

$$\begin{aligned} \textcircled{1} \quad & \lim_{x \rightarrow 1} \frac{x^2 + 3x + 10}{x^2 - 4} \\ &= \lim_{x \rightarrow 1} \frac{(x+5)(x-2)}{(x-2)(x+2)} \\ &= 2 \end{aligned}$$

$$\begin{aligned} \textcircled{2} \quad & \lim_{h \rightarrow 0} \frac{3h + 4h^2}{h^2 - h^3} \\ &= \lim_{h \rightarrow 0} \frac{h(3 + 4h)}{h^2(h-1)} \\ &= \lim_{h \rightarrow 0} \frac{3 + 4h}{h(h-1)} \\ & \text{DNE infinite discontinuity.} \end{aligned}$$

$$\textcircled{3} \quad \lim_{x \rightarrow \pi} \left( \frac{(x - \pi)^2}{\pi x^2} \right)$$

substitution works!

$$\begin{aligned} & \frac{(\pi - \pi)^2}{\pi(\pi)^2} \\ &= 0 \end{aligned}$$

$$\textcircled{4} \quad \lim_{x \rightarrow 2} \frac{\sqrt{4 - 4x + x^2}}{x - 2}$$

$$\lim_{x \rightarrow 2} \frac{\sqrt{(x-2)^2}}{x-2}$$

$$\lim_{x \rightarrow 2} \frac{|x-2|}{x-2}$$

$$\text{DNE} \quad \lim_{x \rightarrow 2^+} \frac{x-2}{x-2} = 1$$

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

Jump discontinuity

⑤

$$\begin{aligned} & \lim_{x \rightarrow 0} \left( \frac{x}{\sqrt{4+x} - \sqrt{4-x}} \right) \cdot \left( \frac{\sqrt{4+x} + \sqrt{4-x}}{\sqrt{4+x} + \sqrt{4-x}} \right) \\ &= \lim_{x \rightarrow 0} \frac{x(\sqrt{4+x} + \sqrt{4-x})}{4+x - (4-x)} \\ &= 4 \end{aligned}$$

$$\begin{aligned} \textcircled{6} \quad & \lim_{x \rightarrow 0} \frac{x^2 + 3x}{(x+2)^2 - (x-2)^2} \\ &= \lim_{x \rightarrow 0} \frac{x(x+3)}{x^2 + 4x + 4 - (x^2 - 4x + 4)} \\ &= \lim_{x \rightarrow 0} \frac{x(x+3)}{8x} \\ &= \frac{3}{8} \end{aligned}$$

$$\begin{aligned} \textcircled{7} \quad & \lim_{x \rightarrow 1} \frac{x^2 - 1}{\sqrt{x+3} - 2} \cdot \frac{\sqrt{x+3} + 2}{\sqrt{x+3} + 2} \\ &= \lim_{x \rightarrow 1} \frac{(x-1)(x+1)(\sqrt{x+3} + 2)}{x+3 - 4} \end{aligned}$$

$$= 2(4)$$

$$= 8$$

$$(8) \lim_{x \rightarrow 0} x(\cos x) \quad \text{Substitute!}$$

$$= 0(1)$$

$$= 0$$

$$(9) \lim_{x \rightarrow 2} \frac{\sqrt{x-1} - 1}{x-2} \cdot \frac{\sqrt{x-1} + 1}{\sqrt{x-1} + 1}$$

$$\lim_{x \rightarrow 2} \frac{\cancel{x-1} - 1}{(x-2)(\sqrt{x-1} + 1)}$$

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

$$(10) \lim_{x \rightarrow 0} \frac{3^{2x} - 1}{3^x - 1} \quad \rightarrow \text{dif. of squares}$$

$$\lim_{x \rightarrow 0} \frac{(3^x - 1)(3^x + 1)}{3^x - 1}$$

$$= 2$$

$$(11) \lim_{x \rightarrow 0} \frac{\frac{1}{x+2} + \frac{1}{x-1}}{x}$$

$$\lim_{x \rightarrow 0} \frac{x-1 + x+2}{(x+2)(x-1)x}$$

$$\lim_{x \rightarrow 0} \frac{2x+1}{(x+2)(x-1)x}$$

DNE infinite discontinuity

$$(12) \lim_{x \rightarrow 3} \frac{\frac{1}{x} - \frac{1}{3}}{x-3} \cdot \frac{3x}{3x}$$

$$\lim_{x \rightarrow 3} \frac{3-x}{(x-3)(3x)}$$

$$\lim_{x \rightarrow 3} \frac{-1}{3x}$$

$$= -\frac{1}{9}$$