Grade 12
Pre-Calculus Mathematics
Achievement Test

Booklet 1

June 2015

Manitoba

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After the administration of this test, print copies of this resource will be available for purchase from 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	31
Booklet 2	9	20	59
Total	9	33	**90**

* The first 6 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 for a total of 31 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.

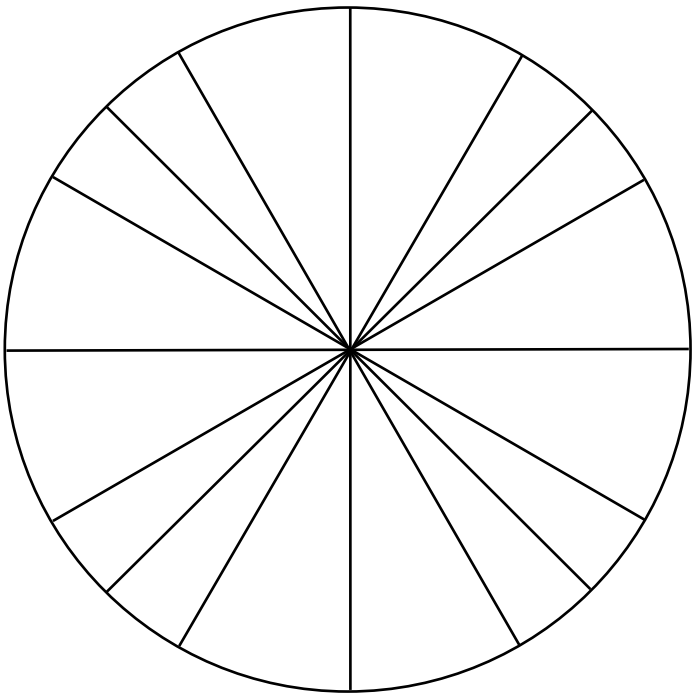
Solve: Give a solution for a problem or determine the value(s) of a variable.

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.

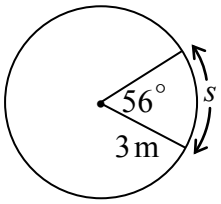
State: Give an answer without an explanation or justification.

Unit Circle (can be used if needed)



Question 1  2 marks

Use the information in the diagram to determine the value of the arc length "s", given the central angle of 56°.



Question 2  4 marks

Solve $\tan^2\theta - 5\tan\theta + 4 = 0$ where $\theta \in \mathbb{R}$.

Question 3  4 marks

103

Solve:

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

Question 4  3 marks

David and Sarah are in a class of 10 boys and 8 girls.
A committee of 3 boys and 2 girls is to be selected from the students in this class.

Determine the number of possible committees if David and Sarah cannot be on the same committee.

Question 5  3 marks

105

In the binomial expansion of $\left(\frac{3}{x^2} - x^5\right)^{10}$, simplify the 7th term.

Question 6  2 marks

A lake affected by acid rain has a pH of 4.4.
A person suffering from heartburn has a stomach acid pH of 1.2.

The pH of a solution is defined as $pH = -\log\left[H^+\right]$ where $\left[H^+\right]$ is the hydrogen ion concentration.

How many times greater is the hydrogen ion concentration of the stomach than that of the lake?

Express your answer as a whole number.

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

Question 7 — 4 marks — 107

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

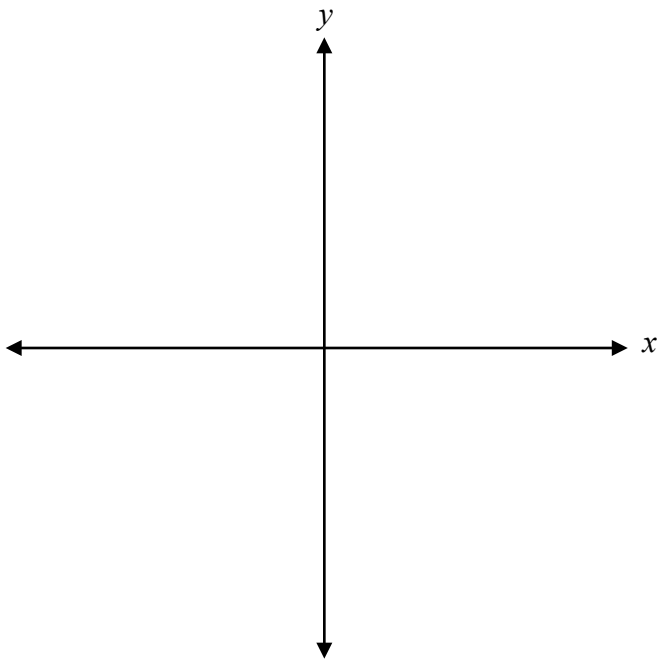
$$\cos 2\theta - 3\sin\theta - 2 = 0$$

Question 8 — 1 mark — 108

Explain how the value of n affects the behaviour of the graph of the polynomial function $p(x) = (x+3)(x-1)^n$, as $p(x)$ approaches the x-intercept at $x = 1$.

