Problem 3.6.2 is referring to a random walk with transition matrix like given on page 128 in Pinsky/Karlin. Obviously $v_0 = E[T|X_0 = 0] = 0$ and $v_N = E[T|X_0 = N] = 0$. Making a first step analysis we get:

$$v_k = q_k(1 + v_{k-1}) + r_k(1 + v_k) + p_k(1 + v_{k+1})$$

$$= 1(q_k + r_k + p_k) + q_k v_{k-1} + r_k v_k + p_k v_{k+1}$$

In order to derive the other equations we would have to consider

$$(q_k + r_k + p_k)v_k = q_k(1 + v_{k-1}) + r_k(1 + v_k) + p_k(1 + v_{k+1})$$

$$v_{k+1} - v_k = \frac{q_k}{p_k}(v_k - v_{k-1}) - \frac{1}{p_k}$$

Define $X_k := v_{k+1} - v_k$. therefore the formula can be rewritten as:

$$X_k = \frac{q_k}{p_k}X_{k-1} - \frac{1}{p_k}$$

$$= \prod_{i=1}^k \frac{q_k}{p_k}X_0 - \sum_{l=1}^{k-1} \prod_{j=0}^{l-1} \frac{q_k}{p_k} - \sum_{l=1}^{k-1} \prod_{j=0}^{l-1} \frac{q_k}{p_k}$$

The trick is now to write $v_{k+1} = \sum_{l=1}^k X_k$ and to fulfill some algebraic calculations. We expect the expected time till absorption to be higher than in the case where $r_k = 0$