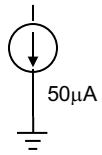
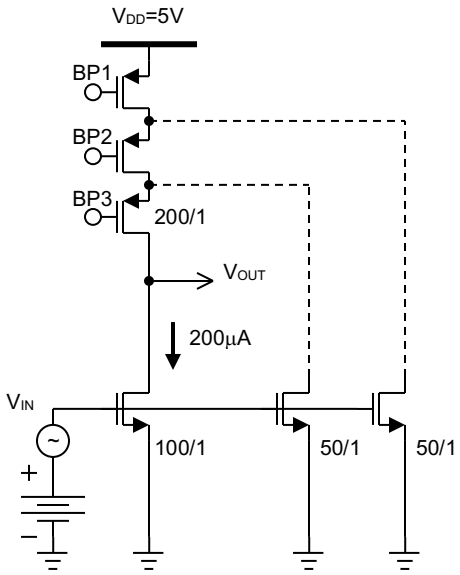
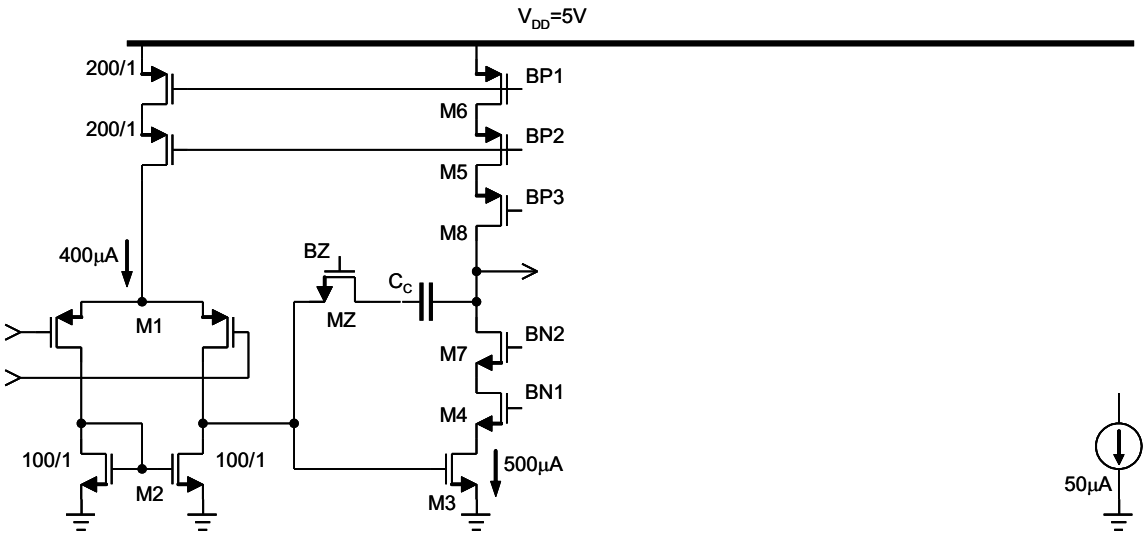
Assuming that the dashed lines are *not* connected, design the bias circuit for BP1/BP2/BP3, and specify all transistor sizes in the bias circuit and the top two PMOS transistors currently unspecified [15pts]. Now, considering the dashed line connection, specify which transistor dimensions must change (and to what W/L ratio) to maintain optimal biasing [10pts].

