

Grade 12
Pre-Calculus Mathematics
Achievement Test

Booklet 1

January 2017

Manitoba Education and Training Cataloguing in Publication Data

Grade 12 pre-calculus mathematics achievement test.
Booklet 1. January 2017

Issued in print and electronic formats.

ISBN: 978-0-7711-8056-9 (print)
ISBN: 978-0-7711-8057-6 (pdf)

1. Mathematics—Examinations, questions, etc.
 2. Educational tests and measurements—Manitoba.
 3. Mathematics—Study and teaching (Secondary)—Manitoba.
 4. Precalculus—Study and teaching (Secondary)—Manitoba.
 5. Mathematical ability—Testing.
- I. Manitoba. Manitoba Education and Training.
510.76

Manitoba Education and Training
School Programs Division
Winnipeg, Manitoba, Canada

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

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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*	—	18	37
Booklet 2	9	19	53
Total	9	37	90

* 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 pages 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 18 questions worth a total of 37 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

$$s = \theta r$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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.

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.

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.

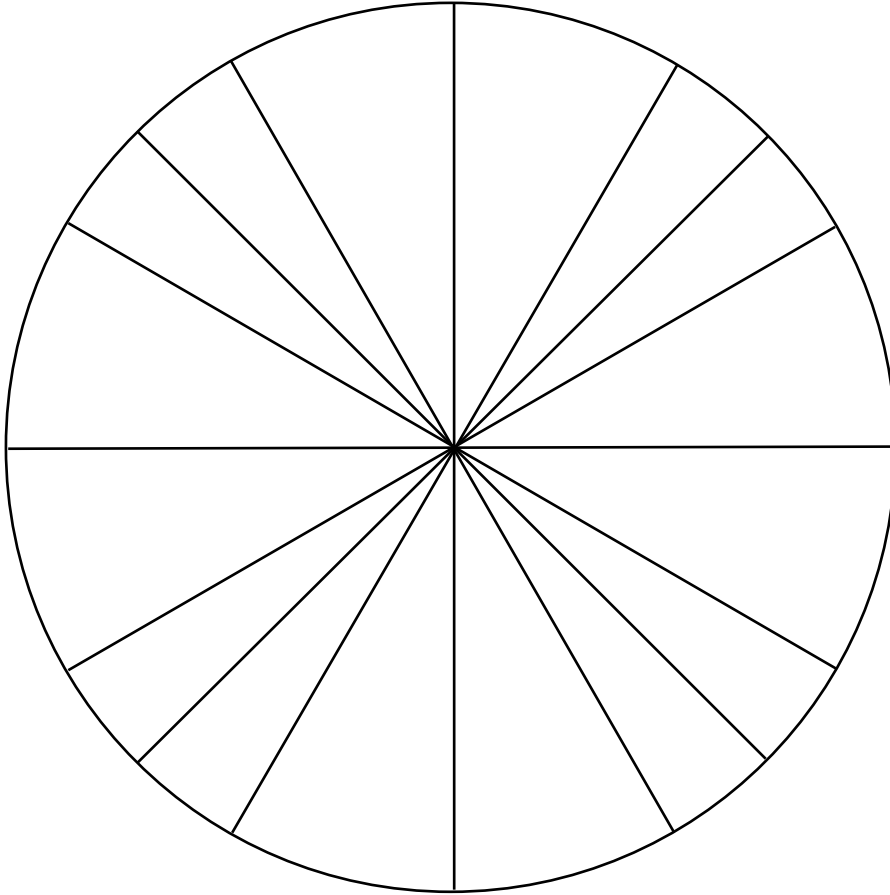
Sketch the graph: Provide a detailed drawing with key features of the graph that includes a minimum of 2 coordinate points.

