\[ F_{\text{DC}} = \frac{1}{2} \varepsilon_0 (15\text{V})^2 N_{\text{g}} \frac{t+\phi}{\phi} \] 
\[ = 200 \text{mN} \]

At DC, force drives spring:
\[ x_{\text{DC}} = \frac{F_{\text{DC}}}{k} = 0.2 \text{mm} \]

At resonance, amplitude is \( Q \) times DC deflection, and phase shift is 90°
\[ x_{\text{Ac},1} = Q \left( \frac{40 \text{mN}}{\text{m/Hz}} \right) \sin (10^4 \omega t - 90°) \]
\[ = (4 \text{mm}) \sin (10^4 \omega t - 270°) \]

For high \( Q \) systems, above resonance, the force drives the mass, and the phase shift is 180 degrees, causing the -1
\[ x_{\text{Ac},2} = \frac{10 \text{mN}}{m (2\omega)} \cos (2 \times 10^4 \omega t) \]
\[ = 0.25 \text{mm} \cos (2 \times 10^4 \omega t) \]

\[ F_{\text{Ac},1} = \frac{1}{2} \varepsilon_0 (15\text{V})(15\text{V})(\frac{t+\phi}{\phi}) N_{\text{g}} \]
\[ = 400 \text{mN} \sin (10^4 \omega t) \]
\[ F_{\text{Ac},2} = \frac{1}{2} \varepsilon_0 (15\text{V})(15\text{V})(\frac{t+\phi}{\phi}) (-\cos (2 \times 10^4 \omega t)) \]
\[ = -10 \text{mN} \cos (2 \times 10^4 \omega t) \]

This term is actually only 3K, as shown in another problem since the spring knocks out 1/4 of the inertia term.

1/6 full credit for 4K