2.58

$n=1$ $\quad \frac{1}{2}\tan\frac{x}{2} = \frac{1}{2}\cot\frac{x}{2} - \cot x$

$$\frac{1}{2}\tan\frac{x}{2} - \frac{1}{2}\cot\frac{x}{2} = -\cot x$$

$$\frac{1}{2}\left(\frac{\sin\frac{x}{2}}{\cos\frac{x}{2}} - \frac{\cos\frac{x}{2}}{\sin\frac{x}{2}}\right) =$$

$$\frac{1}{2}\;\frac{\sin^2\frac{x}{2} - \cos^2\frac{x}{2}}{\cos\frac{x}{2}\sin\frac{x}{2}} =$$

$$\frac{1}{2}\left(-\frac{\cos x}{0.5\sin x}\right) = -\cot x$$

$n=k+1$ $\quad \underbrace{\frac{1}{2}\tan\frac{x}{2} + \dots + \frac{1}{2^n}\tan\frac{x}{2^n}} + \frac{1}{2^{n+1}}\tan\frac{x}{2^{n+1}} \overset{?}{=} \frac{1}{2^{n+1}}\cot\frac{x}{2^{n+1}} - \cot x$

$$\frac{1}{2^n}\cot\frac{x}{2^n} - \cancel{\cot x} + \frac{1}{2^{n+1}}\tan\frac{x}{2^{n+1}} \overset{?}{=} \frac{1}{2^{n+1}}\cot\frac{x}{2^{n+1}} - \cancel{\cot x}$$

$$\frac{1}{2^n}\cot\frac{x}{2^n} \overset{?}{=} \frac{1}{2^{n+1}}\left(\cot\frac{x}{2^{n+1}} - \tan\frac{x}{2^{n+1}}\right)$$

$$\frac{1}{2^n}\cot\frac{x}{2^n} \overset{?}{=} \frac{1}{2^{n+1}}\cdot\frac{\cos^2\frac{x}{2^{n+1}} - \sin^2\frac{x}{2^{n+1}}}{\sin\frac{x}{2^{n+1}}\cos\frac{x}{2^{n+1}}}$$

$$\frac{1}{2^n}\cot\frac{x}{2^n} = \frac{1}{2^{n+1}}\cdot\frac{\cos\frac{x}{2^n}}{0.5\sin\frac{x}{2^n}}$$