1. Let t_j be the mean first passage time to state 1, starting from state j. Hence, the quantity we are looking for is t_2. We have the following recursion:

$$\begin{aligned} t_2 &= 1 + p_{21}t_1 + p_{22}t_2 \\ &= 1 + p_{22}t_2 \\ &= 1 + 0.4t_2, \end{aligned}$$

since $t_1 = 0$. Hence, $t_2 = 1/0.6 = 5/3$.

2. Let t_1^* be the mean recurrence time to state 1. Using our result for t_2 found in part (1), we have

$$t_1^* = 1 + p_{11}t_1 + p_{12}t_2 = 1 + 0 + (0.2)(5/3) = 4/3.$$