READ ME FIRST: *Show all essential work very neatly. Use correct notation when presenting your computations and arguments. Write using complete sentences. Remember this: "=" denotes "equals" , "⇒" denotes "implies" , and "⇔" denotes "is equivalent to". Since the answer consists of all the magic transformations, do not "box" your final results. Communicate. Show me all the magic on the page, for I do not read minds. Eschew obfuscation.*

1. (5 pts.) Evaluate the following using the 1st Part of the Fundamental Theorem of Calculus.

$$\int_1^9 \frac{1}{x\sqrt{x}}\,dx =$$

2. (5 pts.) Using a complete sentence and appropriate notation, state precisely the First Part of the Fundamental Theorem of Calculus. [This is sometimes called the *Evaluation Theorem*.]

3. (5 pts.) Express the following sum using sigma notation, but do not attempt to find its numerical value.

$$-\frac{1}{2}+\frac{1}{4}-\frac{1}{6}+\frac{1}{8}-\frac{1}{10}+\frac{1}{12} =$$

4. (5 pts.) Obtain the upper limit of summation and rewrite the summand in order to make the following equation true. **Do not attempt to evaluate the sum.**

$$\sum_{k=8}^{45} 2^{3k} = \sum_{j=0}$$

5. (5 pts.) Express the following limit as a definite integral. Do not attempt to evaluate the integral.

$$L = \lim_{\max \Delta x_k \to 0} \sum_{k=1}^{n} (2\cos^3 x_k^*)\,\Delta x_k \ ; \quad a = -\pi,\ b = 2\pi.$$

L =

6. (5 pts.) Using complete sentences and appropriate notation, state the Second Part of the Fundamental Theorem of Calculus.

7. (10 pts.) Find each of the following derivatives.

(a) $\frac{d}{dx}\left[\int_{x}^{\pi} 4\sin(t^3)\ dt \right] =$

(b) $\frac{d}{dx}\left[\int_{-1}^{x^2} \sqrt{t+1}\ dt \right] =$

8. (5 pts.) (a) (3 pts.) Give the definition of the function ln(x) in terms of a definite integral and give its domain and range. Label correctly. (**Hint**: To start, complete the sentence,"ln(x) = ...")

(b) (2 pts.) Given ln(a) = 4 and ln(b) = -3, evaluate the following integral.

$\int_{1}^{ab^2} \frac{1}{t}\ dt =$

9. (5 pts.) Write the solution to the following initial value problem in terms of a definite integral taken with respect to the variable **t**, so the differential denoting the variable of integration is ***dt***. DO NOT ATTEMPT TO EVALUATE THE DEFINITE INTEGRAL IN *t* THAT YOU OBTAIN.

$$\frac{dy}{dx} = 4e^{x^2}, \quad y(\pi/4) = 1.$$

$y(x) =$

10. (5 pts.) Evaluate the definite integral below by expressing it in terms of u correctly and then evaluating the resulting integral using a formula from geometry.

$$\int_1^{e^4} \frac{\sqrt{16-(\ln(x))^2}}{x}\,dx\ ;\ u = \ln(x)$$

$$\int_1^{e^4} \frac{\sqrt{16-(\ln(x))^2}}{x}\,dx =$$

11. (10 pts.) Write each of the following two sums in closed form.

(a) $\displaystyle\sum_{k=1}^{n}\left(\frac{1}{k+1} - \frac{1}{k+2}\right) =$

(b) $\displaystyle\sum_{k=0}^{100}\left(\frac{1}{5^k}\right) =$

12. (10 pts.) If the function f is continuous on [a,b], then the *net signed area* A between $y = f(x)$ and the interval [a,b] is defined by

$$A = \lim_{n\to\infty}\sum_{k=1}^{n} f(x_k^*)\,\Delta x.$$

Reveal all the details in computing the numerical value of the net signed area of $f(x) = 4x^3$ over the interval [0,1] using only the definition above with

$$x_k^*$$

the right end point of each subinterval in the regular partition. *Do not use the Fundamental Theorem, Part 1.*

13. (10 pts.) A particle moves with a velocity of $v(t) = 2\cos(2t)$ along an s-axis. Find the displacement and total distance traveled over the time interval $[\pi/2, 3\pi/4]$.

Displacement =

Total_Distance =

14. (5 pts.) Evaluate the following limit:

$$L = \lim_{x \to 0} (1 + x)^{1/(3x)} =$$

15. (10 pts.) Let the function g be defined by the equation

$$g(x) = \int_0^x e^{t^2}\, dt - 5x$$

for $x \in (-\infty, \infty)$. Then

(a) $g(0) =$

(b) $g'(0) =$

(c) $g''(0) =$

(d) Determine the open intervals where g is increasing or decreasing. Be specific.

(e) Determine the open intervals where g is concave up or concave down. Be specific.

Silly 10 Point Bonus: Reveal the magic in evaluating the following limit:

$$\lim_{x \to 0^-} \frac{1}{x} \int_{-x}^{x} \frac{\sec(t)}{\pi^2 + t^4}\, dt$$

[Say where your work is, for it won't fit here.]