Grade 12
Pre-Calculus Mathematics
Achievement Test

Booklet 1

June 2026

Manitoba

Grade 12 Pre-Calculus Mathematics Achievement Test:
Booklet 1 (June 2026)

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

Websites are subject to change without notice.

Disponible en français.

While the department is committed to making its publications as accessible as possible, some parts of this document are not fully accessible at this time.

Available in alternate formats upon request.

Grade 12 Pre-Calculus Mathematics Achievement Test

DESCRIPTION

Time Required to Complete the Test: 3 hours
Additional Time Allowed: 30 minutes

Number and Marks by Question Type

	Selected Response	Constructed Response	Marks
Booklet 1*	**—**	**15**	**35**
Booklet 2	9	20	56
Total	9	35	**91**

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

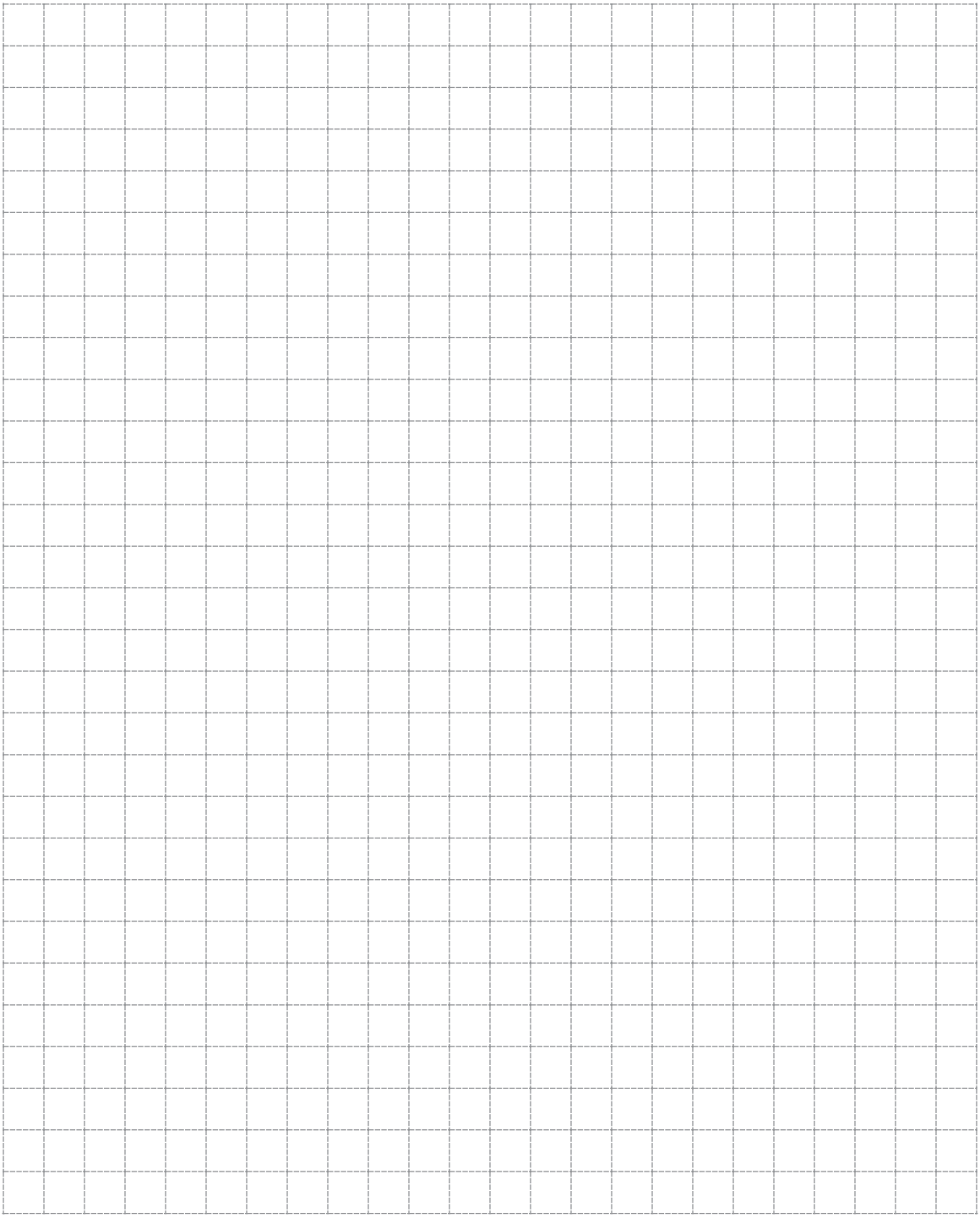
Note that diagrams and graphs provided in the test booklets may not be drawn to scale.

