EE 355 Analog Electronics Name _____
Test 2 November 9, 2017

RULES

This is a closed book, closed notes test. You are, however, allowed one piece of paper (both sides, hand-written) for notes and definitions. You must staple your equations sheet to the back of your test when you hand your test in.

You are permitted to use a calculator.

You have 75 minutes to complete the test. Please read through the entire test before starting, and read through the directions carefully. To receive partial credit, you must show your work.

I you have any questions, please raise your hand, and I will come to you to answer them. Do not hesitate to ask questions.

Circle/box all of your answers.

Use the following parameters unless otherwise specified

Diode Parameters

$V_{ON} = 0.7$, $V_Z = 5.6V$, $n = 1$, $I_0 = 0.1pA$

Transistor Parameters

$\beta = 99$, $V_{BE,ON} = 0.7V$, $V_{CE,SAT} = 0.2V$
$V_{EB,ON} = 0.7V$, $V_{EC,SAT} = 0.2V$
$V^+ = 10V$, $V^- = -10V$
$U_T = 26mV$, $V_A = 100V$

Problem	Value	Score
1	20	
2	10	
3	20	
4	25	
5	25	
Total	100	

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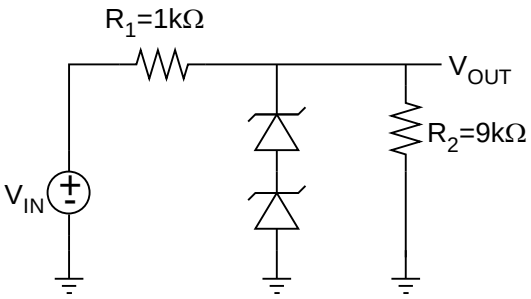
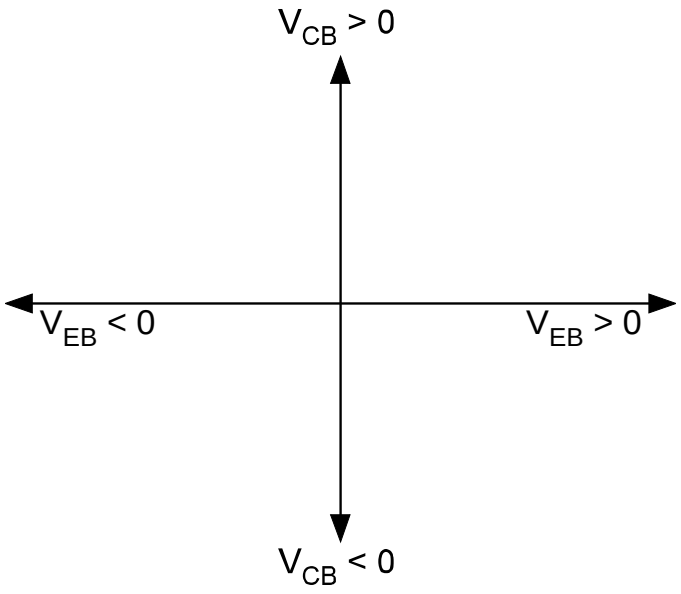
PROBLEM 1 (20 Points)

For the following circuit, sketch V_{OUT} versus V_{IN} as V_{IN} varies from 0 to 20V.
(Note. x-axis = V_{IN} and y-axis = V_{OUT})



PROBLEM 2 (10 Points)

A. For a pnp BJT, label the region of operation for each quadrant of the figure below. (5 Points)

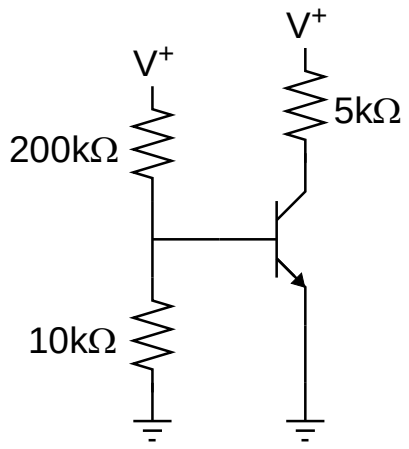


B. For an npn BJT, sketch the DC collector current for three values of base current, I_B = 1mA, 2mA, 3mA. Label the regions of operation (and the boundaries between them). For this problem, you may let $V_A=\infty$. Provide as many numerical values on the plot as possible. (5 Points)

PROBLEM 3 (20 Points)

For the following two circuits, determine which region of operation the transistor is in and determine its operating point (all terminal voltages and currents). Write your answers on the lines that have been provided.

