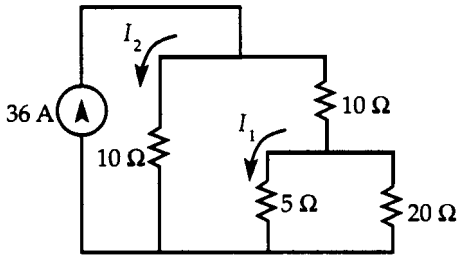
EE1050 Final given: Spring 01

(The space between problems has been removed.)

1. (20 pts) The following questions are similar to what you might see on the FE exam. You don't have to show your work here, in fact use scratch paper if you need more room.

a) Find I_1 in amps.

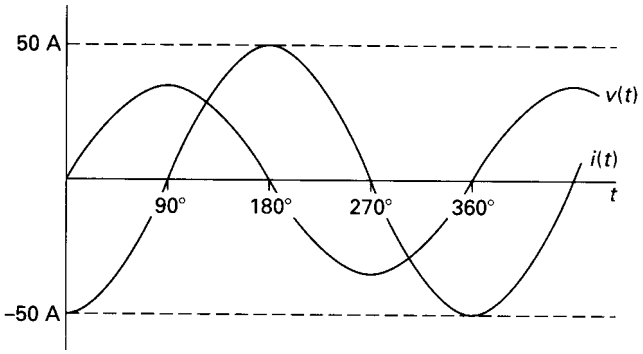


(A) 3
(B) 4.2
(C) 12
(D) 15
(E) 20.6

b) What is the average power dissipated by an electric heater with a resistance of 50 Ω and drawing a current of 20 sin(30t) A ?

(A) 4 kW
(B) 10 kW
(C) 14.14 kW
(D) 20 kW
(E) 50 kW

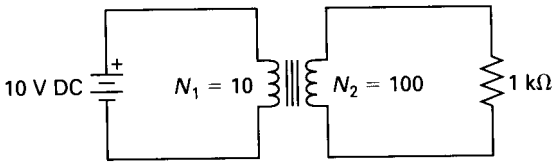
c) What is the correct phasor (polar) expression for the effective current in the graph shown?



(A) 35 / -90 º A
(B) 35 / 90 º A
(C) 35 / 270 º A
(D) 50 / -90 º A
(E) 50 / 90 º A

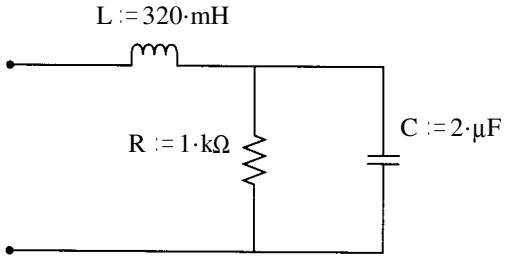
Notes: By "effective", they mean RMS.
The phase angle is relative to the voltage.

d) How much power is dissipated by the 1 kΩ resistor?



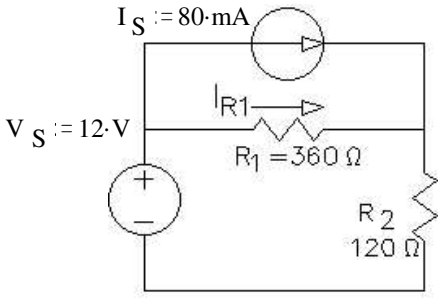
(A) 0 W
(B) 0.001 W
(C) 0.1 W
(D) 10 W
(E) 10 MW

e) What is the equivalent impedance when the circuit shown is connected to a 120 V 60 Hz source?

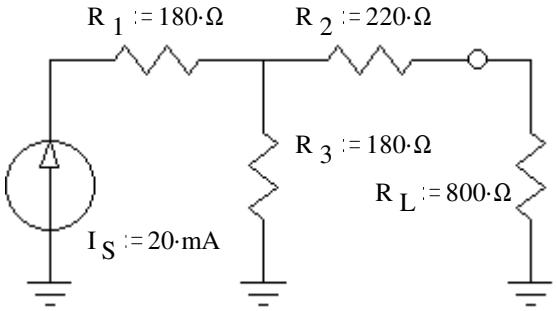


(A) 120 Ω / 83 º
(B) 120 Ω / 90 º
(C) 732 Ω /-30 º
(D) 991 Ω /-5.7 º
(E) 1206 Ω /-90 º

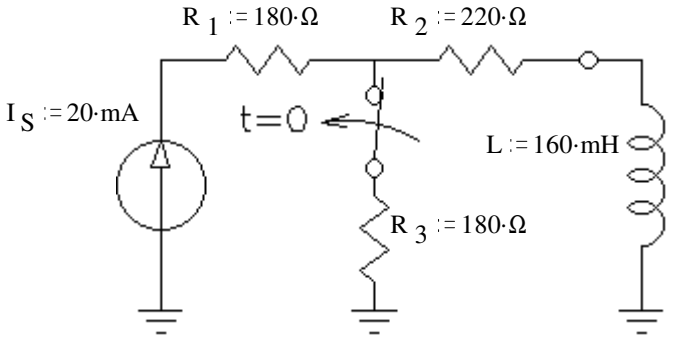
2. (13 pts) Use the method of superposition to find the current through R_1, (I_{R1}). Be sure to clearly show and **circle** your intermediate results.



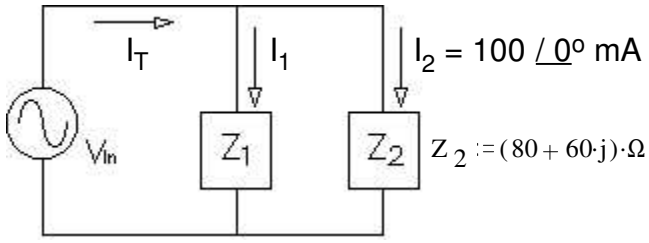
3. (23 pts)
   a) Find and draw the Thévenin equivalent of the circuit shown. The load resistor is R_L.
   b) Find and draw the Norton equivalent of the same circuit.
   c) Find the load voltage using either your Thévenin or Norton equivalent circuit.
   d) Find the power dissipated in the load resistor.



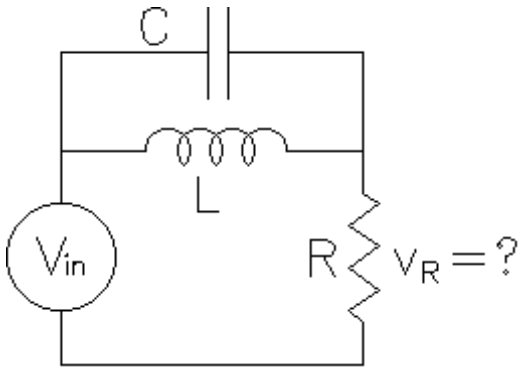
4. (18 pts) The switch has been in the open position for a long time and is closed (as shown) at time t = 0. Find the initial and final conditions and write the full expression for $i_L(t)$, including all the constants that you find.
   When the switch is closed this circuit is very similar to the circuit in problem 3. Use your answers to that problem here if you can.
   Don't panic, this is just a first order system.



5. (24 pts)
   a) Find V_{in} in polar form.
   b) Find I_T.
   c) Circle 1:
      i) The source current leads the source voltage
      ii) The source voltage leads the source current
   d) By how much? I.E. what is the phase angle between the voltage and current?



6. (16 pts)
   a) Find the differential equation for v_R, the voltage across the resistor.
   b) Find the characteristic equation.



7. (22 pts) In the circuit shown, use the 0.7 V -drop model for the silicon diode.

a) Assume that diode D_1 conducts.

Assume that diode D_2 does not conduct.

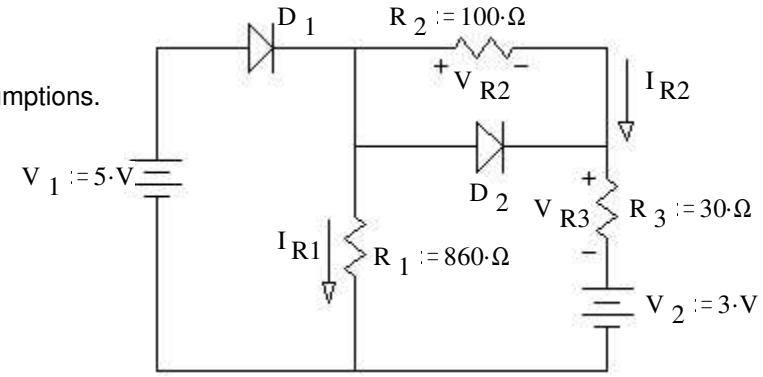
Find I_{R1}, I_{R2}, V_{R2}, and V_{R3} based on these assumptions.

