Grade 12
Pre-Calculus Mathematics
Achievement Test

Booklet 1

January 2017

Manitoba

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After the administration of this test, print copies of this resource will be available for purchase from the Manitoba Learning Resource Centre (formerly the Manitoba Text Book Bureau). Order online at www.mtbb.mb.ca.

This resource will also be available on the Manitoba Education and Training 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

	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

$s = \theta r$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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.

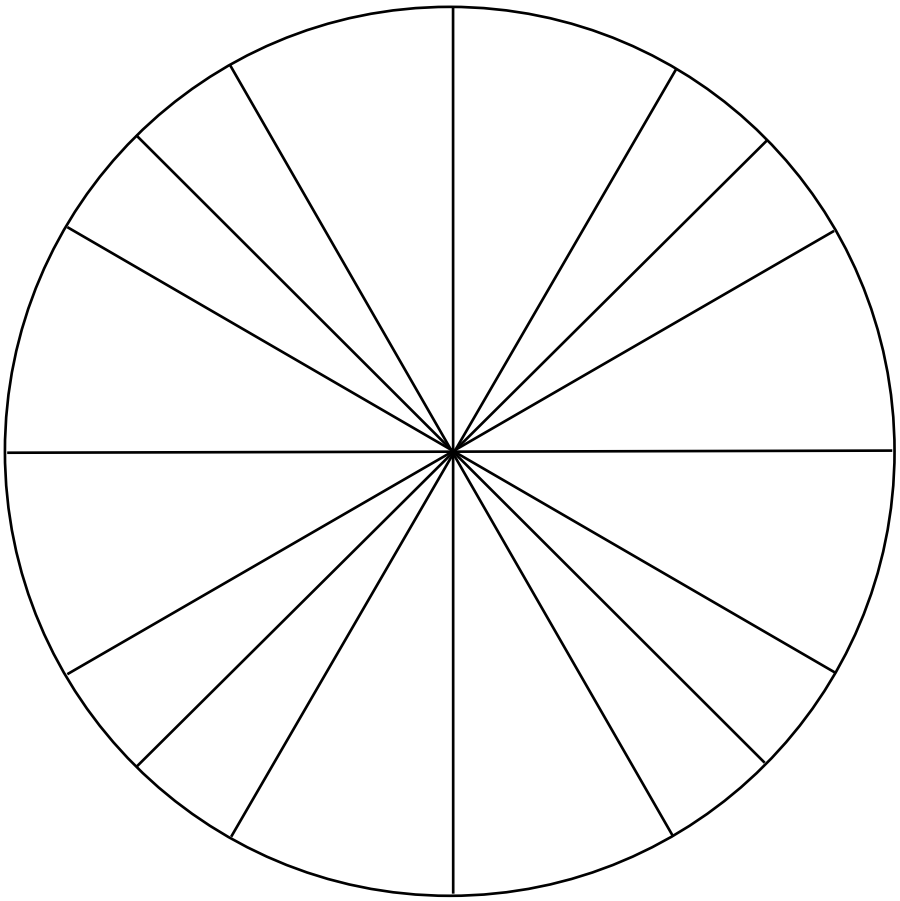
Sketch the graph: Provide a detailed drawing with key features of the graph that includes a minimum of 2 coordinate points.

