(d) (2 pts) Eventually the weight does stop moving up and down. How high above the water does the weight hang when it has eventually come to rest?

equilibrium height = $50 - 27.25 = 22.75$ meters

At equilibrium, force of gravity balances spring force $\Rightarrow mg = k(\ell - \ell_0) \Rightarrow$

$(70)(9.8) = 56(\ell - 15) \Rightarrow \ell = 15 + \frac{(70)(9.8)}{56}$

$\Rightarrow \ell = 15 + 12.25 = 27.25$ met.

(e) (3 pts) When the weight is first dropped, what is its acceleration a when it passes through (for the first time) what will be its eventual equilibrium height?

$a = \frac{F^{tot}}{m} = 0$ Since spring force and gravity cancel at equilibrium height.

(f) (2 pts) Sometime before the up and down oscillations of the weight die completely away, you observe it oscillating about the equilibrium height with maximum excursions of ± 1m. What is the period T of this oscillation?

$T = \frac{2\pi}{\omega}$

$\omega = \sqrt{k/m}$

$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{70 \text{ kg}}{56 \text{ kg/sec}^2}} = 7.02$ sec

(g) (2 pts) Suppose, after the up and down oscillations have died away, a sudden gust of wind starts the mass swinging to and fro with an amplitude of ± .5 meter. What is the period of this oscillation?

$T = \frac{2\pi}{\omega}$

$T = 2\pi\sqrt{\ell/g} = 2\pi\sqrt{\frac{27.25 \text{ met}}{9.8 \text{ met/sec}^2}} = 10.48$ sec

$\omega = \sqrt{g/\ell}$