1. Consider the schematic given at the right in which the rail voltages are ±15V, R1=R2=R3=R4= 1k. Assume that a forward-biased diode has a drop of .7 volt and the Zener diode breaks down at 5 Volts.

a. (20) Find Va, Vb, Vc, and Vd if Vin = 5V.

b. (5) Find the current in R4 if Vin = 5V.

c. (5) What is the operating mode of the transistor if Vin = -1V?

d. (5) Given limitations of real op amps, why is it not possible for Q1 to saturate?

e. (5) If Vin = 1 V, find Vd.
2. In the given circuit, $V_1=7.1\, \text{V}$, $R_2=100\, \text{K}$, $R_1=1\, \text{K}$, $V_2=15\, \text{V}$ and the Zener diode has a breakdown voltage of 5 volts. The transistor has a $\beta$ of 100.

a. (10) Find $I_B$.
b. (10) Find $I_C$.
c. (10) Find $V_{CE}$.
d. (10) What is the current in $D_5$?
e. (10) What is the operating mode of the transistor?
f. (10) Suppose that $V_1=30\, \text{V}$. What is $V_{CE}$ now?