1. \((20\text{ points})\) Calculate the following definite or indefinite integrals.

(a) \(\int_{2/\sqrt{3}}^{\sqrt{2}} \frac{dx}{x\sqrt{x^2 - 1}}\)

(b) \(\int_{0}^{2} \frac{dx}{x^2 + 4}\)

(c) \(\int \frac{1 + x}{\sqrt{1 - x^2}} \, dx\)

(d) \(\int \frac{\tan^{-1} x}{x^2 + 1} \, dx\)

(e) \(\int_{0}^{3} \frac{x}{x^2 + 9} \, dx\)

2. \((10\text{ points})\) Evaluate the following limits.

(a) \(\lim_{x\to 4} \left[ \frac{1}{\sqrt{x} - 2} - \frac{4}{x - 4} \right]\)

(b) \(\lim_{x\to 1} \frac{e^x - e}{\ln x}\)

(c) \(\lim_{x\to 0^+} \sqrt{x} \ln x\)

(d) \(\lim_{t\to \infty} \frac{\ln(t + 2)}{\log_2 t}\)

3. \((10\text{ points})\) Let \(f(x) = x^{1/x}\) be a function in the domain \(x > 0\). Find

\[
\lim_{x\to 0^+} f(x) \quad \text{and} \quad \lim_{x\to \infty} f(x).
\]

Find the critical points of \(f(x)\) and determine the local extrema for \(f(x)\). Suppose we know that

\[
\lim_{x\to 0^+} f'(x) = 0,
\]

sketch the graph of \(y = f(x)\) in its domain.

4. \((10\text{ points})\) A painting of length \(b\) is located at a height \(h\) above eye level. Find the distance \(x\) at which the viewing angle \(\theta\) is maximized.