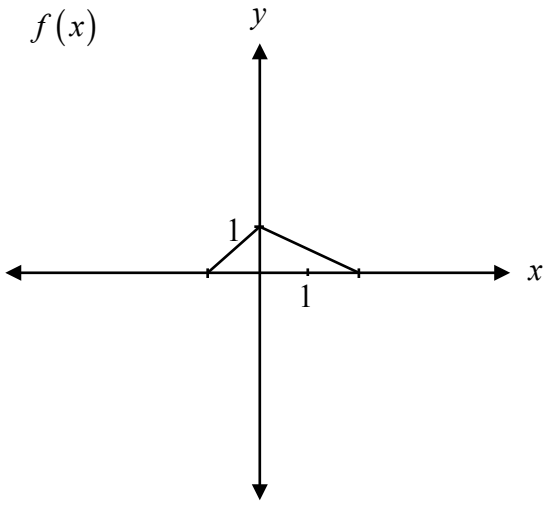
Question 9 — 1 mark — 109

Sketch the angle -320° in standard position.



Question 10 — 1 mark — 110

Given the graph of $y = f(x)$, explain how to graph $y = f(-x)$.

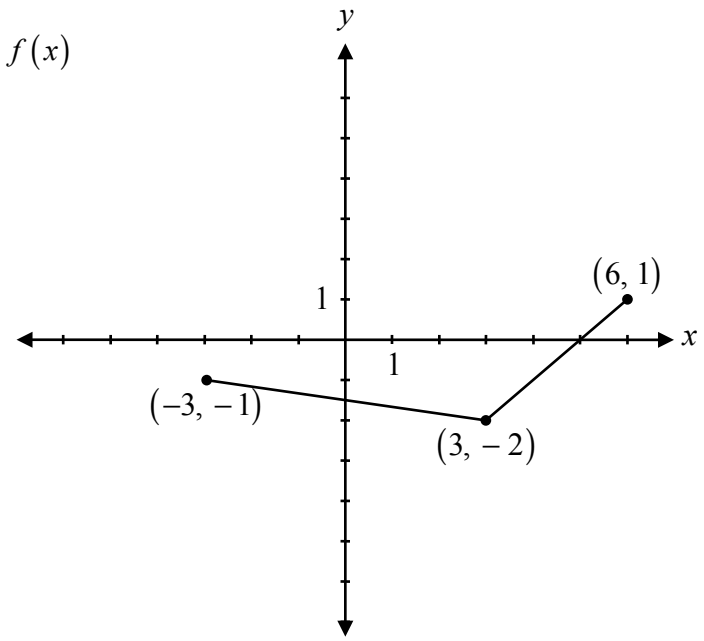


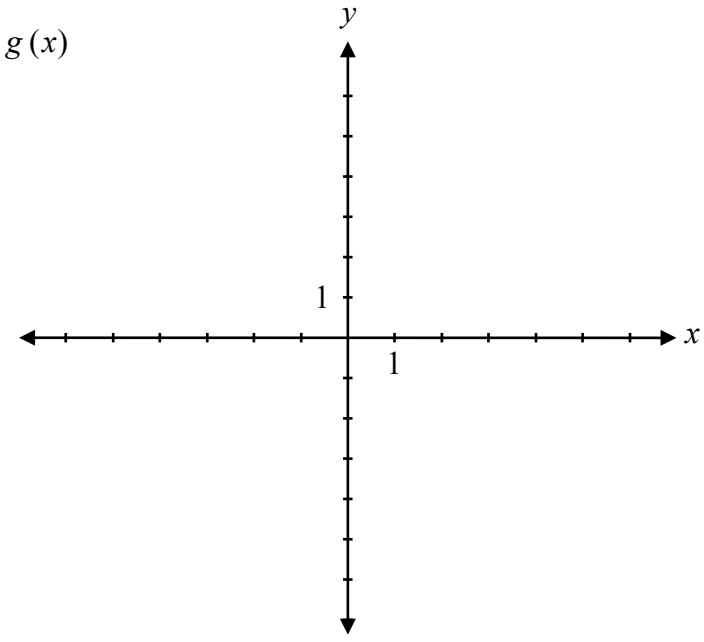
Question 11 — 1 mark — 111

Explain how the graph of $y = \dfrac{3(x-1)}{(x-1)}$ is different than the graph of $y = 3$.