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

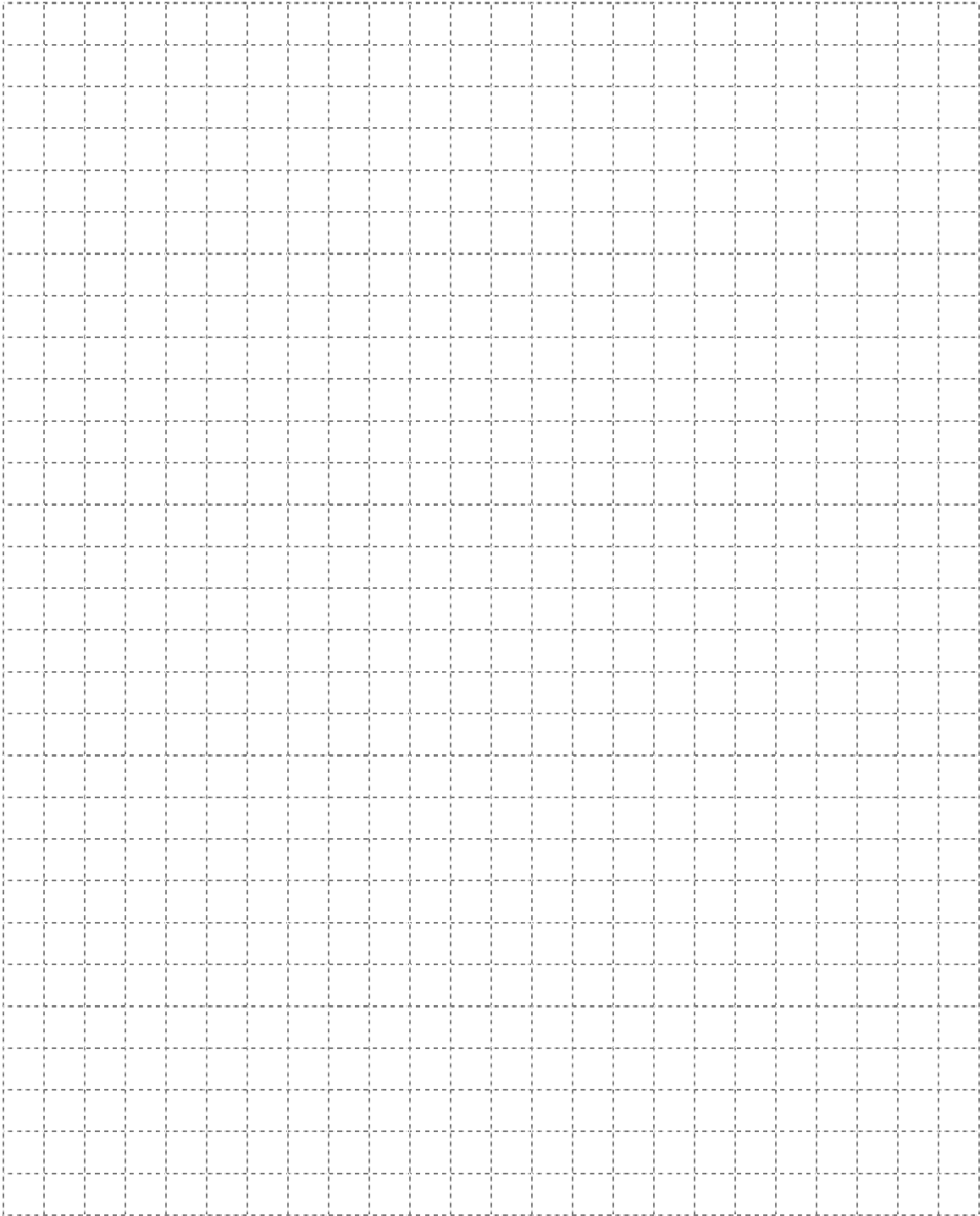
State: Give an answer without an explanation or justification.


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 

1 mark 101

There are 24 different movies Kiandra can download to her computer. Determine the number of ways she can select 15 movies.

Question 2 

a) 1 mark b) 1 mark

102
103

Given $\theta = 40^\circ$,

a) convert θ to radians.

b) determine the coterminal angles of θ where $\theta \in \mathbb{R}$.

Question 3

3 marks 104

Peter invests \$560 per month at an annual interest rate of 4.2%, compounded monthly. Determine how many monthly investments he will need to make to obtain at least \$500 000.

Express your answer as a whole number.

Use the formula:


$$FV = \frac{R[(1+i)^n - 1]}{i}$$

where FV = the future value

R = the investment amount each period

$i = \frac{\text{the annual interest rate}}{\text{the number of compounding periods per year}}$

$n = \text{the number of investments}$

Question 4 

2 marks 105

Ishmael has 4 dogs, 5 cats, and 3 horses.

If he arranges all of them in a row, determine how many ways they can be arranged if each type of animal must be grouped together.

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

Question 5

3 marks 106

Solve the following equation algebraically over the interval $0 \leq \theta \leq 2\pi$.

$$2 \cos^2 \theta + 9 \cos \theta - 5 = 0$$

Determine which term contains $\frac{1}{x^6}$ in the binomial expansion of $\left(\frac{2}{x^3} + 3x^2\right)^7$.

