UNIVERSITY OF CALIFORNIA, SAN DIEGO

Electrical and Computer Engineering Department

ECE 65 – Winter 2019

Components and Circuits lab

Midterm Exam

Closed books, two double-sided cheat sheets, and calculators are allowed

Electronic devices are not allowed.

Please put all answers in the answer sheets.

The question sheet will not be graded.

Be sure to write your name and PID on **all pages of the answer sheets**.

Please do not begin until told. Show your work. Good luck.

All electronic devices including cell phones must be turned off and stored away in a backpack or a purse. Anyone caught with such a device on their person during the exam will be charged with academic dishonesty.
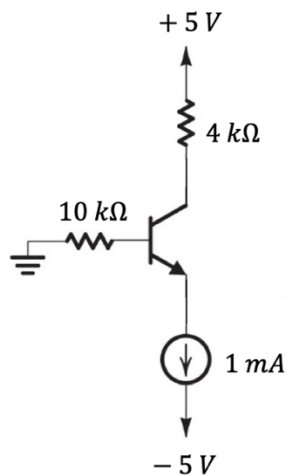
Problem 1. (10 points)

In the following op-amp circuit, the output voltage, V_o, can be varied by turning the wiper of the $100\ k\Omega$ potentiometer.

    a) Find the range over which V_o can be varied.

    b) If the potentiometer is a "10-turn" device, find the change in V_o corresponding to each turn of the pot.

Assume an ideal op-amp with $V_{sat} = \pm 10V$ and $I_{out_{max}} = 20\ mA$.
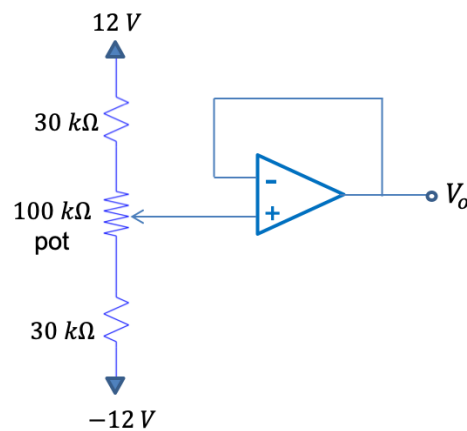
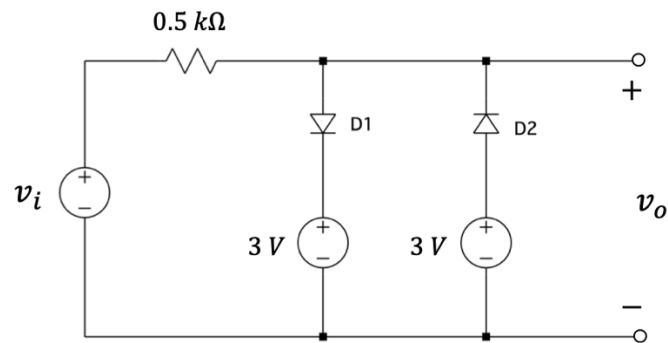

Problem 2. (10 points)

In the following circuit, <u>find</u> the values of the collector, base and emitter currents and the collector, base and emitter node voltages. Assume $\beta = 100$, $V_{D0} = 0.7\ V$, $V_{sat} = 0.2\ V$.
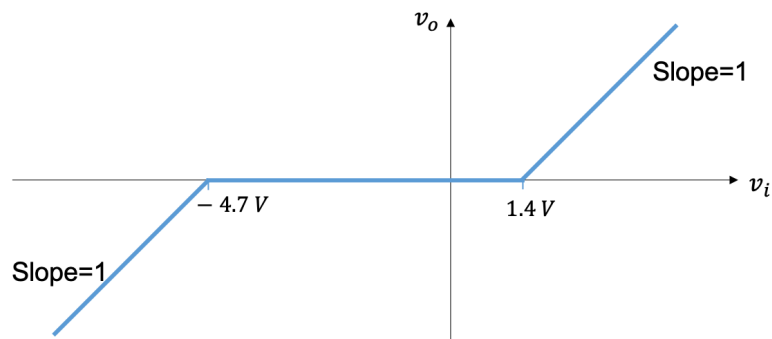
Problem 3. (10 points)

Part a. (8 points)

    I.   <u>Find</u> and <u>Draw</u> the transfer function (v_o vs v_i) for the below circuit. Assume $V_{D0} = 0.7\ V$.

    II.   Sketch the output waveform for input signal $v_i = 5\sin(\omega t)$.

Part b. (2 points)

<u>Design</u> a two-port network using diodes (a diode waveform shaping circuit) that would result in the following transfer function.

Assume you have access to PN junction diodes with $V_{D0} = 0.7\ V$ and Zener diodes with $V_Z = 4\ V$. You can use DC voltage sources and any other circuit elements in your design, but you **must use Zener diode(s)** in your design.