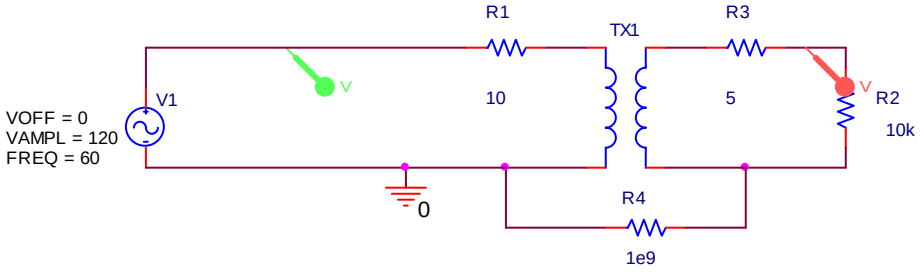
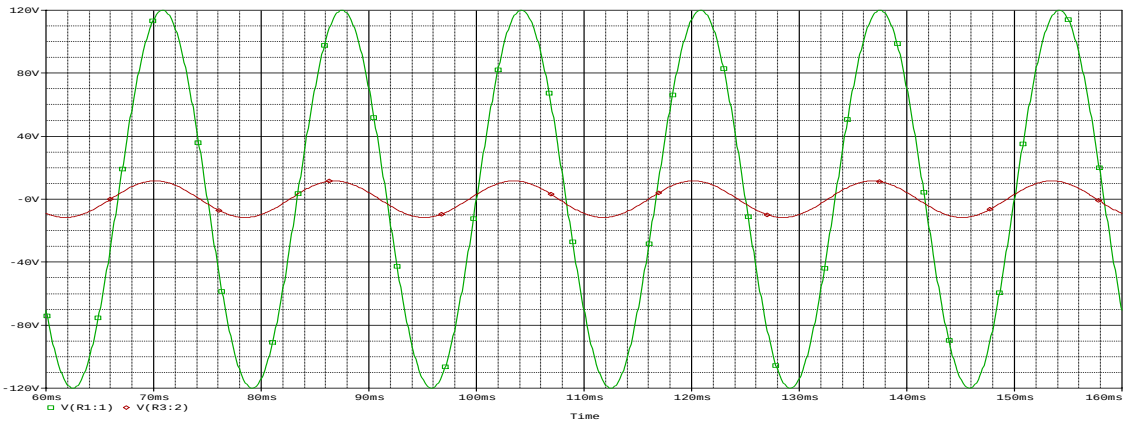
Questions about Transformers
These should help prepare you for question 4 of quiz 1.

Spring 2004

d. The original inductor is now used as the primary of a transformer. The secondary is formed by wrapping an additional winding around the primary, as was done in a recent experiment. Note: the smaller resistances shown are for the inductors. Also, note that a very large resistor has been used to connect the primary to the secondary. This is because PSpice requires everything to be referenced to ground. This resistance is so large that it acts like an open circuit.



