

DO NOT TURN TO THE NEXT PAGE until your proctor tells you.

Please read the directions carefully.

- ▶ You have 100 minutes for 32 Problems.
- ▶ Mark your answers on your Answer Form with a pencil.
- ▶ Extra scratch paper is neither given nor allowed. You may use blank pages/spaces in the booklet as scratch paper.
- ▶ There are no penalties for incorrect answers. Answer as many problems as you can; go back and check your work and also go to questions you skip, before the time is over.
- ▶ Use of calculators is prohibited. Cell phones must be turned off completely and placed out of sight. MathCON problems are ALL done without a calculator.
- ▶ The problems are divided into three categories by the difficulty levels:
3 Points (Questions 1-8)
5 Points (Questions 9-24)
7 Points (Questions 25-32)
- ▶ Problems 29-32, the last four problems are constructed-response problems. Enter your numerical answer in the grid on your answer sheet as shown on the right.

1. Although not required, it is suggested that you write your answer from left to right in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.

2. Mark no more than one circle in any column.
3. You may start your answers in any column, space permitting. Leave unused columns blank, and there should be no blank columns between columns that are not blank. For example, if your answer is 201, then either arrangement of filled-in circles shown below is acceptable.

For example: Answer: 201 – either position is correct.

	2	0	1
Ⓐ	Ⓐ	●	Ⓐ
Ⓑ	Ⓑ	Ⓑ	●
Ⓒ	●	Ⓒ	Ⓒ
Ⓓ	Ⓓ	Ⓓ	Ⓓ

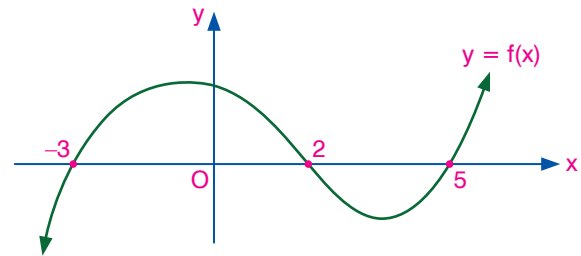
2	0	1	
Ⓐ	●	Ⓐ	Ⓐ
Ⓑ	Ⓑ	●	Ⓑ
●	Ⓒ	Ⓒ	Ⓒ
Ⓓ	Ⓓ	Ⓓ	Ⓓ

4. No problem has a negative answer.
- ▶ Notations in Geometry Problems:
- A : Point A
- $\overleftrightarrow{AB}$: Line through points A and B
- $\overline{AB}$: Line segment joining A and B
- AB : Length of the line segment AB
- $\angle ABC$: Angle with the vertex point at B
- $m\angle ABC$: Measure of angle ABC
- $\perp$: Perpendicular
- // : Parallel

1. [Algebra, 3 Points]

The graph of function $f(x)$ is given on the right.
What can be the value of n that satisfies the following equation?

$$f(n) + f(n + 4) = 0$$



A) -3

B) -2

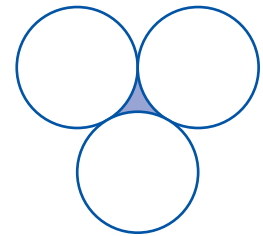
C) -1

D) 1

E) 5

2. [Geometry, 3 Points]

In the adjacent diagram, three identical circles touch each other externally.
The radius of each circle is 24 cm. What is the perimeter of the shaded region?



A) 8π cm

B) 12π cm

C) 16π cm

D) 24π cm

E) None of the preceding

3. [Number Theory, 3 Points]

A two-digit whole number MN is divisible by both 3 and 5, but not divisible by 4.
What is the sum of all possible values of MN ?

A) 135

B) 165

C) 195

D) 225

E) 255

4. [Combinatorics, 3 Points]

Given that m and b are integers.

$$-2 \leq m \leq 2$$

$$-2 \leq b \leq 2$$

If m and b are chosen at random, what is the probability that the x -intercept of the line

$$y = mx + b$$

exists, and its x -coordinate is negative?

A) $\frac{9}{25}$

B) $\frac{8}{25}$

C) $\frac{6}{25}$

D) $\frac{1}{5}$

E) $\frac{4}{25}$

5. [Algebra, 3 Points]

What is the value of $\frac{2023^3 - 1}{2023^2 + 2024}$?

A) 2022

B) 2023

C) 4044

D) 4046

E) None of the preceding

16. [Combinatorics, 5 Points]

All the digits from 1 to 9 are randomly arranged to make a nine-digit number.

What is the probability that the resulting number is divisible by 45?

A) $\frac{1}{9}$

B) $\frac{2}{9}$

C) $\frac{4}{9}$

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

E) $\frac{1}{27}$