Solution for exercise 1.6.7 in Pitman

Question a) The exercise is closely related to example 7 p.68. Using the same notation and approach

$$P(\text{Current flows}) = P((S_1 \cup S_2) \cap S_3) = (1 - P(S_1^c \cap S_2^c))P(S_3) = (1 - q_1q_2)q_3$$

(use $1 = p_1p_2 + q_1p_2 + p_1q_2 + q_1q_2$ to get the result in Pitman)

Question b)

$$P(\text{Current flows}) = P(((S_1 \cup S_2) \cap S_3)cupS_4) = 1 - (1 - q_1q_2)q_3q_4$$

(or use exclusion/inclusion like Pitman)