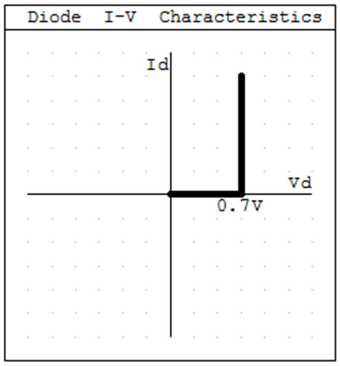
HOMEWORK SET 9

TEXTBOOK PROBLEMS:

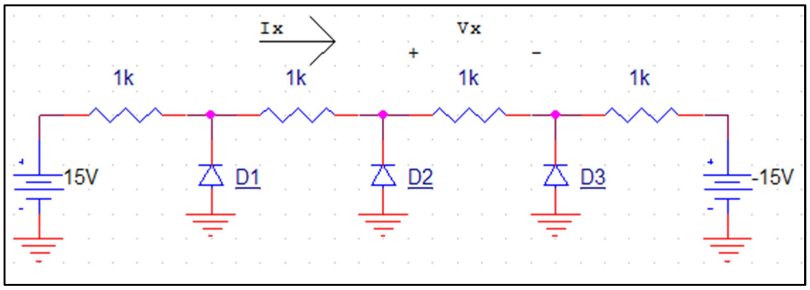
None

SUPPLEMENTAL QUESTIONS:

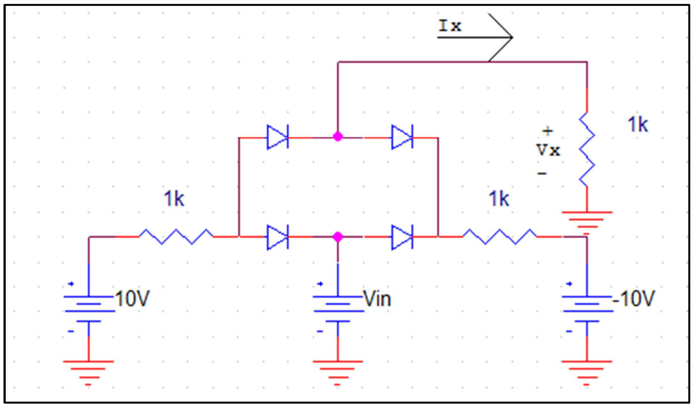
1. Given the provided diodes I-V characteristics, determine the following circuit characteristics:



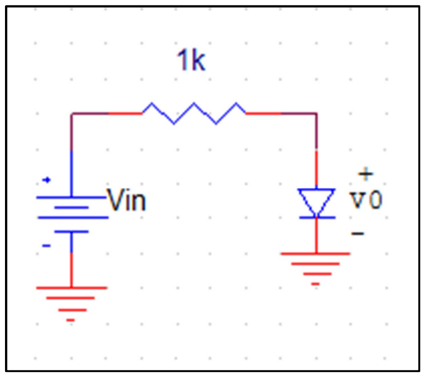
a) Find the voltage "Vx" and the current "Ix"



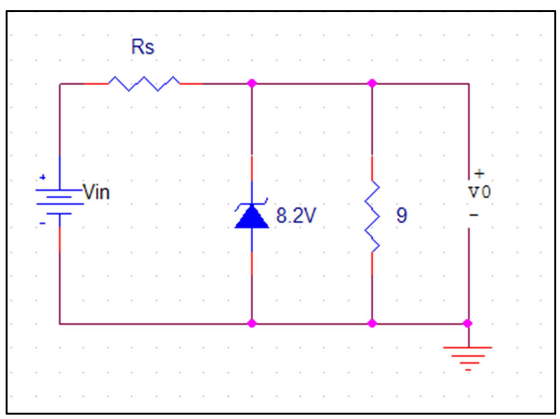
b) Plot the voltage "Vx" and the current "Ix" for Vin = [-10 to 10] V. It is recommended you use Excel or Matlab to generate the plot in 0.1V increments.



2. Consider the circuit show below and answer the following:
   a. Construct the diodes I-V characteristics assuming the diode represents a physical component with the following specifications [T = 300K, Is = 10^{-14}A, n = 1]
   b. Construct the load-line behavior of the circuit by finding the points where the diode current [I_D = 0] and the diode voltage [V_D = 0] given the supply voltage [V_{in} = 10VDC]
   c. From the chart you have just constructed, determine the quiescent operating point for this circuit
   d. Now assume that "V_{in}" includes an AC source given by: [$V_{in} = 10 + 0.5\sin(2000\,\pi\, t)$], determine the maximum and minimum diode voltage and currents

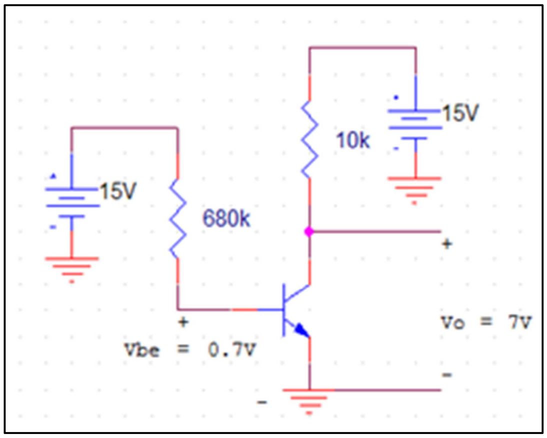


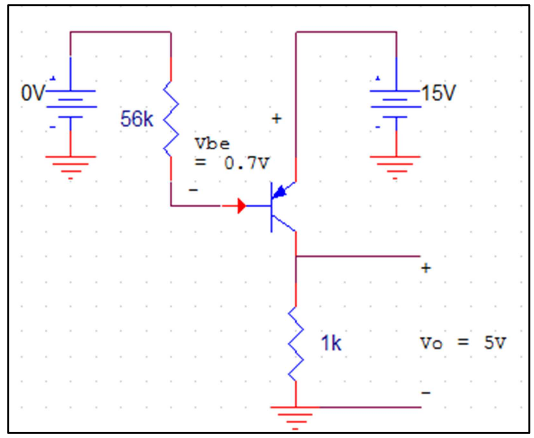
3. Consider the voltage regulator circuit shown below. The Zener diode provides a constant reverse bias voltage of [V_Z = 8.2V] for I_z = [0.75 to 1.0] A. Select the value of "R_S" so that the output voltage [V_L = 8.2V] while the input voltage "Vin" varies +/- 10% from 12V.



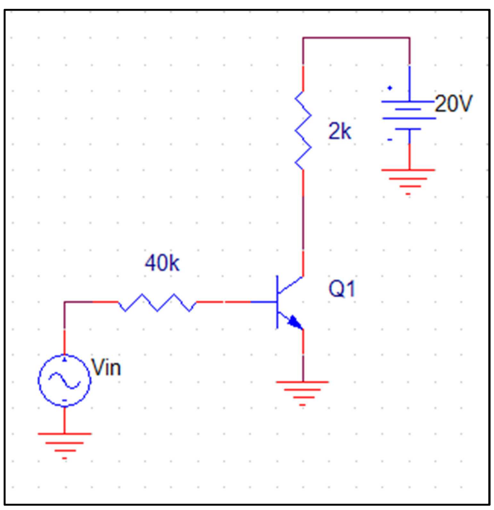
4. Design a clipper circuit to clip off the portions of an input voltage that fall above 3V or below -5V for an input voltage range between -10V to +10V. You may use Schottky diodes that approximate the ideal diode model with a [V_f = 0.7V] and any Zener diode you wish. Supply rails for your circuit are +/- 15V. Ensure that the peak currents through any diode do not exceed 1mA.

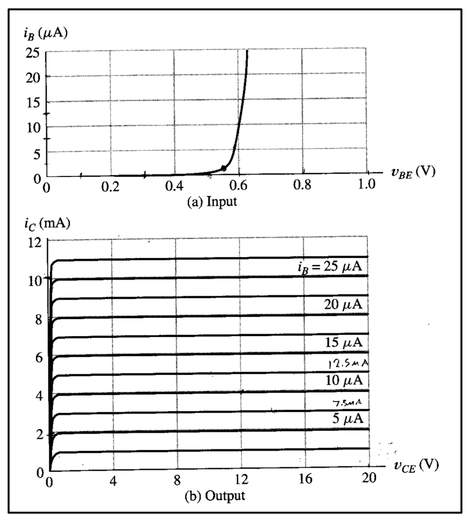
5. Determine both the current gain "β" and the collector-emitter current ratio "α" for the following circuits:





6. Consider the common emitter amplifier shown with a source excitation of [Vin = 0.8 + 0.2sin(2000 π t)]. Using the provided operating characteristics of the BJT transistor, answer the following questions:

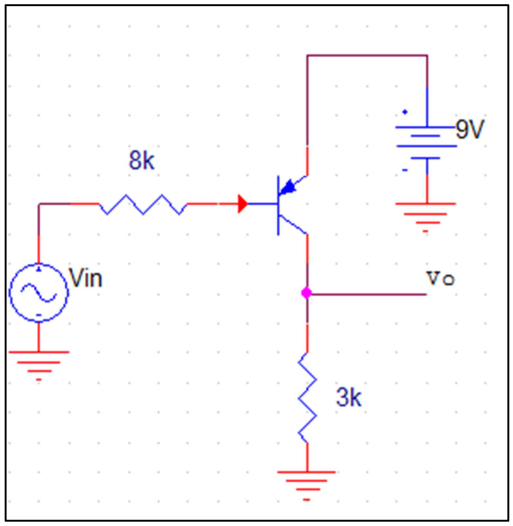




a. Construct the load-line behavior of the amplifier and determine the maximum, minimum and quiescent point (Q-point) for "I_b" and "V_{be}" and "I_c" and "V_{ce}".

b. Draw the "Vin" and "Vout" waveforms. You may want to use Matlab or Excel.

7. Consider the common emitter amplifier shown with a source excitation of [Vin = 8.2 + 0.2sin(2000 π t)]. The BJT has the following characteristics [$\beta = 50$, $I_s = 10^{-13}$A]



a. Construct the load-line behavior of the amplifier and determine the maximum, minimum and quiescent point (Q-point) for "I_b" and "V_{be}" and "I_c" and "V_o".

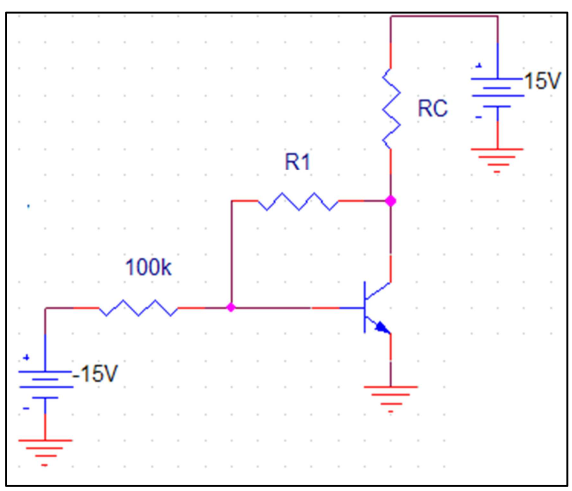
b. What is the voltage gain of the amplifier?

c. Draw the "Vin" and "Vout" waveforms. You may want to use Matlab or Excel.

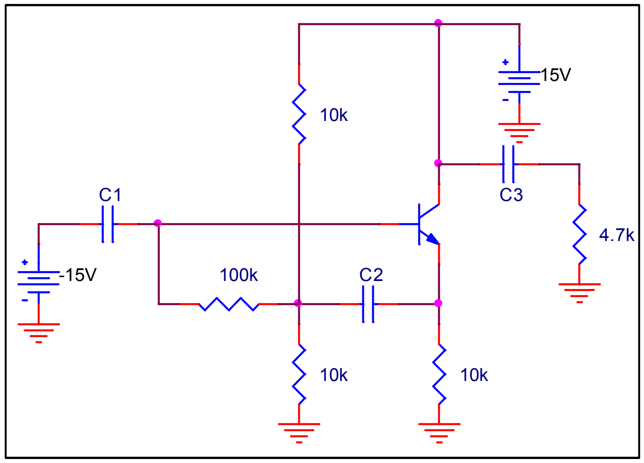
d. Simulate your results using PSPICE and verify your analysis. Be sure and explain the root cause of any discrepancies.

e. Explain the differences in the signal characteristics from Question-2

8. Consider the common emitter amplifier with negative feedback as shown where the BJT has the following characteristics [$\beta = 100$, $V_{be} = 0.7V$]. If a bias point of [$V_{ce} = 0.5V$] and [$I_C = 2mA$] are required, determine the value of "R1" and "R_C".



9. Consider the amplifier shown below and answer the following questions considering the BJT has the following characteristics [$\beta = 200$, $V_{beqQ} = 0.7V$]. You can assume that each capacitor is sufficiently large to look like an AC short circuit.



a. Draw the small-signal equivalent circuit

b. Determine the voltage gain

c. Determine the input impedance