$$\lim_{x\to\pi} \frac{\cos x+1}{(x-\pi)^2} = \frac{0}{0} = \lim_{x\to\pi} \frac{-\sin x}{2(x-\pi)} = \frac{0}{0}$$

$$= \lim_{x\to\pi} \frac{-\cos x}{2}$$

$$= \boxed{\frac{1}{2}}$$

$$\lim_{x\to 0} \frac{\sin x - x}{7x^3} = \frac{0}{0} = \lim_{x\to 0} \frac{\cos x - 1}{21x^2} = \frac{0}{0}$$

$$= \lim_{x\to 0} \frac{-\sin x}{42x} = \frac{0}{0}$$

$$= \lim_{x\to 0} \frac{-\cos x}{42}$$

$$= \boxed{\frac{-1}{42}}$$

$$\lim_{x\to\infty} \frac{\tan^{-1}x - \pi/2}{1/x} = \frac{0}{0} = \lim_{x\to\infty} \frac{\frac{1}{1+x^2}}{-1/x^2}$$

$$= \lim_{x\to\infty} -\frac{x^2}{1+x^2}$$

$$= \boxed{-1}$$

$$\lim_{x\to 3} \frac{x-1-\sqrt{x^2-5}}{x-3} = \frac{2-2}{0} = \frac{0}{0}$$

$$= \lim_{x\to 3} \frac{1-\frac{x}{\sqrt{x^2-5}}}{1}$$

$$= 1 - \frac{3}{2}$$

$$= \boxed{-\frac{1}{2}}$$

$$\lim_{y\to 2} \frac{y^2+y-6}{\sqrt{8-y^2}-y} = \frac{0}{0} = \lim_{y\to 2} \frac{2y+1}{\frac{-y}{\sqrt{8-y^2}}-1}$$

$$= \frac{5}{-1-1} = \boxed{-\frac{5}{2}}$$

$$\lim_{x\to 2} \frac{x^2-4x+4}{\sin^2 \pi x} = \frac{0}{0} = \lim_{x\to 2} \frac{2x-4}{2\pi \sin \pi x \cos \pi x}$$

$$= \lim_{x\to 2} \frac{2x-4}{\pi \sin 2\pi x} = \frac{0}{0}$$

$$= \lim \frac{2}{2\pi^2 \cos 2\pi x}$$

$$= \boxed{\frac{1}{\pi^2}}$$

$$\lim_{x\to 2} \frac{(3x+2)^{1/3}-2}{x-2} = \frac{2-2}{0} = \frac{0}{0}$$

$$= \lim_{x\to 2} \frac{(3x-2)^{-2/3}}{1}$$

$$= 8^{-2/3}$$

$$= \boxed{\frac{1}{4}}$$

$$\lim_{x\to \infty} \frac{3x^4-x^2}{6x^4+12} = \frac{3}{6} = \boxed{\frac{1}{2}}$$

$$\lim_{x\to \infty} \frac{4x^3-2x^2+6}{\pi x^3+4} = \boxed{\frac{4}{\pi}}$$

$$\lim_{x\to \frac{\pi}{2}^-} \frac{\tan x}{3/(2x-\pi)} = \frac{\infty}{\infty} = \lim_{x\to \frac{\pi}{2}} \frac{\sec^2 x}{\frac{-6}{(2x-\pi)^2}}$$

$$= \lim_{x\to \frac{\pi}{2}^-} \left(-\frac{1}{6}\right) \frac{(2x-\pi)^2}{\cos^2 x} = \frac{0}{0}$$

$$= -\frac{1}{6} \lim_{x\to \frac{\pi}{2}^-} \frac{4(2x-\pi)}{-\sin 2x} = \frac{0}{0}$$

$$= \frac{2}{3} \lim_{x\to \frac{\pi}{2}^-} \frac{2}{2\cos 2x}$$

$$= \boxed{\frac{-2}{3}}$$

$$\lim_{x\to\infty} x\ln\left(1+\frac{1}{x}\right) = \lim_{x\to\infty} \frac{\ln\left(1+\frac{1}{x}\right)}{1/x} = \frac{0}{0}$$

$$= \lim_{x\to\infty} \frac{-1/x^2}{1+\frac{1}{x}} \cdot \frac{1}{-1/x^2}$$

$$= \lim_{x\to\infty} \frac{x}{x+1}$$

$$= \underline{1}$$

$$\lim_{x\to\frac{\pi}{2}^-} \left(\frac{\pi}{2}-x\right)\sec x = \lim_{x\to\frac{\pi}{2}^-} \frac{\frac{\pi}{2}-x}{\cos x} = \frac{0}{0}$$

