$f(x) = \ln x$

$f'(x) = \frac{1}{x} = x^{-1}$

$f''(x) = -x^{-2}$

$f'''(x) = 2x^{-3}$

$f^{(4)}(x) = -3(2)x^{-4}$

$f^{(5)}(x) = 4(3)(2)x^{-5}$

$\vdots$

$f^{(n)}(x) = (-1)^{n+1}\frac{(n-1)!}{x^n}$

So $|f^{(n+1)}(x)| = \frac{n!}{x^{n+1}}$. On interval $[1, 1.2]$, $|f^{(n+1)}(x)| \leq n!$

So on $[1, 1.2]$, $|R_n(x)| \leq \frac{n!}{(n+1)!}|x-1|^{n+1} = \frac{1}{n+1}|x-1|^{n+1}$.

So $|R_n(1.2)| \leq \frac{(0.2)^{n+1}}{n+1} = \frac{1}{(n+1)5^{n+1}}$

We want $\frac{1}{(n+1)5^{n+1}} \leq 0.0005$

$$(n+1)5^{n+1} \geq 2000$$

$n=2$: $3 \cdot 5^3 = 3 \cdot 125 < 2000$

$n=3$: $4 \cdot 5^4 = 4 \cdot 625 > 2000$

So $n=3$.