1. 1.875 min or "less than 2 min"

2. 7.5 min

3. $\delta = 2.3\, g/cm^3 (1\,Kg/1000\,g)(100\,cm/m)^3 = 2300\ Kg/m^3$

$m = \forall \delta = (500\times10^{-6})(1\times10^{-3})^2(2300) = 1.15\times10^{-6}\ Kg$

$K = \frac{N_{Leg}}{N_{zig}} \frac{E w t^3}{L^3} = \frac{2}{1} \frac{(190\times10^{9})(10\times10^{-6})(5\times10^{-6})^3}{(100\times10^{-6})^3} = 475\ N/m$

$\omega^2 = \frac{k}{m} = \frac{475}{1.15\times10^{-6}} = 4.13\times10^{8}\ (rad/s)^2$

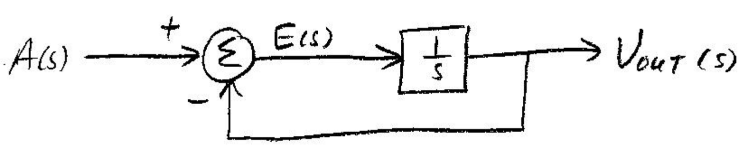
$S = \frac{1}{\omega^2} = 2.42\times10^{-9}\ s^2$

4. $d = aS = \frac{a}{\omega_n^2} = \frac{10(9.8)}{(2\pi\times1000)^2} = 2.48\times10^{-6} m = 2.48\,\mu m$

5. $S = \frac{d}{a} = \frac{10\times10^{-6}}{10(9.8)} = 1.02\times10^{-7}\ s^2$

$S = \frac{1}{\omega_n^2} \rightarrow f_n = \frac{\omega_n}{2\pi} = \frac{1}{2\pi\sqrt{S}} = \frac{1}{2\pi\sqrt{1.02\times10^{-7}}} = 498\ Hz$

6.



(1) $E(s) = A(s) - V_{OUT}(s)$

(2) $V_{OUT}(s) = \frac{E(s)}{s}$

$\therefore V_{OUT}(s) = \frac{A(s) - V_{OUT}(s)}{s}$

or $sV_{OUT}(s) = A(s) - V_{OUT}(s)$

$\therefore V_{OUT}(s)[s+1] = A(s)$

$\therefore G(s) = \frac{V_{OUT}(s)}{A(s)} = \frac{1}{s+1}$

$$A(s) = \mathcal{L}[2u(t)] = \frac{2}{s}$$

$$V_{OUT}(s) = A(s)\,G(s) = \frac{2}{s(s+1)} = \frac{K_1}{s} + \frac{K_2}{s+1}$$

$$K_1 = \left.\frac{2}{s+1}\right|_{s=0} = 2$$

$$K_2 = \left.\frac{2}{s}\right|_{s=-1} = -2$$

$$\therefore V_{OUT}(s) = \frac{2}{s} - \frac{2}{s+1}$$

$$v_{OUT}(t) = \mathcal{L}^{-1}[V_{OUT}(s)] = 2(1-e^{-t})$$