15.5, number 19: Compute

$$\int_0^{\pi/4} \int_0^{\ln \sec v} \int_{-\infty}^{2t} e^x \, dx \, dt \, dv.$$

Answer:

$$\begin{aligned}
& \int_0^{\pi/4} \int_0^{\ln \sec v} \int_{-\infty}^{2t} e^x \, dx \, dt \, dv \\
= \; & \int_0^{\pi/4} \int_0^{\ln \sec v} \lim_{b \to -\infty} e^x \Big|_b^{2t} \, dt \, dv \\
= \; & \int_0^{\pi/4} \int_0^{\ln \sec v} \lim_{b \to -\infty} (e^{2t} - e^b) \, dt \, dv \\
= \; & \int_0^{\pi/4} \int_0^{\ln \sec v} e^{2t} \, dt \, dv \\
= \; & \int_0^{\pi/4} \tfrac{1}{2} e^{2t} \Big|_0^{\ln \sec v} \, dv \\
= \; & \int_0^{\pi/4} \tfrac{1}{2} (e^{2 \ln \sec v} - 1) \, dv \\
= \; & \int_0^{\pi/4} \tfrac{1}{2} (\sec^2 v - 1) \, dv \\
= \; & \tfrac{1}{2} (\tan v - v) \Big|_0^{\pi/4} \\
= \; & \boxed{\tfrac{1}{2} (1 - \tfrac{\pi}{4})}
\end{aligned}$$