

Grade 12
Pre-Calculus Mathematics
Achievement Test

Booklet 1

January 2015

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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

	Multiple Choice	Constructed Response	Marks
Booklet 1*	–	15	33
Booklet 2	10	20	57
Total	10	35	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 15 questions for a total of 33 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 3 decimal places unless instructed otherwise.

Formula Sheet

$$s = \theta r$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$P(n, r) \text{ or } {}_n P_r = \frac{n!}{(n-r)!}$$

$$C(n, r) \text{ or } {}_n C_r = \frac{n!}{r!(n-r)!}$$

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

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

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

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.

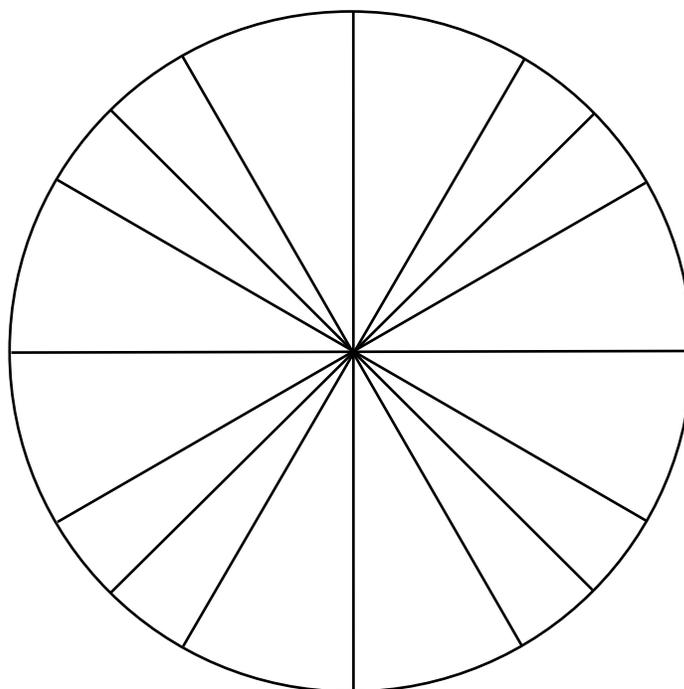
Solve: Give a solution for a problem or determine the value(s) of a variable.

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 

1 mark

101

Convert $-\frac{13\pi}{5}$ to degrees.

Question 2 

a) 1 mark b) 1 mark c) 1 mark

102
103
104

a) From a group of 9 people, in how many ways can you select a committee of 4 members?

b) From a group of 9 people, in how many ways can you select a president, a vice president, a secretary, and a treasurer?

c) Explain why the answers in a) and b) are different.

Question 3 

a) 2 marks b) 2 marks

105
106

A population of 500 bacteria will triple in 20 hours.

Using the formula given below,

$$A = Pe^{rt}$$

A = population after t hours

P = initial population

r = rate of growth

t = time in hours

a) Determine the rate of growth, r .

b) Determine how many hours it will take for the initial population to double with the same rate of growth.

Question 4 

a) 1 mark b) 2 marks

107
108

Talla incorrectly solved the following trigonometric equation:

Solve: $2 \sec x - 5 = 0$; $0^\circ \leq x \leq 360^\circ$.

Talla's work:

$$2 \sec x - 5 = 0$$

$$\cancel{\sec x = \frac{5}{2}}$$

No solution, $\sec x$ cannot be greater than 1.

a) Explain her error.

b) Determine the correct solution.

Simplify the 6th term in the expansion of:

$$\left(2x - \frac{3}{x^2}\right)^{10}$$

Question 6 

1 mark

110

Determine the arc length subtended by a central angle if the diameter is 19 cm and the central angle is 1.6 radians.

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

Question 7

4 marks

111

Solve the following equation algebraically for x , where $0 \leq x \leq 2\pi$.

$$2 \cos^2 x = -3 \sin x$$

Question 8

1 mark

112

In how many different ways can you arrange the letters in the word VOLLEYBALL?

