In a dairy barn there are two water troughs (i.e. drinking places). From each trough only one cow can drink at the same time. When both troughs are occupied new arriving cows wait pa tiently for their turn. It takes an exponential time to drink with mean 3 minutes. Cows arrive at the water troughs according to a Poisson process with rate 20 cows per hour.

(i) Determine the probability that there are i cows at the water troughs (waiting or drinking), $i = 0, 1, 2, \ldots$

(ii) Determine the mean number of cows waiting at the troughs and the mean waiting ti me.

(iii) What is the fraction of cows finding both troughs occupied on arrival?

(iv) How many troughs are needed such that at most 10% of the cows find all troughs occupied on arrival?