6. Spring ***(7 points)*** First, we measure the lengthening of the spring under its own weight. The relative lengthening of each loop is propotional to the order number of the loop. So, the average value of those legth increments is half of the largest increment (for the topmost loop). The topmost loop is deformed by the weight of the whole spring, hence the average deformation corresponds to the half-weight of the spring,

$$kx_1 = mg/2.$$

Now we add a load to the lower end of the spring and measure the new deformation x_2. Since the additional weight of the load increases the stress of all the loops by the same value Mg, each loop is deformed additionally by the same length increment. The sum of those additional increments is $x_2 - x_1$; according to the Hook's law, $k(x_2 - x_1) = Mg$. So, $\frac{x_2}{x_1} - 1 = \frac{2M}{m}$, and

$$M = \frac{m}{2}\,\frac{x_2 - x_1}{x_1} \approx 6\,\mathrm{g}.$$