

Grade 12
Pre-Calculus Mathematics
Achievement Test

Booklet 1

January 2026

Manitoba 

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

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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*	—	17	37
Booklet 2	8	20	53
Total	8	37	90

* The first 4 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.

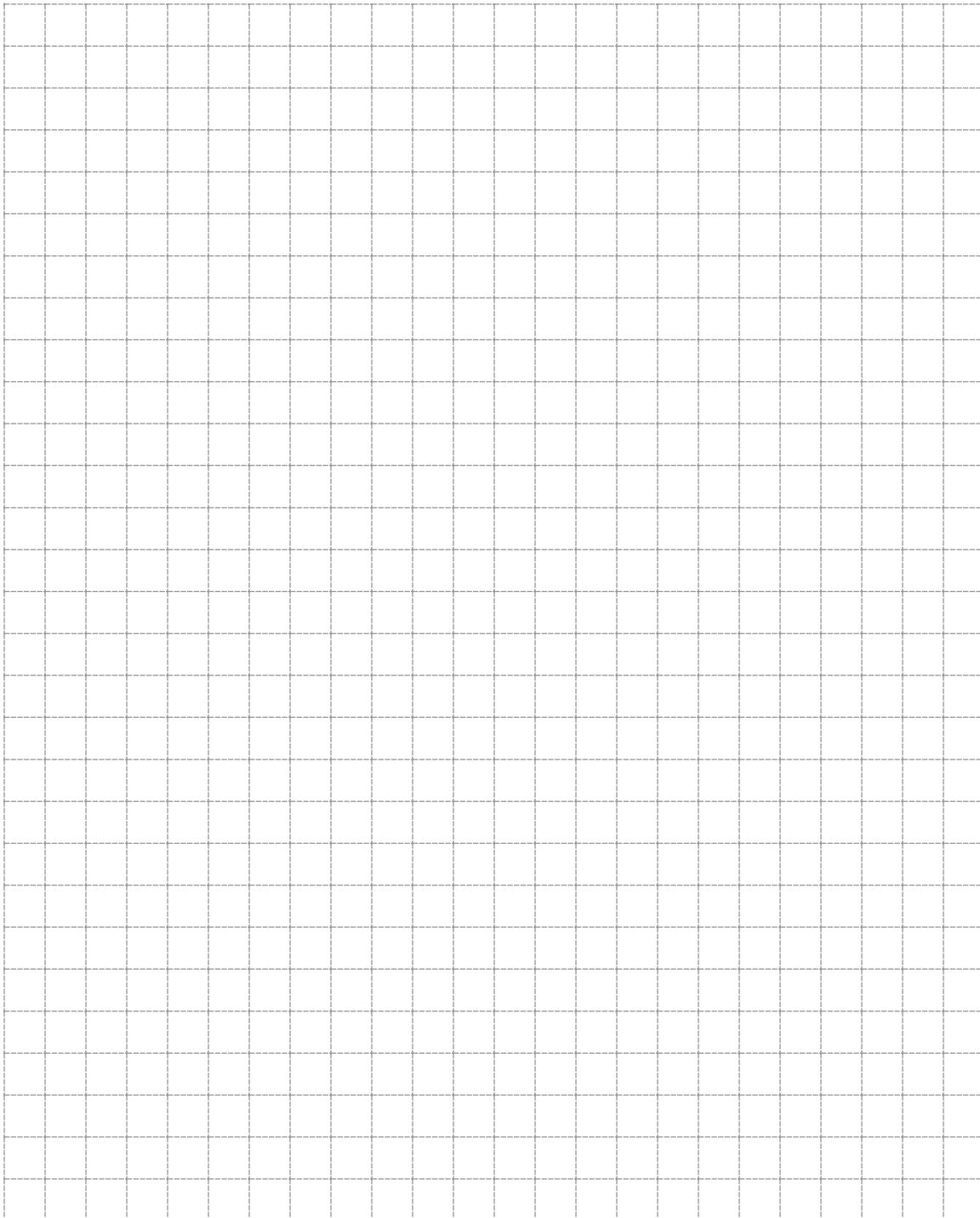
Note that diagrams and graphs provided in the test booklets may not be drawn to scale.

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 (3 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

$$s = \theta r$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\text{Given } ax^2 + bx + c = 0,$$

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

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.

