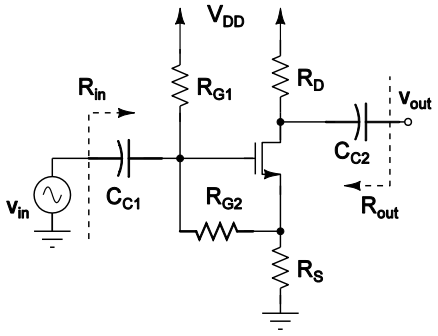
For all BJTs, assume: $|V_{BE,on}| = 0.7V$, $\beta = 100$, and $|V_{CE,sat}| = 0.1V$ (use $V_T = 25mV$).

For all MOSFETs, assume: $|V_{TH}| = 1V$ and $\mu\, C_{ox} \frac{W}{L} = 1000 \frac{\mu A}{V^2}$.

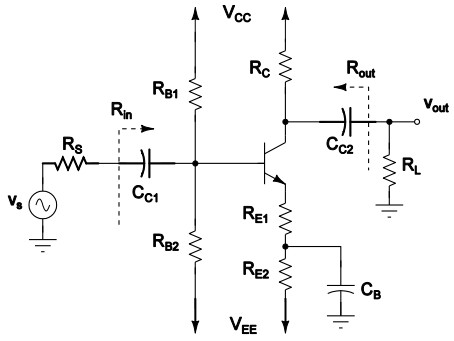
Q1: Consider the circuit shown to the right. Assume $\frac{W}{L} = 100$, $R_{G1} = 82k\Omega$, $R_{G2} = 18k\Omega$, $R_{S1} = 200\Omega$, $R_D = 15k\Omega$, and $V_{DD} = 10V$.



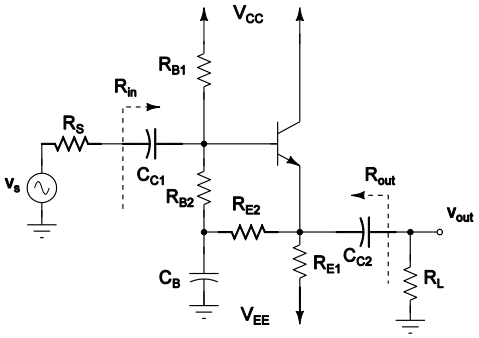
a) What is the DC drain current, I_D, for the transistor?
b) What are the minimum and maximum voltages (i.e., voltage swing) at the drain terminal of the transistor?
c) Draw the small signal equivalent circuit and calculate g_m.
d) What is the voltage gain, $A_v = \frac{v_{out}}{v_{in}}$, for the circuit?
e) What are the input and output resistances of the circuit as indicated on the schematic.

Q2: For the circuits shown below, assume the transistors are biased with $I_C = 1mA$ in the active region. Draw the AC (not small-signal) circuit for each case and identify each stage. Calculate the overall voltage gain, $A_v = \frac{v_{out}}{v_s}$, input resistance R_{in}, and output resistance R_{out} for each circuit using formulas provided inside the cover of the textbook. Write down the full expressions before inserting component values.

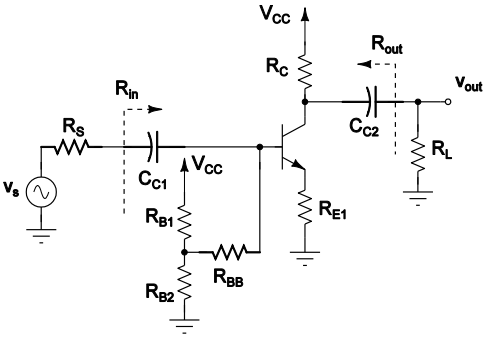
Resistor values are: $R_{B1} = R_{BB} = 100k\Omega$, $R_{B2} = 50k\Omega$, $R_S = 10k\Omega$, $R_{E1} = R_{E2} = 1k\Omega$, $R_C = 5k\Omega$, and $R_L = 10k\Omega$.



(a)



(b)



(c)

Q3: For the circuits shown below, assume the transistors are biased with $I_D = 1mA$ in the active region. Draw the AC (not small-signal) circuit for each case and identify each stage. Calculate the overall voltage gain, $A_v = \frac{v_{out}}{v_s}$, input resistance R_{in}, and output resistance R_{out} for each circuit using formulas provided inside the cover of the textbook. Write down the full expressions before inserting component values.

Resistor values are:

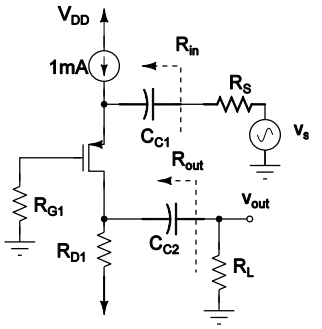
$R_{G1} = R_{G2} = 500k\Omega$,

$R_{D1} = R_{D2} = 10k\Omega$,

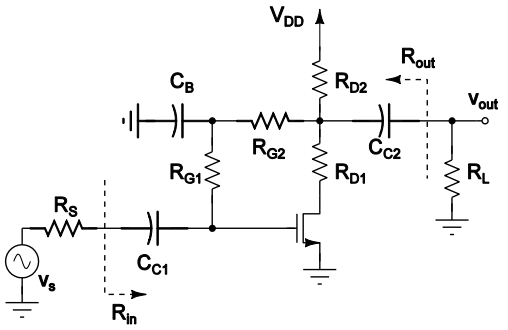
$R_{S1} = 5k\Omega$,

$R_L = 2k\Omega$, and $R_S = 100k\Omega$.

Note: The current source for circuit *a* is a DC current source.



(a)



(b)