State your answer as a factorial.

Question 9

2 marks

113

Is $(x - 2)$ a factor of the polynomial $p(x) = -x^4 - 3x^3 + 11x^2 + 3x - 10$?

Justify your response.

Determine the period of the sinusoidal function $y = \frac{1}{2} \sin\left(\frac{1}{3}x\right)$.

State your answer in radians.

Question 11

2 marks

115

The domain of $f(x)$ is $x \leq 2$. The domain of $g(x)$ is $x \geq -7$.

State the domain of $f(x) + g(x)$.

Justify your answer.

Question 12

3 marks

116

Prove the identity below for all permissible values of θ .

$$\frac{1}{1 + \cos \theta} = \csc^2 \theta - \frac{\cot \theta}{\sin \theta}$$

Left-Hand Side	Right-Hand Side

Question 13

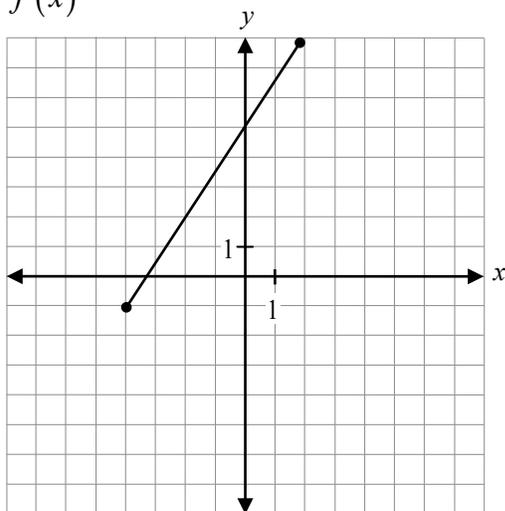
1 mark

117

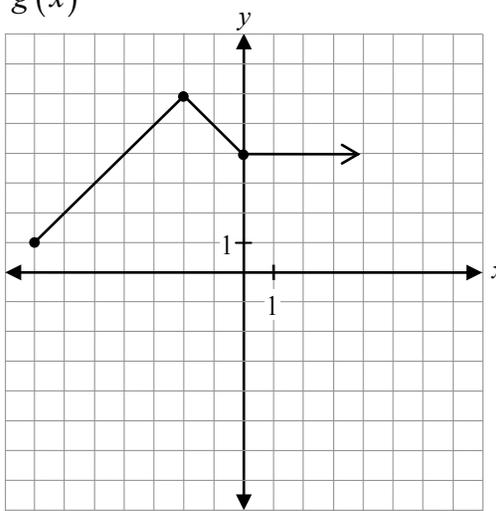
Explain how the end behaviours of the graphs of polynomial functions with an even degree and with an odd degree are different.

Given the graphs of $f(x)$ and $g(x)$, sketch the graph of $g(x) - f(x)$.

