Suppose that you are asked to minimize the magnitude of vibrations for a system that can be modeled as a mass $m_1$ connected to two springs (see the figure on the next page) and is subject to harmonic excitation. The system parameters are:

- $k_1 = 750 \text{ N/m}$
- $m_1 = 10 \text{ kg}$
- $F = 10 \sin 10t \text{ N}$

You are asked to reduce (or attempt to eliminate) the vibration of the main equipment (i.e., $m_1$) by connecting a relatively small mass and spring to it. You are not allowed however, to increase the mass of the entire system by more than 20%.

**Q1** What are the equations of motion?

**Q2** Choose values of $k_2$ and $m_2$ such that the vibration of the mass $m_1$ is minimized.

**Q3** What is the magnitude of vibration of the second mass?

**Q4** Now assume that the springs available have stiffness $k$ in the range of 250 to 500 N/m. Can you use these springs?

**Q5** Compare the results you get with the best single degree of freedom you could have designed (i.e., by only manipulating the springs or even adding damping, but no new mass).

**Q6** Are there any other considerations that are not dealt with yet?
Figure 1: Schematic for Project 3.

\[ F(t) = 10 \sin 10t \]