Grade 12
Pre-Calculus Mathematics
Achievement Test

Booklet 2

January 2016

Manitoba

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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>.

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Disponible en français.

Available in alternate formats upon request.

Instructions

Selected Response Questions

- There are 8 questions worth a total of 8 marks.
- Calculators are **not** allowed for this part of the test.
- You may use the spaces beside each question for rough work.
- Provide only one answer per question.
- There is no penalty for guessing.
- Record your answers on the sheet provided.

Constructed Response Questions

- There are 24 questions worth a total of 55 marks.
- Calculators are **not** allowed for this part of the test.
- For full marks, your answer must show all pertinent diagrams, calculations, and explanations.
- Your solutions should be neat, clear, and well organized.
- Write each solution in the space provided.

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

Question 14 — 1 mark

Identify the maximum number of x-intercepts for a polynomial function of degree 3.

a) 1

b) 2

c) 3

d) 4

Question 15 — 1 mark

The graph of $y = f(x)$ contains the point (a, b). The graph of $g(x)$ is a transformation of the graph of $f(x)$ and contains the point $(3a, b)$.

Identify the function that represents $g(x)$.

a) $g(x) = f(3x)$

b) $g(x) = 3f(x)$

c) $g(x) = f\left(\frac{x}{3}\right)$

d) $g(x) = \frac{1}{3}f(x)$

Question 16 — 1 mark

The angle 2.95 radians, in standard position, terminates in quadrant:

a) I

b) II

c) III

d) IV

Question 17 — 1 mark

Evaluate:

$$2\sin\frac{\pi}{8}\cos\frac{\pi}{8}$$

a) $\frac{1}{2}$

b) $\frac{\sqrt{2}}{2}$

c) 1

d) $\sqrt{2}$

Question 18 — 1 mark

Identify which of the following represents the 5th term in the expansion of $\left(4x^2 - 2y^3\right)^{15}$.

a) ${}_{15}C_5\left(4x^2\right)^{10}\left(-2y^3\right)^5$

b) ${}_{15}C_5\left(4x^2\right)^{11}\left(-2y^3\right)^4$

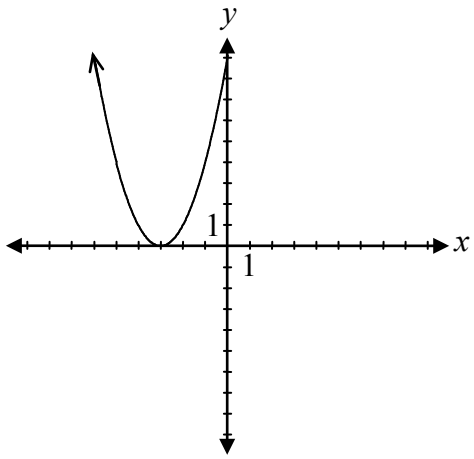
c) ${}_{15}C_4\left(4x^2\right)^{10}\left(-2y^3\right)^5$

d) ${}_{15}C_4\left(4x^2\right)^{11}\left(-2y^3\right)^4$

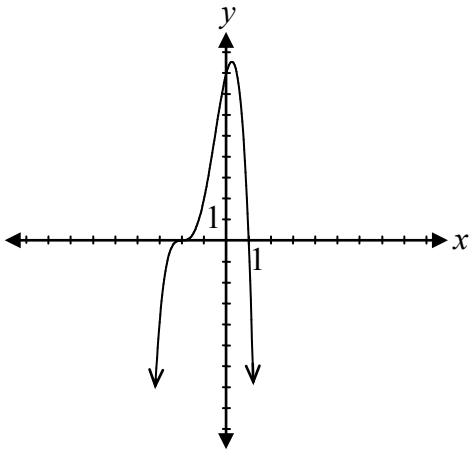
Question 19 — 1 mark

Identify which of the following graphs of polynomial functions has a zero with a multiplicity of 3.