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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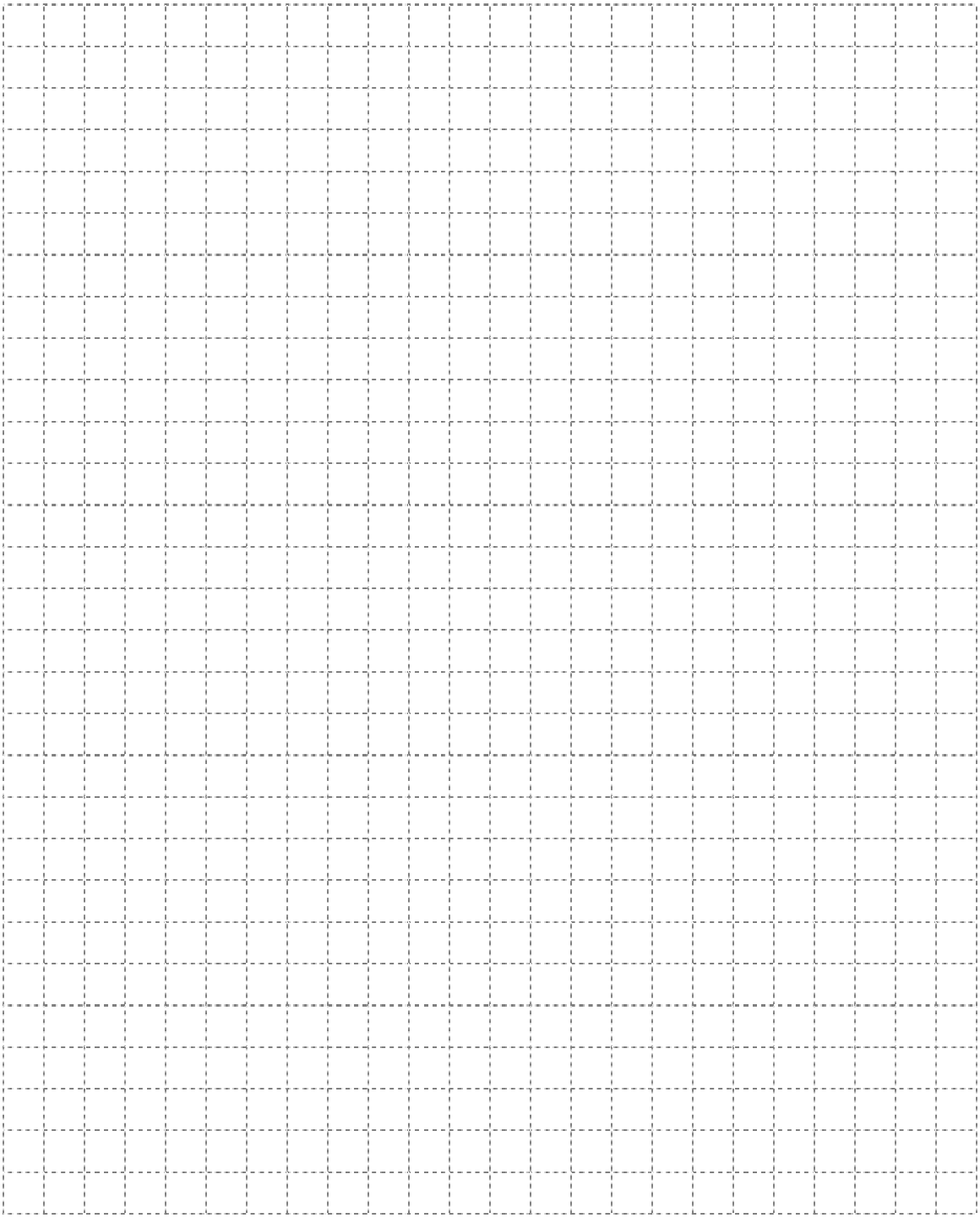


Question 1  1 mark 101

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:

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

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 = 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 $0 \leq \theta \leq 2\pi$.

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

Question 6 — 2 marks

107

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

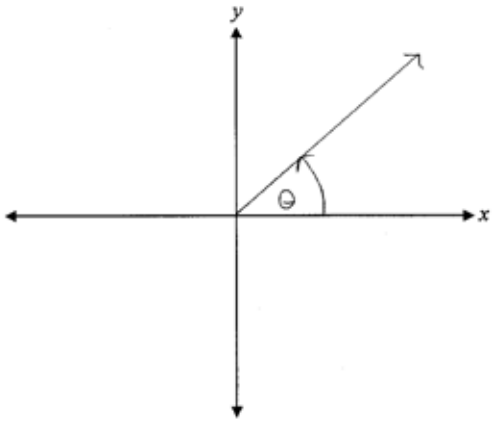
108

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

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 $\sec\theta + \cos\theta = \dfrac{2 - \sin^2\theta}{\cos\theta}$,

