Problem 1:

The system below is formed with two circular pipes of diameters D1 and D2 connected together. A mass M sits on a piston at height H1 so that fluid of density $\rho$ is just level with the top of the pipe at H2. Solve for the Mass in terms of $\rho$, H1, H2, D1 and D2. Assume that the piston is massless.

Using Bernoulli's equation

at (1) \[ P_{A_{\text{Atm}}} + \frac{Mg}{A_1} + \rho g H_1 = \text{Constant} \]

at (2) \[ P_{A_{\text{Atm}}} + \rho g H_2 = \text{Constant} \]

So \[ P_{A_{\text{Atm}}} + \frac{Mg}{A_1} + \rho g H_1 = \rho g H_2 + P_{A_{\text{Atm}}} \]

\[ M = \rho (H_2 - H_1) A_1 \]

\[ = \rho \pi \frac{D^2}{4} (H_2 - H_1) \]
Problem 2:
A massless spring with spring constant $K_1$ is depressed a distance $X_1$ and used to fire a ball towards a second massless, uncompressed spring of spring constant $K_2$. Find the distance $X_2$ that the second spring will be compressed. Energy is conserved.

$$E_i = E_f$$
$$E_i = \frac{1}{2} k_1 x_1^2$$
$$E_f = \frac{1}{2} k_2 x_2^2$$

So

$$\frac{1}{2} k_1 x_1^2 = \frac{1}{2} k_2 x_2^2$$

$$x_2 = \sqrt{\frac{k_1}{k_2}} x_1$$