1. Evaluate the improper integrals

$$(a)\ \int_{-8}^{1} \frac{1}{x^{1/3}}\,dx \qquad (b)\ \int_{-\infty}^{0} xe^{x}\,dx \qquad (c)\ \int_{0}^{1} x\ln x\,dx$$

$$(d)\ \int_{-\infty}^{\infty} 2xe^{-x^2}\,dx \qquad (e)\ \int_{-1}^{4} \frac{1}{\sqrt{|x|}}\,dx \qquad (f)\ \int_{0}^{2} \frac{1}{\sqrt{|x-1|}}\,dx$$

2. Use integration, the Direct Comparison Test, or the Limit Comparison Test to test the integrals for convergence

$$(a)\ \int_{0}^{1} \frac{e^{-\sqrt{x}}}{\sqrt{x}}\,dx \qquad (b)\ \int_{1}^{\infty} \frac{\sqrt{x+1}}{x^2}\,dx \qquad (c)\ \int_{\pi}^{\infty} \frac{2+\cos x}{x}\,dx$$

$$(d)\ \int_{\pi}^{\infty} \frac{1+\sin x}{x^2}\,dx \qquad (e)\ \int_{1}^{\infty} \frac{e^{x}}{x}\,dx \qquad (f)\ \int_{-\infty}^{\infty} \frac{1}{\sqrt{x^4+1}}\,dx$$

3. An example for $\int_{-\infty}^{\infty} f(x)\,dx$ may not equal to $\lim_{b\to\infty}\int_{-b}^{b} f(x)\,dx$.
Show that

$$\int_{0}^{\infty} \frac{2x}{x^2+1}\,dx$$

diverges and hence that

$$\int_{-\infty}^{\infty} \frac{2x}{x^2+1}\,dx$$

diverges. Then show that

$$\lim_{b\to\infty}\int_{-b}^{b} \frac{2x}{x^2+1}\,dx = 0.$$