I_{R1} = _____

I_{R2} = _____

V_{R2} = _____

V_{R3} = _____



b) Was the assumption about D_1 correct? yes no (circle one)

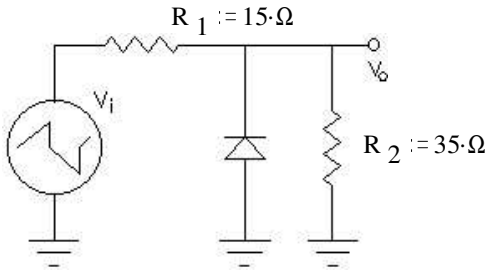
How do you know?

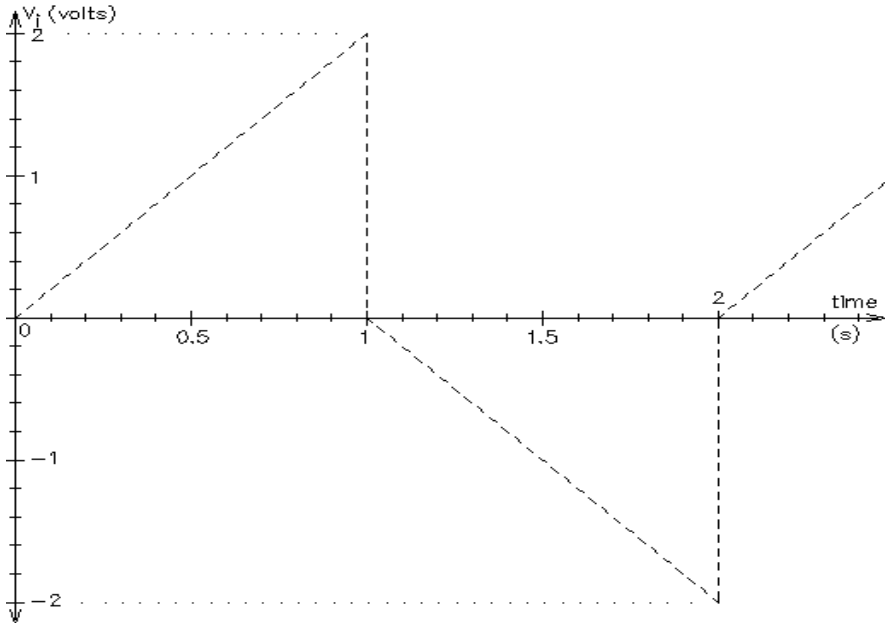
c) Was the assumption about D_2 correct? yes no (circle one)

How do you know?

d) If you have to make new assumptions based on your answers to b) and c), which of the following need to be recalculated. I_{R1} I_{R2} V_{R2} V_{R3} (circle any number)

8. (14 pts) The voltage waveform shown below (dashed line) is applied to the circuit shown at right. On the same graph, accurately draw the output voltage you expect to see across the 35 Ω resistor. Use the constant-voltage-drop model for the silicon diode. Label times and voltage levels at all points where your output changes direction.





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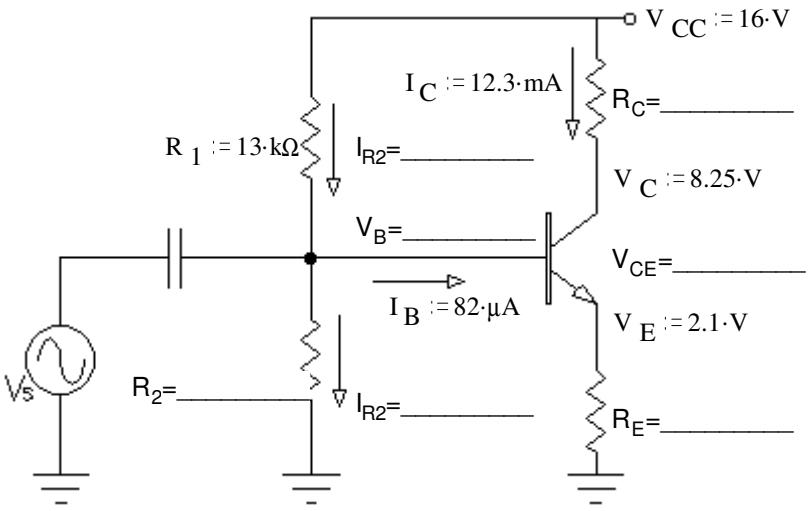
9. (30 pts) Fill in the blanks in the circuit. You may neglect I_B's effect on I_E, but do not neglect it on the base side of the transistor.



b) Is the transistor operating in the active region?

Yes No
(Circle one)

Show your evidence.

c) What is the value of β of this transistor?

d) If we neglect I_B and use the values of R_1 and R_2 above to calculate V_B, what do you get?

e) Considering only I_C and V_{CE}, how much power does this transistor dissipate or contribute?

f) If the v_s signal were applied at the base, an AC signal would also appear at the collector. How much larger would it be. (Voltage gain).

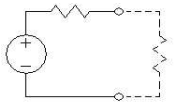
10. Do you want your grade and scores posted on my door and on the internet? Yes No
(Circle one)

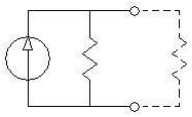
If your answer is yes, then provide some sort of alias or password: _____

The grades will be posted on my door in alphabetical order under the alias that you provide here. I will not post grades under your real name. The internet version will be an excel spreadsheet which you can download. Both will show all your homework, lab, and exam scores.

Answers 1.a) C b) B c) A d) A e) C 2. 25mA - 20mA = 5mA

3.a) $R_{Th} := 400\cdot\Omega$ b) $R_N := 400\cdot\Omega$ c) 2.4V

$V_{Th} := 3.6\cdot V$ 

$I_N := 9\cdot mA$ 

d) 7.2mW

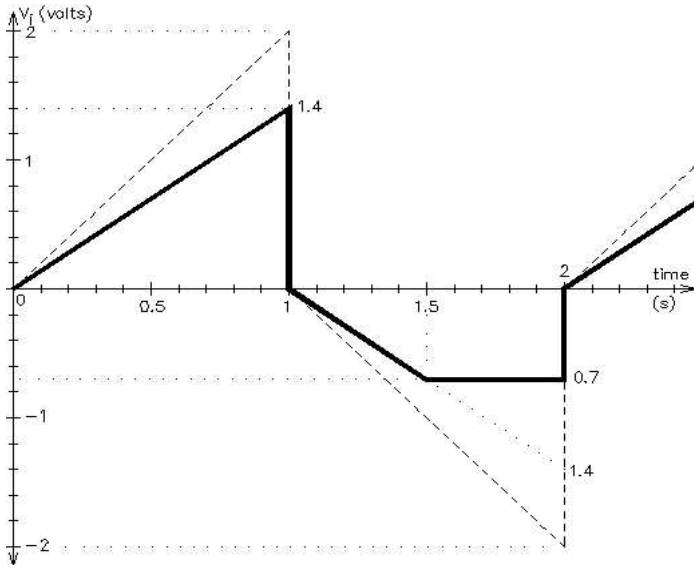
4) $9\cdot mA + (11\cdot mA)\cdot e^{-\frac{t}{0.4\cdot ms}}$

5.a) 10V /36.9° b) 314mA /43.0° c) current leads voltage d) 6.16°

6.a) $\frac{d^2}{dt^2} v_{in}(t) + \frac{1}{L\cdot C}\cdot v_{in}(t) = \frac{d^2}{dt^2} v_R(t) + \frac{1}{R\cdot C}\cdot\frac{d}{dt} v_R(t) + \frac{1}{L\cdot C}\cdot v_R(t)$ b) $s^2 + \frac{1}{R\cdot C}\cdot s + \frac{1}{L\cdot C} = 0$

7.a) 5mA, 10mA, 1V, 0.3V b) yes, $I_{D1} > 0$
c) no, $V_{D2} > 0.7V$ d) all but I_{R1}

8.



9.a) $V_B = 2.8V$, $I_{R1} = 1.015mA$, $I_{R2} = 0.933mA$,
$R_2 = 3k\Omega$, $R_E = 171\Omega$, $V_{CE} = 6.15V$, $R_C = 630\Omega$

b) yes, VCE > 0.2V c) 150 d) 3V e) 75.6mW f) 3.69

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