

$$1. a. \text{ For a cantilever: } K = \frac{Ewt^3}{4L^3} = \frac{(170 \times 10^9)(10 \times 10^{-6})(20 \times 10^{-6})^3}{4(500 \times 10^{-6})^3} = 27.2 \text{ N/m}$$

$$b. \text{ } \theta = (20 \times 10^{-6})(1000 \times 10^{-6})(1000 \times 10^{-6}) = 2 \times 10^{-11} \text{ m}^3$$

$$c. \text{ } \delta = (2.35 \text{ g/cm}^3)(100 \text{ cm/m})^3(1 \text{ kg}/1000 \text{ g}) = 2350 \text{ Kg/m}^3$$

$$m = \delta \theta = (2350)(2 \times 10^{-11}) = 4.7 \times 10^{-8} \text{ Kg} = 4.7 \times 10^{-5} \text{ g}$$

$$d. \text{ } f = \frac{\omega}{2\pi} = \frac{1}{2\pi} \sqrt{\frac{K}{m}} = \frac{1}{2\pi} \sqrt{\frac{27.2}{4.7 \times 10^{-8}}} = 3828.7 \text{ Hz}$$

$$2. \text{ } K \approx \frac{N_{\text{leg}}}{N_{\text{leg}}} \frac{Ewt^3}{L^3} = \frac{4}{1} \frac{Ewt^3}{L^3}$$

$$K \approx \frac{4Ewt^3}{L^3}$$

$$3. a. \text{ } Q = 35$$

$$b. \text{ } \beta = \frac{1}{2Q} = \frac{1}{70} = 0.0143$$

$$c. \text{ } f_n = 2.5 \text{ KHz}$$

$$d. \text{ } m = 100 \mu\text{g} = (100 \times 10^{-6})(1 \times 10^{-3} \text{ kg/g}) = 1 \times 10^{-7} \text{ Kg}$$

$$\frac{K}{m} = \omega_n^2$$

$$K = m(2\pi f_n)^2 = 1 \times 10^{-7} (2\pi(2500))^2 = 24.67 \text{ N/m}$$

$$e. \text{ } \frac{c}{m} = \frac{\omega_n}{Q}$$

$$c = \frac{m\omega_n}{Q} = \frac{1 \times 10^{-7} (2\pi(2500))}{35} = 4.49 \times 10^{-5} \text{ kg/s}$$

$$f. \text{ input amplitude} = 0.1 \mu\text{m}$$

$$\text{output amplitude at } \omega_n \approx (\text{input amplitude}) Q$$

$$= (0.1 \mu\text{m})(35)$$

$$= 3.5 \mu\text{m}$$

$$g. \text{ } \frac{\omega_n}{Q} = \frac{2\pi(2500)}{35} = 448.8 \text{ s}^{-1}$$

$$\omega_n^2 = (2\pi(2500))^2 = 2.47 \times 10^8 \text{ s}^{-2}$$

$$T(s) = \frac{\omega_n}{s^2 + \frac{\omega_n}{Q}s + \omega_n^2} = \frac{448.8s + 2.47 \times 10^8}{s^2 + 448.8s + 2.47 \times 10^8}$$

4. a. $Q \approx \frac{\pi}{\ln(9.256/7.91)} = 20$

$$f \approx \frac{1}{5 \times 10^{-4}} = 2 \text{ kHz}$$

3-0235 — 50 SHEETS — 5 SQUARES
3-0236 — 100 SHEETS — 5 SQUARES
3-0237 — 200 SHEETS — 5 SQUARES
3-0137 — 200 SHEETS — FILLER

COMET