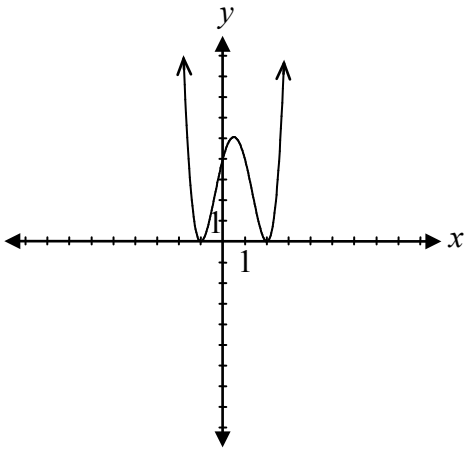
a)



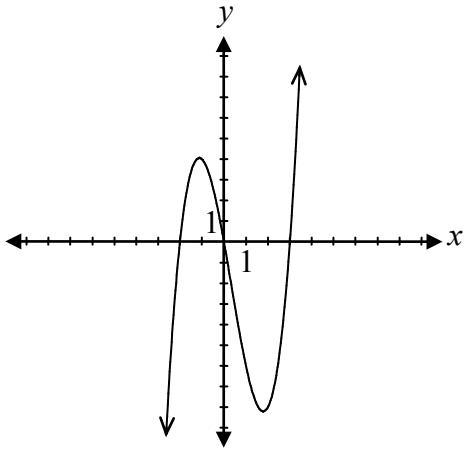
b)



c)



d)



Question 20 — 1 mark

A non-permissible value of x for the function $f(x) = \dfrac{1}{\cos x + 1}$ is:

a) -1

b) 0

c) π

d) $\dfrac{3\pi}{2}$

Question 21 — 1 mark

Identify which of the following statements is true for the rational function $f(x) = \dfrac{4(x-1)(x-2)}{(x-1)(x+3)}$.

a) The equation of the horizontal asymptote is $y = 4$.

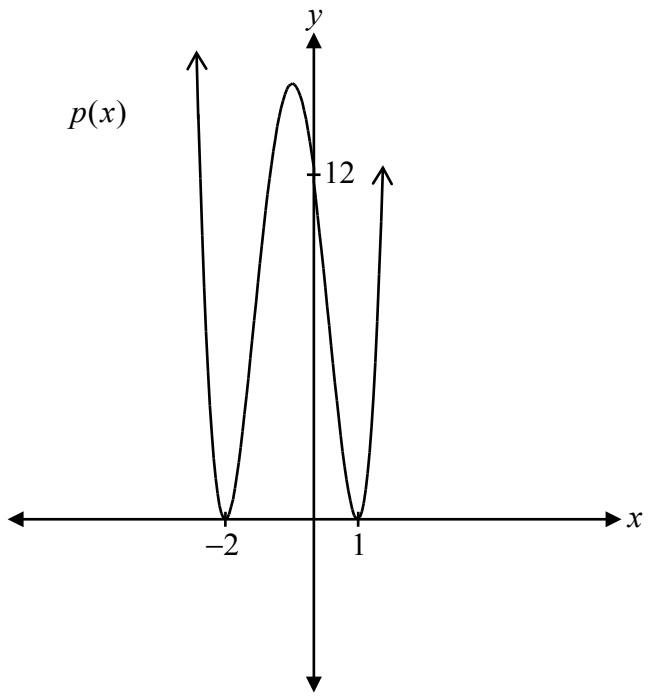
b) The equation of the vertical asymptote is $x = 1$.

c) The y-intercept is 0.

d) There is a point of discontinuity (hole) when $x = 2$.

Question 22 — 3 marks — 115

Determine the equation of the polynomial function, $p(x)$, represented by the graph.



$p(x) =$ _____

Question 23 — 1 mark — 116

Evaluate:

$$\log_4 2$$

Question 24 — 2 marks — 117

Evaluate:

$$\left(\cos\frac{11\pi}{3}\right)\left(\csc\frac{11\pi}{6}\right)$$

Question 25 — 1 mark — 118

Estimate the value of $\log_2 5$.

Justify your answer.

Question 26 — 2 marks — 119

If θ terminates in quadrant III and $\cos\theta = -\frac{6}{7}$, determine the exact value of $\tan\theta$.

Question 27 — 1 mark — 120

Given $f(x) = x^2 + x - 4$ and $g(x) = \sqrt{x+5}$, Taz was asked to find $f(g(x))$.

