

1. Evaluate the following integrals:

(a) $\int \sec^3 x \tan^3 x \, dx$

(b) $\int \frac{x^2}{x^2 + 9} \, dx$

(c) $\int \frac{x^2}{\sqrt{9 - x^2}} \, dx$

(d) $\int \frac{x^2}{\sqrt{x^2 - 9}} \, dx$

(e) $\int \frac{3x}{x^2 - 3x - 4} \, dx$

(f) $\int \frac{x^3 + x + 2}{x^2 + 2x - 8} \, dx$

(g) $\int \frac{3x + 8}{x^3 + 5x^2 + 6x} \, dx$

(h) $\int \frac{x + 2}{x^3 + x} \, dx$

(i) $\int \frac{4}{x^2 + 2x + 10} \, dx$

(j) $\int \frac{4}{(x^2 + 2x + 10)^{\frac{3}{2}}} \, dx$

(k) $\int \frac{3x - 1}{\sqrt{12 - 4x - x^2}} \, dx$

(l) $\int \frac{3x + 5}{\sqrt{3x + 1}} \, dx$

(m) $\int \frac{x^2}{(3x + 4)^{10}} \, dx$

(n) $\int \frac{1}{\sqrt[4]{x} + \sqrt[3]{x}} \, dx$

(o) $\int_0^1 x^{-\frac{1}{3}} \, dx$

(p) $\int_1^\infty x^{-\frac{1}{3}} \, dx$

(q) $\int_0^2 \frac{x}{\sqrt{4 - x^2}} \, dx$

(r) $\int_0^2 \frac{1}{\sqrt{4 - x^2}} \, dx$

(s) $\int_0^2 \frac{1}{4 - x^2} \, dx$

(t) $\int_{-\infty}^\infty \frac{1}{\sqrt[3]{x}} \, dx$

2. Find each limit, (if it exists).

(a) $\lim_{x \rightarrow 1} \frac{\sin(\pi x)}{x - 1}$

(b) $\lim_{x \rightarrow 1} \frac{e^{x-1} - 1}{x^2 - 1}$

(c) $\lim_{x \rightarrow \infty} \frac{\ln x}{\sqrt{x}}$

(d) $\lim_{x \rightarrow \infty} x \sin\left(\frac{1}{x}\right)$

(e) $\lim_{x \rightarrow 0} \frac{x \sin x}{\cos x - 1}$

(f) $\lim_{x \rightarrow \infty} \left(\sqrt{x^2 + 1} - x\right)$

(g) $\lim_{x \rightarrow 0} \frac{\sin x}{\cos x}$

(h) $\lim_{x \rightarrow \infty} \left(\frac{1}{x}\right)^{\frac{1}{x}}$

(i) $\lim_{x \rightarrow 0^+} (\cos x)^{\frac{1}{x}}$

3. Use a comparison to determine whether the following integrals converge or diverge:

(a) $\int_1^{\infty} \frac{x}{1 + x^3} dx$

(b) $\int \frac{2 + \sin x}{\sqrt{x}} dx$

(c) $\int_2^{\infty} \frac{x}{x^{\frac{3}{2}} - 1} dx$

(d) $\int_0^{\infty} \frac{\sin^2 x}{1 + e^x} dx$