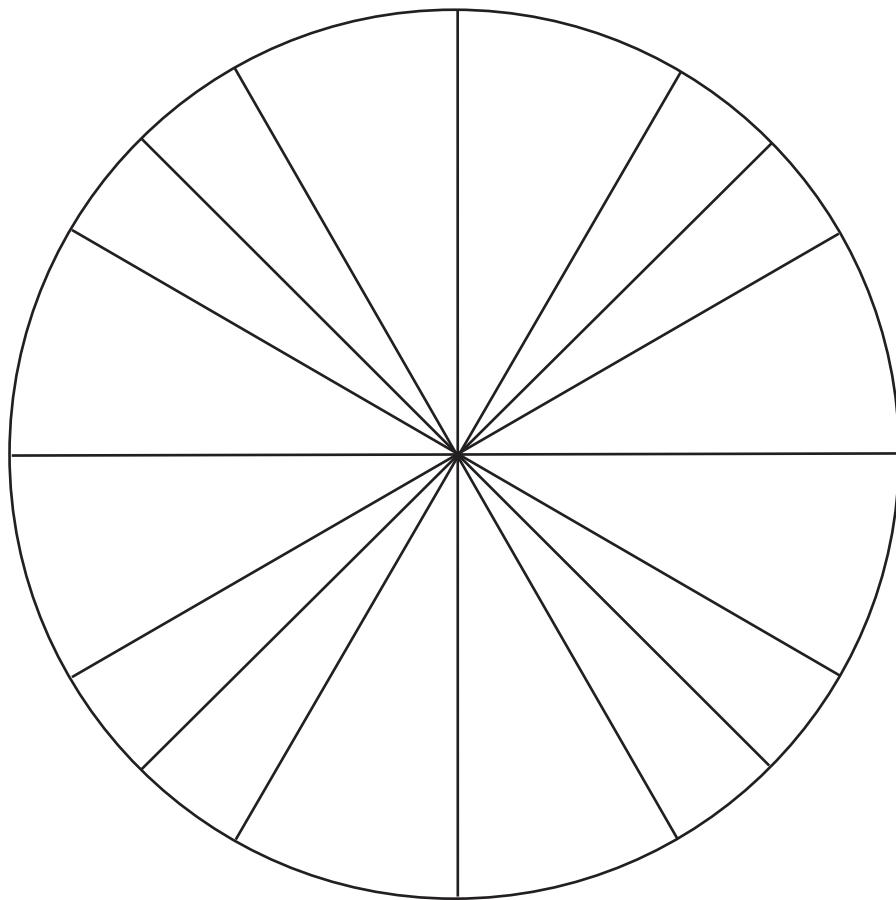
Sketch the graph: Provide a detailed drawing with key features of the graph that includes a minimum of two coordinate points.

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

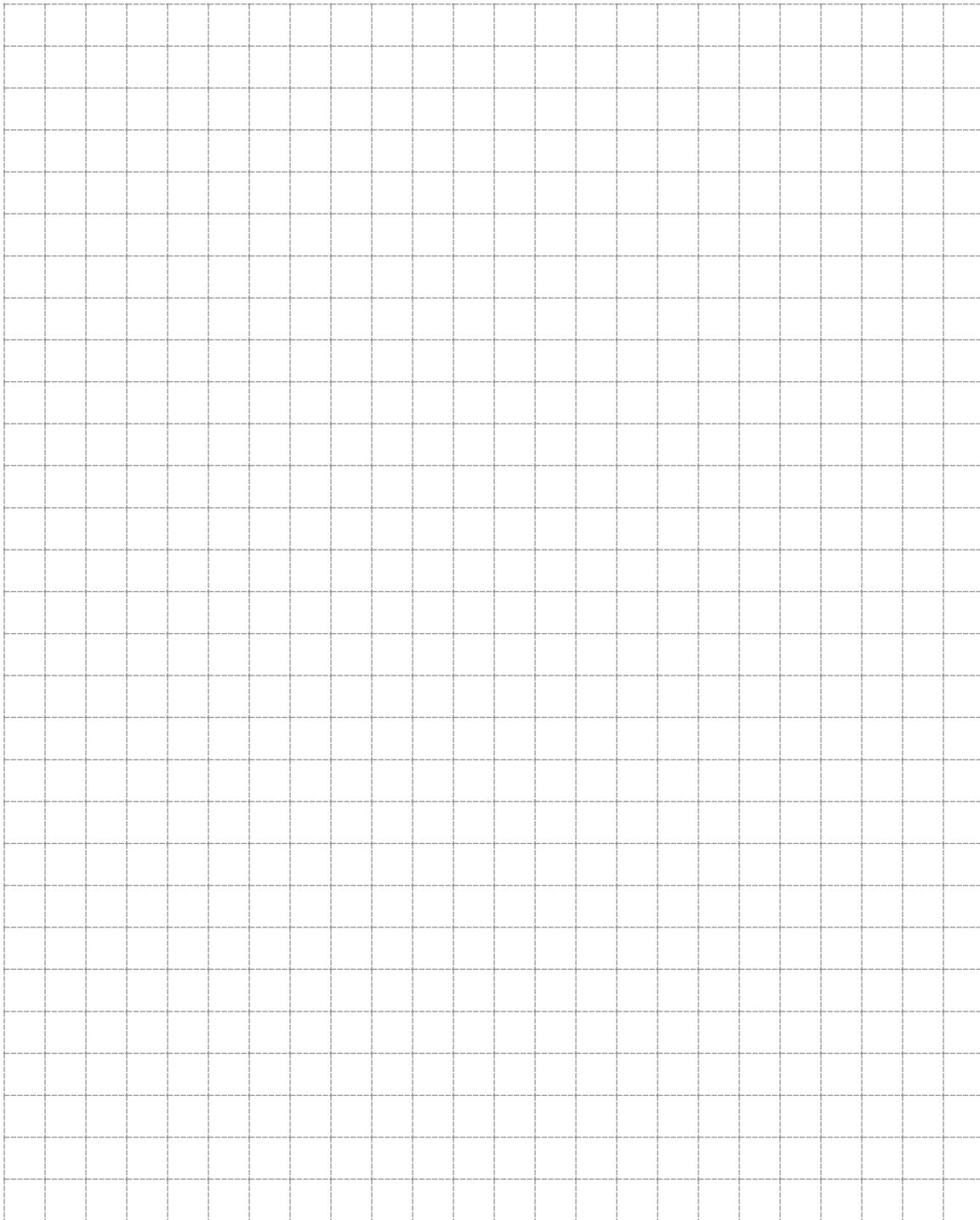
State: Give an answer without an explanation or justification.

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

Liam went for a ride on a Ferris wheel with a radius of 5 metres. Determine the distance he travelled if the Ferris wheel stopped after rotating 1260° .

Question 2 **4 marks**

102

Determine and simplify the term that contains x^{12} in the binomial expansion of $(2x^4 - 3)^7$.

Question 3 **a) 1 mark b) 2 marks**103
104

The normal healing of wounds can be modeled by an exponential function. The area of the wound decreases according to the formula,

$$A = A_0 e^{-0.35t}$$

where: A is the area of the wound in cm^2 , after t days,

A_0 is the initial area of the wound in cm^2 , and

t is the time, in days, after healing begins.

If a wound has an initial area of 25 cm^2 , determine:

a) the area of the wound after 3 days.

b) the amount of time it will take for the area of the wound to decrease to 4 cm^2 .

Question 4 **3 marks**

105

During a hockey practice, 4 players are wearing a green jersey and 5 players are wearing a red jersey. Determine the number of ways three players can be selected if at least two of the players must be wearing a red jersey.

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

Question 5**4 marks**

106

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

$$2\sin^2 x + 5\cos x + 1 = 0$$

Question 6**1 mark**

107

The function, $y = f(x)$, has a domain of $[-8, 4]$. The domain of the graph of $y = f(bx)$ is $[-4, 2]$.

State the value of b .

Question 7**1 mark**

108

Describe the difference between the graph of $f(x) = \frac{(x+3)(x-4)}{(x+3)}$ and the graph of $g(x) = x - 4$.

