PROOF OF FORMULA 4.235.3

$$\int_0^\infty \ln x \, \frac{(1-x^2)x^{n-3}}{1-x^{2n}} \, dx = -\frac{\pi^2}{4n^2} \tan^2 \left(\frac{\pi}{n} \right)$$

Start with

$$\int_0^\infty \ln x \, \frac{(1-x^2)x^{n-3}}{1-x^{2n}} \, dx = \int_0^\infty \ln x \, \frac{x^{n-3}}{1-x^{2n}} \, dx - \int_0^\infty \ln x \, \frac{x^{n-1}}{1-x^{2n}} \, dx.$$

The result now follows from entry 4.254.2

$$\int_0^\infty \frac{x^{p-1} \ln x}{1-x^q} \, dx = -\frac{\pi^2}{q^2 \sin^2 \left(\frac{\pi p}{q} \right)}.$$