PROBLEM SET #9

Issued: Friday, October 26, 2018

Due: Friday, November 2, 2018, at 12:00 noon via Gradescope.

1. Sedra & Smith, Problem 10.2
2. Sedra & Smith, Problem 10.6
3. Sedra & Smith, Problem 10.29
4. For the amplifier in Figure PS9.1, assume that M_1 has the properties listed in Table PS9.1. First, find values for each of the MOSFET internal capacitances C_{GS}, C_{GD}, C_{DB} and C_{SB} assuming that the body terminal is grounded. Then find the voltage gain A_v, the current gain A_i, input and output resistances R_{in} & R_{out}, upper and lower corner frequencies f_L & f_H, and the maximum amplitude of the signal source v_s.

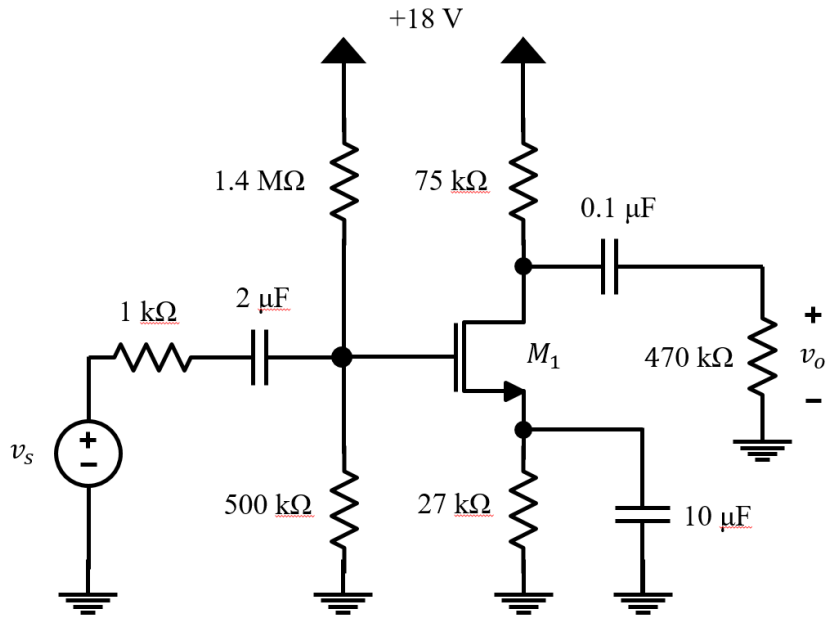

Figure PS9.1

PARAMETER	*VALUE*	*UNIT*
W	10	μm
L	1	μm
μ_n	450	$cm^2/(V \cdot s)$
C_{ox}''	0.5	$fF/\mu m^2$
V_{tn}	1	V
L_{ov}	0.05	μm
C_{db0}	20	fF
C_{sb0}	20	fF
V_0	0.7	V

Table PS9.1

5. For the amplifier in Figure PS9.2, assume that Q_1 has $\beta = 125$, V_A =50 V, $C_{jc,0}$ = 1.0 pF, $C_{je,0}$ = 3.5 pF, $V_{bi,c}$= 0.9V, $V_{bi,e}$= 1.0V, and τ_F = 1 ns. You should also calculate the collector-to-substrate capacitance C_{CS} assuming $C_{cs0} = 20$ fF and $V_{bi(collector-substrate)} = 0.65$ V. Find A_v, A_i, R_{in}, R_{out}, f_L, f_H and the maximum amplitude of the signal source v_s.

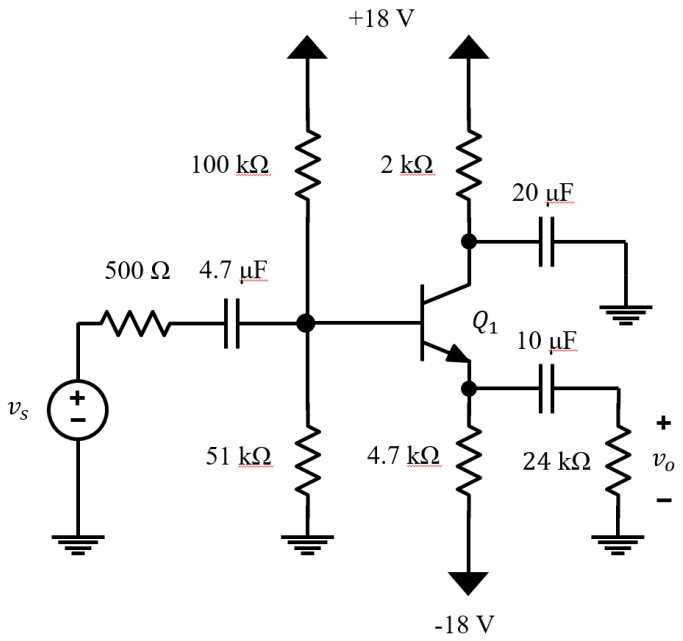

Figure PS9.2

6. For the amplifier in Figure PS9.3, assume that M_1 has $k_p = 200$ μA/V^2 and $V_{tp} = -1$ V. Find A_v, A_i, R_{in}, R_{out} and the maximum amplitude of the signal source v_s.

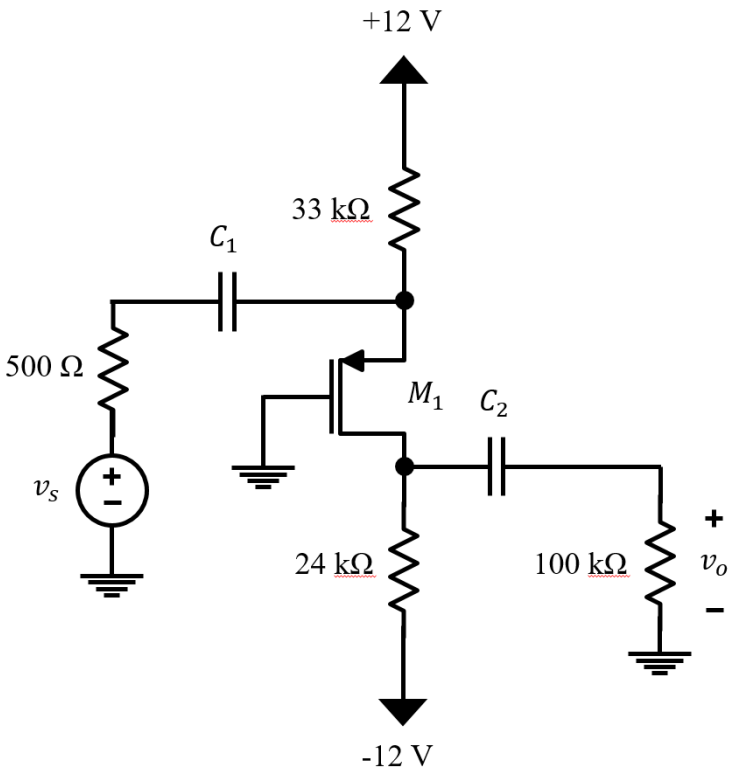

Figure PS9.3

7. A single-transistor amplifier is needed that has a gain of 52 dB and an input resistance of 1 MΩ. What is the preferred choice of amplifier topology? Explain your reasoning for making this selection.

8. A single-transistor amplifier is needed that has a gain of approximately 0 dB and an input resistance of 25 MΩ with a load resistor of 10 kΩ. What is the preferred choice of amplifier topology? Explain your reasoning for making this selection.

9. A single-transistor amplifier is needed that has a gain of approximately +10 V/V and an input resistance of 2 kΩ. What is the preferred choice of amplifier topology? Explain your reasoning for making this selection.