Question 8**1 mark**

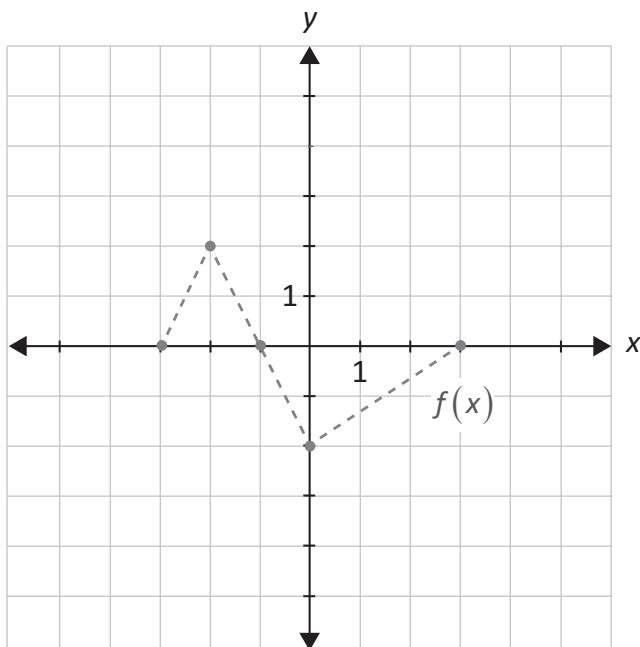
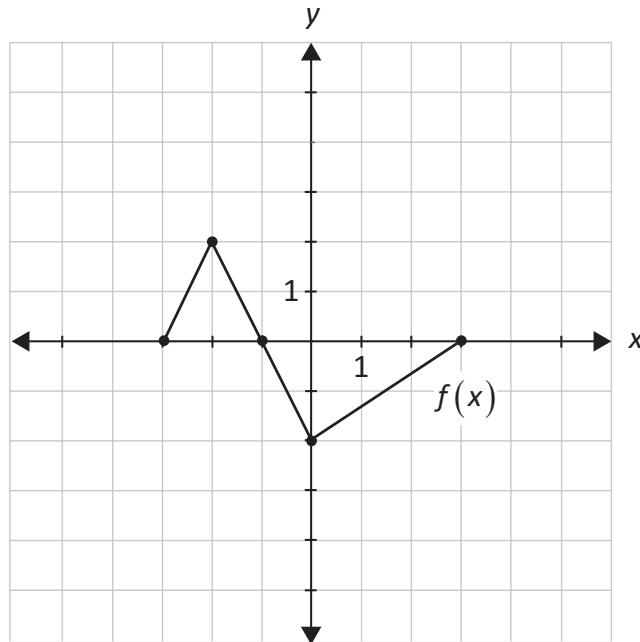
109

Determine if the point $\left(-\frac{3}{5}, \frac{2}{\sqrt{3}}\right)$ is on the unit circle. Justify your answer.

Question 9**3 marks**

110

Given the graph of $f(x)$, sketch the graph of $g(x) = f(-(x-1)) + 3$.



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

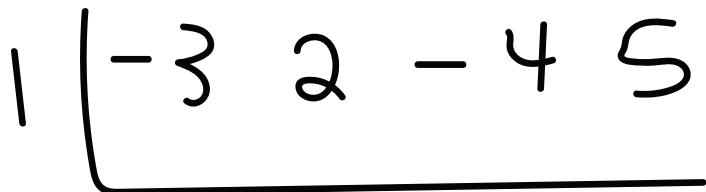
No marks will be awarded for the graph of $f(x)$.

Question 10**1 mark**

111

Bonnie was asked to determine the factors of $p(x) = -3x^4 + 2x^2 - 4x + 5$.

Describe the error she made in her set up of synthetic division.



Handwritten synthetic division setup:

1	-3	2	-4	5
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Question 11**a) 1 mark b) 1 mark**112
113

Given the functions, $f(x) = \frac{1}{x-1}$ and $g(x) = x-3$,

a) state the equation of $f(g(x))$.

$$f(g(x)) = \underline{\hspace{2cm}}$$

b) state the domain of $f(g(x))$.

Domain: _____

Question 12**3 marks**

114

Prove the identity for all permissible values of x .

$$\tan 2x = \frac{2}{\cot x - \tan x}$$

Left-Hand Side	Right-Hand Side

Question 13**a) 1 mark b) 1 mark**115
116

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

a) determine the equation of $h(x) = g(x) - f(x)$.

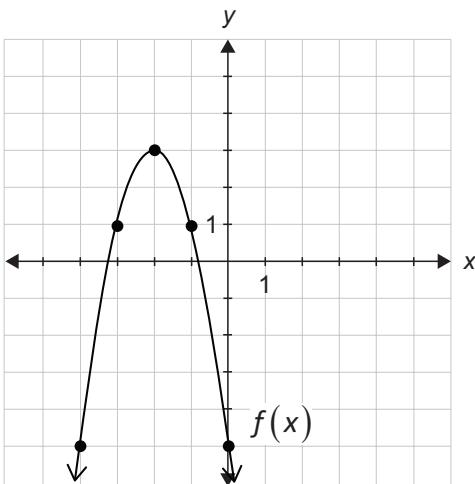
$$h(x) = \underline{\hspace{10cm}}$$

b) state the range of $h(x)$.

