AP Calculus BC   ***Name***____________________________
2009 Summer Assignment   ***Page 1***

Directions:
Illustrate and explain your work on separate paper. Carefully read and respond to *each statement* below. If you experience difficulty, contact Mr. Weisner (bdweisner@smcps.org) at any time during the summer. On the first day of school, bring both this paper and your completed work to class on the first day of school. Just before the first day of school, briefly scan this paper to refamiliarize yourself with its contents.

You may need to Research this online.

Series that Approximate a Function:

1. Write the first 5 terms of the polynomial that approximates *sin (x)* .

2. Evaluate *sin* $(\pi/13)$ using the polynomial in Step 1 and a calculator. Use the 'STO' button to store the entire decimal value of $(\pi/13)$. Show the value of the first 5 terms, each truncated to 7 places. After adding these 5 terms, compare the result to the calculator's direct answer to *sin* $(\pi/13)$. What is the percent error in your result?

3. Develop the *sin (x)* polynomial in step 1 above using the series $\sum_{n=0}^{\infty} \frac{f^{(n)}(0)x^{(n)}}{n!}$

4. Write the first 5 terms of the polynomial that approximates *cos (x)* .

5. Evaluate *cos* $(\pi/13)$ using the polynomial in Step 4 and a calculator. Use the 'STO' button to store the entire decimal value of $(\pi/13)$. Show the value of the first 5 terms, each truncated to 7 places. After adding these 5 terms, compare the result to the calculator's direct answer to *cos* $(\pi/13)$. What is the percent error in your result?

6. Develop the *cos (x)* polynomial in step 4 above using the series given in step 3 above.

7. Draw and label a graph of $y = \sin(x)$ on the closed interval $[-2\pi, 2\pi]$.

8. Does this graph exhibit line symmetry about the y-axis or point symmetry across the origin?

9. Is $y = \sin(x)$ an odd function or an even function? Use the answer to step 6 in your explanation.

10. Draw and label a graph of $y = \cos(x)$ on the closed interval $[-2\pi, 2\pi]$.

11. Does this graph exhibit line symmetry about the y-axis or point symmetry across the origin?

12. Is $y = \cos(x)$ an odd function or an even function? Use the answer to step 11 in your explanation.

13. Examine the exponents in steps 1 and 4 and the word answers to steps 9 and 12. Identify and state a connection between the series polynomial and the graph of both *sin (x)* and *cos (x)*. This mnemonic might help you distinguish one series from the other.

14. Use the polynomials in steps 1 and 4 to show $\frac{d}{dx} \sin(x) = \cos(x)$.

15. Use the polynomials in steps 1 and 4 to show $\frac{d}{dx} \cos(x) = -\sin(x)$.

The Adding Machine
One interpretation of the integral is its use as an 'accumulator', which I like to refer to as an 'adding machine'. Use the examples below to illustrate this interpretation. Pick a specific function and hand-draw a diagram for each. Each diagram should include a single cross-section of the shape involved. Show the calculus used to determine the exact area or volume of each shape.

- Only hand-drawn, not downloaded, illustrations are accepted.
- Explain in words how Calculus uses the concept of 'limit' to obtain an exact answer.
    1. Find the area under a curve $y = f(x)$ using rectangles.
    2. Find the volume of a solid of revolution using disks.
    3. Find the volume of a solid with a known cross-section starting with the area of the cross-section.

Infinite Geometric Series (new topic)
Research this online. We talked briefly about this topic when 'series' was first introduced. [Consider the series $1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \ldots$] Write a description, both in words and in symbols, of such a series. Explain the requirement(s) for an IGS to add up to some limiting value. Write out the first six terms of four different IGS that have a limit and give the value of the limit. Write out the first six terms of four other IGS that have no limit.

Familiar Phrases
Identify what each familiar phrase yields, what it represents, and/or how you find it. When possible, identify in which non-Calculus math class you first encountered the concept.

- Integral over interval
- The integral of a rate of change
- Instantaneous rate of change
- Average rate of change
- One-half the sum of the bases times the height
- Ant farm