

$$-1 \leq \cos\left(\frac{1}{x}\right) \leq 1$$

$$-\frac{1}{x} \leq \frac{1}{x} \cos\left(\frac{1}{x}\right) \leq \frac{1}{x}$$

take $\lim_{x \rightarrow 0}$

$$-\infty \leq \frac{1}{x} \cos\left(\frac{1}{x}\right) \leq \infty$$

oscillating infinitely