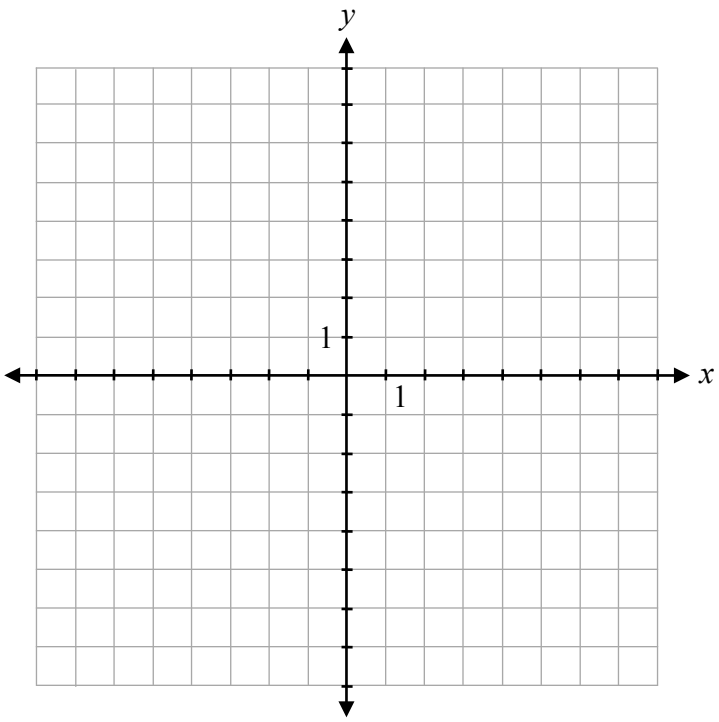
Taz's solution:

$$f(g(x)) = \left(\sqrt{x+5}\right)^2 + x - 4$$
$$= x + 5 + x - 4$$
$$= 2x + 1, \quad x \geq -5$$

Describe the error in Taz's solution.

Question 28 — 3 marks — 121

Sketch the graph of the function $f(x) = 3\log_2(x+1)$.



Question 29 — 1 mark — 122

Write an equation of a rational function that would not have any vertical asymptotes.

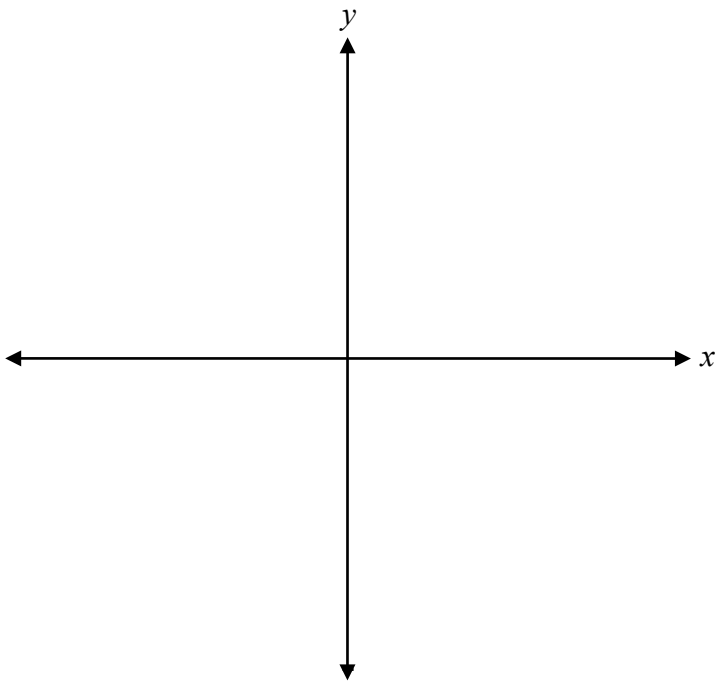
Question 30 — 2 marks — 123

Determine the exact value of $\tan 75^\circ$.

