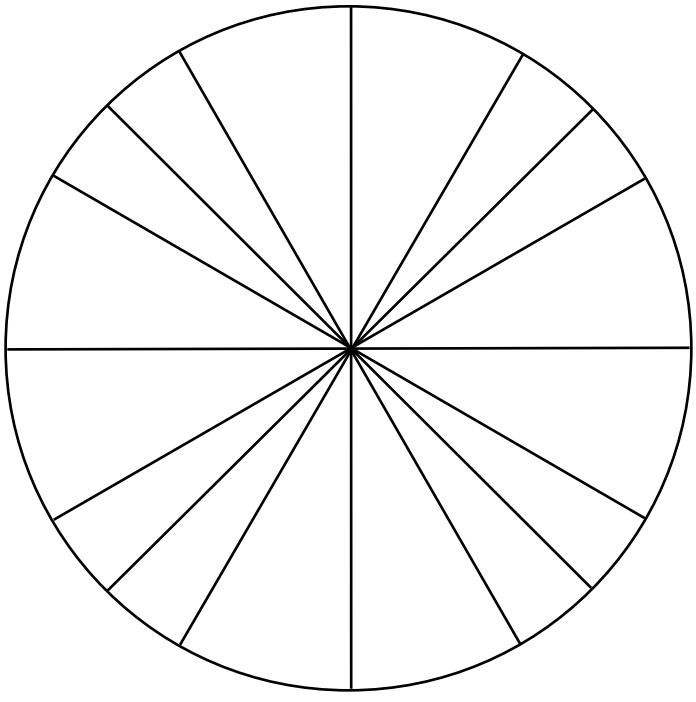
Verify: Establish the truth of a statement by substitution or comparison.

Determine: Use a mathematical formula, an algebraic equation, or a numerical calculation to solve a problem.

State: Give an answer without an explanation or justification.

Describe: Use words to provide the process or to report details of the response.

Unit Circle (can be used if needed)



Question 1  2 marks 101

A pizza with a diameter of 15 inches is cut into equal slices, each with a central angle of 36°.
Determine the length of the crust on the outer edge of one slice of pizza.

Question 2  a) 1 mark b) 2 marks

102
103

There are 9 girls and 7 boys in a math class from which a committee of 5 is to be chosen.

a) How many different committees of 5 can be formed if one of the boys, William, must be on the committee?

b) How many different committees of 5 can be formed if there must be 2 girls and 3 boys on the committee?

Question 3  3 marks 104

Solve the following equation over the interval $[0, 2\pi]$:

$$\sin^2\theta + 6\sin\theta - 2 = 0$$

Question 4  4 marks 105

Solve:

$$6(5)^{3x+2} = 9^{2-x}$$

Note: A calculator is not required for the remaining test questions.

Question 5 — 4 marks — 106

Solve $(2\sin\theta - 1)(\sin\theta + 1) = 0$ where $\theta \in \mathbb{R}$.

Question 6 — 1 mark

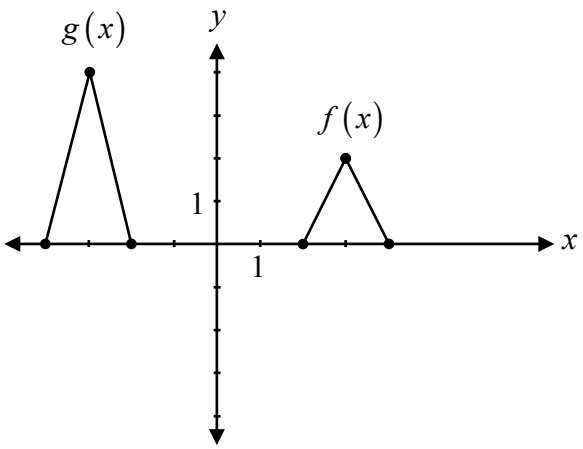
107

The roots of the polynomial equation $3(x-2)(x+1)^2 = 0$ are $x = 2$ and $x = -1$.

Explain what these roots represent on the graph of $p(x) = 3(x-2)(x+1)^2$.

Question 7 — 2 marks — 108

Determine an equation for $g(x)$ as a transformation of $f(x)$.



$g(x) =$ _____

Question 8 — 1 mark — 109

A student must determine the factors of $5x^4 - 2x^3 + 4x - 1$. He used $5, -2, 4,$ and -1 as the coefficients of the polynomial when using synthetic division.

Explain the student's error.

Question 9 — 2 marks — 110

Describe the transformations of $y = f(x)$ when asked to sketch the graph of $y = -f(x-4)$.

