# BRAUER AND NOHEL: PROBLEM 3, PG. 9

For $i = 1, 2, 3$, let $x_i''$ denote the acceleration of the $i$th mass, $d^2x_i/dt^2$. Let $F_i$ be the force acting on the $i$th mass. We use $mx_i'' = F_i$ to write the equations of motion:

$$\begin{aligned} m_1x_1'' &= -k_1x_1 + k_2(x_2 - x_1) \\ m_2x_2'' &= -k_x(x_2 - x_1) + k_3(x_3 - x_2) \\ m_3x_3'' &= -k_3(x_3 - x_2) + F(t)\ . \end{aligned}$$

Note that the forces acting on a particle comes only from direct action: a spring connected to the mass, or the assumed force $F(t)$ acting on the third mass. For example, the first mass does not "know" directly about the forces corresponding to $F(t)$ or the third spring. The forces act locally on a mass and accelerate it according to $F = ma$. For example, the third spring doesn't somehow "know" how to divide its restoring spring force to accelerate the various masses in the system, and it can't simply apply its restoring force in equal magnitude to accelerate however many masses might be in the system (that would be some spring!).

If we interpret "the systems starts from rest" to mean that the initial velocity of each mass is zero and the initial position is equilibrium, then the initial conditions would of course be

$$x_1 = x_2 = x_3 = x_1' = x_2' = x_3' = 0\ .$$