Research problem – analysis of a spring mechanism

Consider system 1 in the figure below, where a frictionless, massless piston is constrained to move vertically. In between the piston and ground, a linear spring with spring stiffness k_1 is attached and the attachment of the spring happens through pin connections (only position is determined, rotation is free). Given $L_{1x} = 1m$, $L_{1y} = 1m$ and $k_1 = 1N/m$, what is the exact relationship between force (in N) and displacement (in m) if you push on the piston (Force is indicated by red arrow). You may assume the spring to be in its relaxed state in the drawn configuration, and you can simulate the Force Displacement-curve until a downwards displacement of 2m. **We are thus looking for the Force Displacement curve (FD-curve) of the piston.**

For system 2, we have added a second frictionless, massless piston to the system that is connected to the first one, through a pinned spring with spring stiffness k_2. Given $L_{2x} = 1m$, $L_{2y} = 1m$ and $k_2 = 1.3N/m$, and spring 2 is in its relaxed state in the drawn configuration, **how does this system behave** when you push the second piston downwards until a displacement of 4m. Bear in mind that piston 1 is free to move. Here you can be qualitative in your answer (or quantitative if you like a challenge!). **Why is the system behaving in this way?**

Now that you know how this system behaves, **how would you use this mechanism in an application**? For this you can be very creative! There are no wrong answers!!

Please limit yourself in your answers, and only use 2 pages (or less).