1. Evaluate the following integrals. Give an exact answer. You do not need to simplify.

(a) (9 points)

$$\int \frac{2x+3}{x^2-x-6}\,dx$$

(b) (9 points)

$$\int \frac{1}{x^4\sqrt{x^2-4}}\,dx$$

2. (10 points) Let R be the region bounded by the curves $y = 0$ and $y = -(x-3)^2 + 4$. Find the volume generated by rotating R about the y-axis.

3. (10 points) Consider the following system consisting of three sheets having the same uniform density. Two of the sheets are disks of unit radius with centers $(-2, 0)$ and $(2, 0)$ respectively. The third sheet is a two by two square with center $(0, -2)$ and with sides parallel to the x and y axes. Find the center of mass $(\overline{x}, \overline{y})$ of this system. Justify your answer.

4. Consider the curve $y = e^{x^2} - \pi$ for $-1 \leq x \leq 1$.

(a) (6 points) Write down an integral that gives the arc length L of this curve. Do not evaluate the integral.

(b) (6 points) Use Simpson's Rule with $n = 4$ subintervals to approximate L from part (a). Show your work by writing out all of the terms in the approximating sum. You do not need to simplify.

5. Determine whether the following integrals are convergent or divergent. If an integral is convergent, give the value to which it converges. (You do not need to simplify.) Otherwise, prove the integral is divergent.

(a) (9 points)

$$\int_2^\infty x^3 e^{-x^2}\, dx$$

(b) (9 points)

$$\int_{-1}^{1} \frac{e^{2x}}{e^{2x}-1}\,dx$$

6. (a) (10 points) Solve the initial value problem $y' + y't = y - yt$ with $y(0) = 3$.

(b) (4 points) Use the solution to (a) to compute

$$\lim_{t \to \infty} y(t).$$

7. (10 points) A 10 ft chain weighing 2 lb/ft lies on the ground. How much work is done in lifting the chain so that one end is 15 ft off the ground and the rest hangs freely below?

8. (8 points) Evaluate

$$\lim_{n\to\infty} \frac{1}{n} \sum_{j=0}^{n-1} \left(\frac{j}{n}\right)^4.$$

(*Hint*: Riemann sum)