November 2017

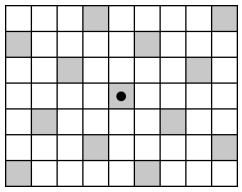
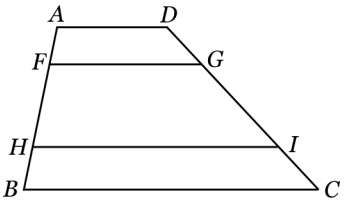
⋆ Regional Level ⋆

The Mandelbrot Competition

Round Two Test

Time Limit: 40 minutes

Name: _____

1. The sum of three distinct positive integers is 2017. When arranged in increasing order, what is the largest possible value of the middle number?	(1)
2. Suppose this repeating pattern of shaded squares is extended infinitely in all directions, then the shaded square with the dot is erased. How many other shaded squares are visible from the center of the dot? One cannot see beyond any part of a shaded square, including its corner. 	(1)
3. Starting with the number 0, perform one of the following operations on each turn: add 2, subtract 2, or multiply by 2. What is the minimum number of turns required to obtain the number 60?	(2)
4. Suppose $ABCD$ is a trapezoid with $\overline{AD} \parallel \overline{BC}$. Draw $\overline{FG}$ parallel to $\overline{AD}$ with $AF = \frac{1}{4}AB$, then draw $\overline{HI}$ parallel to $\overline{AD}$ with $AH = \frac{3}{4}AB$. If the perimeter of $AFGD$ is 10 while the perimeter of $AHID$ is 14, what is the perimeter of $ABCD$? 	(2)
5. For which positive real number q is a $(2q)\%$ increase followed by a $(3q)\%$ increase equivalent to a single $(6q)\%$ increase?	(2)
6. Let r and s be real numbers from 0 to 1 chosen independently at random. What is the probability that at least one of the numbers $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, ... is located between r and s?	(3)
7. Given the three equations $z^{60} = 1$, $z^{72} = 1$ and $z^{90} = 1$, how many complex numbers z are solutions to two of the equations, but not all three?	(3)

SCORE: