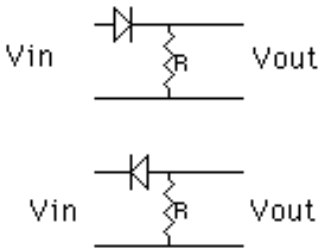
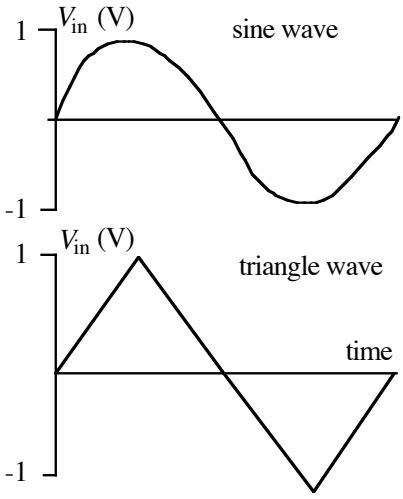
Physics 4700 Homework IV

Due: Oct 25

Note: The output is measured across the resistor after the input voltage has passed through the forward biased diode.

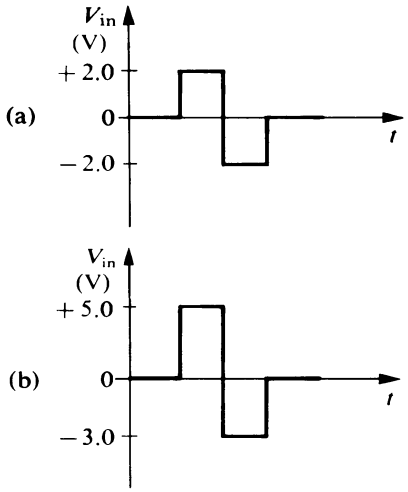
1. Given the following circuits and input waveforms sketch the output waveforms (4 waveforms in all). Assume the diodes are silicon.

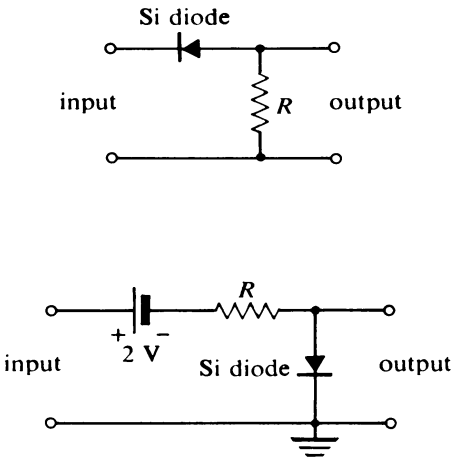




Note: The output is measured across the resistor after the input voltage has passed through the forward biased diode. In (b), how does the battery power affect the input signal?

2. Sketch the output waveform to scale for the following.

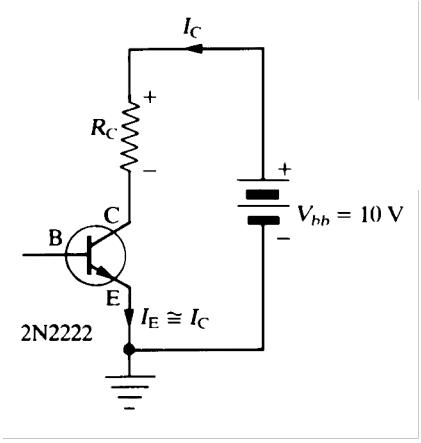




3. The simple model for a bi-polar transistor has two parameters α and β.
   a. How are I_C, I_B, and I_E related?
   b. How are I_C and I_B related in terms of α? In terms of β?
   c. How are I_C and I_E related in terms of α? In terms of β?
   d. How are I_B and I_E related in terms of α? In terms of β?

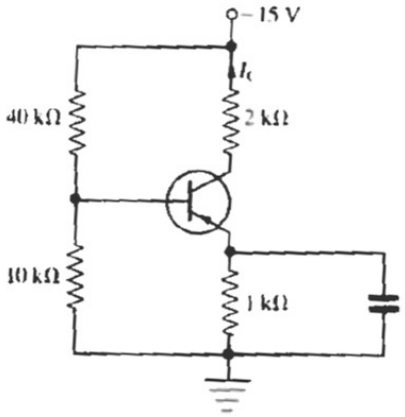
Note: Calculate the max I_C for max power and then compare the I_C due to the resistors.

4. In this problem assume that the emitter is grounded and the collector resistor is connected between the collector and power supply. Consider a transistor with a maximum power dissipation of 200 mW and a 20 V power supply. On the graph of I_C *vs.* V_{CE} sketch the maximum power curve and shade in the forbidden region of operation. Also draw the dc load line for a 2 kΩ collector resistor. Is this a safe load line? Repeat for 400 Ω collector resistor. Is this a safe load line?

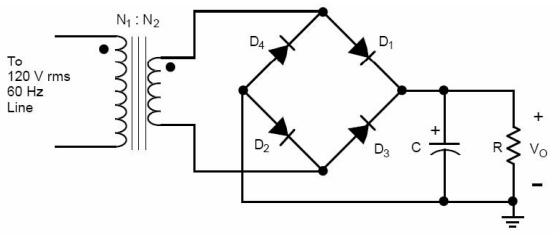


Note: The transistor is an NPN. How is I_C related to I_E? Use Kirchhoffs's law to determine V_{CE}.

5. Calculate I_C and V_{CE}. The transistor is silicon and has a β of 100.



6. Use the EasyEDA program (download free at www.EasyEDA.com and see the instruction on the web posted under the lab section) to simulate the output of a full-wave rectifier. Pick reasonable values for R and C to smooth out the 60 Hz input voltage. When you analyze the circuit with the program you will want to use the *transient* option.



Note: How does the capacitor affect the signal for a given input frequency?

7. Plot V_{out} vs. V_{in} for the following circuit if $V_{in} = V_0 \sin \omega t$, with $V_0 = 2$ V and $\omega = 360$ Hz. Assume the diode is made of silicon.