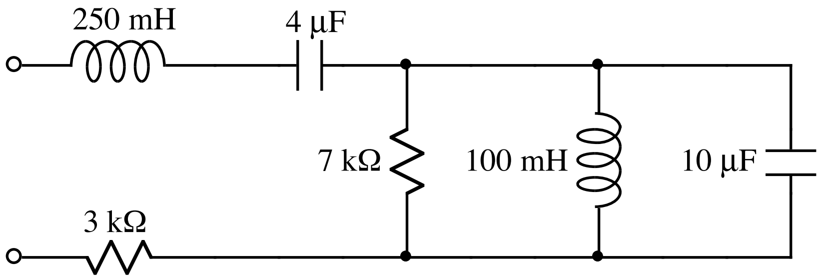
HOMEWORK #14 prob 4 solution

EX: Find the total impedance of the circuitry shown below if ω = 1000 rad/s.



SOL'N: We convert to the frequency-domain by computing impedances.

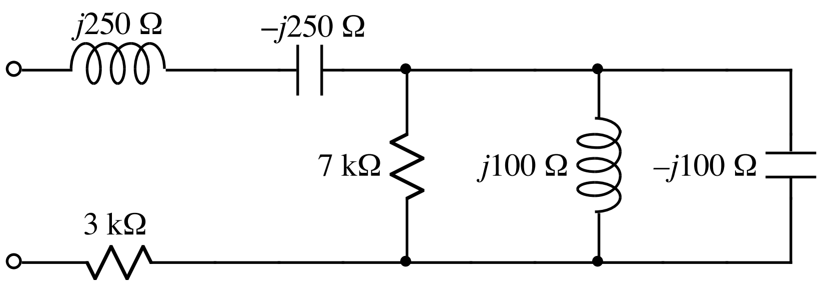
$$j\omega L = j1\text{k} \cdot 250\text{m } \Omega = j250 \text{ k}\Omega$$

$$\frac{1}{j\omega C} = \frac{1}{j1\text{k} \cdot 4\mu}\Omega = -j250\ \Omega$$

$$j\omega L = j1\text{k} \cdot 100\text{m } \Omega = j100 \text{ k}\Omega$$

$$\frac{1}{j\omega C} = \frac{1}{j1\text{k} \cdot 10\mu}\Omega = -j100\ \Omega$$

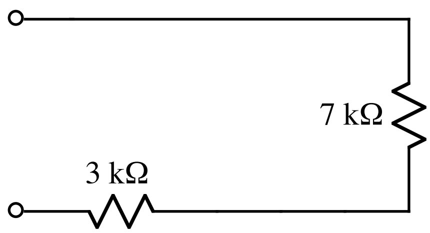
The circuit diagram in the frequency-domain is shown below.



The series *L* and *C* in series at the top left of the circuit sum to zero, which means they cancel out to act like a wire. The parallel *L* and *C* at the right combine to create an equivalent impedance of infinity, or an open circuit.

$$j100 \,\|\, -j100\ \Omega = j100\ \Omega \cdot 1 \,\|\, -1 = j100\ \Omega \cdot \frac{1(-1)}{1-1} = j100\ \Omega \cdot \frac{1}{0} = \infty\ \Omega$$

Thus, the *L* and *C* on the right disappear. We are left with a simple circuit consisting of only two resistors:



The equivalent impedance is obviously 10 kΩ.

$z_{tot} = 10$ kΩ