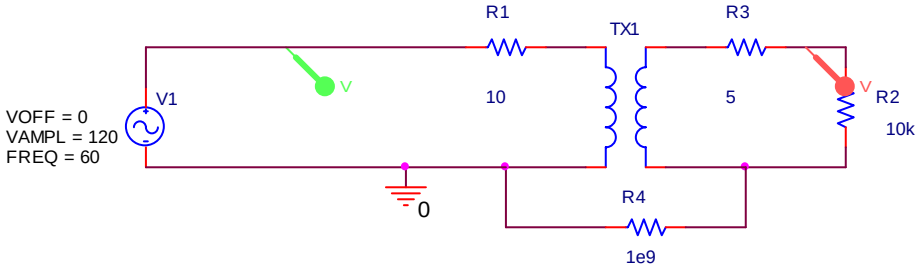


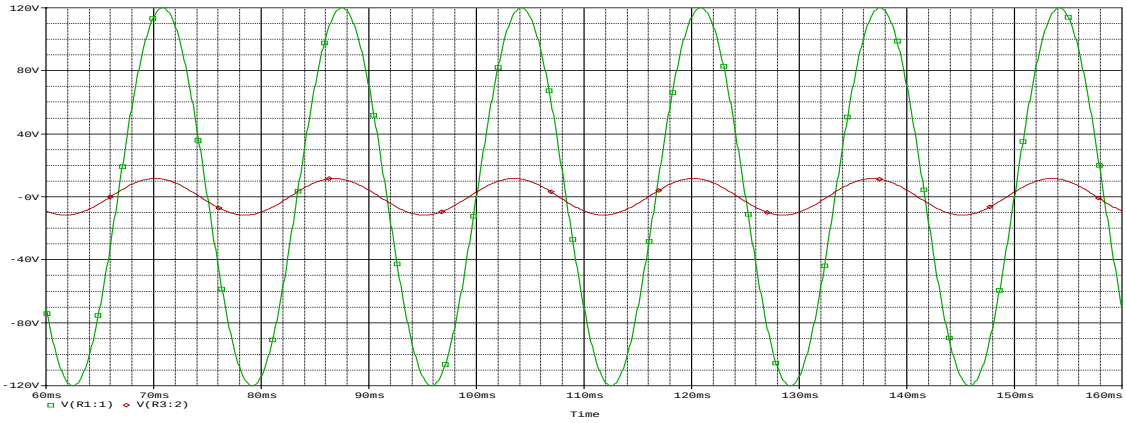
i) Assuming an ideal transformer, what inductance must the secondary have to produce the plot above (the AC line voltage is stepped down from 120Volts to 12Volts. *(3 points)*

ii) Again assuming an ideal transformer, what would the equation [in the form $i(t)=A\sin(\omega t)$] be for the current through the load resistor, R2? (Assume R4 is negligible) *(4 points)*

Spring 2004 solution

d. The original inductor is now used as the primary of a transformer. The secondary is formed by wrapping an additional winding around the primary, as was done in a recent experiment. Note: the smaller resistances shown are for the inductors. Also, note that a very large resistor has been used to connect the primary to the secondary. This is because PSpice requires everything to be referenced to ground. This resistance is so large that it acts like an open circuit. *[Note: we know that L1 is 0.1mH from a previous part.]*





i) Assuming an ideal transformer, what inductance must the secondary have to produce the plot above (the AC line voltage is stepped down from 120Volts to 12Volts. *(3 points)*

The inductor we tested has an inductance of about 0.1mH. From the general transformer equations, we know that $a = \frac{V_2}{V_1} = \sqrt{\frac{L_2}{L_1}}$. *My voltage ratio, a, is 12/120 or 0.1. Therefore my inductance must be :*

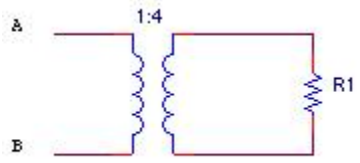
L2= L1(a)^2*=(0.1m)(0.1)*^{2}*. Therefore* ***L2 = 0.001mH***

ii) Again assuming an ideal transformer, what would the equation [in the form i(t)=Asin(ωt)] be for the current through the load resistor, R2? (Assume R4 is negligible) *(4 points)*

*The voltage through the load loop can be taken from the plot. It is v(t)=12Vsin(2π*60 t). Since v(t)=i(t)R and the load resistance is 10K ohms, we can simply divide v(t) by 10K to get an equation for the current.* ***i(t) = 1.2mA sin (120π t)=1.2mA sin(377 t)***

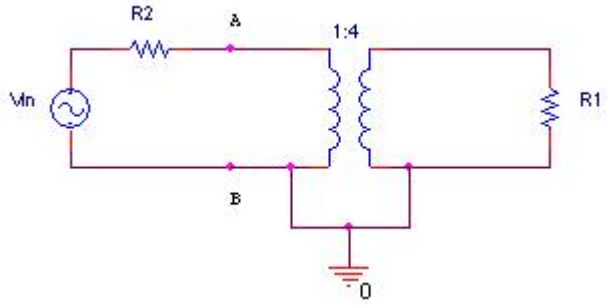
Spring 2003

4. Transformer (20 pts)



a) In the circuit above, the transformer is ideal. If R1=1KΩ, find the equivalent impedance, Z_{AB}, seen from points A and B. (6 pts)

b) We have connected the above circuit to an AC source with a resistor of R2 = 1KΩ.