Question 31 — 4 marks — 124

Sketch the graph of the following function:

$$f(x) = \frac{(x+3)(x-3)}{x(x-3)}$$



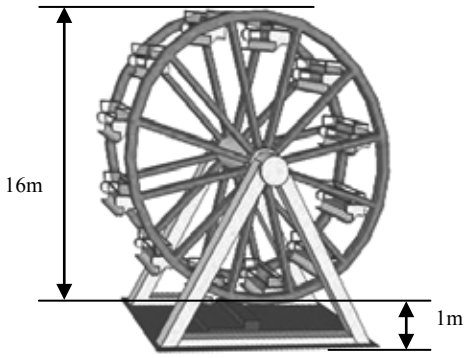
Question 32 — 2 marks — 125

In the binomial expansion of $\left(\frac{1}{x^3} - 2x^2\right)^9$, determine which term contains x^3.

Question 33 — 4 marks

José and Dana get on a Ferris wheel, which is 1 metre off the ground. The diameter of the Ferris wheel is 16 metres. Their ride lasts for 4 minutes, in which time the Ferris wheel makes one revolution.

Determine the values of A, B, C, and D, if the sinusoidal function that models the situation is $h(t) = A\cos[B(t - C)] + D$, where h is the height at which José and Dana are located on the Ferris wheel, from the ground, in metres, and t is the time, in minutes.



A = _____

B = _____

C = _____

D = _____

Question 34 — 3 marks — 127

Solve algebraically:

$${}_nP_3 = 4!(n-1)$$

Question 35 — 2 marks — 128

Given $f(x) = \dfrac{2}{x-1}$, determine the equation of the inverse, $f^{-1}(x)$.

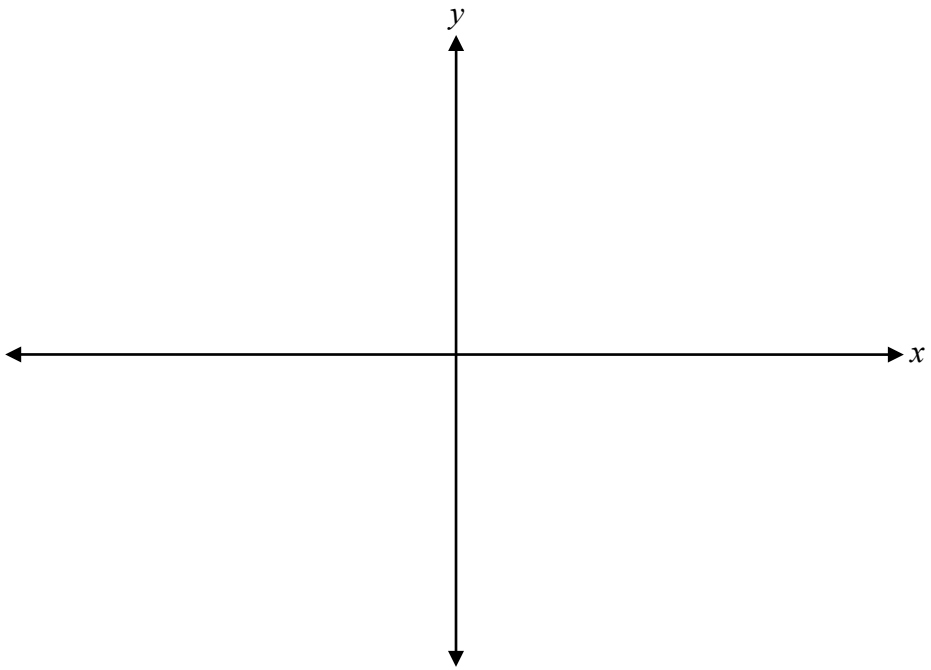
Question 36 — 3 marks — 129

Solve:

$$4\log_3 2 - \frac{1}{3}\log_3 8 = \log_3 a$$

Question 37 — 3 marks — 130

Sketch the graph of at least one period of the function $y = 3\cos(\pi x) - 1$.



