

⑨ The Mr. Fusion in the DeLorean Time Machine generates an instantaneous sinusoidal EMF with $V_{rms} = 4.0V$. What is V_{max} ?

$$V_{rms} = \frac{V_{max}}{\sqrt{2}} \Rightarrow V_{max} = \sqrt{2} V_{rms} = \sqrt{2} \cdot 4.0V = \boxed{5.66V} \quad (\text{ANS})$$

⑤⑤ My PHASER has an RLC series circuit with $L = 0.300H$, $C = 6.00\mu F$. The driver has $V_{max} = 440V$. (a) What is $\omega_{resonant}$? (b) At resonance $I_{max} = 0.560A$. What is R ? (c) What is V_{max} drop across each element?

(a) Resonant freq: $\omega = \frac{1}{\sqrt{LC}} = (0.300H \cdot 6.00 \times 10^{-6}F)^{-1/2}$
 $= \boxed{745.4 \text{ Hz}} \quad (\text{ANS})$

(b) I can relate V_{max} to I_{max} by ohm's Law:

$$V_{max} = I_{max} Z \Rightarrow V_{max} = I_{max} \sqrt{R^2 + (Z_L - Z_C)^2}$$

At resonance $Z_L = Z_C$ so // $V_{max} = I_{max} \cdot R$

so // $R = \frac{V_{max}}{I_{max}} = \frac{440V}{0.560A} = \boxed{786 \Omega} \quad (\text{ANS})$

(c) To get the voltage drop across each element I use Ohm's Law and the individual impedances

$$V_R = I_{\max} \cdot R = (0.560A)(786\Omega) = \boxed{440V} \text{ (ANS)}$$

$$V_L = I_{\max} \cdot Z_L = (0.560A) \omega L = (0.560A)(745.4\text{Hz})(0.300\text{H})$$

$$= \boxed{125V} \text{ (ANS)}$$

$$V_C = V_L = 125V \text{ because } Z_L = Z_C$$

- ⑥ OSCILLOSCOPES are my friend! Mine is set to 0.1 V/div , and a sinusoidal signal spans 6 boxes peak to peak. What is V_{rms} ?

The max voltage is $\frac{1}{2}$ the number of peak to peak boxes:

$$V_{\text{max}} = \frac{1}{2} 6 \text{ DIV} \cdot 0.1 \text{ V/DIV} = 0.3 \text{ V}$$

V_{rms} is related to V_{max} by: $V_{\text{rms}} = V_{\text{max}}/\sqrt{2} = \boxed{0.21 \text{ V}}$ (ANS)

- ⑦ A coil with $R=120 \Omega$ and $L=12.0 \text{ H}$ is connected to $\omega=60.0 \text{ Hz}$ and $V_{\text{rms}}=110 \text{ V}$ power. (a) What is impedance? (b) What is current?

(a) Total impedance is given by: $Z_{\text{TOT}} = \sqrt{R^2 + Z_L^2} = \sqrt{R^2 + (\omega L)^2}$

$$\text{so// } Z_{\text{TOT}} = \left[(120 \Omega)^2 + (60.0 \text{ Hz} \cdot 12.0 \text{ H})^2 \right]^{\frac{1}{2}} = \boxed{730 \Omega} \text{ (ANS)}$$

(b) Current is given by Ohm's Law:

$$V_{\text{RMS}} = I_{\text{RMS}} Z_{\text{TOT}} \rightarrow I_{\text{RMS}} = \frac{V_{\text{RMS}}}{Z_{\text{TOT}}} = \frac{110 \text{ V}}{730 \Omega} = \boxed{0.15 \text{ AMP}} \text{ (ANS)}$$

- 73) A Capacitor in a radio has reactance of 6.20Ω at 520 Hz .
What is capacitance?

Reactance is given by: $Z_c = 1/\omega C \rightarrow C = 1/\omega Z_c$

$$\text{sol/} \quad C = \frac{1}{(520 \text{ Hz})(6.20 \Omega)} = \boxed{3.0 \times 10^{-4} \text{ F}} \quad (\text{Ans})$$

- 76) At what frequency does the maximum current flow thru the Battestar Galactica's RLC circuit, which has $R = 4.50 \Omega$, $L = 450 \text{ mH}$ and $C = 520 \text{ pF}$?

Maximum current flows at the resonant frequency because impedance is at a minimum:

$$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{(450 \times 10^{-3} \text{ H} \cdot 520 \times 10^{-12} \text{ F})^{1/2}} = \boxed{65.4 \text{ kHz}} \quad (\text{Ans})$$