PROOF OF FORMULA 3.351.1

$$\int_0^a x^n e^{-\mu x}\, dx = \frac{n!}{\mu^{n+1}} - e^{-a\mu} \sum_{k=0}^{n} \frac{n!}{k!} \frac{a^k}{\mu^{n-k+1}} = \frac{\gamma(n+1, a\mu)}{\mu^{n+1}}$$

Entry **2.321.2** states that

$$\int x^n e^{-\mu x} dx = -e^{-\mu x} \left(\sum_{k=0}^{n} \frac{k! \binom{n}{k}}{\mu^{k+1}} x^{n-k} \right).$$

The result follows directly from here.

The expression in terms of the incomplete gamma function

$$\gamma(\alpha, x) = \int_0^{\alpha} x^{\nu-1} e^{-x}\, dx,$$

comes from the change of variables $t = \mu x$.