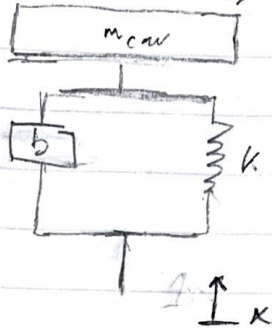


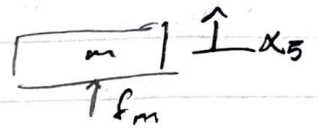
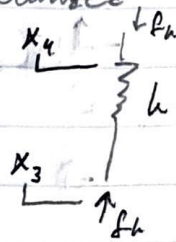
Problem 3:

* Schematic of system



* Where $m = h = b = 5$

* Break into idealized elements:



* equations for idealized elements:

damper: $f_b = b(\dot{x}_1 - \dot{x}_2)$ Spring: $f_k = k(x_3 - x_4)$

on mass: $\sum F = ma \rightarrow f_m = m\ddot{x}_5$

* relate position vectors: $x_2 = x_4 = x_5 = y$; $x_1 = x_3 = x$

$\therefore f_b = b(\dot{x} - \dot{y})$ $f_k = k(x - y)$ $f_m = m\ddot{y}$

$$f_m = f_b + f_k$$

* Combine into one differential equation:

$$f_b + f_k = f_m \rightarrow b\dot{x} - b\dot{y} + kx - ky = m\ddot{y}$$

* isolate input & output terms: $b\dot{x} + kx = m\ddot{y} + b\dot{y} + ky$

* input variables: $\mathcal{L}(\dot{x} + x) = \mathcal{L}(\ddot{y} + \dot{y} + y)$

solution:

$$\boxed{\dot{x} + x = \ddot{y} + \dot{y} + y}$$