CHAPTER 1: GEOMETRIC SEQUENCES & SERIES PROJECT

TOTAL MARKS = 6 MARKS PER ACTIVITY = 24 MARKS

Using the information you have learned about geometric sequences and series, complete each activity below by going to each link and having a look at the fractals that have been generated or that you generate and answer the questions included below. **Add screen captures of the image you have created at each question for marks.**

Activity 1 – Number of Line Segments in a Hilbert Curve:

1. At the following link, you will notice that you have a line. As displayed, the line segment at this level 0 (iteration 0) has a size or length of 1.0 and number of lines you have is 1.
   http://www.shodor.org/interactivate/activities/AnotherHilbertCurve/
   a. **How many lines do you have at iteration 0 (level 0)?**
2. Click on next stage (Previous Stage Next Stage) and see how the line is segmented and redesigned at iteration (level) 1. You can also see the number of line segments that are created
   a. **How many line segments are there at iteration 1 (level 1)?**
3. Click on next stage again (Previous Stage Next Stage) and see how the line is segmented and redesigned at iteration (step) 3.
   a. **How many line segments are there at iteration 2 (level 2)?**
4. Continue clicking on next stage (Previous Stage Next Stage) to see how the line is segmented and redesigned to create a fractal image. You can determine the ratio of each iteration (stage) using the previous information.
   a. **What is the ratio of this geometric sequence representing the number of line segments in each iteration?**
5. You now have enough information to determine the total number line segments for infinite number of iterations. Answer the following question using **level 1 (2a)** as the first term of the geometric sequence.
   a. **Determine the number of line segments at the 7^{th} iteration (level).**
   b. **Determine the number of line segments at the 9^{th} iteration (level).**
6. Answer the following questions using **level 1 (2a)** as the first term of the geometric sequence.
   a. **Determine the sum of the total number of the line segments for 10 iterations.**
   b. **Write the total sum of this geometric series in sigma notation for 10 iterations.**

Activity 2 – Number of Line Segments in Koch's Snowflake:

1. At the following link, you will notice that you have a triangle. As displayed, the number of line segments at this level 0 (iteration 0) has a size or length of 1.0 and number of lines you have is 3.
   http://www.shodor.org/interactivate/activities/KochSnowflake/
   a. **How many line segments do you have at iteration 0 (level 0)?**
2. Click on next stage (Previous Stage Next Stage) and see how the line is segmented and redesigned at iteration (level) 1. You can also see the number of line segments that are created
   a. **How many line segments are there at iteration 1 (level 1)?**

3. Click on next stage again (Previous Stage Next Stage) and see how the line is segmented and redesigned at iteration (step) 3.
    a. **How many line segments are there at iteration 2 (level 2)?**
4. Continue clicking on next stage (Previous Stage Next Stage) to see how the line is segmented and redesigned to create a fractal snowflake. You can determine the ratio of each iteration (stage) using the previous information.
    a. **What is the ratio of this geometric sequence representing the number of line segments in each iteration?**
5. You now have enough information to determine the total number line segments for infinite number of iterations. Answer the following question using **level 1 (2a)** as the first term of the geometric sequence.
    a. **Determine the number of line segments at the 9^{th} iteration (level).**
    b. **Determine the number of line segments at the 11^{th} iteration (level).**
6. Answer the following questions using **level 1 (2a)** as the first term of the geometric sequence.
    a. **Determine the sum of the total number of the line segments for 10 iterations.**
    b. **Write the total sum of this geometric series in sigma notation for 10 iterations.**

Activity 3 – Number of Triangles in the Sierpinski Triangle:

