1) Shown below is a diff amp with an input large enough to drive the amplifier into nonlinear operation.

![Diff Amp Diagram](image)

A) Let Vin = +1 volt and find V1 and V2
B) Let Vin = -1 volt and find V1 and V2.

2) Shown below is a diff amp which will be used as a linear amplifier. All the transistors are in their active region. Assume $\beta = 50$, $V_{BE} = 0.7$ and all the transistors are matched.

![Diff Amp Diagram](image)

A) Find the value of $V_B$ which is needed to make this amplifier work as a diff amp. Assume $\beta = \infty$ for this part of question 1.
B) Find R so that the gain $V_o/V_i = 5$. *(HINT: R SETS g_m)*
C) Find $Z_{in}$ and $Z_{out}$.
3) 

A) Find $V_{eq}$ in terms of $R_c$, $Re$, etc. Assume $\beta = \infty$.

\[ \beta = \infty \]

B) Find the gain $= \frac{V_o}{V_{in}}$ and $\text{Zin}$ in terms of $R_c$, $R_T$, etc. Assume $\beta = 50$.

\[ \beta = 50 \]
4) The circuit shown below is a diff amp biased up with a current mirror. The current through Q2 is given as 4 mA. The input voltage consists of an AC source, Vd, and a DC common mode source, VCM. The output is connected to a load resistor, RL = 500Ω

A) Find R and find Vcq, the collector quiescent voltage. (Assume β= ∞)

B) Find +VCMR and -VCMR. Assume β = ∞, RE = Rb = 0 (+/-VCMR is the maximum and minimum value that the voltage source VCM can have and still have a working diff amp.)

C) Find the Gain = vo/vd, ZIN, and Zo. Is the gain negative or positive. (Assume β = 100, RE = 10 Ω and Rb = 1k)

5) The circuit shown below is similar to the diff amp shown above but the output feeds an emitter follower. This will change the gain and output impedance. Find Zo and the Gain = v0/vd for the circuit shown below.