$$\int_{-\infty}^{\infty} \cos 2t \ dt = \sum_{k\in\mathbb{Z}} \int_{\pi k}^{\pi(k+1)} \cos 2t \ dt = \sum_{k\in\mathbb{Z}} 0 = 0$$

8.1.25

$$\begin{aligned}
I &= \int_{-1}^{1} \sqrt{1+x^2} \ dx \\
&= 2\int_{0}^{1} \sqrt{1+x^2} \ dx \\
&= 2\int_{0}^{\frac{\pi}{2}} \sec\theta \sec^2\theta \ d\theta && [x=\tan\theta, dx=\sec^2\theta d\theta] \\
&= 2\left([\sec\theta\tan\theta]_0^{\frac{\pi}{2}} - \int_0^{\frac{\pi}{2}} \sec\theta \tan^2\theta \ d\theta \right) \\
&= 2\left([\sec\theta\tan\theta]_0^{\frac{\pi}{2}} - \int_0^{\frac{\pi}{2}} \sec\theta \left(\sec^2\theta - 1\right) \ d\theta \right) \\
&= 2\left([\sec\theta\tan\theta]_0^{\frac{\pi}{2}} - \frac{I}{2} + \int_0^{\frac{\pi}{2}} \sec\theta \ d\theta \right) \\
&= 2\left([\sec\theta\tan\theta]_0^{\frac{\pi}{2}} - \frac{I}{2} + [\ln|\sec\theta+\tan\theta|]_0^{\frac{\pi}{2}} \right) \implies \\
2I &= 2\left[\sec\theta\tan\theta + \ln|\sec\theta+\tan\theta|\right]_0^{\frac{\pi}{2}} \implies \\
I &= \left[x\sqrt{1+x^2} + \ln\left|\sqrt{1+x^2}+x\right|\right]_0^1 \\
&= \left[\sqrt{2} + \ln|\sqrt{2}+1| - \ln|1|\right] \\
&= \ln(\sqrt{2}+1) + \sqrt{2}
\end{aligned}$$

$$\lim_{t\to\frac{\pi}{2}} \tan t$$