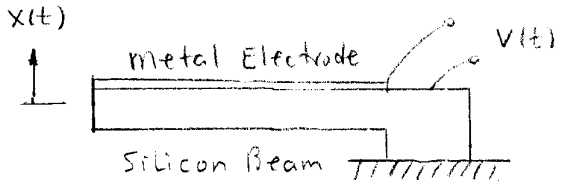
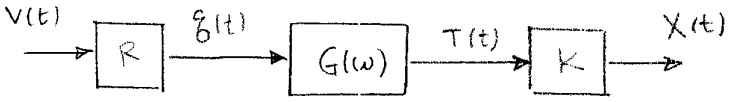
Spring 2004 Exam Problem

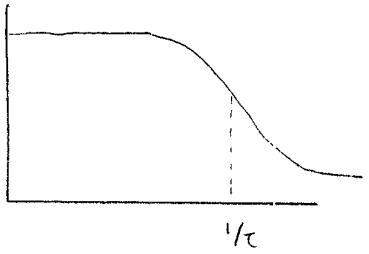




(a) $$G(\omega) = \frac{1}{hA + pvc(j\omega)} = \frac{1}{hA} \cdot \frac{1}{1+\tau(j\omega)}$$

where $$\tau = \frac{pvc}{hA} = \text{time constant}$$

(b) $|G(\omega)|$



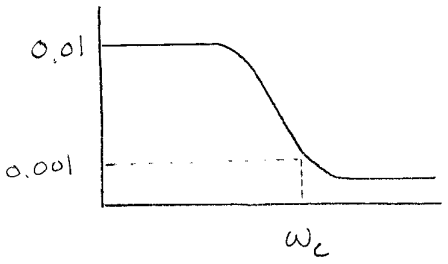
- Low-pass filter
- bandwidth = $1/\tau$

(c) Actuator A has larger size and hence larger τ

$\Rightarrow$ A has smaller bandwidth

B has larger bandwidth

(d)



$$|G| = \frac{0.01}{\sqrt{1+\tau^2\omega_c^2}} = 0.001$$

$$\frac{1}{\sqrt{1+\tau^2\omega_c^2}} = 0.1$$

$$1+\tau^2\omega_c^2 = 100$$

Hence $$\omega_c = \frac{\sqrt{99}}{\tau} = 100\sqrt{99} \approx 1000 \text{ Hz}$$

When $\omega > 1000$ Hz, the response cannot be measured.