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$$|R_n(x)| = \frac{\left(\frac{2}{\pi}\right)^{4n} |x|^{2n}}{2n!} < 10^{-5} \longrightarrow [-1, 1]$$

$$|R_n(x)| = \frac{\left(\frac{2}{\pi}\right)^{4n} |-1|^{2n}}{2n!} = \left(\frac{2}{\pi}\right)^{4n} \frac{1}{2n!} < 10^{-5}$$

$$\longrightarrow \approx \frac{\left(\frac{2}{\pi}\right)!}{2n!} < 10^{-5} \longrightarrow n! \lesssim \left(\frac{2}{\pi}\right)! \cdot 10^5$$

$$\boxed{n \leq 10^5}$$