



★ NATIONAL LEVEL ★

February 2019

# The Mandelbrot Competition

## Round Five Test

Name: \_\_\_\_\_

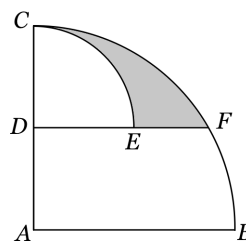
Time Limit:  
40 minutes

1. Place the digits 1 to 6 in the grid, then find the largest product of two digits that are next to one another either horizontally or vertically. (Here the largest product is 24.) What is the minimum largest product that can occur?

1	4	5
3	6	2

①

2. In the diagram,  $CAB$  is a quarter circle with center  $A$  and radius  $AB = 12$ . Plot the midpoint  $D$  of  $\overline{AC}$ , then draw  $\overline{DF}$  perpendicular to  $\overline{AC}$  with point  $F$  on arc  $BC$ . Finally, draw another quarter circle  $CDE$  with center  $D$ . What is the exact area of the shaded region?



①

3. The graph of  $\sin x + \cos y = 0$ , where  $x$  and  $y$  are real numbers in radian measure, is an infinite grid of squares. What is the exact area of one square?

②

4. A box contains distinct blocks of four different colors; one of the colors is blue. There are 157 ways to pick two blocks of different colors. However, there are only 119 ways to pick two blocks of different colors, neither of which are blue. Determine the number of blocks in the box.

②

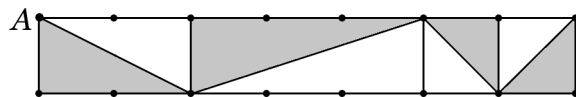
5. Find the number of ways to write  $3^6 5^8$  in the form  $a^b c^d$ , where  $a, b, c, d$  are positive integers each greater than 1, and  $a < c$ .

②

6. The integers from 1 to 94 inclusive are written on cards. Dan removes a two-digit number  $D$ , then multiplies all the remaining numbers and finally adds  $D$  to his product. If the result is a multiple of 97, then what is  $D$ ?

③

7. Starting from corner  $A$ , draw a zig-zag path made up of diagonal segments until the path reaches one of the right corners. For each segment of the path, shade in one right triangle, above or below. How many different such paths with shadings are there if none of the shaded triangles may share an edge?



③

SCORE: