

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]

Given that $a^3 + b^3 = (a + b) \cdot (a^2 - ab + b^2)$.

Evaluate the following expression.

$$\frac{983^3 + 17^3}{983^2 - 983 \cdot 17 + 17^2}$$

A) 17

B) 58

C) 100

D) 983

E) 1000

2. [Geometry, 3 Points]

XYZ is a triangle,

Points P, Q, and R lie on YZ, XZ, and XY, respectively.

YP = YR,

ZP = ZQ,

$m\angle XYZ = 50^\circ$, and

$m\angle XZY = 70^\circ$,

What is the measure of $m\angle QPR$?

A) 35°

B) 50°

C) 55°

D) 60°

E) 65°

3. [Number Theory, 3 Points]

Let B and C be nonzero digits, and 1BC is a three-digit number.

$$1BC = (1 + B + C) \cdot (B + C + 2)$$

What is the value of $B^2 + C$?

A) 20

B) 21

C) 31

D) 33

E) 41

4. [Combinatorics, 3 Points]

Lena rolls a fair 8-sided die labeled 1, 2, 3, 4, 5, 6, 7, and 8.

Marco rolls a fair 20-sided die labeled 1, 2, 3, ..., 20.

What is the probability that both dice show the same number?

A) $\frac{1}{8}$

B) $\frac{2}{25}$

C) $\frac{1}{12}$

D) $\frac{1}{20}$

E) None of the preceding

7. [Number Theory, 3 Points]

When all the positive integer factors of the number 40 are divided into two groups as shown, the sum of the numbers in Group A is equal to the sum of the numbers in Group B.

Given that one of the numbers in Group A is 40 and one of the numbers in Group B is 5, what is the **smallest** number in Group B?

A	B
40	5
$\vdots$	$\vdots$
Sum	Sum

A) 1

B) 2

C) 4

D) 5

E) None of the preceding

13. [Algebra, 5 Points]

An arithmetic sequence has a constant difference between consecutive terms.

The third term of the sequence is 20, and the sum of the first eight terms is 244.

What is the first term of the sequence?

A) 6

B) 8

C) 10

D) 12

E) 14