1) Find \( \lim_{x \to \pi} \tan(x) \)

\[
\lim_{x \to \pi} \tan(x) = 0
\]

\[
\lim_{x \to 0} e^x = 1
\]

\[
\lim_{x \to \pi} e^\tan(x) = 1
\]

(over)
2) Find the horizontal and vertical asymptotes of
\[ f(x) = \frac{x + 2}{\sqrt{9x^2 - 27}} \]

**Horizontal**

\[
\lim_{x \to -\infty} f(x) = \lim_{x \to -\infty} \frac{x^2}{\sqrt{9x^2 - 27}}
\]

\[
= \lim_{x \to -\infty} \frac{\frac{x^2}{x^2}}{\sqrt{9 - \frac{27}{x^2}}}
\]

\[
= \lim_{x \to -\infty} \frac{1}{\sqrt{9 - \frac{27}{x^2}}}
\]

\[
= \frac{1}{\sqrt{9 - 0}} = \frac{1}{3}
\]

1. Divide by highest power of \( x \) in denominator
2. Use \( x = \sqrt{a} \) for \( x > 0 \), simplify numerator
3. Use the fact that \( \frac{\sqrt{a}}{\sqrt{b}} = \sqrt{\frac{a}{b}} \)
4. Simplify \( \sqrt{ } \)
5. Use limit laws

\[
\lim_{x \to +\infty} f(x) = \lim_{x \to +\infty} \frac{x^2}{\sqrt{9x^2 - 27}}
\]

\[
= \lim_{x \to +\infty} \frac{\frac{x^2}{x^2}}{\sqrt{9 - \frac{27}{x^2}}}
\]

\[
= \lim_{x \to +\infty} \frac{1}{\sqrt{9 - \frac{27}{x^2}}}
\]

\[
= \lim_{x \to +\infty} \frac{1}{\sqrt{9 - 0}} = \frac{1}{3}
\]

Note: all steps are the same as above except that \( x = -\sqrt{a} \) for \( x < 0 \)

**Vertical**

Find \( x \) where denominator goes to 0
\[ \sqrt{9x^2 - 27} = 0 \Rightarrow 9x^2 - 27 = 0 \Rightarrow 9x^2 = 27 \Rightarrow x^2 = 3 \Rightarrow x = \pm \sqrt{3} \]

Taking \( \lim_{x \to \sqrt{3}} f(x) \) and \( \lim_{x \to -\sqrt{3}} f(x) \), we get something non-zero on top and zero on bottom. So, these must be vertical asymptotes. Since \( f(x) \) is not defined from \( -\sqrt{3} \) to \( \sqrt{3} \), we only need to look at \( \lim_{x \to -\sqrt{3}} \) and \( \lim_{x \to \sqrt{3}} \). As we approach \( -\sqrt{3} \) from the left, the top and bottom are both > 0, so \( \lim_{x \to -\sqrt{3}} f(x) = +\infty \). So, \( x = \pm \sqrt{3} \) are vertical asymptotes.