Question 7

1 mark ¹⁰⁸

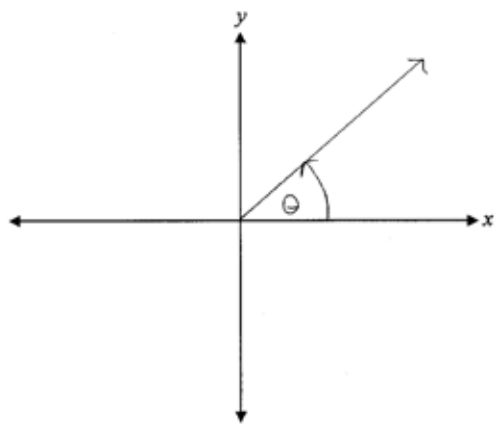
Determine the radius of a circle which has an arc length of 5 cm with a central angle of 3 radians.

Question 8

1 mark 109

Tyler incorrectly sketched the angle $\theta = -\frac{7\pi}{4}$ in standard position.

Describe his error.



Question 9

a) 1 mark b) 3 marks

110
111

Given the identity $\sec \theta + \cos \theta = \frac{2 - \sin^2 \theta}{\cos \theta}$,

a) determine the non-permissible values of θ , over the interval $0 \leq \theta \leq 2\pi$.

b) prove the identity for all permissible values of θ .

Left-Hand Side	Right-Hand Side

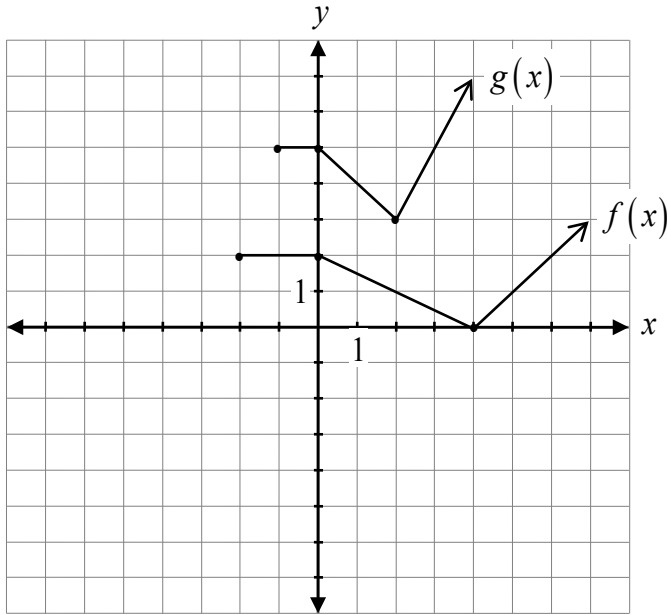
Expand using the laws of logarithms.

$$\log\left(\frac{a}{b^4}\right)$$

Question 11

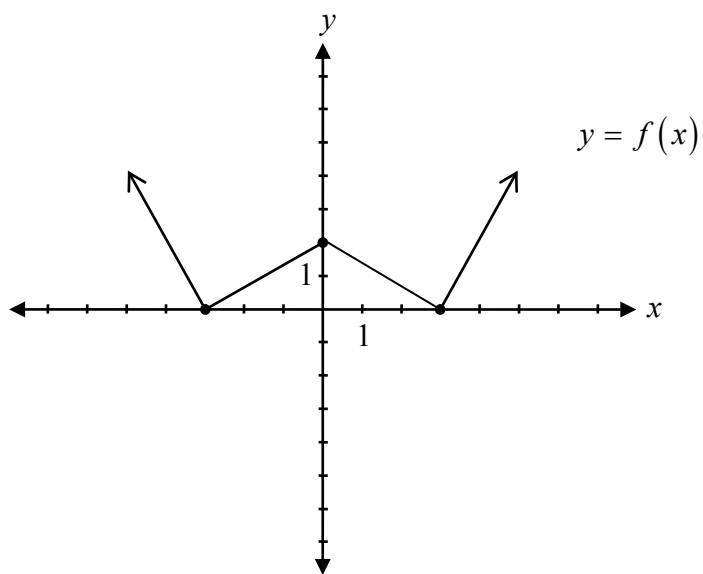
2 marks 113

State the equation of $g(x)$ in terms of $f(x)$.



$g(x) =$ _____

Explain why the inverse of the graph of $y = f(x)$ is not a function.



Question 13

2 marks ¹¹⁵

Solve the following equation algebraically:

$$\log(x^2 + 5) - \log(x^2 + 1) = \log 3$$

Question 14

2 marks 116

Describe the transformations used to obtain the graph of the function $y = 5f(x + 1)$ from the graph of $y = f(x)$.