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

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

Left-Hand Side	Right-Hand Side

Question 10 — 2 marks

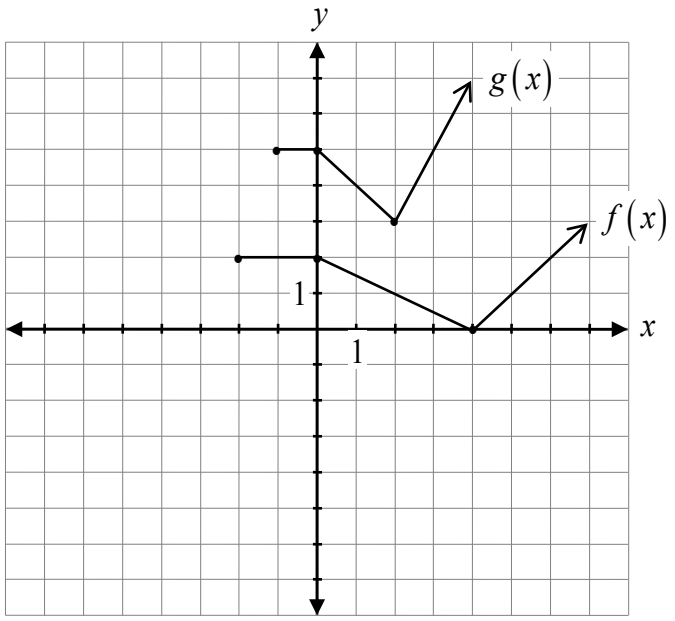
112

Expand using the laws of logarithms.

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

Question 11 — 2 marks

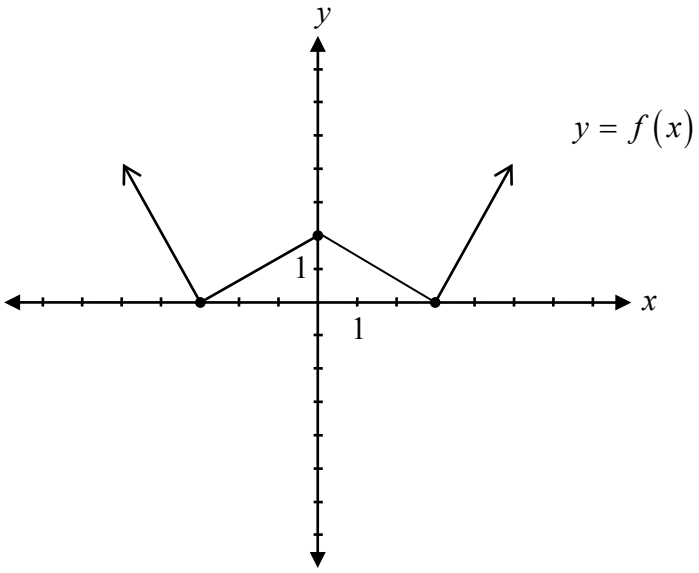
State the equation of $g(x)$ in terms of $f(x)$.



$g(x) =$ _____

Question 12 — 1 mark

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:

