Name: _____

Write all of your responses on these exam pages, use the backs if necessary. Show all your work, answers without supporting justification will not receive credit.

1. (*60 Points*): Find the following integrals. Keep your answer in exact form.

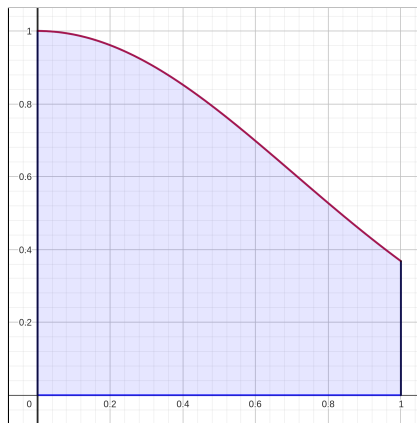   (a) $\displaystyle \int \frac{\sin(\ln(t))}{t}\, dt$

    (b) $\displaystyle \int_{1}^{2} x^5 \ln(x)\, dx$

(c) $\displaystyle\int \frac{x+3}{x^2+6x+5}\, dx$

(d) $\displaystyle\int x\sin(x)\cos(x)\, dx$

(e) $\displaystyle\int_1^\infty \frac{\ln(x)}{x}\, dx$

2. (*60 Points*): Integral Applications

   (a) Find the volume generated by rotating the region bounded by $y = e^{-x^2}$, $y = 0$, $x = 0$ and $x = 1$ about the y-axis.

(b) Find the exact length of the curve, $12x = 4y^3 + 3y^{-1}$, for $1 \le y \le 3$.

3. (*60 Points*): Sequences and Series

    (a) Determine whether the series is convergent or divergent.

$$\sum_{n=1}^{\infty} \frac{(-5)^{2n}}{n^2\, 9^n}$$

    (b) Determine whether the series is absolutely convergent, conditionally convergent, or divergent.

$$\sum_{n=1}^{\infty} \frac{(-1)^n (n+1) 3^n}{2^{2n+1}}$$

(c) Find the radius of convergence and interval of convergence of the series.

$$\sum_{n=0}^{\infty} \frac{2^n(x-3)^n}{\sqrt{n+3}}$$

(d) Find the Maclaurin series for $f(x) = 10^x$ and the associated radius of convergence.

(e) Find the Taylor series of $f(x) = \cos(x)$ at $x = \pi/3$.

4. (*30 Points*): Parametric Equations

    (a) Find dy/dx and d^2y/dx^2 for $x = t^2 + 1$, $y = e^t - 1$. For which values of t is the curve concave upward?

(b) Find the exact length of the curve, $x = t\sin(t)$, $y = t\cos(t)$ for $0 \leq t \leq 4\pi$.