Physics 3345 **Professor Scalise**
Fall 2000 **Assignment #4**

Due: Monday 25 September 2000

1. Play the Chaos Game on a computer and print the result.

   One of the most interesting fractals arises from what Michael Barnsley has dubbed "The Chaos Game"(Barnsley, M. Fractals Everywhere. Boston: Academic Press, 1989.). The chaos game is played as follows. First pick three points at the vertices of a triangle (any triangle works—right, equilateral, isosceles, whatever). Color one of the vertices red, the second blue, and the third green.

   Next, take a die and color two of the faces red, two blue, and two green. Now start with any point in the triangle. This point is the seed for the game. (Actually, the seed can be anywhere in the plane, even miles away from the triangle.) Then roll the die. Depending on what color comes up, move the seed half the distance to the appropriately colored vertex. That is, if red comes up, move the point half the distance to the red vertex. Now erase the original point and begin again, using the result of the previous roll as the seed for the next. That is, roll the die again and move the new point half the distance to the appropriately colored vertex, and then erase the starting point.

   Now continue in this fashion for a small number of rolls of the die. Five rolls are sufficient if you are playing the game "by hand" or on a graphing calculator, and eight are sufficient if you are playing on a high-resolution computer screen. (If you start with a point outside the triangle, you will need more of these initial rolls.)

   After a few initial rolls of the die, begin to record the track of these traveling points after each roll of the die. The goal of the chaos game is to roll the die many hundreds of times and predict what the resulting pattern of points will be. Most students who are unfamiliar with the game guess that the resulting image will be a random smear of points. Others predict that the points will eventually fill the entire triangle. Both guesses are quite natural, given the random nature of the chaos game. But both guesses are completely wrong. The resulting image is anything but a random smear; with probability one, the points form what mathematicians call the Sierpinski triangle.

2. Marion & Thornton 4-1.

3. Marion & Thornton 4-3.

4. Marion & Thornton 4-5.

5. Marion & Thornton 4-20.