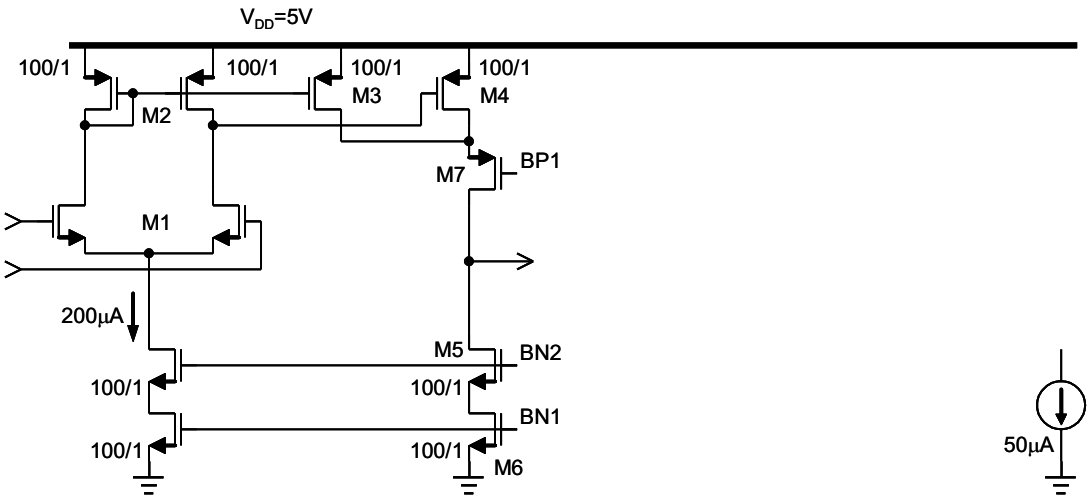




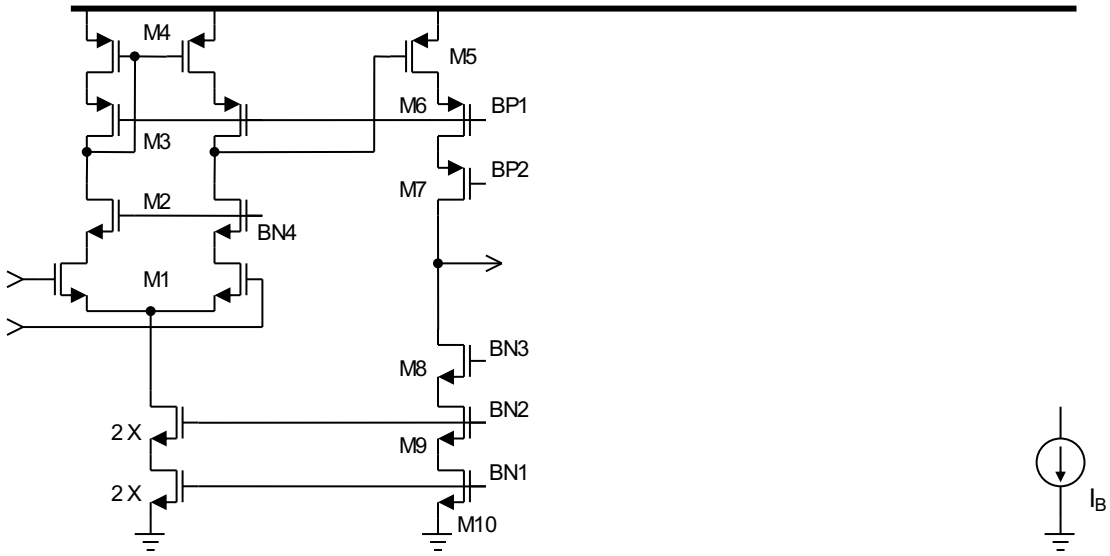
Design the bias circuit for BP1/BP2/BP3/BN1/BN2 and specify appropriate transistor sizes. Maks sure no systematic offset results from transistor sizing. *Assuming W/L of MZ is half that of M3*, design the bias for BZ such that RHP is canceled. Find the approximate input to output small-signal gain (expression only).



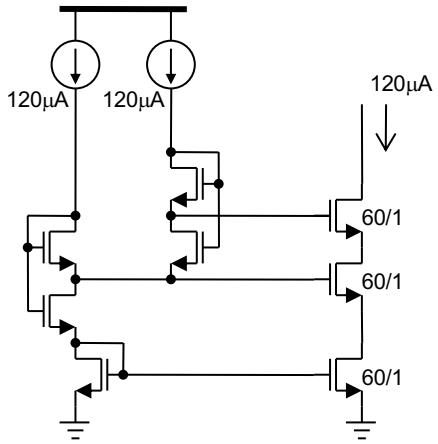
Design the bias circuit for BN1/BN2/BP1 and specify W/L of M7. Find the input to output small-signal gain (expression only).