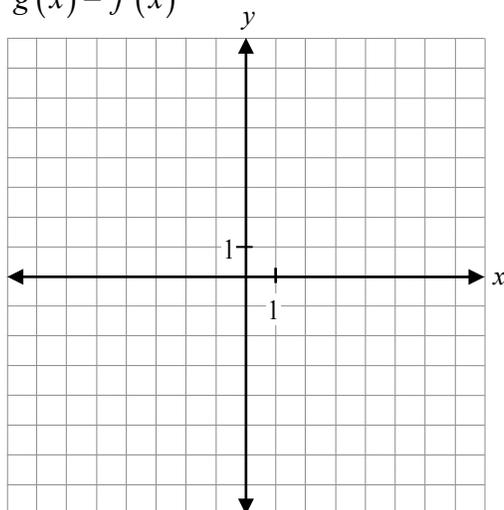
$f(x)$



$g(x)$

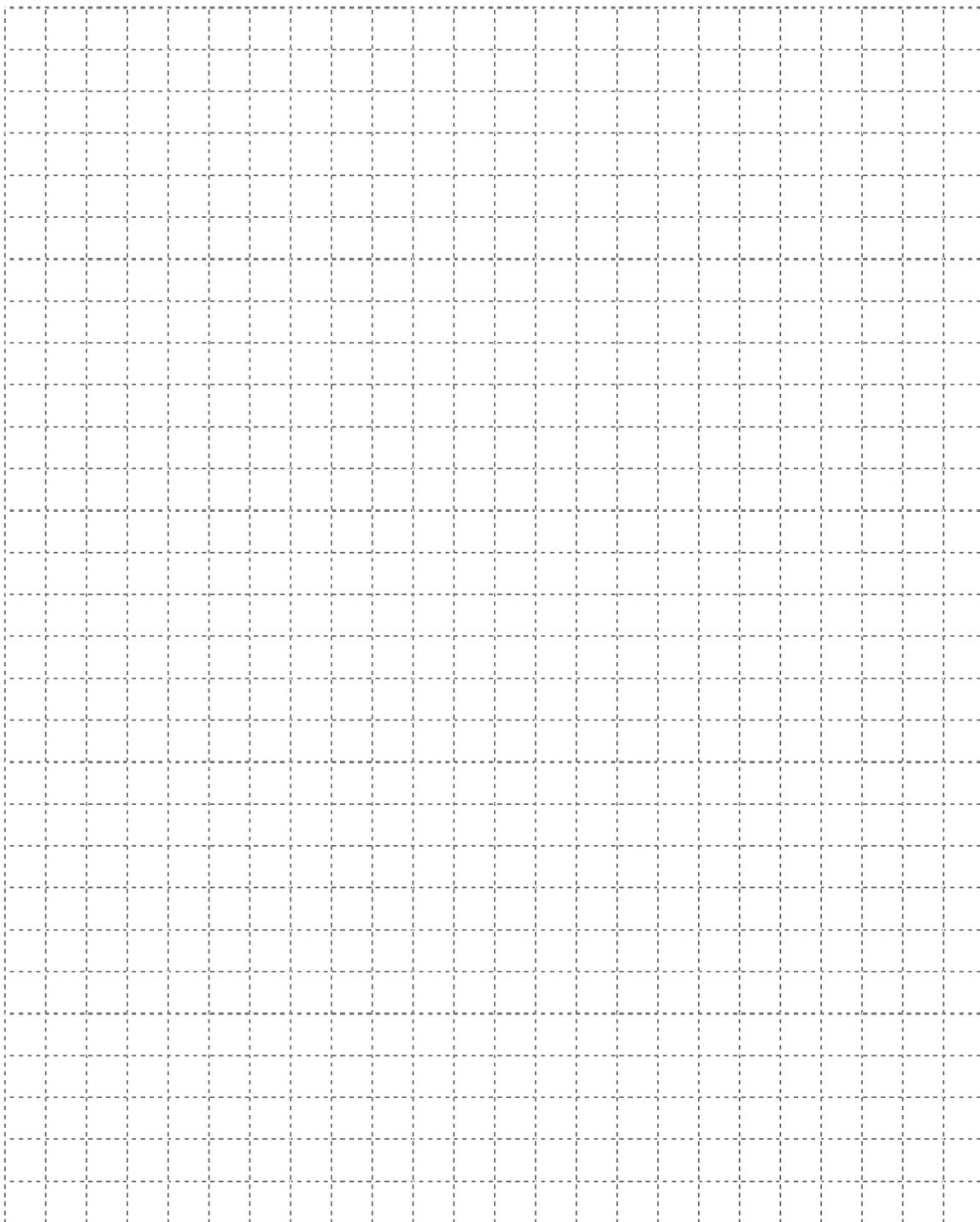


$g(x) - f(x)$



Given $f(x) = -3x + 7$, evaluate $f^{-1}(-2)$.

No marks will be awarded for work done on this page.



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