11. [12 points] You construct a snowflake by starting with a square piece of paper of side length 3 inches. You divide the square into a three by three grid of squares of side length one and remove the four squares in the grid that share a side with the center square in the grid. For each remaining square in the grid, subdivide each of them into 9 equally sized squares and remove the four squares in each of these new grids that share a side with the center square in the grid. You continue in this manner for a long time.

$$N = 0 \qquad N = 1 \qquad N = 2 \qquad N = 3$$
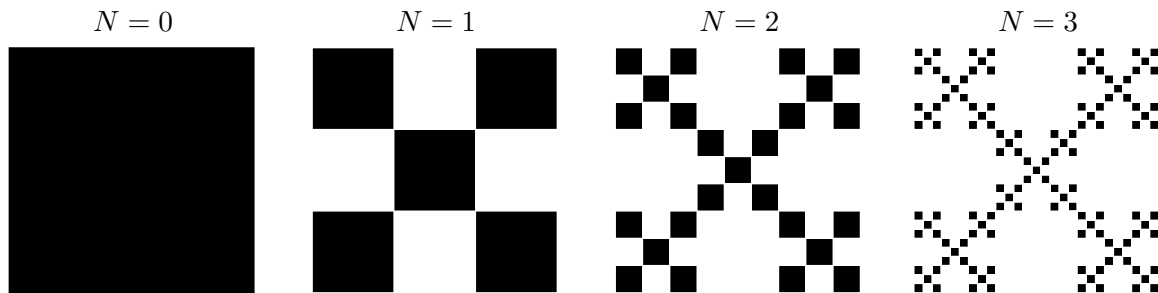
   a. [3 points] Write a formula that gives the perimeter, P_N, of the black squares that make up the snowflake after N steps.

   b. [2 points] Find $\lim\limits_{N \to \infty} P_N$.

   c. [3 points] Suppose $N \geq 1$. Write a sum that gives the area, A_N of all the squares you have **removed** after N steps.

   d. [2 points] Write a closed form expression for A_N.

   e. [2 points] Find the limit as $N \to \infty$ of your expression in (d).