DIRECTIONS

- Write each solution in the space provided.
- For full marks, your answers must show all pertinent diagrams, calculations, and explanations.
- 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 (three decimal places) unless instructed otherwise.

Electronic communication between students through phones, email, or file sharing during the test is strictly prohibited. Please turn off your cell phone and all other such devices.

NO MARKS WILL BE AWARDED FOR WORK DONE ON THIS PAGE.



Formula Sheet

$$s = \theta r$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Terminology Sheet

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

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

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

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.

Express: Write or present a mathematical concept in a specific form, often using symbols or equations.

Identify: 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.

Prove: Show that a mathematical statement is true using logical reasoning and/or known facts.

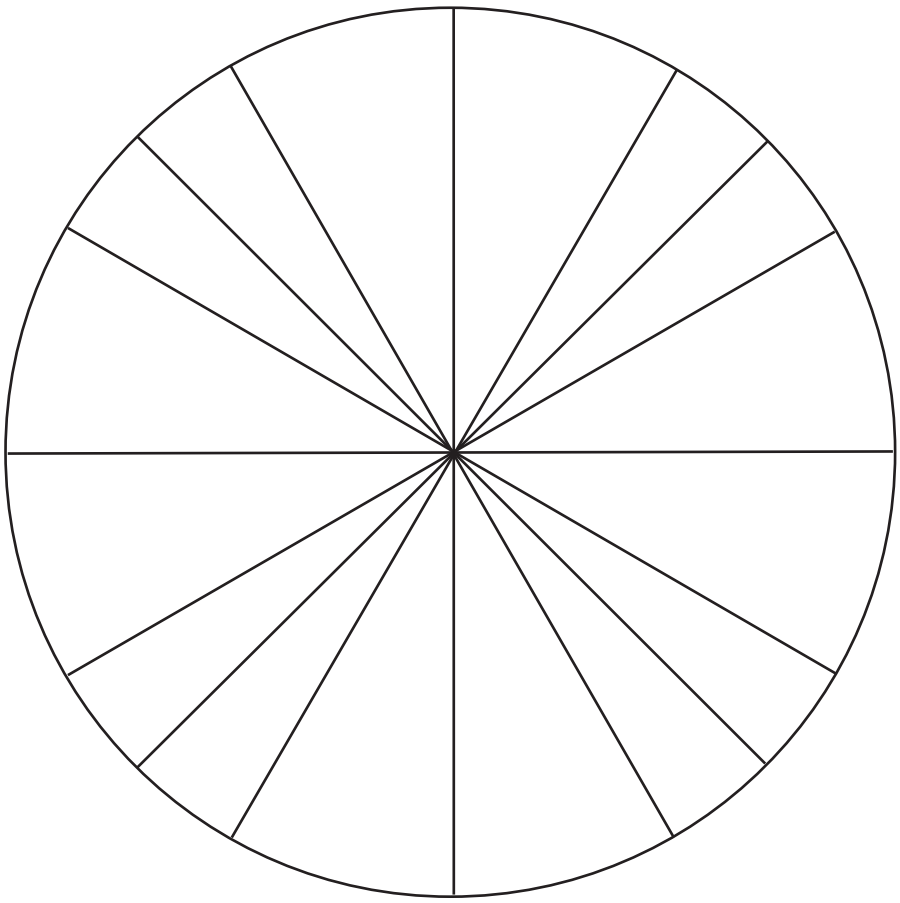
Sketch the graph: Provide a detailed drawing with key features of the graph that includes a minimum of two coordinate points.

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

State: Give an answer without an explanation or justification.

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

NO MARKS WILL BE AWARDED FOR WORK DONE ON THIS PAGE.