Question 10 — 3 marks — 111

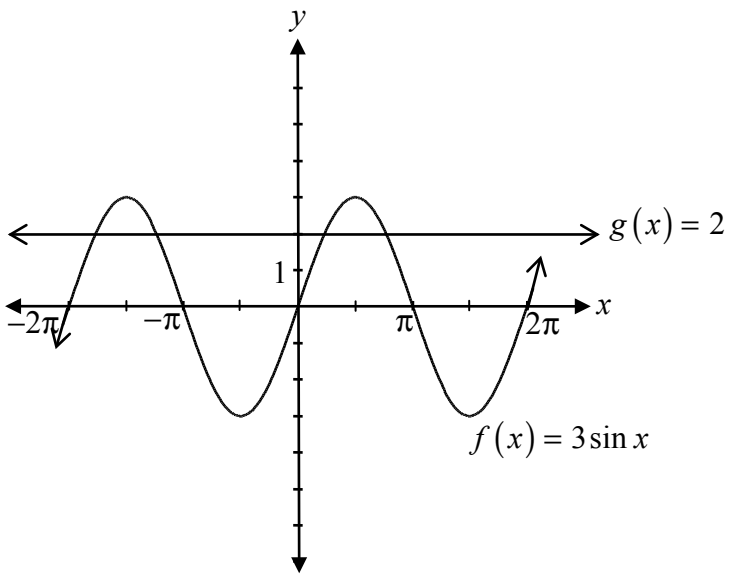
Prove the identity below for all permissible values of θ:

$$\sin\theta + \frac{\cos\theta}{\tan\theta} = \frac{1}{\cos\theta\tan\theta}$$

Left-Hand Side	Right-Hand Side

Question 11 — 1 mark — 112

Describe how to use the graphs of $f(x) = 3\sin x$ and $g(x) = 2$ to solve the equation $3\sin x = 2$.



Question 12 — 1 mark — 113

A hockey arena has 5 doors.

Determine the number of ways that you can enter through one door but exit through a different door.

Question 13 — 2 marks — 114

Given that $(x+3)$ is one of the factors, express $2x^3 + 7x^2 + 2x - 3$ as a product of factors.

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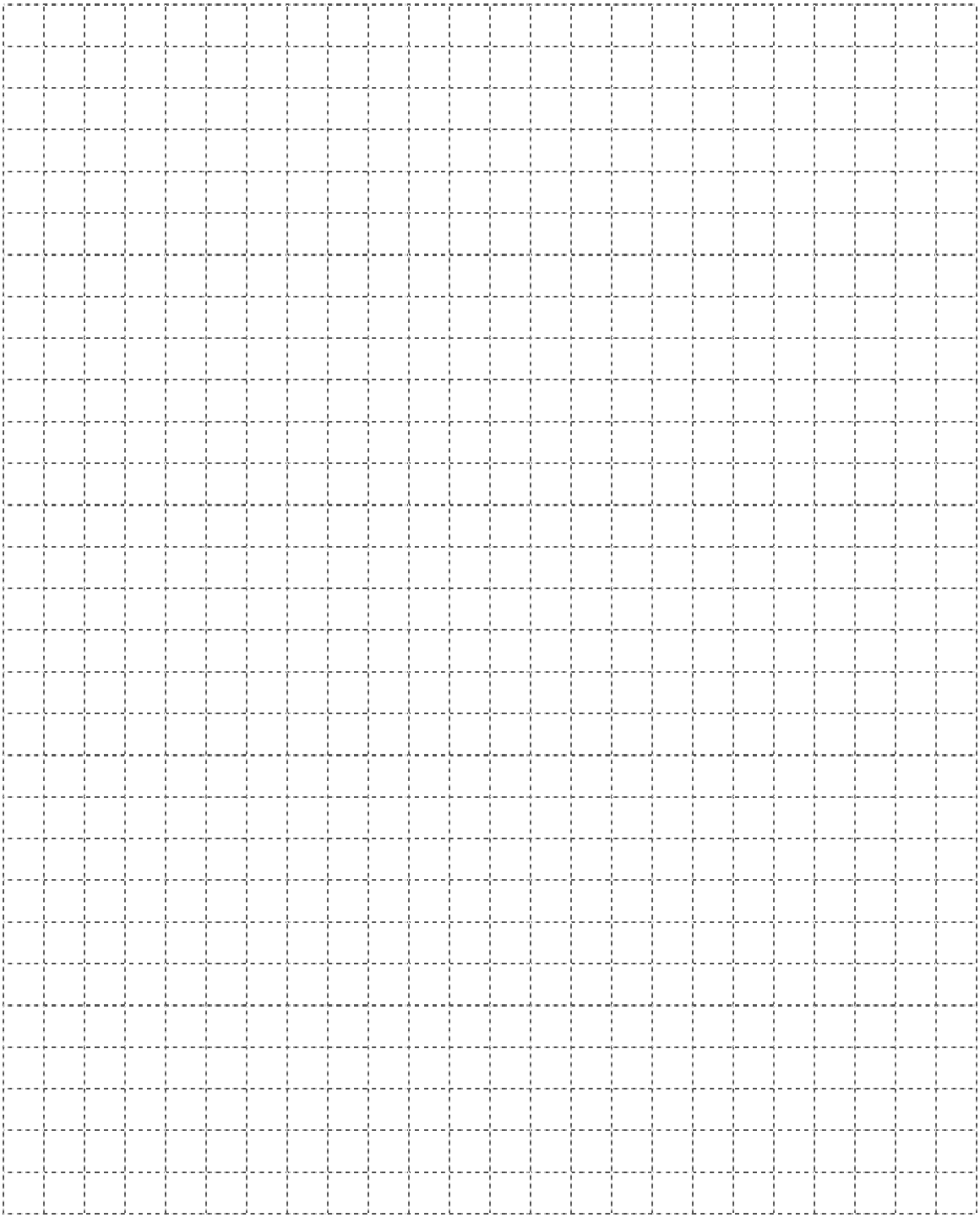

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