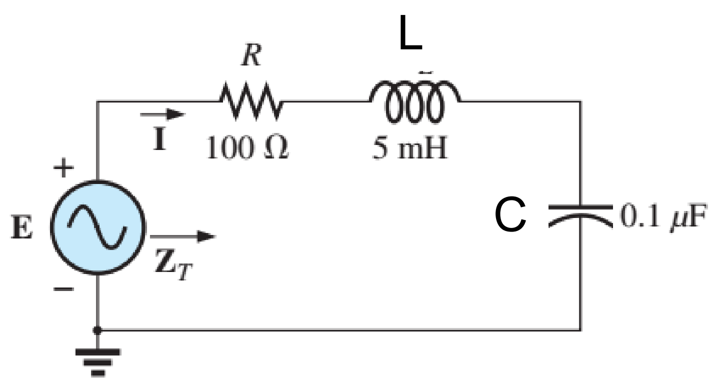
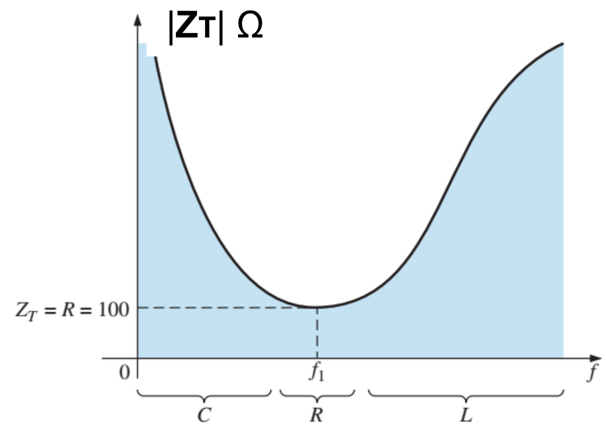
Frequency Response of Basic Elements

- Find $|Z_T|$ for this circuit as a function of frequency (as the frequency changes)





ICP:

1) Calculate $|Z_T|$ at 100Hz, 10kHz and 100kHz
2) At what frequency does $|Z_T|$ hit its minimum?
3) Sketch $|Z_T|$ as a function of frequency (calculator…)

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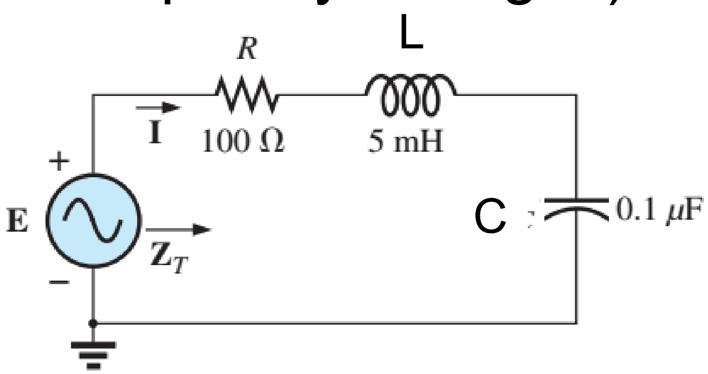


$$|\vec{Z}_T| = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

$$= \sqrt{R^2 + \left(\frac{\omega L(\omega C)}{\omega C} - \frac{1}{\omega C}\right)^2}$$

$$|\vec{Z}_T| = \sqrt{R^2 + \left(\frac{\omega^2 LC - 1}{\omega C}\right)^2}$$

1) Calculate $|\mathbf{Z}_T|$ at 100Hz, 10kHz and 100kHz

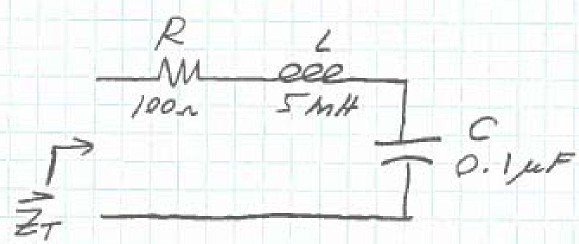
HERE

$\omega = 2\pi f$

$C = 0.1\,\mu F$

$L = 5\,mH$

$R = 100\,\Omega$



$$\vec{Z}_T = R + jX_L - jX_C$$

$$= R + j(X_L - X_C)$$

$$\therefore |\vec{Z}_T| = \sqrt{R^2 + (X_L - X_C)^2}$$

Solving for 100Hz, 10kHz and 100kHz yields:

f	$\lvert\vec{Z}_T\rvert$
100HZ	15.9kΩ
10kHZ	185Ω
100kHZ	3.13kΩ

NP

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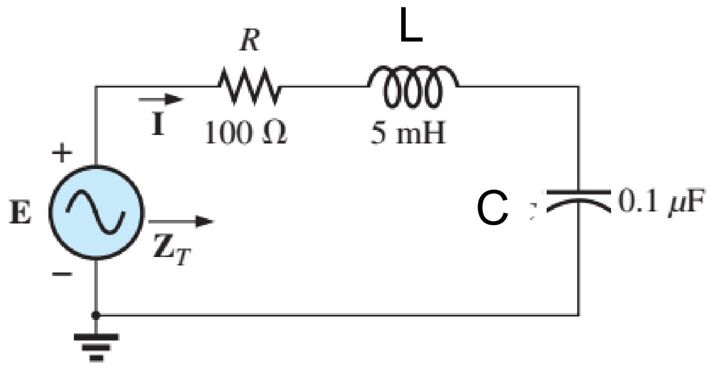
- Find $|\mathbf{Z_T}|$ for this circuit as a function of frequency (as the frequency changes)



$$|\vec{Z}_T| = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

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$$|\vec{Z}_T| = \sqrt{R^2 + \left(\frac{\omega^2 LC - 1}{\omega C}\right)^2}$$

2) At what frequency does $|\mathbf{Z_T}|$ hit its minimum?

f	$\lvert\vec{Z}_T\rvert$
100Hz	15.9kΩ
10kHz	185Ω
100kHz	3.13kΩ
7.12kHz	100Ω

$|\mathbf{Z_T}|$ = 100 Ohms at f =7.12kHz

$$X_L = X_C$$

$$2\pi f L = \frac{1}{2\pi f C}$$

$$f^2 = \frac{1}{2\pi C(2\pi L)}$$

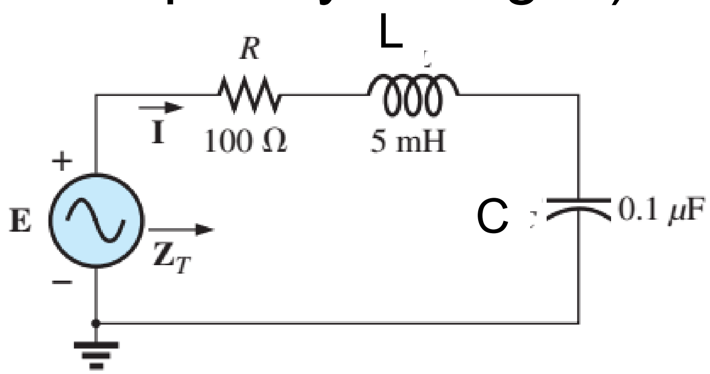
$$f^2 = \frac{1}{(2\pi)(2\pi)CL}$$

$$\therefore f = \frac{1}{2\pi\sqrt{LC}}$$

Or at **f = 7.12kHz**

Frequency Response of Basic Elements

- Find |**Z**T| for this circuit as a function of frequency (as the frequency changes)



HP Prime Example - SOLVE App
(note: X is the variable that ranges, f in this case)

$$Z=\sqrt{R^2+\left(\frac{(2*\pi*X)^2*L*C-1}{2*\pi*X*C}\right)^2}$$

3) Sketch |**Z**T| as a function of frequency (calculator…)

$$|\vec{Z}_T| = \sqrt{R^2+\left(\frac{\omega^2 LC - 1}{\omega C}\right)^2}$$

$\omega = 2\pi f$

$C = 0.1\,\mu F$

$L = 5\,mH$

$R = 100\,\Omega$

Set R, L and C values (Num), then Plot: