1.17 $\Gamma(x) = \int_0^\infty u^{x-1} e^{-u} du$

$$\Gamma(x+1) = \int_0^\infty u^x e^{-u} du$$

$$= \int_0^\infty -u^x e^{-u} d(-u)$$

$$= [-u^x e^{-u}]_0^\infty + \int_0^\infty e^{-u} du^x$$

$$= 0 + \int_0^\infty x u^{x-1} e^{-u} du$$

$$= x\Gamma(x)$$

By induction $\Gamma(1) = 1 = 0!$

suppose $\Gamma(x+1) = x!$ holds.

Then $\Gamma(x+2) = (x+1)\Gamma(x+1) = (x+1)x! = (x+1)!$