

Calculus I

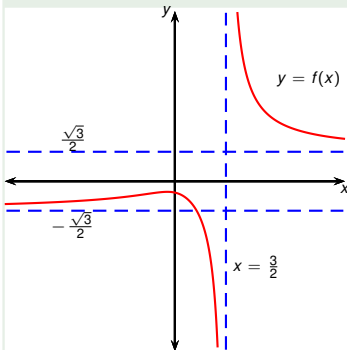
Type 2: $\lim_{x \rightarrow \pm\infty}$ involving radicals.

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2019

Example

Find the horizontal and vertical asymptotes of $f(x) = \frac{\sqrt{3x^2+1}}{2x-3}$.



If $x > 0$ then $x = \sqrt{x^2}$.
If $x < 0$ then $x = -\sqrt{x^2}$.

Vertical Asymptote:

$$x = \frac{3}{2}.$$

$$\lim_{x \rightarrow \infty} \frac{\sqrt{3x^2+1}}{2x-3} \cdot \frac{\frac{1}{x}}{\frac{1}{x}} = \lim_{x \rightarrow \infty} \frac{\sqrt{3x^2+1}}{2x-3} \cdot \frac{1}{\frac{1}{\sqrt{x^2}}}$$

$$= \lim_{x \rightarrow \infty} \frac{\sqrt{3 + \frac{1}{x^2}}}{2 - \frac{3}{x}} = \frac{\sqrt{\lim_{x \rightarrow \infty} 3 + \lim_{x \rightarrow \infty} \frac{1}{x^2}}}{\lim_{x \rightarrow \infty} 2 - 3 \lim_{x \rightarrow \infty} \frac{1}{x}}$$

$$= \frac{\sqrt{3+0}}{2-0} = \frac{\sqrt{3}}{2}$$

$$\lim_{x \rightarrow -\infty} \frac{\sqrt{3x^2+1}}{2x-3} \cdot \frac{\frac{1}{x}}{\frac{1}{x}} = \lim_{x \rightarrow -\infty} \frac{\sqrt{3x^2+1}}{2x-3} \cdot \frac{-1}{\frac{1}{\sqrt{x^2}}}$$

$$= \lim_{x \rightarrow -\infty} -\frac{\sqrt{3 + \frac{1}{x^2}}}{2 - \frac{3}{x}} = -\frac{\sqrt{3}}{2}$$