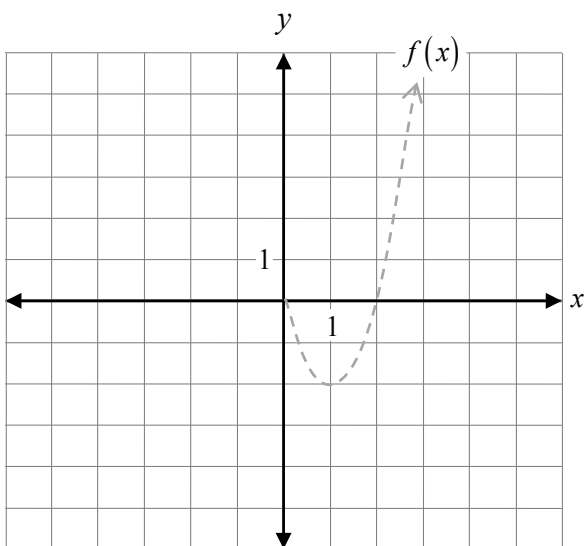
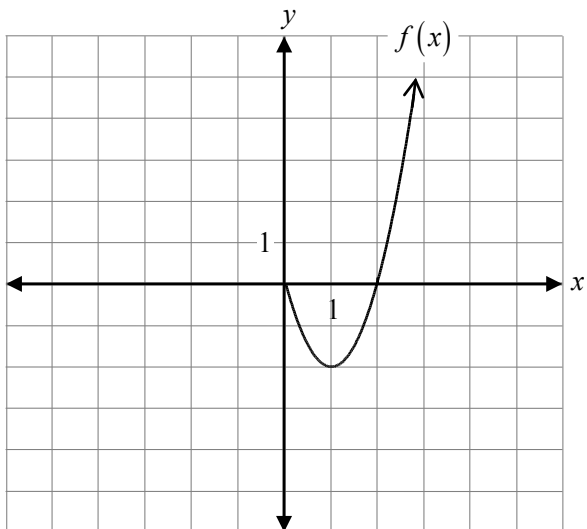
Question 15

3 marks ¹¹⁷

Solve algebraically:

$${}_n C_2 = 3n + 4$$

Given the graph of $f(x)$, sketch the graph of $y = \left| \frac{1}{2} f(x-1) \right|$.



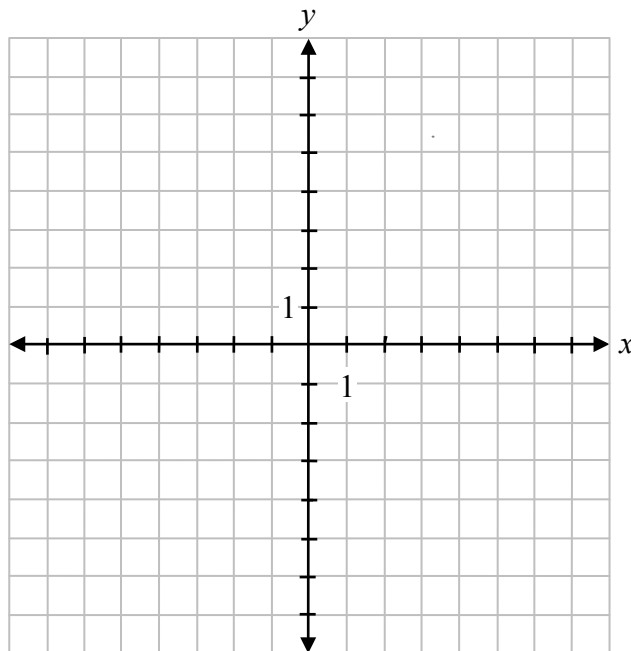
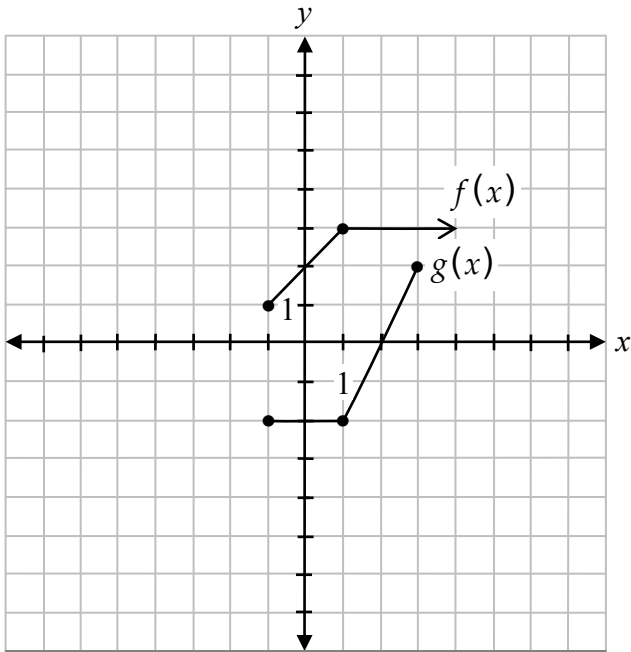
The graph of $f(x)$ has already been drawn for your reference. No marks will be awarded for the graph of $f(x)$.