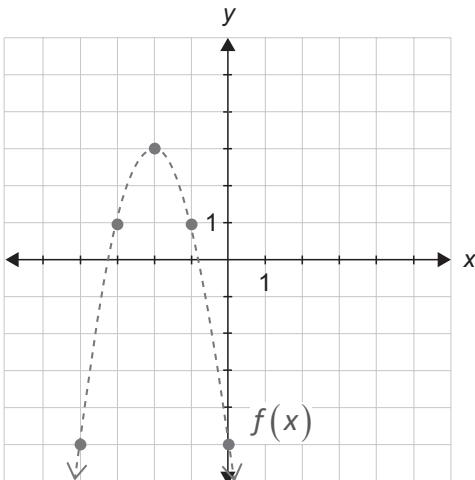
Range: $\underline{\hspace{10cm}}$

Question 14**a) 1 mark b) 1 mark**117
118

Given the graph of $f(x)$,



a) sketch the graph after a reflection over the line $y = x$.



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

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

b) state a restriction on the domain of $f(x)$ in order for its inverse to be a function.

Question 15**1 mark**119

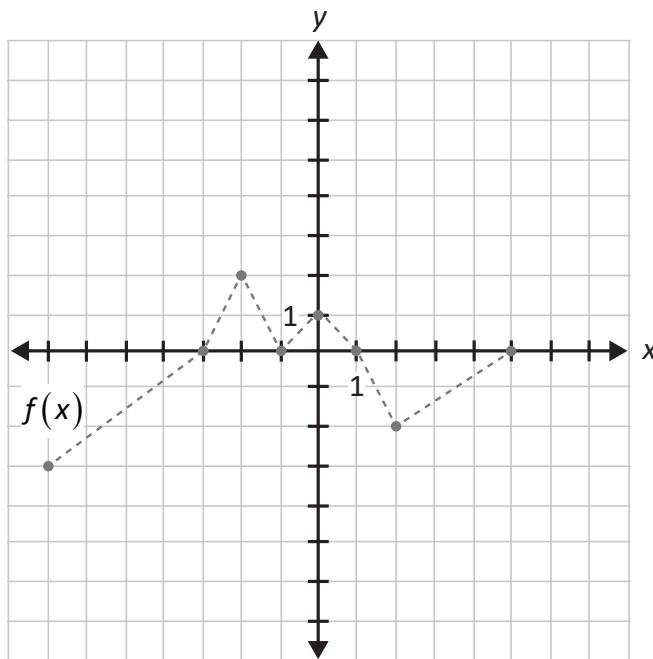
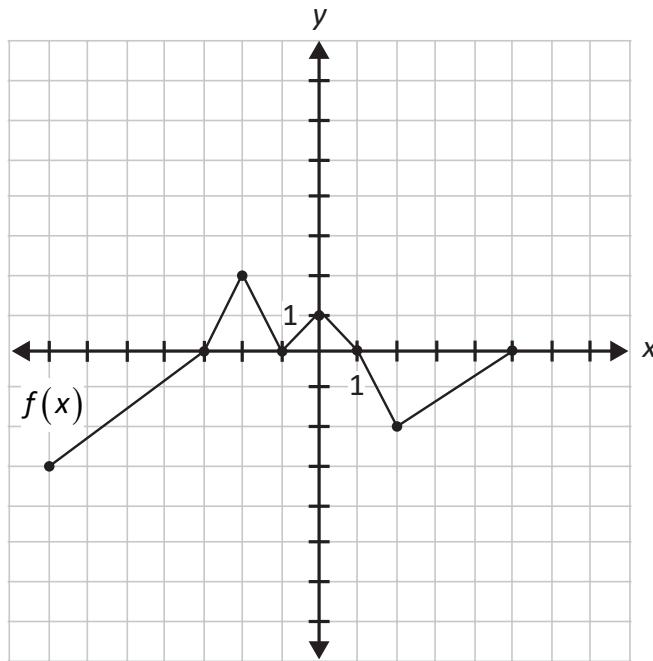
Describe a transformation of a function that would not affect its domain.

Question 16

1 mark

120

Given the graph of $f(x)$, sketch the graph of the function $y = |f(x)|$.



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

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

Question 17**3 marks**

121

Determine, algebraically, all of the zeros of the polynomial function, $p(x) = 3x^3 + x^2 - 20x + 12$.

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