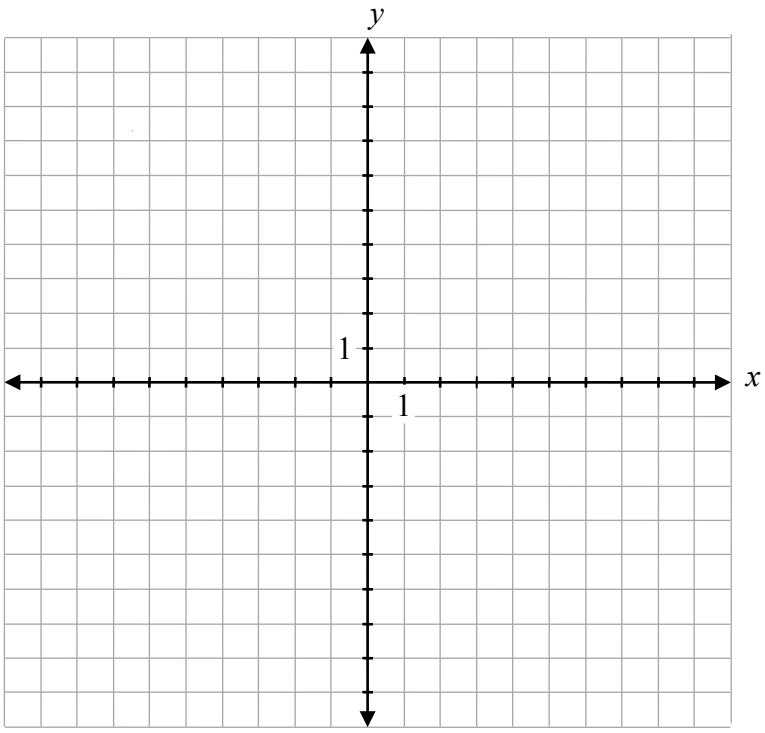
Question 38 — 3 marks — 131

Using the laws of logarithms, fully expand the expression:

$$\log_a\left(\frac{x^3}{y\sqrt{z}}\right)$$

Question 39 — 4 marks — 132

Sketch the graph of $f(x) = 3\sqrt{x-2} + 1$.



Question 40 — a) 1 mark b) 1 mark

133
134

a) Determine the domain of the graph of the function $f(x) = \sqrt{x^2 - 4}$.

b) Explain why the domain of $f(x) = \sqrt{x^2 - 4}$ is restricted.

Question 41 — a) 1 mark b) 1 mark

135
136

Given the point $(-12, -18)$ on the graph of $f(x)$, determine the new points after the following transformations of $f(x)$.

