1) a) $\text{CDF}(x;\lambda) = \int_0^x \lambda e^{-\lambda i}\, di = -e^{-\lambda i}\big|_0^x = \lim_{i\to\infty}(-e^{-\lambda i}) - (-e^{-\lambda x})$

$= 0 + e^{-\lambda x} = e^{-\lambda x}$

b) $\text{mean} = \mathbb{E}[p(x|\lambda)] = \int_0^\infty \lambda e^{-\lambda x} x\, dx = -xe^{-\lambda x} - \dfrac{e^{-\lambda x}}{\lambda}\Big|_0^\infty$

$= \lim_{x\to\infty}\left(-xe^{-\lambda x} - \dfrac{e^{-\lambda x}}{\lambda}\right) + 0 + \dfrac{1}{\lambda} = \dfrac{1}{\lambda}$

c) $\text{variance} = \sigma^2 = \int_0^\infty (x - \text{mean}_{p(x|\lambda)})^2 \lambda e^{-\lambda x}\, dx$

$= \int_0^\infty (x - \tfrac{1}{\lambda})\lambda e^{-\lambda x}\, dx = \int_0^\infty x\lambda e^{-\lambda x} - e^{-\lambda x}\, dx$

$= -xe^{-\lambda x} - \dfrac{e^{-\lambda x}}{\lambda} - \dfrac{e^{-\lambda x}}{\lambda}\Big|_0^\infty = -xe^{-\lambda x} - 2\cdot\dfrac{e^{-\lambda x}}{\lambda}\Big|_0^\infty = (-x - \tfrac{2}{\lambda})e^{-\lambda x}\Big|_0^\infty$

$= \lim_{x\to\infty}\left((-x-\tfrac{2}{\lambda})e^{-\lambda x}\right) - (-(0)-\tfrac{2}{\lambda})e^{-\lambda\cdot 0} = 0 + (\tfrac{2}{\lambda})\cdot 1 = \dfrac{2}{\lambda}$