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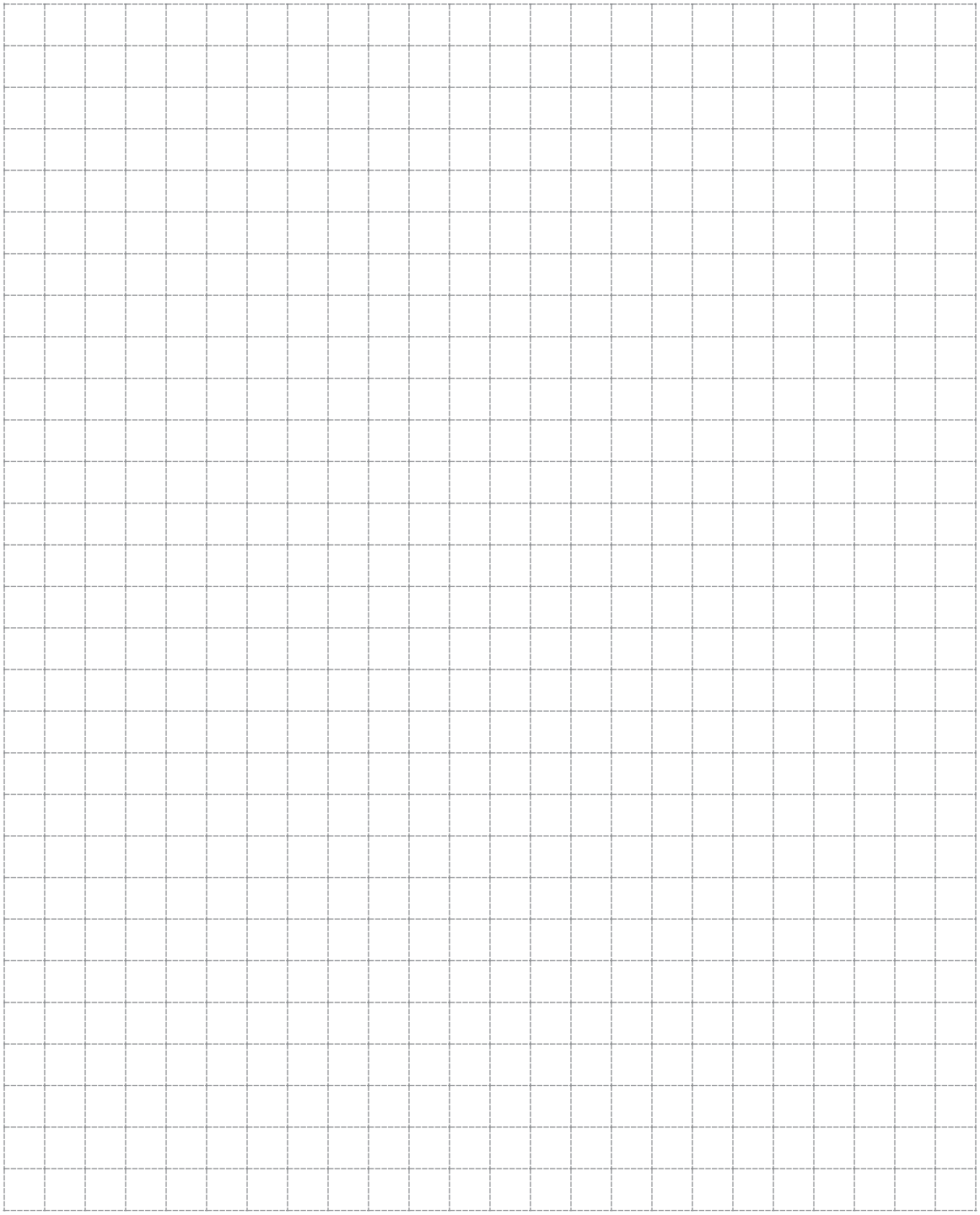


Question 1  **2 marks** 101

Jack rolled a water bottle from one edge of his desk to the other. The desk measures 60 cm from edge to edge. The water bottle has a diameter of 7 cm. Determine the angle that the water bottle rotated, in degrees.

Question 2  **2 marks** 102

There are 15 dogs and 12 cats in an animal shelter. Determine the number of ways that three dogs and two cats can be selected if Scout, one of the dogs, must be selected.

Question 3  **3 marks** 103

Emily wants to save money to buy a car. She invests $180 per month at an annual interest rate of 4.5%, compounded monthly.

Determine, algebraically, the number of monthly investments she will need to make to obtain at least $15 000. Express the final answer as a whole number.

Use the formula: $FV = \dfrac{R\left[\left(1+i\right)^{n}-1\right]}{i}$

where $FV =$ the future value

$R =$ the investment amount each period

$i = \left[\dfrac{\text{the annual interest rate (as a decimal)}}{\text{the number of compounding periods per year}}\right]$

$n =$ the number of investments

Question 4  **3 marks** 104

Determine and simplify the 4th term in the binomial expansion of $\left(3x-\frac{2}{x^2}\right)^6$.

Question 5  3 marks 105

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

$$4\cos^2 x - 3\cos x - 1 = 0$$

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

Question 6 — 1 mark

106

State an equation for a rational function, $g(x)$, whose graph has a vertical asymptote at $x = 7$.

$g(x) =$ _____

Question 7 — 2 marks

107

State an equation of a radical function, $f(x)$, with a domain of $x \leq 0$ and a range of $y \geq 1$.

$f(x) =$ _____

Question 8 — 3 marks — 108

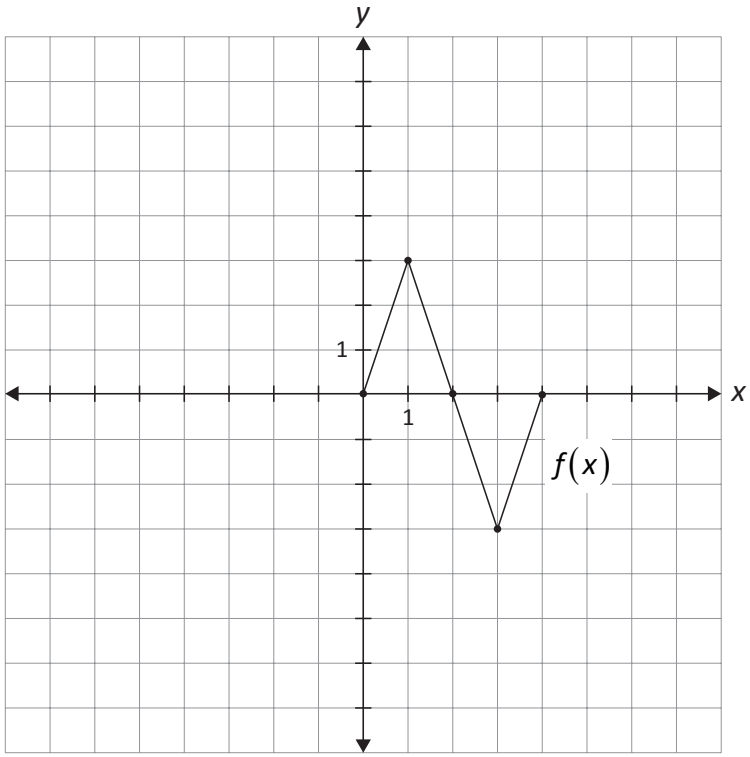
Prove the identity for all permissible values of x.

