

1. Evaluate the following integrals:

a.  $\int [5 \cos(10x) - 10 \sin(5x)] dx$

b.  $\int_{-1}^1 (x^3 + 2)^2 dx$

c.  $\int_0^3 (9 + x^2)^{-1} dx$

d.  $\int x^{-1} (\ln x)^{-1} dx$

2. Consider the points  $P(1, 0, -1)$ ,  $Q(2, 4, 5)$ , and  $R(3, 1, 7)$ .

a. Find a vector orthogonal to the plane through the points  $P$ ,  $Q$ , and  $R$ .

b. Find the area of the triangle  $PQR$ .

3. Let  $R$  be the region between the graph of  $\sqrt{x^2 + 1}$  and the interval  $[0, \sqrt{3}]$  on the  $x$ -axis.

a. Determine the volume of the solid generated by revolving  $R$  about the  $x$ -axis.

b. Determine the volume of the solid generated by revolving  $R$  about the  $y$ -axis.

4. a. State the mean value theorem.

b. Suppose  $f$  is continuous for  $0 \leq x \leq 3$  and differentiable for  $0 < x < 3$ , with  $f'(x) \geq 2$  for  $0 < x < 3$ . If  $f(0) \geq 4$ , show that  $f(3) \geq 10$ .

5. a. State the fundamental theorem of calculus.

b. Evaluate  $\frac{d}{dx} \left( \int_x^{x^2} \tan t \, dt \right)$ , when  $|x| < \sqrt{\pi/2}$ .