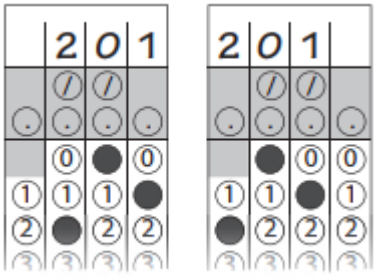
DO NOT TURN TO THE NEXT PAGE until your proctor tells you.

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

Let $X = \frac{2019}{2018} + \frac{2018}{2019} + \frac{2019}{2020}$ and $Y = \frac{1}{2020} + \frac{1}{2019} - \frac{1}{2018}$. Which of the following equations is correct?

A) $X - Y = 4$

B) $X + Y = 1$

C) $Y = X + 4$

D) $X = 4 - Y$

E) None of the preceding

Problem 2

Number Theory
3 Points

Let a, b and c are distinct prime numbers such that $a(c - b) = 18$ and $b(c - a) = 40$. Find $a + b + c$.

A) 13

B) 17

C) 19

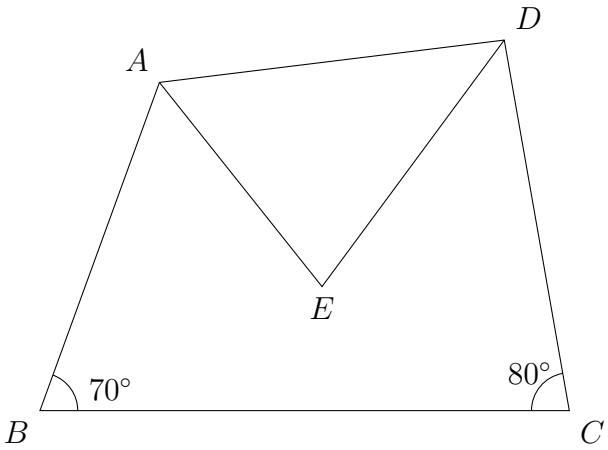
D) 21

E) None of the preceding

Problem 3

Geometry
3 Points

$ABCD$ is a quadrilateral where AE and DE are angle bisectors. Find the value of $m\angle AED$.



A) 60°

B) 75°

C) 90°

D) 100°

E) None of the preceding

Problem 4

Algebra
5 Points

If $5^2 + 5^3 + 5^4 + \ldots + 5^{20} = M$, then what is the value of $5^2 + 5^3 + 5^4 + \ldots + 5^{18}$?

A) $M + 19$

B) $M - 5^{21}$

C) $\dfrac{M - 150}{25}$

D) $\dfrac{M - 36}{9}$

E) $\dfrac{M}{25}$

Problem 5

Geometry
5 Points

How many distinct isosceles triangles can be created with integer sides and perimeter of 200 units?

A) 49

B) 64

C) 81

D) 96

E) None of the preceding

Problem 6

Number Theory
5 Points

For how many integers n is $|n^2 - 6n + 5|$ prime?

A) 1

B) 2

C) 3

D) 4

E) 5

Problem 7

Combinatorics
5 Points

How many ways can you select three integers from 1 to 10 such that no two integers chosen are consecutive?

A) 30

B) 56

C) 120

D) 360

E) 720

Problem 8

Algebra
7 Points

Find the sum of all real solutions of the equation $(x-5)^{2x-6}=1$.

A) 9

B) 10

C) 13

D) 15

E) None of the preceding

Problem 9

Number Theory
7 Points

Suppose xx, yy and zz are two-digit whole numbers. If $x^2+y^2+z^2 = 74$ then find the number of positive divisors of $(xx)^2 + (yy)^2 + (zz)^2$.

Problem 10

Geometry
7 Points

Find the area of the right triangle ABC if $a + b + c = 28$ and $a^2 + b^2 + c^2 = 288$.