1. Consider the given circuit, $\beta = \beta_0 = 100$, $I_{CQ2}$ is 1 mA, $R_1 = R_2 = R_3 = 10K$, and $V_{CC}$ is 15V.

   a) (10) What is $V_{CEQ2}$?
   
   b) (10) What is $I_{BQ1}$?
   
   c) (10) What is $A_{VDM}$?
   
   d) (10) What is the value of the negative supply $-V_{CC}$?
   
   e) (10) What would you modify (except supply voltages) to double the input impedance of this amplifier in differential mode?
2. You are to design a 20 W Class B public address amplifier with two .5 V inputs that will operate off of a pair of 6 Volt batteries. Assume that available op amps can come within .3V of the rail voltage.

a) (10) Draw your circuit showing component values and biasing. Note that sufficient gain must be provided to obtain maximum power output. Design your circuit so the low-frequency response goes down to DC.

b) (10) What component is likely to limit high-frequency response in your circuit? If more bandwidth is needed, how could it be increased?

c) (10) What is the maximum impedance of the speaker (load) that still meets the power requirement?

d) (10) Given that class B amplifiers have distortion, explain how your circuit minimizes the problem. Class AB operation is not an option here.

3. (10) Using 3 PMOS and 3 NMOS transistors, draw a schematic diagram for a 3-input CMOS NOR gate.