A. (10 Points)



Region of Operation _____

V_B = _____

V_E = _____

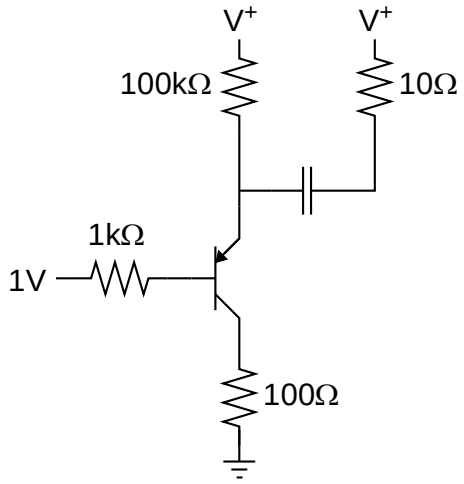
V_C = _____

I_B = _____

I_E = _____

I_C = _____

B. (10 Points)



Region of Operation _____

V_B = _____

V_E = _____

V_C = _____

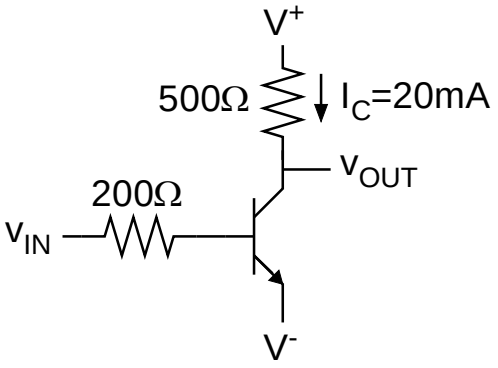
I_B = _____

I_E = _____

I_C = _____

PROBLEM 4 (25 Points)

Use the following circuit for this problem. The DC value of v_{IN} is not provided. Assume the transistor is in forward-active mode.



A. Calculate the transconductance of the transistor. (3 Points)

B. Calculate r_π term of the transistor. (3 Points)

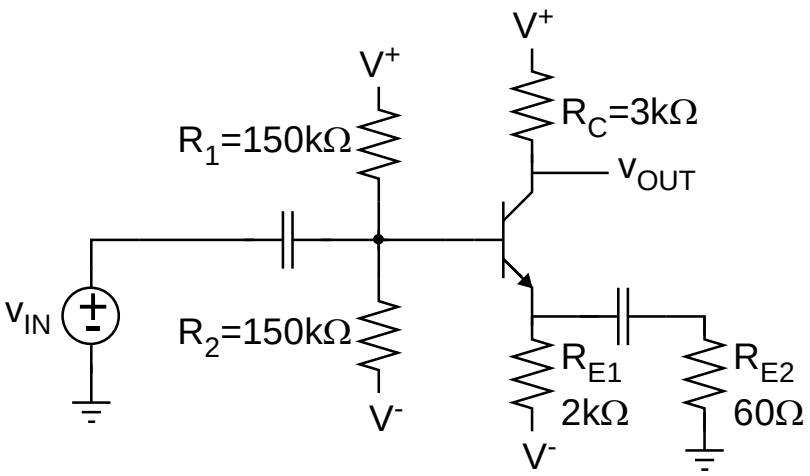
C. Calculate r_o term of the transistor. (3 Points)

C. Draw the small-signal equivalent circuit for this amplifier (Hint. Use the hybrid-π model). (8 Points)

D. Calculate the small-signal voltage gain for this circuit. (8 Points)

PROBLEM 5 (25 Points)

For the following circuit, calculate the small-signal voltage gain. Let $V_A=\infty$ for this problem.



(Extra Work Page for Problem 5)