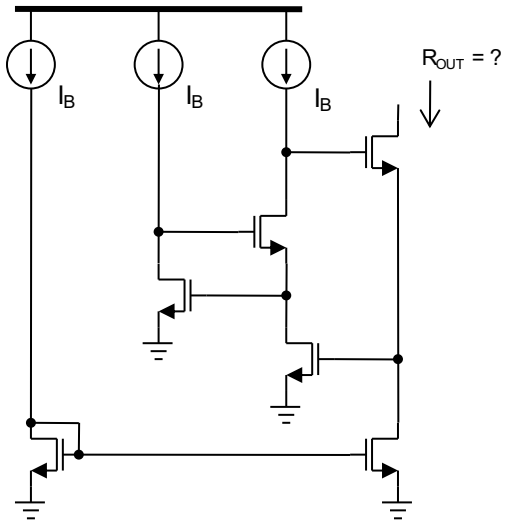
Design the bias circuit for BP1/BP2/BN1/BN2/BN3/BN4. They are 1X devices unless specified otherwise (e.g. 2X). Find the approximate input to output small-signal gain (expression).



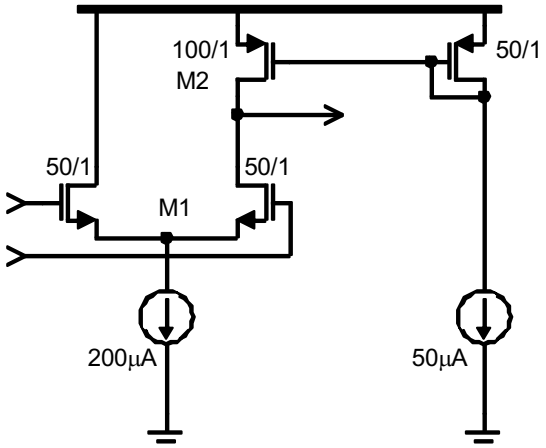
Specify W/L dimensions for the five biasing transistors for optimum biasing.



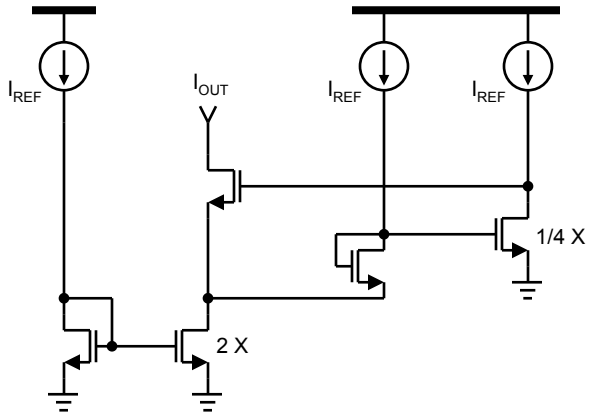
Find the equivalent small-signal output resistance (expression). They are all 1X devices.



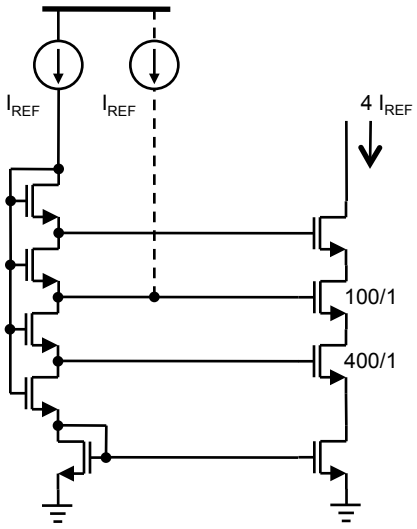
Find the Norton equivalent “Gm” and “Rout”.



What is the resulting output current I_{OUT}? Find (expressions with V_T's and Δ's) all node voltages, and the output resistance (expression - label transistors as needed) of the current source. Assume 1X devices unless specified otherwise (e.g. 2X).



First, ignore the dotted current source, and appropriately size the transistors. Now include the dotted current source, and re-size the transistors as needed. Device sizes already specified must be kept as is.



Find the Norton equivalent small-signal Gm and Rout (expression). Assume 1X devices unless specified otherwise (e.g. 2X). Assume V_{DC} is large enough (and not too large) to keep all transistors in saturation.