[12] 1. Find the centroid of the region bounded by the curves $y = e^{2x}$, $y = 0$, $x = 0$, $x = \ln 2$.

[7] 2. The curve $y = 1 - x^2$, $0 \leq x \leq 1$ is rotated around the line $y = 2$. Set up, but do not evaluate, an integral for the surface area generated.

[9] 3. (a) Determine the constants A, B, C, D in such a way that:

$$\frac{x^2 + 2x - 1}{(x-1)^2(x^2+1)} = \frac{A}{(x-1)^2} + \frac{B}{x-1} + \frac{C(2x) + D}{x^2+1}$$

[8] (b) Evaluate the following integral by using partial fraction method:

$$\int \frac{x^2 + 2x - 1}{(x-1)^2(x^2+1)}\, dx.$$

4. Determine if each of the following integrals converge or diverge and evaluate the convergent ones.

[8] (a) $\int_{-\infty}^{-3} \frac{1}{x^2+9}\, dx$

[9] (b) $\int_0^1 \frac{\ln x}{\sqrt[3]{x}}\, dx$

[10] 5. Find the length of the arc of $y = \frac{x^2}{2} - \frac{\ln x}{4}$, $1 \leq x \leq 4$.

[7] 6. (a) Evaluate the integral $\int \frac{1}{(3t-1)(t-3)}\, dt$.

[8] (b) Evaluate the integral $\int \frac{1}{3 - 5\sin 2x}\, dx$.

[8] 7. (a) Show that the following reduction formula is valid for any integer $n \geq 2$:

$$\int \sin^n x\, dx = -\frac{1}{n} \cos x \sin^{n-1} x + \frac{n-1}{n} \int \sin^{n-2} x\, dx$$

[6] (b) Use the above recursive formula to evaluate $\int \sin^6 x\, dx$.

[8] (c) Evaluate the following integral by using trigonometric subsitution:

$$\int x^4 \sqrt{9 - x^2}\, dx$$

[8] 8. Use the fact that $x^4 + 4 = x^4 + 4x^2 + 4 - 4x^2 = (x^2 + 2x + 2)(x^2 - 2x + 2)$ to evaluate $\int_0^1 \frac{1}{x^4+4}\, dx$.