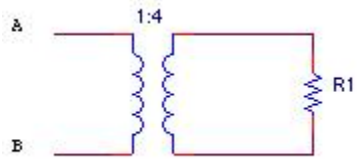


If the input voltage has an amplitude of 10V, find the voltage at point A. (8 pts)

c) What is the value of the voltage across R1? (6 pts)

Spring 2003 solution

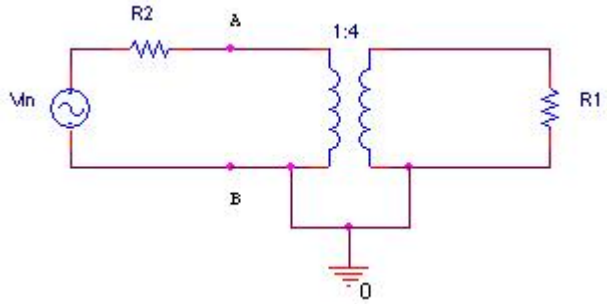
4. Transformer (20 pts)



d) In the circuit above, the transformer is ideal. If R1=1KΩ, find the equivalent impedance, Z_{AB}, seen from points A and B. (6 pts)

$Z_{AB} = R1/a^2$ a=N2/N1=4 $Z_{AB} = 1K/16$ ***Z_{AB}=62.5ohms***

e) We have connected the above circuit to an AC source with a resistor of R2 = 1KΩ.



If the input voltage has an amplitude of 10V, find the voltage at point A. (8 pts)

V_A = [(62.5)/(1062.5)]10V =.588V ***V_A = 588mV***

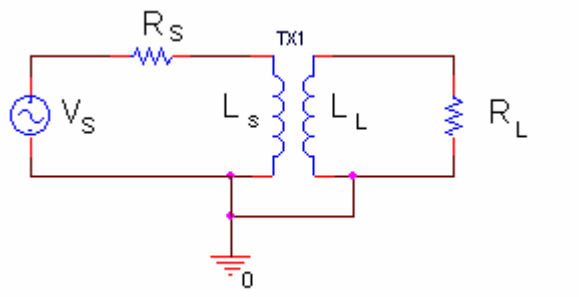
f) What is the value of the voltage across R1? (6 pts)

V2/V1 = a V_A =V1 V2=.588(4) = 2.35V ***V_{R1}=2.35V***

Fall 2002

5. Transformer (20 points)

In the circuit, the Vs is 100 mV, R_s has negligible amount of resistance, the R_L is 500 ohms.



a) Assuming a perfect matching and coil L_s has 50 turns, how many turns L_l has to have in order to obtain voltage of 1 volt across the load R_L? (6 points)

b) What is the impedance Zin of Ls? (6 points)

c) What is the current in the loop containing the load? (4 points)

d) Assuming a non-ideal transformer, list two transfer design methods (only) that would increase the voltage output at the load. (4 points)

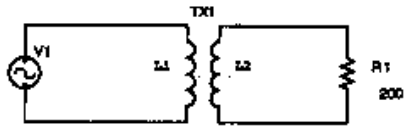
Fall 2002 Solution
(none available)

Fall 2001 solution

EI TEST 3A Fall 2001 Name_____ Sect_____

Please show all work on all questions for full credit, some explanation of your answer is required.

5) Transformer



a) If the L1 coil has 100 turns, and L2 coil has 400 turns what is the voltage across R1? (4 pt)

$$\frac{V_2}{V_1} = \frac{N_2}{N_1} = \frac{400}{100} \Rightarrow \boxed{V_2 = V_{R_1} = 4V_1}$$

b) In terms of V1, what is the current in the loop containing L2, and R1?(4pt)

$$I_2 = \frac{V_2}{R_1} = \frac{4V_1}{200} \Rightarrow \boxed{I_2 = 20\,mA}$$

c) What is the Impedance Zin of L1? (4 pt)

$$Z_{in} = \frac{R_1}{a^2} = \frac{200\,\Omega}{4^2} \Rightarrow \boxed{Z_{in} = 12.5\,\Omega}$$

d) In the inductors that make up this transformer, which would increase the inductance most? (4 pt)

a.) air core b) wood core (c) iron core ~~d) [illegible]~~

magnetic material

e) Which would be the best voltage source to use in this circuit (4pt)

a) 100mv DC b) 5V DC (c) 100mvsin(500t) (d) 5Vsin(500kt)

Both c and d will be considered correct