Explain why $f(x) = (x + 2)^3(x - 1)^{\frac{1}{2}}$ is not a polynomial function.

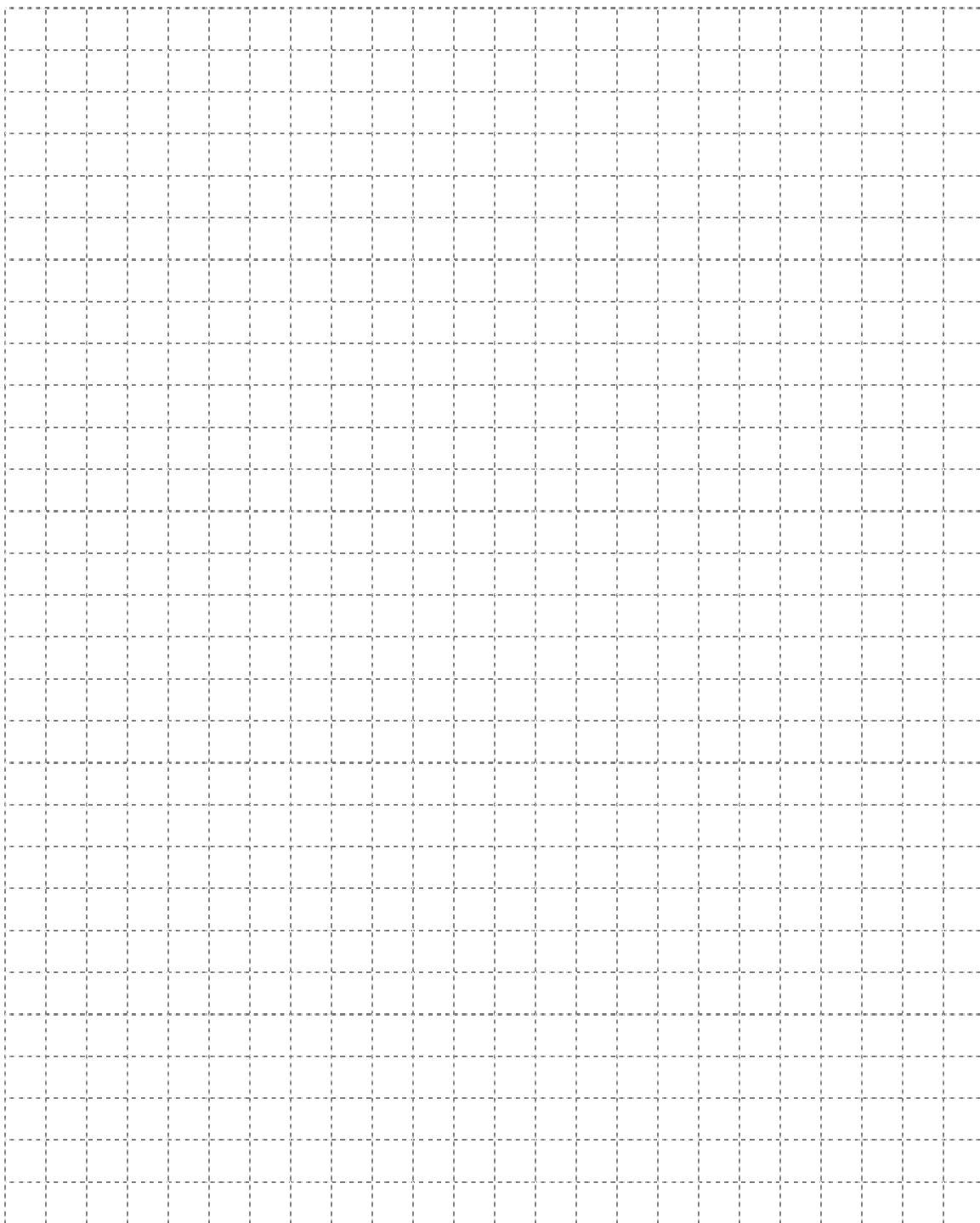
Question 18

2 marks 120

Given the graphs of $f(x)$ and $g(x)$, sketch the graph of $h(x) = (f \circ g)(x)$.



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