PROOF OF FORMULA 3.622.2

$$\int_0^{\pi/4} \tan^\mu x\, dx = \frac{1}{2}\beta\left(\frac{\mu+1}{2}\right)$$

Let $t = \tan x$ to obtain

$$\int_0^{\pi/4} \tan^\mu x\, dx = \int_0^1 \frac{t^\mu\, dt}{1+t^2}.$$

The change of variables $s = t^2$ now gives

$$\int_0^{\pi/4} \tan^\mu x\, dx = \frac{1}{2}\int_0^1 \frac{s^{\mu/2-1/2}\, ds}{1+s}.$$

The result now follows from the integral representation

$$\beta(a) = \int_0^1 \frac{s^{a-1}\, ds}{1+s}.$$