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

Question 14 — 2 marks

116

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

Question 15 — 3 marks

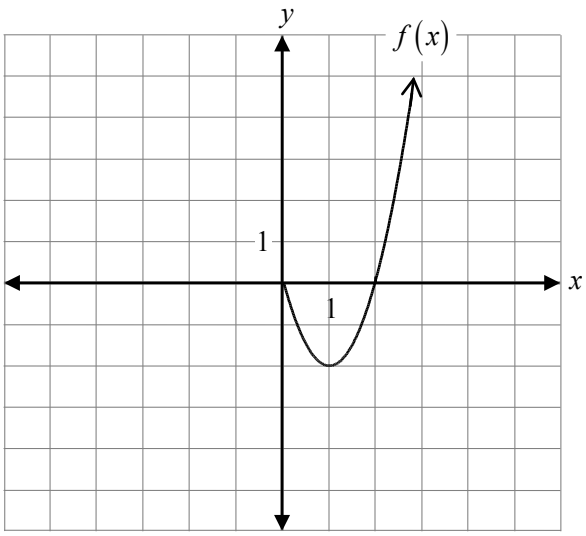
117

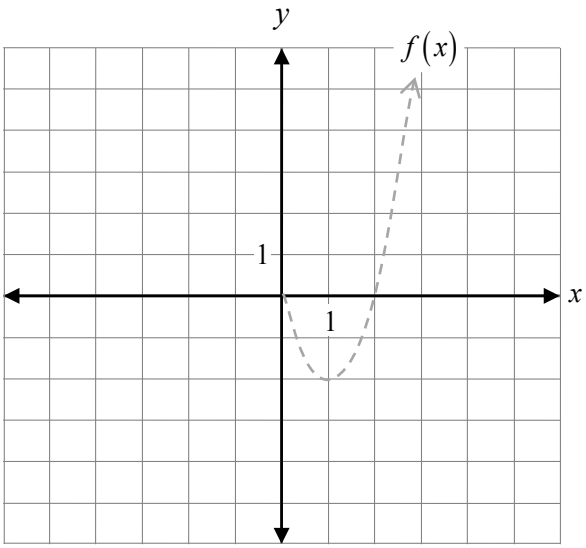
Solve algebraically:

$${}_nC_2 = 3n + 4$$

Question 16 — 3 marks

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.

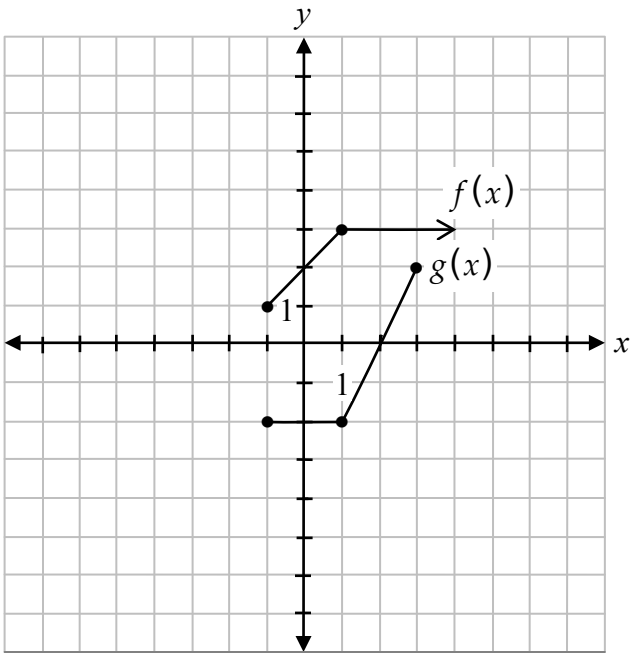
No marks will be awarded for the graph of $f(x)$.

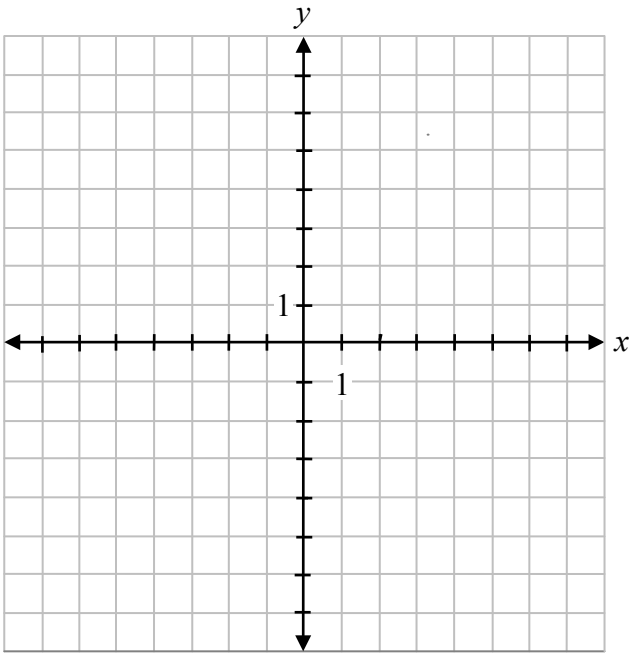
Question 17 — 1 mark

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 $h(x) = (f \bullet g)(x)$.