$$= \lim_{x\to\frac{\pi}{2}^-} \frac{-1}{-\sin x}$$

$$= \underline{1}$$

$$\lim_{x\to\infty} \frac{e^{1/x}-1}{\sin\frac{1}{x}} = \frac{1-1}{0} = \frac{0}{0} = \lim_{x\to\infty} \frac{-\frac{1}{x^2}e^{1/x}}{-\frac{1}{x^2}\cos\frac{1}{x}}$$

$$= \lim_{x\to\infty} \frac{e^{1/x}}{\cos 1/x} = \frac{1}{1}$$

$$= \underline{1}$$

$$\lim_{x\to 0^+} \sin x\sqrt{\frac{1-x}{x}} = \lim_{x\to 0} \sin x\sqrt{\frac{x(1-x)}{x^2}}$$

$$= \lim_{x\to 0} \frac{\sin x}{x} \lim_{x\to 0} \sqrt{x(1-x)}$$

$$= 1 \cdot 0$$

$$= \underline{0}$$

$$\lim_{x\to 0}\left(\cot x - \frac{1}{x}\right) = \lim_{x\to 0}\left(\frac{\cos x}{\sin x} - \frac{1}{x}\right)$$

$$= \lim_{x\to 0}\left(\frac{x\cos x - \sin x}{x\sin x}\right) = \frac{0}{0}$$

$$= \lim_{x\to 0}\left(\frac{\cos x - x\sin x - \cos x}{\sin x + x\cos x}\right)$$

$$= \lim_{x\to 0}\frac{-x\sin x}{\sin x + x\cos x} = \frac{0}{0}$$

$$= \lim_{x\to 0}\frac{-\sin x - x\cos x}{\cos x + \cos x - x\sin x}$$

$$= -\frac{0}{2}$$

$$= 0$$

$$\lim_{x\to\infty}\left(x - \sqrt{x^2+1}\right) = \infty - \infty = \lim_{x\to\infty} x\left(1 - \sqrt{1+\frac{1}{x^2}}\right)$$

$$= \lim_{t\to 0}\frac{1-\sqrt{1+t^2}}{t} = \frac{0}{0} \qquad t = \frac{1}{x}$$

$$= \lim_{t\to 0}\frac{-t(1+t^2)^{-1/2}}{1}$$

$$= 0$$

or $\lim\left(1 - \frac{x}{\sqrt{x^2+1}}\right) = 1 - 1 = 0$

$$\lim_{\theta\to\frac{\pi}{2}^-}(\tan\theta - \sec\theta) = \infty - \infty = \lim_{\theta\to\frac{\pi}{2}^-}\left(\frac{\sin\theta}{\cos\theta} - \frac{1}{\cos\theta}\right)$$

$$= \lim_{\theta\to\frac{\pi}{2}^-}\left(\frac{\sin\theta - 1}{\cos\theta}\right) = \frac{0}{0}$$

$$= \lim_{\theta\to\frac{\pi}{2}^-}\frac{\cos\theta}{-\sin\theta} = \frac{0}{-1}$$

$$= 0$$

$$\lim_{x\to 0^+} \ln x^{2x} = \lim_{x\to 0} 2x\ln x$$
$$= 2\lim_{x\to 0} \frac{\ln x}{1/x} = \frac{\infty}{\infty}$$
$$= 2\lim_{x\to 0} \frac{1/x}{-1/x^2}$$
$$= -2\lim_{x\to 0} x$$
$$= \underline{0}|$$

$$\lim_{x\to 0} \ln(1+4x)^{3/x} = 3\lim_{x\to 0} \frac{\ln(1+4x)}{x}$$
$$= 3\lim_{x\to 0} \frac{\frac{4}{1+4x}}{1}$$
$$= \underline{12}|$$

$$\lim_{\theta\to \frac{\pi}{2}^-} \ln(\tan\theta)^{\cos\theta} = \lim_{\theta\to \frac{\pi}{2}^-} \cos\theta \ln(\tan\theta)$$
$$= \lim_{\theta\to \frac{\pi}{2}^-} \frac{\ln(\tan\theta)}{\sec\theta}$$
$$= \lim_{\theta\to \frac{\pi}{2}^-} \frac{\sec^2\theta/\tan\theta}{\sec\theta\tan\theta}$$
$$= \lim_{\theta\to \frac{\pi}{2}^-} \frac{\sec\theta}{\tan^2\theta}$$
$$= \frac{0}{\infty}$$
$$= \underline{0}|$$

$$\lim_{x\to 0^+}(1+x)^{\cot x} = e^L$$

$$L = \lim_{x\to 0} \ln(1+x)^{\cot x}$$
$$= \lim_{x\to 0} \cot x \ln(1+x)$$
$$= \lim_{x\to 0} \frac{\ln(1+x)}{\tan x} = \frac{0}{0}$$
$$= \lim_{x\to 0} \frac{\frac{1}{1+x}}{\sec^2 x} = 1$$

