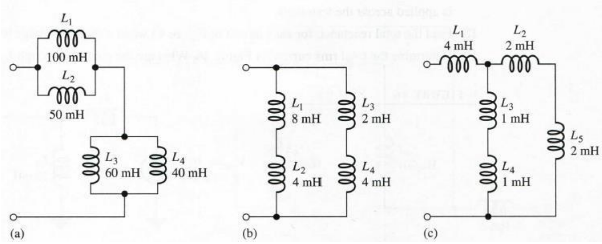
Electronic Circuits Homework 4

1. Determine the total inductance of each circuit in Figure. (11-12)

(a) $\frac{100\times50}{100+50}+\frac{60\times40}{60+40}\approx 57(mH)$

(b) $\frac{(8+4)\times(2+4)}{(8+4)+(2+4)}=4(mH)$

(c) $\frac{(1+1)\times(2+2)}{(1+1)+(2+2)}+4\approx 0.057(H)\approx 5(mH)$



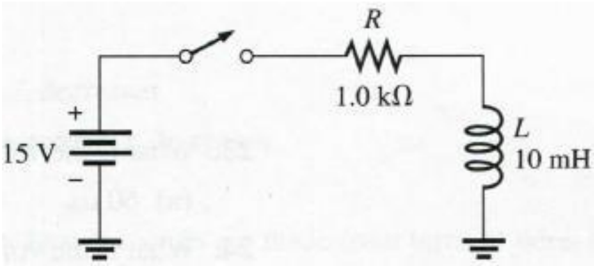
2. Determine the time constant for each of the following series RL combinations: (11-13)

(a) R=100Ω, L=100μH (b) R=4.7kΩ, L=10mH (c) R=1.5MΩ, L=3H

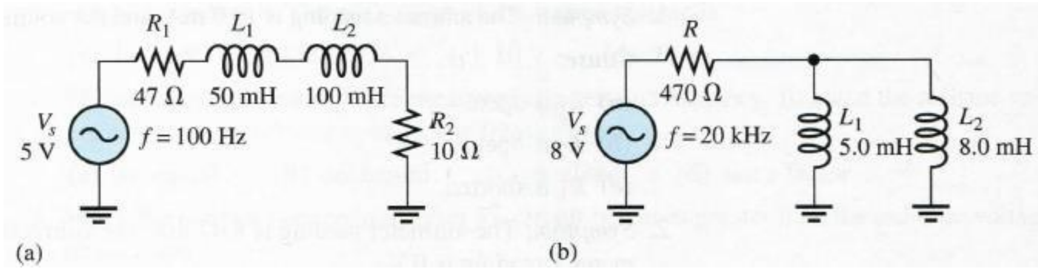
$1(\mu S)$ $\approx 2(\mu S)$ $2(\mu S)$

3. In the circuit of Figure, there is initially no current. Determine the inductor voltage at the following times after the switch is closed: (a) 10μs (b) 20μs (c) 30μs (d) 40μs (e) 50μs (11-15)

time constant: $\frac{0.01}{1000}=10(\mu S)$
(a) $15\times37\%=5.55(V)$
(b) $15\times14\%=2.1(V)$
(c) $15\times5\%=0.75(V)$
(d) $15\times2\%=0.3(V)$
(e) $15\times1\%=0.15(V)$



4. Determine the impedance and phase angle in each circuit in Figure. (12-4)



(a) $X_L=2\pi\times100\times(0.05+0.1)\approx 94.25(\Omega)$

$Z=\sqrt{{X_L}^2+(47+10)^2}\approx 110(\Omega)$

$\angle:\tan^{-1}\frac{X_L}{47+10}\approx\tan^{-1}1.65$

(b) $X_L=2\pi\times20000\times\frac{0.005\times0.008}{0.005+0.008}\approx 386.66(\Omega)$