a) $\dfrac{1}{f(x)}$

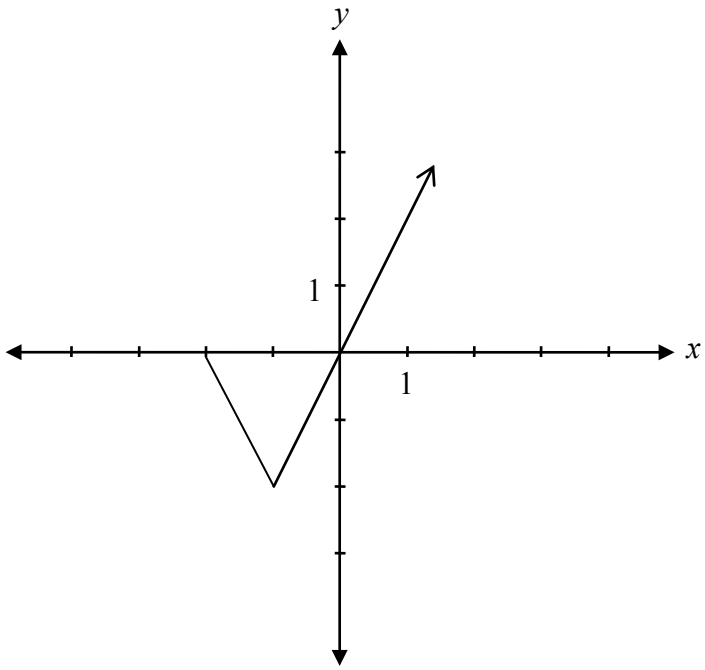
b) $f(-x)+10$

Question 42 — 1 mark — 137

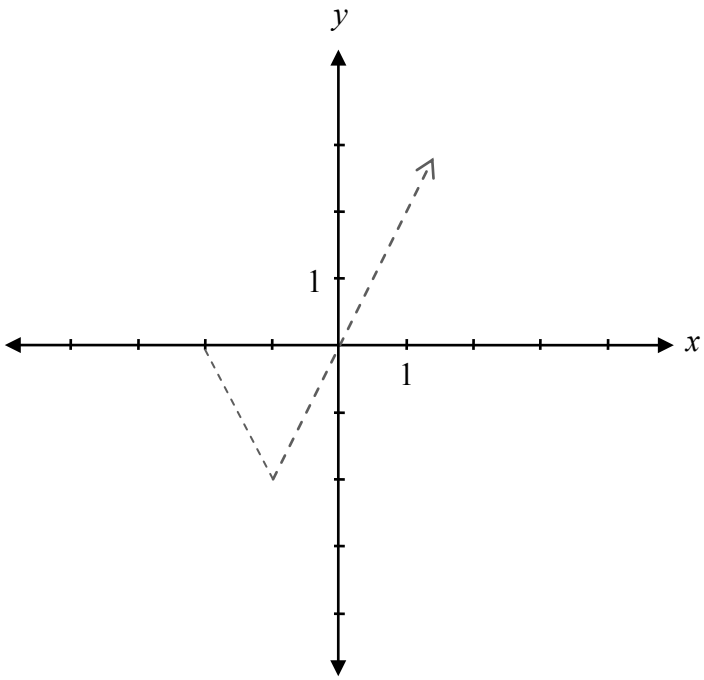
Explain why there is no solution for the equation $\csc\theta = -\frac{1}{2}$.

Question 43 — 3 marks

Given the graph of $y = f(x)$,



sketch the graph of $y = |f(2x)| + 1$.



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

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

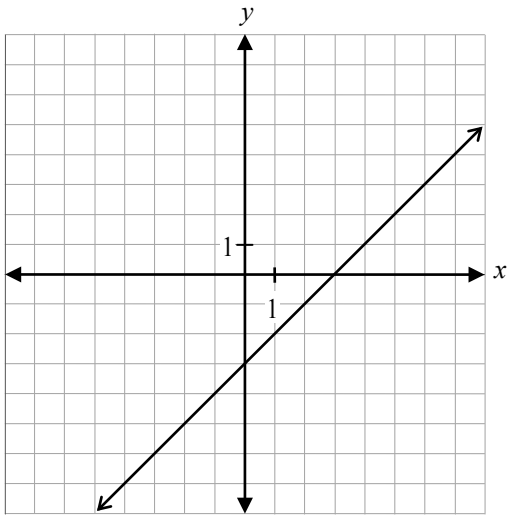
Question 44 — 1 mark — 139

Given $f(x) = 2^x + 1$, state the equation of the horizontal asymptote.

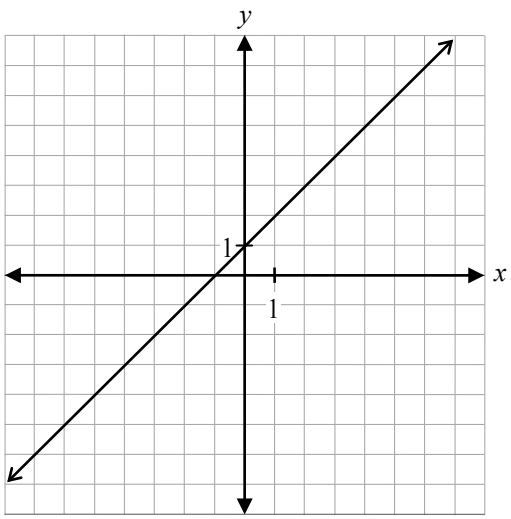
Question 45 — 2 marks — 140

Given the following graphs of $f(x) = x - 3$ and $g(x) = x + 1$,

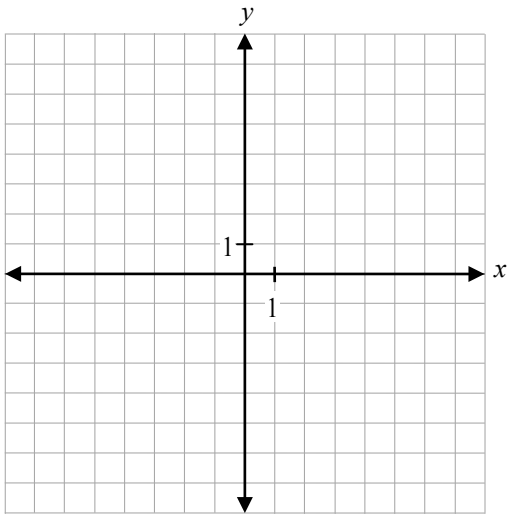
$f(x)$



$g(x)$



sketch the graph of $h(x) = (f \bullet g)(x)$.



