Luke Verlangieri | AA 311

1) $R = \frac{\rho L}{A}$ $V = LA$ $\Delta V =$

$$\frac{\Delta R}{R} = \frac{\rho\left(\frac{L'}{A'}\right) - \rho\left(\frac{L_0}{A_0}\right)}{\rho \frac{L_0}{A_0}} = \frac{\frac{L'}{A'} - \frac{L_0}{A_0}}{\frac{L_0}{A_0}}$$

Because $A_0 L_0 \approx L'A'$

$$A' \approx \frac{A_0 L_0}{L'}$$

$$\frac{\frac{L'^2}{A_0 L_0} - \frac{L_0}{A_0}}{\frac{L_0}{A_0}} = \frac{L'^2 - L_0^2}{\cancel{A_0} L_0} \cdot \frac{\cancel{A_0}}{L_0}$$

$$\frac{L'^2 - L_0^2}{L_0^2} \rightarrow L'^2 = \Delta L^2 + L_0^2 + 2\Delta L L_0$$

$$\frac{\Delta L^2 + \cancel{L_0^2} + 2\Delta L L_0 - \cancel{L_0^2}}{L_0^2} = \frac{\Delta R}{R}$$

$$\frac{\Delta L^2 + 2\Delta L L_0}{L_0^2} = \frac{\Delta R}{R}$$

$$\frac{\Delta L^2}{L_0^2} + \frac{2\Delta L}{L_0} = \frac{\Delta R}{R}$$

$\Delta L << L$

Because ΔL is very small $\left(\frac{\Delta L^2}{L_0^2}\right)$ is even smaller, we can ignore it

$$\boxed{\frac{2\Delta L}{L_0} \approx \frac{\Delta R}{R}}$$

b) There are a couple of ways to do this the one that sticks out to me the most would be pairing this with a resistor so that there is an RC circuit and because there is an RC there is a τ, which is solved for using the charging/discharging eqns. Once tau is known C is also known. $V(t) = V_0(1 - e^{-t/RC})$

If you know the current going through the system and the time it takes to change the voltage a threshold amount.

We ~~a~~ $C = \frac{Q}{V}$ $\rightarrow$ $C = \frac{I \cdot t}{\Delta V}$

$\delta C = \frac{\delta Q}{\delta V}$

you can also find the capacitance.