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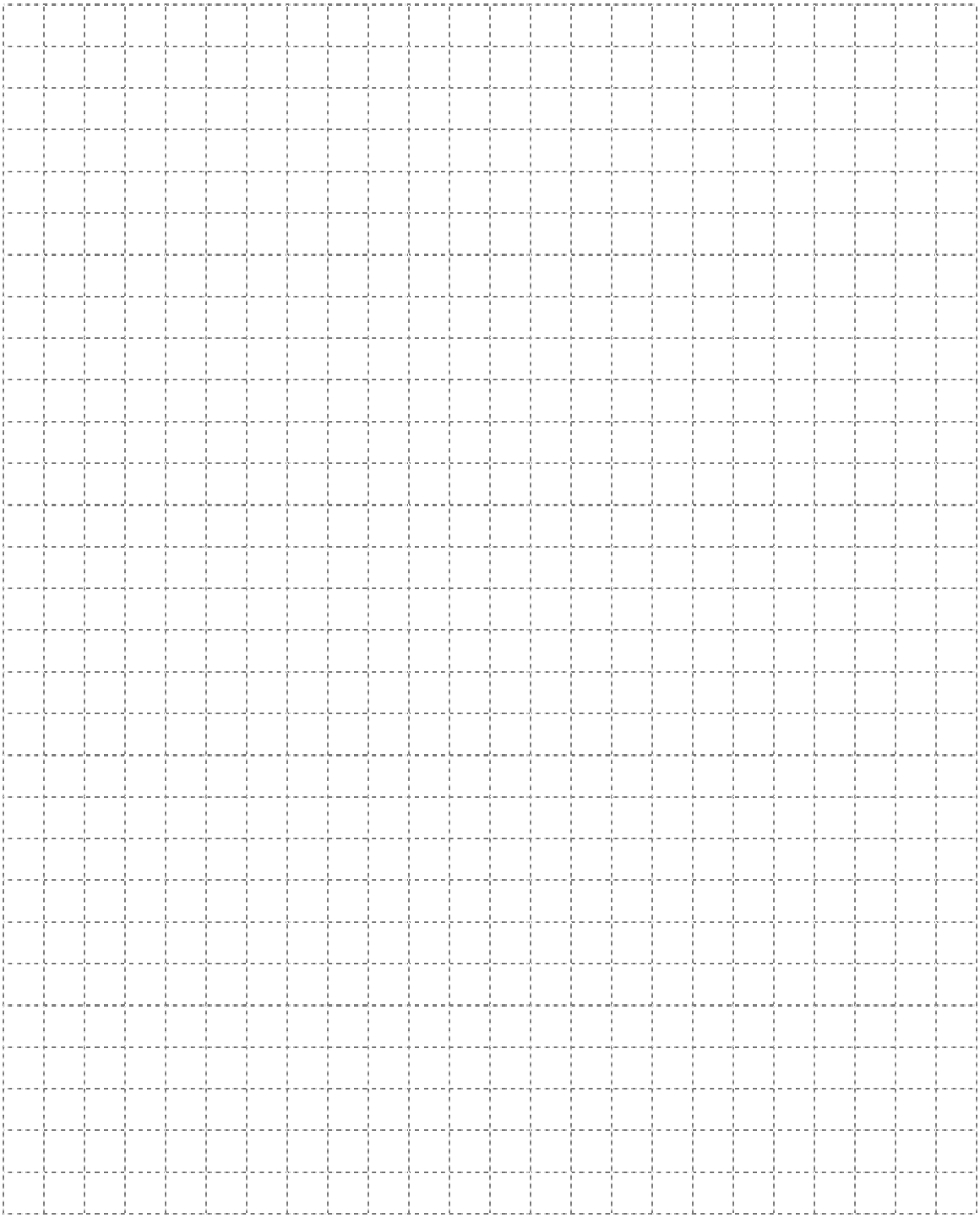

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