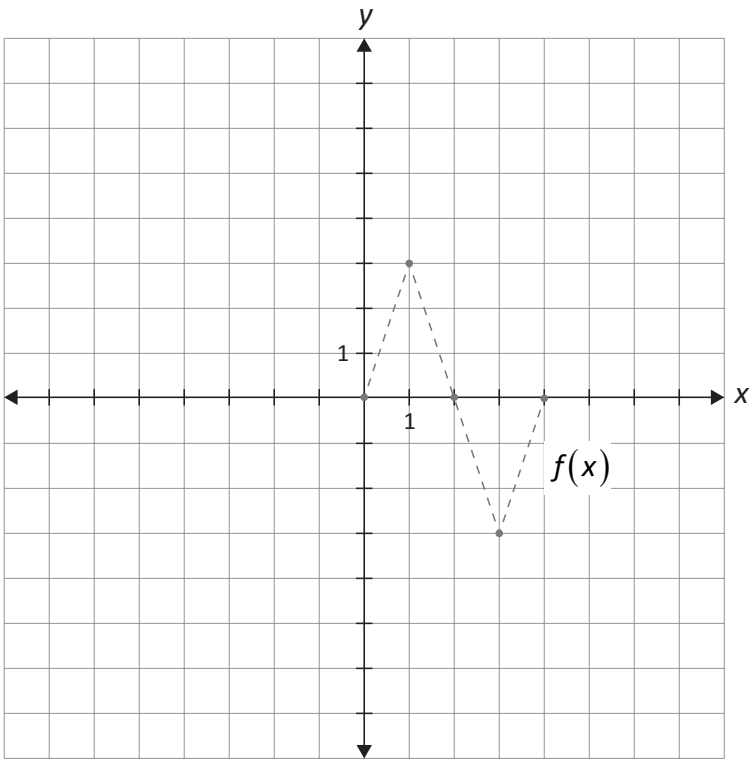
$$\frac{\cos x + \sin^2 x \sec x}{\sin x} = \sec x \csc x$$

Left-Hand Side	Right-Hand Side

Question 9 — 3 marks

Given the graph of, $y = f(x)$, sketch the graph of $y = 2\left|f(-x)\right|$.





The graph of $f(x)$ has already been drawn for your reference.

No marks will be awarded for the graph of $f(x)$.

Question 10 — 3 marks — 110

Solve, algebraically.

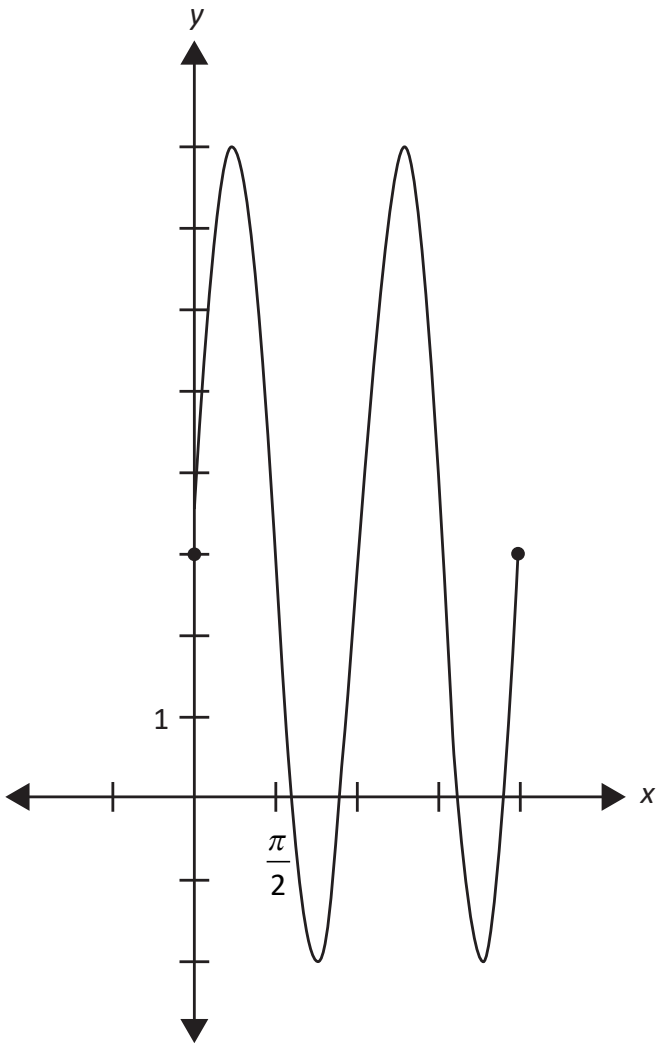
$$\log(x-1)+\log(x+2)=1$$

Question 11 — 1 mark — 111

Justify that there are only two negative terms in the expansion of $\left(-2x+5y\right)^4$.

