

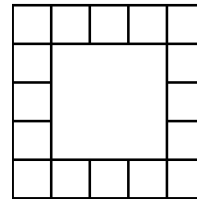
The Mandelbrot Competition

Round Two Test

Name: _____

Time Limit:
40 minutes

1. Sixteen squares are arranged into four overlapping lines, with five squares in each line, as shown at right. Suppose we place thirteen chips on the squares so that each line contains exactly five chips. (It is OK to place more than one chip per square.) How many chips must be placed on the four corner squares in total?



1

2. Note that $x = 1$ satisfies the equation $\frac{1}{x+1} - \frac{1}{x+2} = \frac{1}{x+5}$. There is also a negative number satisfying this equation. What is its value?

1

3. Suppose that $P_1P_2P_3 \cdots P_{20}$ is a regular 20-sided polygon. Determine the measure of the acute angle between lines $P_{20}P_{13}$ and $P_{19}P_7$, in degrees.

2

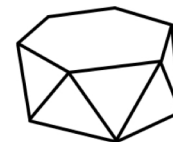
4. A square is sliced into 1000 congruent rectangles using 999 horizontal lines. If each rectangle has a perimeter of 2013, then what is the perimeter of the original square, rounded to the nearest hundred?

2

5. Find all pairs (a, b) of natural numbers with $a < b$ having the property that there exists a right triangle with legs of length a and b whose hypotenuse has length $\frac{1}{3}ab - a - b$.

2

6. The solid shown here is created by placing two regular hexagons, each with side length 1, directly above one another 1 unit apart, then rotating the top hexagon by 30° clockwise and joining each vertex to the two nearest vertices of the other hexagon. What is the volume of this solid?



3

7. When $(x^2 + x + 1)^{54}$ is fully expanded we obtain $x^{108} + 54x^{107} + \cdots + 1$. How many coefficients of the resulting polynomial are divisible by 3?

3

SCORE: