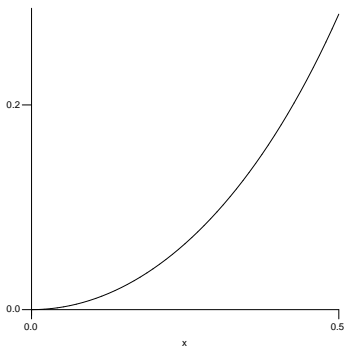
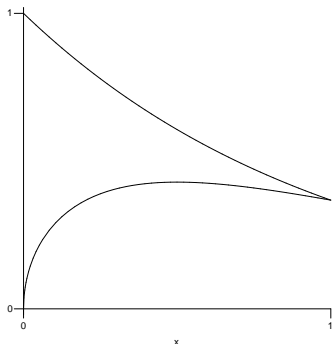


1. Determine the average value of the function $f(x) = x^2 \ln x$ on $1 \leq x \leq 3$.

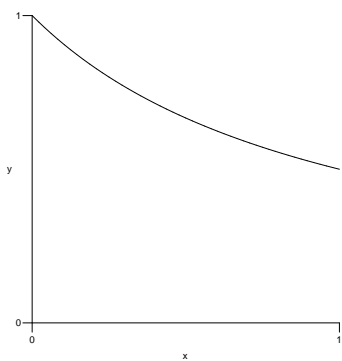
2. Determine the area bounded by the x -axis and the curve $y = \frac{x^2}{\sqrt{1-x^2}}$ on $0 \leq x \leq \frac{1}{2}$.



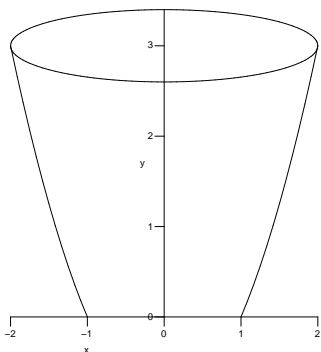
3. Determine the volume of the solid generated by rotating about the x -axis the region in the first quadrant bounded by the functions $f(x) = \sqrt{x} e^{-x}$ and $y = e^{-x}$ on $0 \leq x \leq 1$.



4. Determine the volume of the solid generated by rotating about the y -axis the region bounded by the y -axis, the x -axis, $x = 1$ and the function $f(x) = \frac{3}{x^2 + 5x + 4}$.



5. Determine the work to empty a bowl filled with water (62.4 lb/ft^3) out of the top if the bowl fits the rotated parabola $y = x^2 - 1$ for $1 \leq x \leq 2$ in feet.



6. Evaluate the integral if it converges. If it diverges, show the diverging limit.

(a) $\int_3^5 \frac{4x}{x^2 - 9} dx$

(b) $\int_3^5 \frac{4x}{\sqrt{x^2 - 9}} dx$

(c) $\int_{10}^{\infty} \frac{4}{(x - 9)^2} dx$

7. Vector Fundamentals

- (a) Determine the unit vector in the direction of the given vector:

$$\vec{w} = 7\vec{i} + \vec{j} - 4\vec{k} \quad \underline{\hspace{10em}}$$

- (b) Determine the scalar projection of $\vec{F} = \langle 3, 6 \rangle$ onto $\vec{d} = \langle 8, 4 \rangle$.

- (c) Determine the angle θ (in degrees) between the vectors $\vec{v} = \langle 0, 7, 1 \rangle$ and $\vec{w} = \langle 2, 2, 1 \rangle$.

- (d) Determine the vector equation of the line passing through points $P(1, 2, 3)$ and $Q(2, 1, -1)$.

- (e) Determine the volume of the parallelepiped formed by the vectors $\vec{a} = \langle 2, 3, -1 \rangle$, $\vec{b} = \langle 5, 1, 2 \rangle$ and $\vec{c} = \langle -1, 3, 7 \rangle$.

8. For what value(s) of a are the vectors $\langle a^2, -1, 3 \rangle$ and $\langle 2, a, -5 \rangle$ orthogonal (perpendicular)?

9. Determine the area of the parallelogram formed by the vectors $\vec{v} = \langle 2, 2, 1 \rangle$ and $\vec{w} = \langle -1, 5, 2 \rangle$

10. Determine the equation of the plane that contains the vectors $\vec{v} = \langle 4, 2, -1 \rangle$ and $\vec{w} = \langle 1, 3, -3 \rangle$ and contains the point $P(2, 3, -5)$.

Identities

$$\cos^2 x + \sin^2 x = 1$$

$$\cot^2 x + 1 = \csc^2 x$$

$$\tan^2 x + 1 = \sec^2 x$$

$$\sin(2x) = 2 \sin x \cos x$$

$$\cos(2x) = \cos^2 x - \sin^2 x$$