$Z=\sqrt{{X_L}^2+470^2}\approx 609(\Omega)$

$\angle:\tan^{-1}\frac{X_L}{470}\approx\tan^{-1}0.82$

5. Draw the waveforms for V_S, V_R *and* V_L in Figure. Show the proper phase relationships (12-13)

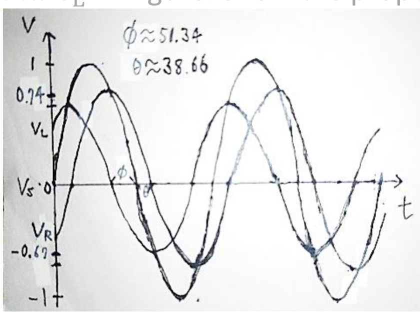
$X_L=2\pi\times60\times0.1\approx 37.70(\Omega)$

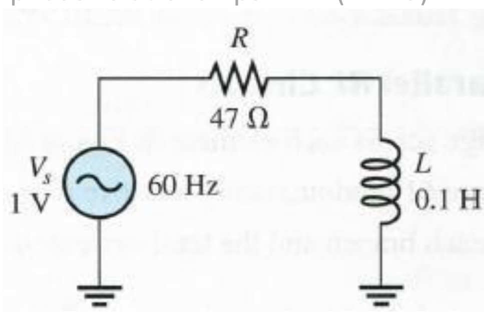
$Z=\sqrt{{X_L}^2+47^2}\approx 60.25(\Omega)$

$\angle:\tan^{-1}\frac{X_L}{47}\approx\tan^{-1}0.80\approx 38.66°$

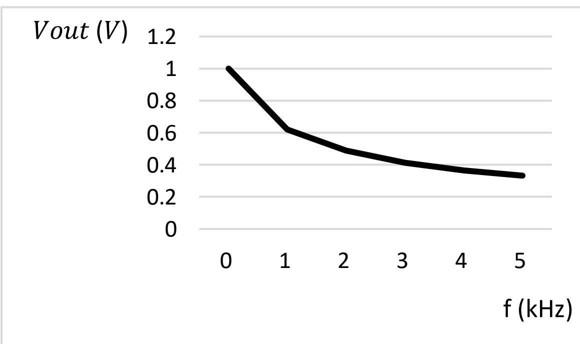
$V_{R-peak}=\sqrt{1^2\times\frac{47}{X_L+47}}\approx 0.74(V)$

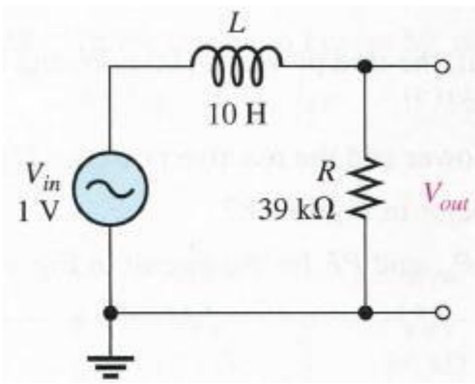
$V_{L-peak}=\sqrt{1^2\times\frac{X_L}{X_L+47}}\approx 0.67(V)$





6. Plot the response curve for the circuit in Figure. Show the output voltage versus frequency in 1 kHz increments from 0 Hz to 5 kHz. (12-30)





7. A certain series RLC circuit operates at a frequency of 5 kHz and has the following values: R=10Ω, C=0.047μF, and L=5mH. Determine the impedance and phase angle. What is the total reactance?

$$X_C = \frac{1}{2\pi\times5000\times0.000000047} \approx 677(\Omega), X_L = 2\pi\times5000\times0.005 \approx 157(\Omega) \qquad \text{(13-1)}$$

Total Reactance $X_{tot} \approx 677 - 157 = 520(\Omega)$

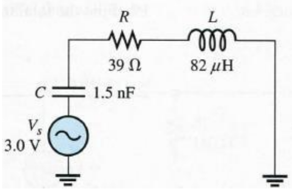
$$Z_{tot} = \sqrt{{X_{tot}}^2 + 10^2} \approx 520(\Omega), \angle: \tan^{-1}\frac{X_{tot}}{10} = \tan^{-1} 52$$