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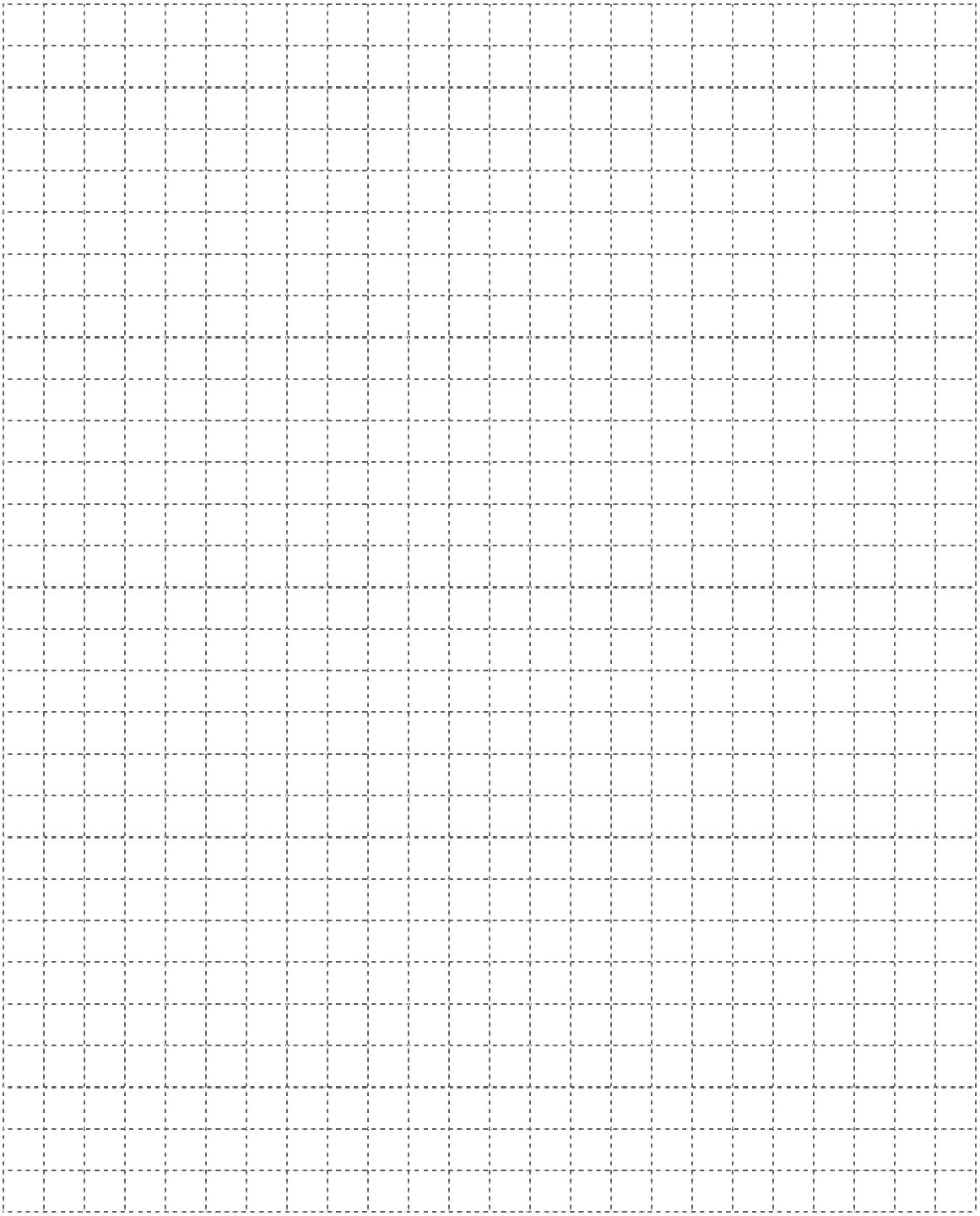

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