

Daily Integral

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1 Easy

Problem 1. Evaluate the following

$$\int_0^2 \frac{x^3}{x^2 + 4} dx$$

$$\begin{aligned}x &= 2 \tan \theta \\dx &= 2 \sec^2 \theta d\theta \\x &= 0 \\u &= 0 \\x &= 2 \\u &= \frac{\pi}{4}\end{aligned}$$

Now we can transform the integral from

$$\begin{aligned}\int_0^2 \frac{x^3}{x^2 + 4} dx &= 2 \int_0^{\pi/4} \frac{8 \tan^3 \theta \sec^2 \theta}{4 \tan^2 \theta + 4} d\theta \\&= 4 \int_0^{\pi/4} \tan^3 \theta d\theta \\&= 4 \int_0^{\pi/4} \tan \theta (\sec^2 \theta - 1) d\theta \\&= 4 \int_0^{\pi/4} \tan \theta \sec^2 \theta - \tan \theta d\theta \\&= 4 \int_0^{\pi/4} \tan \theta \frac{d[\tan \theta]}{d\theta} d\theta + 4 \int_0^{\pi/4} \frac{-\sin \theta}{\cos \theta} d\theta \\&= 2 [\tan^2 \theta]_0^{\pi/4} + 4 [\ln \cos \theta]_0^{\pi/4} \\&= 2 + 4 \ln \left(\frac{1}{2} \right)^{1/2} \\&= 2 - \ln 4\end{aligned}$$