Question 12 — 2 marks — 112

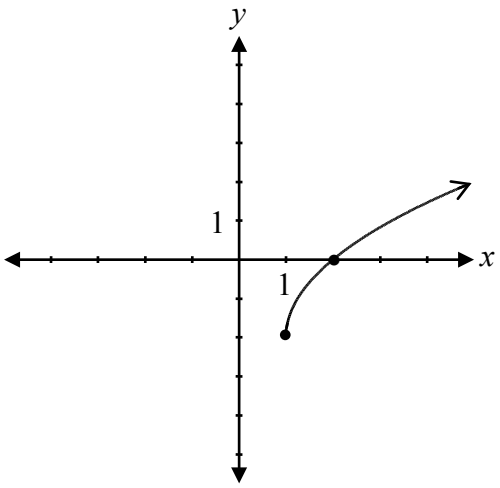
Given the graph of $f(x)$, sketch the graph of $g(x) = 2f(3x)$.





Question 13 — 3 marks — 113

Determine the equation of the radical function represented by the graph.



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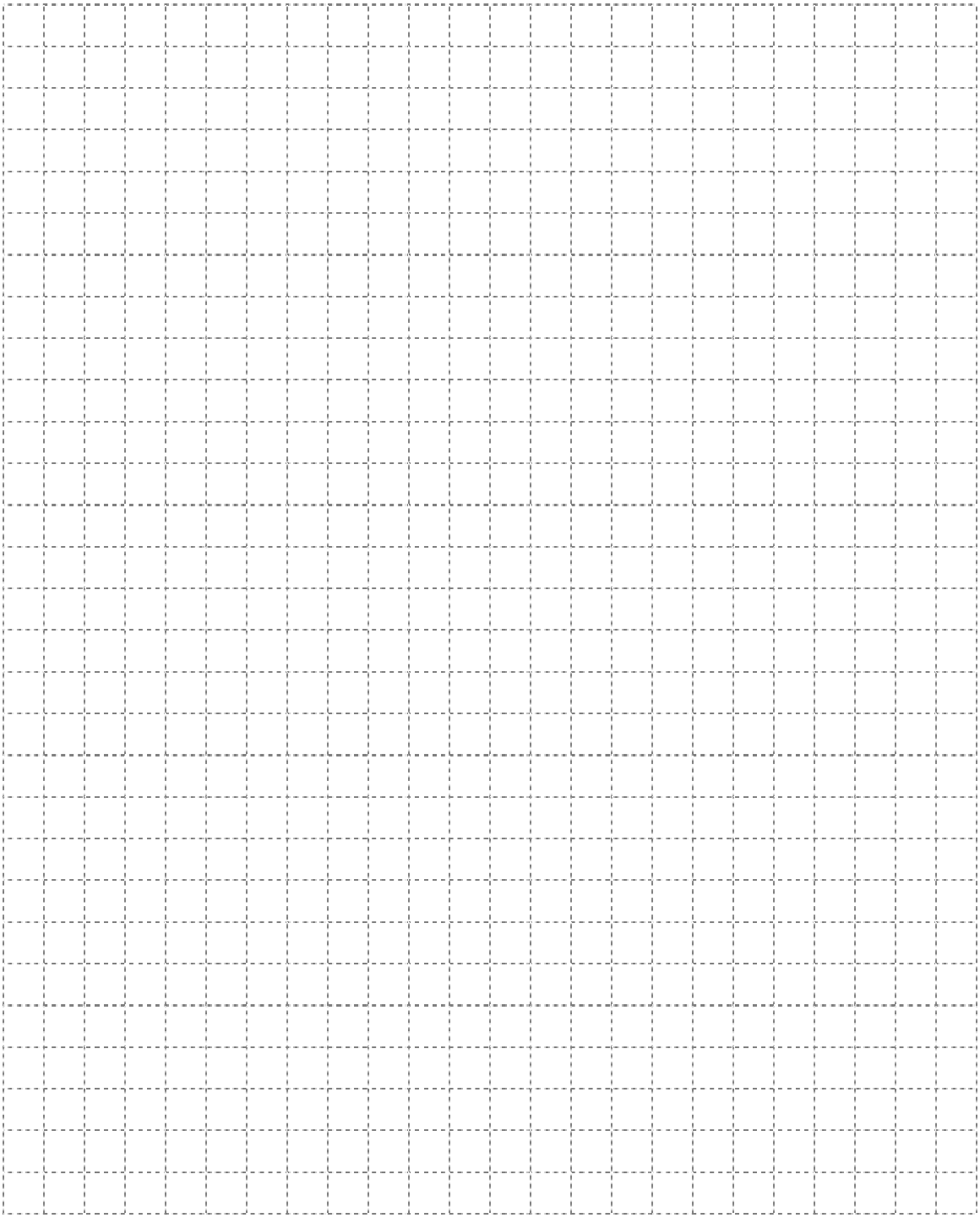

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