

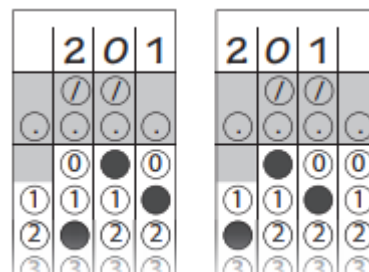
DO NOT TURN TO THE NEXT PAGE
until your proctor tells you.

Please read the directions carefully.

- ◆ You have **100 minutes** for **40 Problems**.
- ◆ Mark your answers on your Answer Form with a pencil.
- ◆ Extra scratch paper is neither given nor allowed. You may use blank pages in the booklet as scratch paper.
- ◆ There are no penalties for incorrect answers. Answer as many problems as you can; return to the others in the time you have left for the test.
- ◆ Calculators are not permitted. Cell phones must be turned off completely and placed out of sight.
- ◆ The problems are divided into three categories, Part **A**, Part **B** and Part **C**, according to difficulty level. A correct answer for a Part A problem is worth 3 points, Part B is worth 5 points, and Part C is worth 7 points. Each problem is a multiple-choice problem except the last four problems in Part C.
- ◆ Problems 37-40, the last four problems of Part C, 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. Columns you don't use should be left 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.



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 \overline{AB} .
- $\angle ABC$: Angle with the vertex point at B
- $m\angle ABC$: Measure of $\angle ABC$
- \perp : Perpendicular
- $//$: Parallel

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Problem 1

Algebra

3 Points

Suppose a and b are non-zero additive inverses (opposites) of each other, what is the value of the following expression?

$$2(a + b - 1)^{2019} + 3\left(\frac{a}{b}\right)^{2020} + 2019$$

- A) 1
- B) 2017
- C) 2019
- D) 2020
- E) None of the preceding

Problem 2

Combinatorics

3 Points

The pages of Ayhan's book are numbered from 1. The page numbers have a total of 459 digits. How many pages does the book have?

- A) 119
- B) 189
- C) 190
- D) 215
- E) 219

Problem 3

Algebra

5 Points

If $a + c = 4.98$ and $b + c = 6.48$, what is the value of $b^2 + bc - ab - ca$?

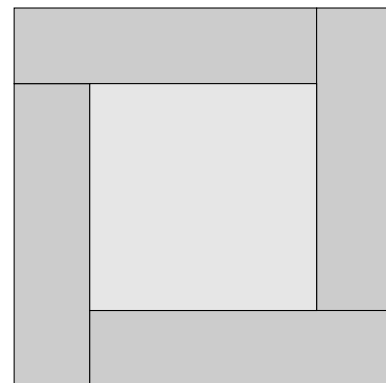
- A) 7.47
- B) 8.16
- C) 9.08
- D) 9.72
- E) None of the preceding

Problem 4

Geometry

5 Points

The diagram shows four identical rectangles placed inside a square. The perimeter of each identical rectangle is 24 cm and the perimeter of the center square is 20 cm. What is the sum of the area of outer rectangles (border area)?



- A) 110
- B) 120
- C) 124
- D) 136
- E) None of the preceding

Problem 5

Algebra

5 Points

Find the value of $10^{2019} + 10^{2017}$ divided by $10^{2019} - 10^{2017}$.

- A) 2019/2017
- B) 101/99
- C) 11/9
- D) 2018
- E) 99/101

Problem 6

Number Theory

5 Points

For how many positive integer values of x is the expression $\frac{x^2 - 7x + 60}{x}$ an integer?

- A) 24
- B) 16
- C) 12
- D) 10
- E) 8

Problem 7

Combinatorics

5 Points

How many three-digit numbers are even but have exactly one odd digit?

- A) 100
- B) 125
- C) 200
- D) 225
- E) None of the preceding

Problem 8

Combinatorics

7 Points

Let x , y , and z be three numbers randomly picked with replacement from the set $\{1, 2, 3, 4, 5\}$. What is the probability that $xz + y$ is even number?

- A) $\frac{2}{5}$
- B) $\frac{23}{25}$
- C) $\frac{39}{125}$
- D) $\frac{64}{125}$
- E) $\frac{59}{125}$

Problem 9

Algebra

7 Points

Let A, B and C be three digits so that the sum of the two-digit numbers AB, BC and CA equals to the three-digit number ABC . What is $A + B + C$?

Problem 10

Geometry

7 Points

ABC is a triangle with $AB = AD = BE$. $m\angle A = 114^\circ$ and $m\angle B = 60^\circ$. Find $m\angle EDC$.

