

$$\begin{aligned}
 \Gamma(\alpha + 1) &= \int_0^\infty \overset{u}{\underbrace{x^{-\alpha}}_{\text{u}}} \underbrace{e^{-x} dx}_{\text{v}} dv \\
 &= \underbrace{(-x^\alpha e^{-x})}_{\substack{u \quad v}} \Big|_0^\infty - \int_0^\infty \underbrace{\overset{du}{\alpha x^{\alpha-1}}}_{\text{u}} \underbrace{(-e^{-x})}_{\text{v}} dx \\
 &= \alpha \int_0^\infty x^{\alpha-1} e^{-x} dx
 \end{aligned}$$