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$x = \ln y. \therefore \quad y = e^x \quad \left(y^{-1}(y)\right)$

$f_X(x) = f_Y\left(e^x\right) e^x \quad \dfrac{d}{dx}(y) = e^x$

$= e^{-e^x} e^x$

$= e^{x-e^x}$

$\therefore f_x(x) = e^{x-e^x} \quad$ for $x \in \mathbb{R}$.

$F_\gamma(y) = \displaystyle\int_0^\infty e^{-y} dy.$

$F_x(x) = p(x \leq x) = p(\ln Y \leq x)$

$= p\left(y \leq e^x\right)$

$= F_Y\left(e^x\right)$

$f_x(x) = \dfrac{d}{dx} F_y\left(e^x\right)$

$1 = e^x f_Y\left(e^x\right)$

$= e^x e^{-e^x}$

$= e^{x-e^x}$