$$\lim_{x\to 0}(1+x)^{\cot x} = e^1 = \underline{e}$$

$$\lim_{x\to\infty}\left(1+\frac{1}{x}\right)^{\ln x} = e^L$$

$$L = \lim_{x\to\infty} \ln\left(1+\frac{1}{x}\right)^{\ln x}$$
$$= \lim_{x\to\infty} (\ln x)\ln\left(1+\frac{1}{x}\right)$$
$$= \lim_{x\to\infty} \frac{\ln(1+1/x)}{1/\ln x}$$
$$= \lim_{x\to\infty} \frac{-1/x^2}{1+\frac{1}{x}} \frac{1}{\frac{-1}{(\ln x)^2}\cdot\frac{1}{x}} \qquad \frac{x+1}{x} \quad \frac{1}{x}$$
$$= \lim_{x\to\infty} \frac{(\ln x)^2}{x+1}$$
$$= \lim_{x\to\infty} 2(\ln x)\frac{1}{x} = 2\lim_{x\to\infty}\frac{1/x}{1}$$
$$= 0$$

$$\lim_{x\to\infty}\left(1+\frac{1}{x}\right)^{\ln x} = e^0 = \underline{1}$$

$$\lim_{x\to\infty}\left(1+\frac{a}{x}\right)^x = e^L$$

$$L = \lim_{x\to\infty} x \ln\left(1+\frac{a}{x}\right)$$

$$= \lim_{x\to\infty} \frac{\ln(1+a/x)}{1/x} = \frac{0}{0}$$

$$= \lim_{x\to\infty} \frac{-a/x^2}{1+\frac{a}{x}} \cdot \frac{1}{-1/x^2}$$

$$= \lim_{x\to\infty} \frac{a}{1+a/x}$$

$$= a$$

$$\lim_{x\to\infty}\left(1+\frac{a}{x}\right)^x = \underline{e^a}$$

$$\lim_{x\to 0}\left(e^{5x}+x\right)^{1/x} = e^L$$

$$\lim_{x\to 0} \ln\left(e^{5x}+x\right)^{1/x} = \lim_{x\to 0} \frac{\ln(e^{5x}+x)}{x}$$

$$= \lim_{x\to 0} \frac{5e^{5x}+1}{e^{5x}+x} \cdot \frac{1}{1}$$

$$= \frac{6}{1} = 6$$

$$\lim_{x\to 0}\left(e^{5x}+x\right)^{1/x} = \underline{e^6}$$

$$\lim_{x\to 0}\left(e^{ax}+x\right)^{1/x} = e^L$$

$$\lim_{x\to 0} \ln\left(e^{ax}+x\right)^{1/x} = \lim_{x\to 0} \frac{\ln(e^{ax}+x)}{x}$$

$$= \lim_{x\to 0} \frac{ae^{x}+1}{e^{ax}+x} \quad \frac{1}{1}$$

$$= a+1$$

$$\lim_{x\to 0}\left(e^{ax}+x\right)^{1/x} = e^{a+1}$$

$$\lim_{x\to 0} (2^{ax}+x)^{1/x} = e^L$$

$$\lim_{x\to 0} \ln(2^{ax}+x)^{1/x} = \lim_{x\to 0} \frac{\ln(2^{ax}+x)}{x}$$

$$= \lim_{x\to 0} \frac{a2^{ax}\ln 2+1}{2^{ax}+x} \cdot \frac{1}{1}$$

$$= a\ln 2 + 1$$

$$\lim_{x\to 0}(2^{ax}+x)^{1/x} = e^{1+a\ln 2}$$

$$= e\, e^{a\ln 2}$$

$$= e \cdot 2^a$$

$$\lim_{x\to 0^+} (\tan x)^x = e^L$$

$$L = \lim_{x\to 0} \ln(\tan x)^x$$

$$= \lim_{x\to 0} x \ln \tan x$$

$$= \lim_{x\to 0} \frac{\ln \tan x}{1/x}$$

$$= \lim_{x\to 0} \frac{\sec^2 x}{\tan x} \cdot \frac{1}{-1/x^2}$$

$$= \lim_{x\to 0} \frac{-x^2}{\sin x \cos x}$$

$$= -\lim_{x\to 0} \frac{x}{\sin x} \cdot \lim_{x\to 0} \frac{x}{\cos x}$$

$$= -1 \cdot 0$$

$$= 0$$

$$\lim_{x\to 0^+} (\tan x)^x = e^0 = 1$$