8. For the RLC circuit in Figure, determine the resonant frequency and the cutoff frequencies. (13-11)

$$f_r = \frac{1}{2\pi\times\sqrt{0.000082\times0.0000000015}} \approx 453803(Hz)$$

$$f_c = \frac{\pm(39\times0.0000000015)+\sqrt{(39\times0.0000000015)^2+4\times0.000082\times0.0000000015}}{4\pi\times0.000082\times0.0000000015}$$

$$\rightarrow f_1 \approx 417531(Hz), f_2 \approx 493227(Hz)$$



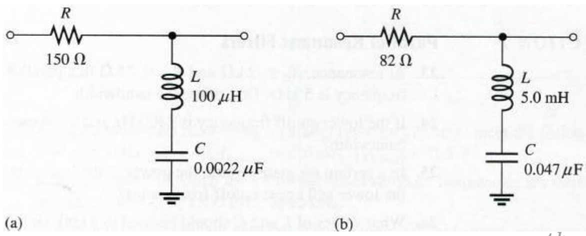
9. Determine fr and BW for each filter in Figure 7. (13-15)

(a) $f_r = \frac{1}{2\pi\times\sqrt{0.0001\times0.0000000022}} \approx 339319(Hz)$

$BW = \frac{150}{2\pi\times0.0001} \approx 238732(Hz)$

(b) $f_r = \frac{1}{2\pi\times\sqrt{0.005\times0.000000047}} \approx 10382(Hz)$

$BW = \frac{82}{2\pi\times0.005} \approx 2610(Hz)$



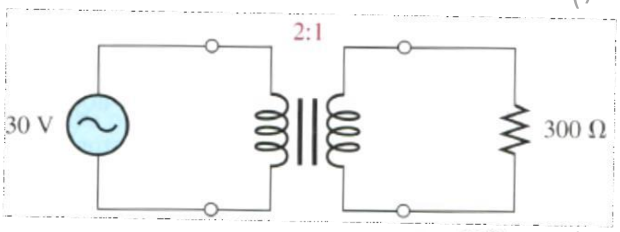
10. Determine the following quantities in Figure: (7^{th} 14-18)

(a) secondary voltage 15 V

(b) secondary current 50 mA

(c) primary current 25 mA

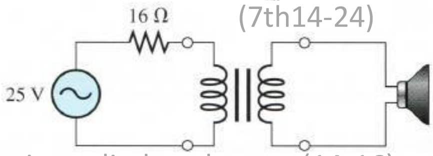
(d) power in the load 0.75 W



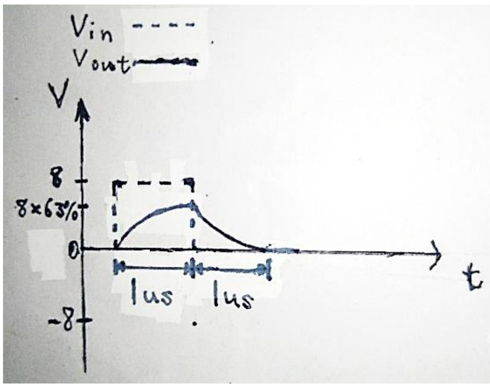
11. In Figure, what is the maximum power in watts delivered to the speaker? (7th14-24)

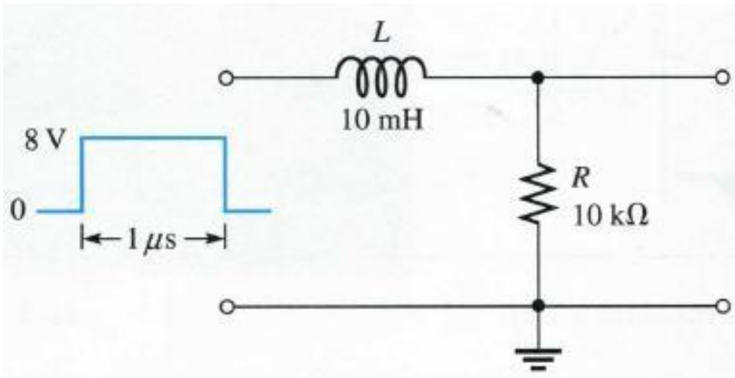
When Impedance matched, same with power consumed by the resistor:

$$\frac{25^2}{16+16} \approx 19.53(W)$$



12. Determine the output voltage for the circuit in Figure. A single-pulse input is applied as shown. (14-16)





13. (a) What is τ in Figure? $\approx 45\ nS$ (b) Draw the output voltage. (14-18)