[14] 1. Find the centroid of the region bounded by the curves $y = x^2$, $y = 0$, $y = \frac{1}{x^3}$, $x = 2$.

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

[15] 3. Evaluate the following integral by using partial fraction method:

$$\int \frac{x^2 + 10x - 6}{(x-1)^2(x^2+4)}\, dx.$$

[14] 4. Determine if the integral $\int_0^1 \frac{\ln x}{\sqrt[4]{x}}\, dx$ is convergent or divergent and evaluate it if it is convergent.

[15] 5. Evaluate the following integral by using trigonometric subsitution:

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

[13] 6. Evaluate the following integral:

$$\int \frac{2\tan x + 3}{3 + 2\sin 2x}\, dx.$$

[14] 7. Show that the improper integral $\int_1^\infty \frac{\sqrt{x^4+1}}{x^3}\, dx$ is divergent and deduce that the area of the surface obtained by revolving the curve $y = \frac{1}{x}, 1 \leq x$ around the x-axis is infinite.

[8] 8. A torus is formed by rotating a circle of radius r about a line in the plane of the circle that is a distance d $(d > r)$ from the centre of the circle. Find the volume of the torus (use theorem of Pappus).