Question 12 — 1 mark — 112

The graph of $y = 5\sin(2x) + 3$ below can be used to solve the equation $0 = 5\sin(2x) + 3$.
State how many solutions there are to the equation $0 = 5\sin(2x) + 3$ over the interval $[0, 2\pi]$.



Question 13

a) 1 mark b) 2 marks

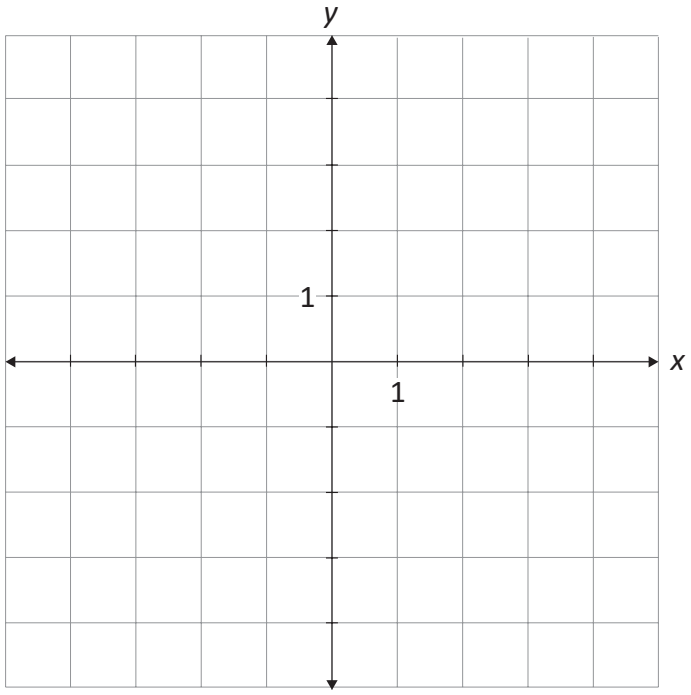
113
114

Given the functions, $f(x) = x^2 - 1$ and $g(x) = x + 1$,

a) state the equation of $h(x) = \dfrac{f(x)}{g(x)}$.

$h(x) =$ _____

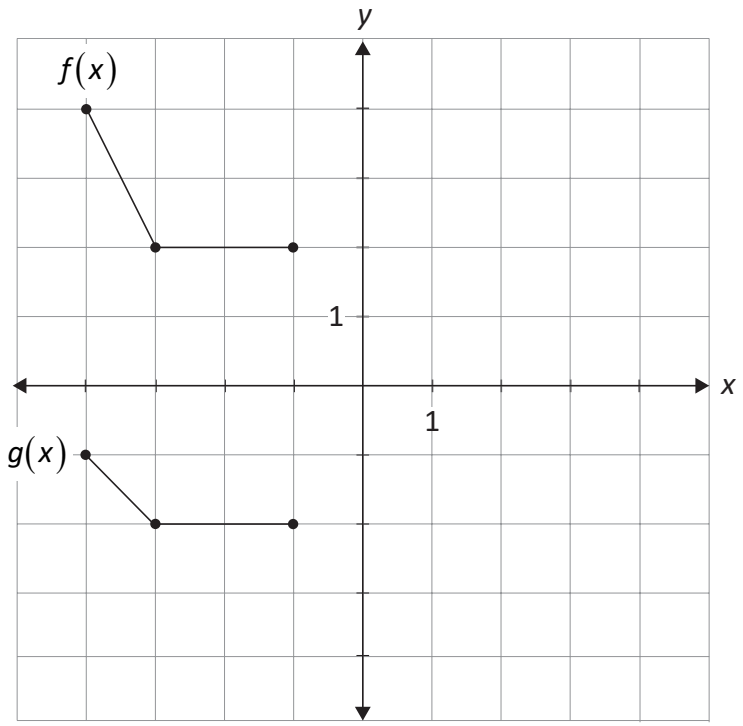
b) sketch the graph of $h(x)$.



Question 14 — 2 marks

115

State an equation for $g(x)$, in terms of $f(x)$.



$g(x) =$ _____

Question 15 — 3 marks

116

Sketch the graph of a polynomial function, $p(x)$, with the following characteristics:

- degree 5
- leading coefficient of –1
- a zero at –3, with a multiplicity of 3
- a zero at 1, with a multiplicity of 2