1. At the following link, you will notice that you have ONE large black triangle. Adjust the steps from 0 to 1 to 2 to 3, etc. to notice how many black triangles remain when you remove a triangle created by connecting the midpoints of each side of the larger triangle. Use can the arrows to change the steps and generate the iterations of the Sierpinski Triangle. Step: ‹ 1 ›
   https://tinyurl.com/Sierpinski-Triangle
    a. **How many black triangles are there at step 0 (Step: ‹ 1 ›)?**
2. Adjust the steps to 1. Count the number of black triangles created/remaining when the middle one is removed.
    a. **How many black triangles are there at step 1 (Step: ‹ 1 ›)?**
3. Adjust the steps to 2. Count the number of black triangles created/remaining when another iteration (step) is created.
    a. **How many black triangles are there at step 2 (Step: ‹ 1 ›)?**
4. Adjust the steps from 2 to 10 and notice how the number of black triangles increases by a certain ratio. You can determine the ratio of each iteration (step) use the previous information.
    a. **What is the ratio of this geometric sequence representing the number of black triangles?**
5. You now have enough information to determine the number of black triangles for infinite number of iterations of the Sierpinski Triangle. Answer the following question using **step 1** as the first term of the geometric sequence.
    a. **Determine the number of black triangles at the 10^{th} iteration (step).**
    b. **Determine the number of black triangles at the 15^{th} iteration (step).**
6. Answer the following questions using **step 1** as the first term of the geometric sequence.

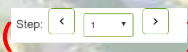
a. **Determine the sum of the total number of black triangles from iteration (step) 1 to 11 of the Sierpinski Triangle.**
b. **Write the sum of this geometric series in sigma notation for 11 iterations.**

Activity 4 – Area of the White Triangle in the Sierpinski Triangle:

1. Use the same link that you used in Activity 3 above for this activity. Go to the following link where you will notice that you have a large black triangle. Assume the area of this large triangle at step 0 (iteration 0) = 1. Adjust the steps from 0 to 1 to 2 to 3, etc. to notice how the area of the black triangles get smaller every time a triangle is removed using the midpoints on the remaining black triangle to draw a new triangle. Use the arrows to change the steps 

https://tinyurl.com/Sierpinski-Triangle
    a. **What is the area of the black triangle at step zero (** 

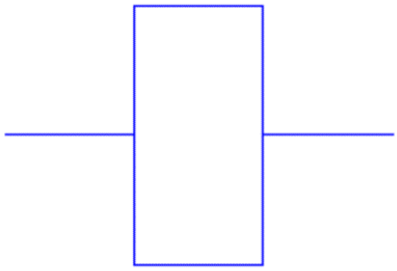
)?
2. Adjust the steps to 1 (iteration #1). Count the number of white triangles in comparison to the black triangles. Remembering that the largest triangle is an area of 1, you can determine the area of the black triangle as a proportion of the whole triangle. For example, if there are 6 black triangles and 4 white triangles, then the area of the black triangles would be 6/10 = 3/5.
    a. **What is the area of the black triangles at step one (** 

)?
3. Adjust the steps to 2 (iteration #2).
    a. **What is the area of the black triangles at step two (** 

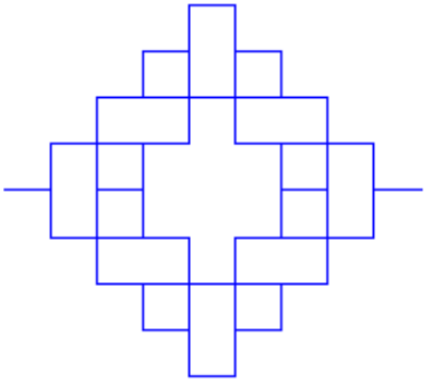
)?
4. Adjust the steps from 2 to 10 and notice how the area of subsequent black triangles decrease by a certain ratio. You can determine the ratio of each iteration (step) use the previous information.
    a. **What is the ratio of the decreasing area of the black triangles?**
5. You now have enough information to determine the area of black triangles for infinite number of iterations of the Sierpinski Triangle. Answer the following question using **step 1** as the first term of the geometric sequence.
    a. **Determine the area of the black triangles at the 6^{th} iteration (step).**
    b. **Determine the area of black triangles at the 11^{th} iteration (step).**
6. Answer the following questions using **step 1** as the first term of the geometric sequence.
    a. **Determine the finite sum of the total area of black triangles for infinite iterations.**
    b. **Write the total sum of this geometric series in sigma notation.**

SUBMIT YOUR WORK WITH SCREEN CAPTURES FOR EACH QUESTION AND PRINT AND SUBMIT YOUR PROJECT IN CLASS OR EMAIL IT TO ME.

1a.



2a.



3a.