131. Solution: E

First, find the conditional probability function of N_2 given $N_1 = n_1$: $p_{2|1}(n_2 \mid n_1) = \dfrac{p(n_1, n_2)}{p_1(n_1)}$,

where $p_1(n_1)$ is the marginal probability function of N_1. To find the latter, sum the joint probability function over all possible values of N_2 obtaining

$$p_1(n_1) = \sum_{n_2=1}^{\infty} p(n_1, n_2) = \frac{3}{4}\left(\frac{1}{4}\right)^{n_1-1} \sum_{n_2=1}^{\infty} e^{-n_1}\left(1 - e^{-n_1}\right)^{n_2-1} = \frac{3}{4}\left(\frac{1}{4}\right)^{n_1-1},$$

since $\sum_{n_2=1}^{\infty} e^{-n_1}\left(1 - e^{-n_1}\right)^{n_2-1} = 1$ as the sum of the probabilities of a geometric random variable. The conditional probability function is

$$p_{2|1}(n_2 \mid n_1) = \frac{p(n_1, n_2)}{p_1(n_1)} = e^{-n_1}\left(1 - e^{-n_1}\right)^{n_2-1},$$

which is the probability function of a geometric random variable with parameter $p = e^{-n_1}$. The mean of this distribution is $1/p = 1/e^{-n_1} = e^{n_1}$, and becomes e^2 when $n_1 = 2$.