UNIVERSITY OF CALIFORNIA, SAN DIEGO

Electrical and Computer Engineering Department

ECE 65 – Spring 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 provided sheets.

Be sure to write your name and PID on **all pages**.

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)

Consider an op-amp connected in the inverting configuration to achieve a closed-loop gain of 40 dB (this is the absolute value of the voltage gain) using $1\ k\Omega$ and $100\ k\Omega$ resistors. A load resistance R_L is connected from the output to ground. A sine-wave signal of peak amplitude V_P is used as the input signal.

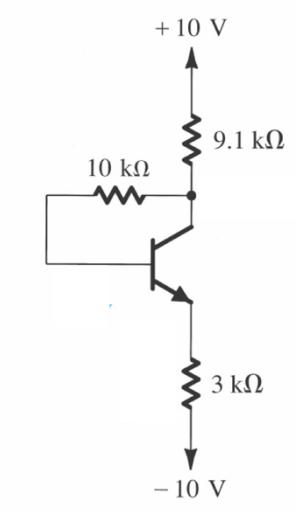
Assume an ideal op-amp with $V_{sat} = \pm 10V$ and $I_{out_{max}} = 20\ mA$, and answer the following questions. Show your work.

a) For $R_L = 400\ \Omega$, what is the maximum possible V_P while an undistorted output sinusoidal signal is obtained?

b) If it is desired to obtain an output sinusoidal signal with a peak amplitude of $10V$, What values of R_L are allowed?

Problem 2. (10 points)

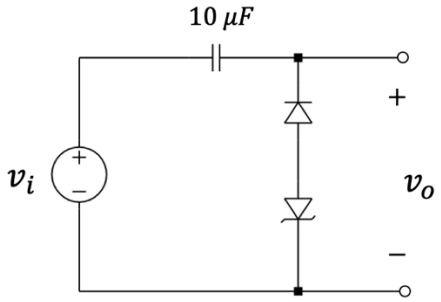
In the following circuit, find the values of the collector, base and emitter currents and the collector, base and emitter node voltages. Assume $\beta = 100,\ V_{D0} = 0.7\ V, V_{sat} = 0.2\ V$.



Problem 3. (10 points)

In the circuit below, $v_i(t) = 4\ sin\ (\omega t)$ where $\omega = 1000$ rad/s, $v_c(0) = 0$, $v_o(0) = 0$.

Use $V_{D0} = 0.7\ V$, $V_Z = 2.3\ V$.



a) What is the value of $v_o(t)$ at t = 2 ms?

b) What is the value of $v_o(t)$ at t = 6 ms?