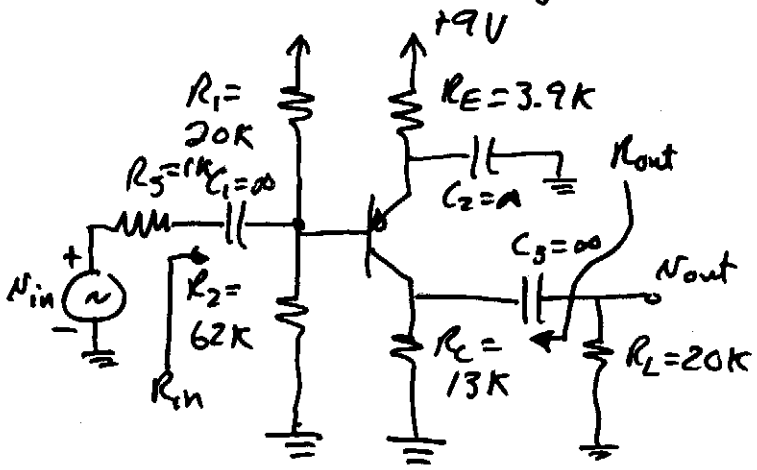
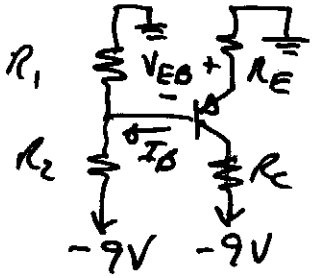
PNP, CE Inverting Amplifier



If $\beta_F = \beta_o = 135$ and $V_A = 100V$ find the small signal $\frac{V_{out}}{V_{in}}$, R_{in}, and R_{out}.

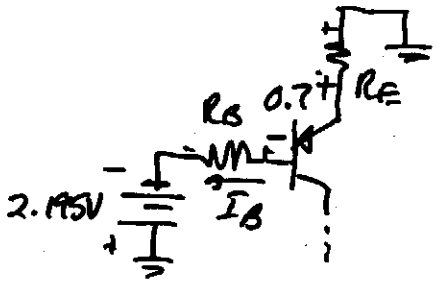
1.) Q-point Assume $V_{EB} = 0.7V$



$$V_{BB} = V_{TH} = -9V\left(\frac{R_1}{R_1+R_2}\right) = \frac{-9.20}{82}$$

$$V_{BB} = -2.195V$$

$$R_B = R_{TH} = R_1 \| R_2 = 20K \| 62K = 15.12K\Omega$$



$$I_B = \frac{2.195 - 0.7}{R_B + (1+\beta_F)R_E} = \frac{1.495}{15.12K + (136)3.9K}$$

$$I_B = 2.75\mu A \rightarrow I_C = 0.37mA$$

$$2.195V = I_B R_B + 0.7 + I_B(1+\beta)R_E$$

$$-1.454$$

$$V_{EC} = 9 - 4.81_{\Lambda} = 2.736V$$

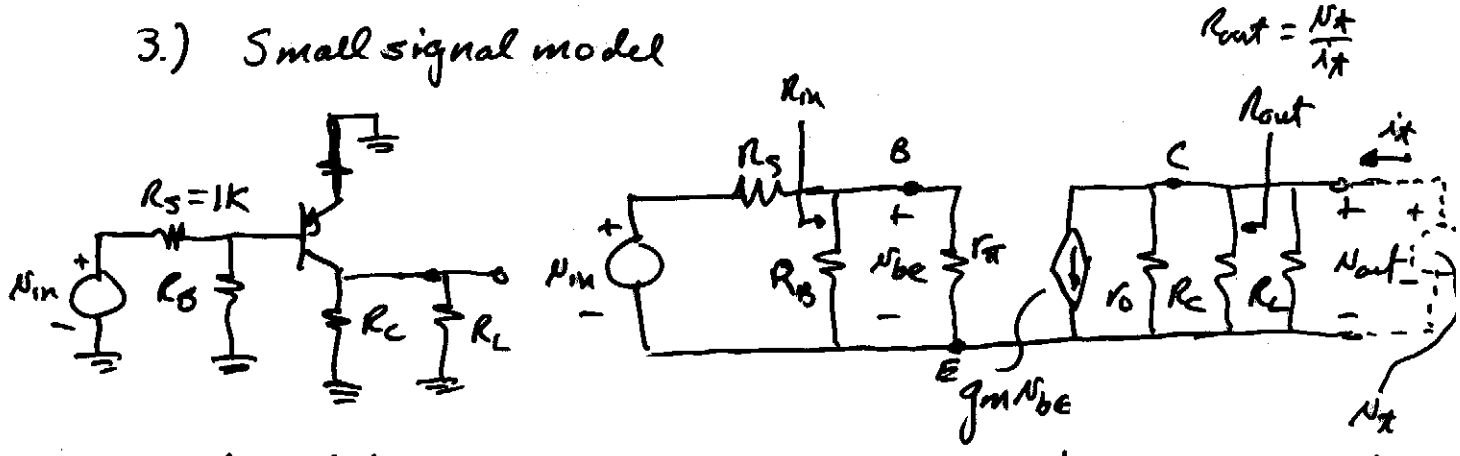
$$V_{EC} = 9 - I_C R_C - I_E R_E$$

$$I_E = 0.373mA$$

2) $g_m = \frac{I_C}{V_T} = \frac{0.37mA}{25mV} = 14.8mS$ $\quad r_\pi = \frac{\beta_F}{g_m} = \frac{136}{14.8}K = 9.12K$

$$r_o = \frac{V_A + V_{EC}}{I_C} = \frac{100 + 2.736}{370\mu A} = 278k\Omega$$

3.) Small signal model



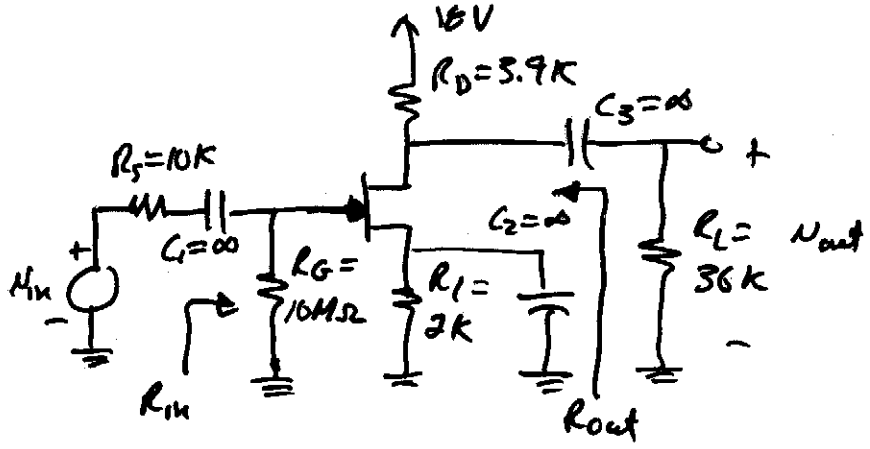
$R_{in} = R_B || r_\pi = 5.69 k\Omega$

$R_{out} = r_o || R_C || R_L \doteq 12.42 k\Omega$

$$\frac{V_{out}}{V_{in}} = \left(\frac{V_{out}}{V_{be}}\right)\left(\frac{V_{be}}{V_{in}}\right) = (-g_m R_{out})\left(\frac{R_{in}}{R_S + R_{in}}\right)$$

$$= (-0.0145)(12.42 k\Omega)\left(\frac{5.69K}{6.69K}\right) = -96.44 \text{ V/V}$$

JFET CS Inverting Amp



$I_{DSS} = 5mA$, $V_p = -5V$

Find R_{in}, R_{out}, & $\frac{V_{out}}{V_{in}}$

$I_D = 1.25mA$

$V_{DS} = 10.6 V$

$g_m = 1.1mS$ $r_o = 48.5 K$

$R_{in} = R_G = 10 M\Omega$, $R_{out} = 3.61 K\Omega$

$$\frac{V_{out}}{V_{in}} = -3.605 \frac{V}{V}$$