

**PROOF OF FORMULA 4.262.5**

$$\int_0^1 \frac{x^n \ln^3 x}{1-x} dx = -\frac{\pi^4}{15} + 6 \sum_{k=0}^{n-1} \frac{1}{(k+1)^4}$$

Let  $x = e^{-t}$  to obtain

$$\int_0^1 \frac{x^n \ln^3 x}{1-x} dx = - \int_0^\infty \frac{t^3 e^{-(n+1)t} dt}{1-e^{-t}}.$$

The result now follows from formula 3.411.17.