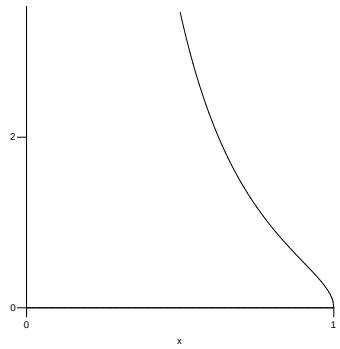
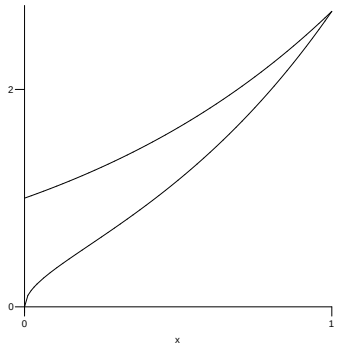
1. Determine the average value of the function $f(x) = x^3 \ln x$ on $1 \leq x \leq 10$.

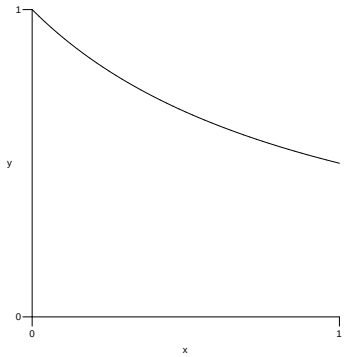
2. Determine the area bounded by the x-axis and the curve $y = \dfrac{\sqrt{1-x^2}}{x^2}$ on $\dfrac{1}{2} \leq x \leq 1$.



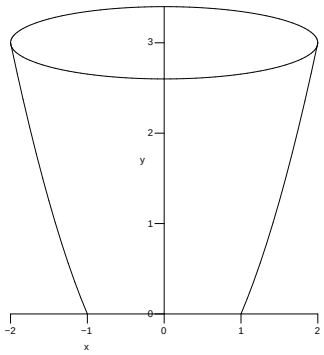
3. Determine the volume of the solid generated by rotating about the x-axis the region in the first quadrant bounded by the functions $f(x) = \sqrt{x}\, e^x$ and $y = e^x$ on $0 \leq x \leq 1$.



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 $f(x) = \dfrac{3}{x^2 + 5x + 4}$.



5. Determine the work to emty 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) $\displaystyle\int_2^\infty \frac{3}{(x-1)^2}\,dx$

(b) $\displaystyle\int_1^2 \frac{x}{x^2-1}\,dx$

(c) $\displaystyle\int_1^2 \frac{3x}{\sqrt{x^2-1}}\,dx$

7. Vector Fundamentals

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

$\vec{w} = 2\vec{i} - 5\vec{j} + 8\vec{k}$ _____

(b) Determine the scalar projection of $\vec{F} = \langle 4, 7 \rangle$ onto $\vec{d} = \langle 9, 2 \rangle$.

(c) Determine the angle θ (in degrees) between the vectors $\vec{v} = \langle -1, 7, 0 \rangle$ and $\vec{w} = \langle 3, 4, 5 \rangle$.

(d) Determine the vector equation of the line passing through points $P(-2, 4, 1)$ and $Q(3, 3, 3)$.

(e) Determine the volume of the parallelopiped formed by the vectors $\vec{a} = \langle 2, -4, 1 \rangle$, $\vec{b} = \langle 5, -1, 4 \rangle$ and $\vec{c} = \langle 1, 3, 8 \rangle$.

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 $\vec{v} = \langle 1, 1, 4\rangle$ and $\vec{w} = \langle -2, 3, 2\rangle$

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