Graduate student problem competition

All graduate students are eligible to participate.
To submit your solution, e-mail it to `bazaliy@mailbox.sc.edu`

Chain on a pulley with friction

A chain consists of $n = 10$ small blocks. It is wrapped a quarter of a circle around a motionless, fixed cylinder. Every block i $(i = 1, 2, \ldots, n - 1, n)$ has a friction coefficient $\mu = 0.2$ with the cylinder surface. Every block is connected to its neighbors by strings. The strings do not touch the cylinder. The first $(i = 1)$ and last $(i = n)$ blocks are connected to strings that are tangent to the cylinder. External forces F_1 and F_n are applied to these strings. There is no gravity.

Initially, applied forces are equal, $F_1 = F_n = F = 10$ N. The system is in equilibrium, forward and backward tension forces acting on each block balance each other, and no friction forces develop where the blocks touch the cylinder.

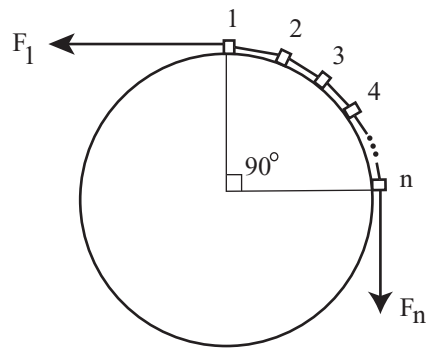The force F_n is then gradually increased to $1.2F$, while F_1 remains equal to F. Find the tensions of each of $n - 1$ strings connecting the blocks.

Figure 1: Chain wrapped around a cylinder. Top view.