Show all work in the allotted space for each problem and circle each answer. No other material will be accepted for test answers.

1. Consider the schematic given at the right in which $V_1 = 2V$, $V_{cc} = 15V$, $R_1 = 1k$ and $RL = 50$ ohm. Assume that a forward-biased diode has a drop of .7 volt.

a. (20) Find $V_a$, $V_b$, $V_c$, and the current in $R_1$ if $Vin = 4V$ and $I_1 = 1 ma$.

b. (10) Estimate $V_b$ if $Vin = 20V$.

c. (10) Very briefly describe how the circuit would perform if the base and emitter of Q1 were shorted.
2. In the given circuit, \( V_1 = 10V, \) \( V_2=20V, \) \( R_1=100K, \) \( R_3=.5K \) and the Zener diodes have a breakdown voltage of 3.6 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 operating mode of the transistor?
   e. (10) Suppose that \( R_C = 10K. \) What is \( I_C \) now?
   f. (10) What is the operating mode of the transistor now?