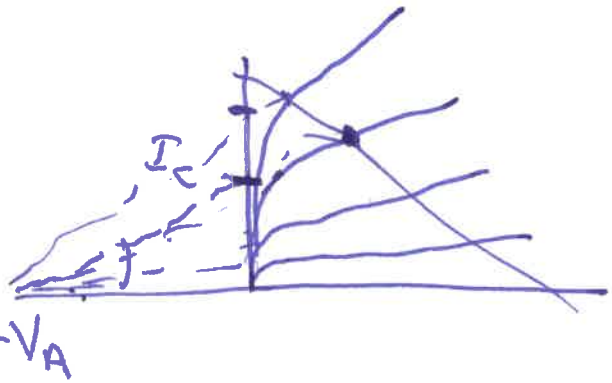
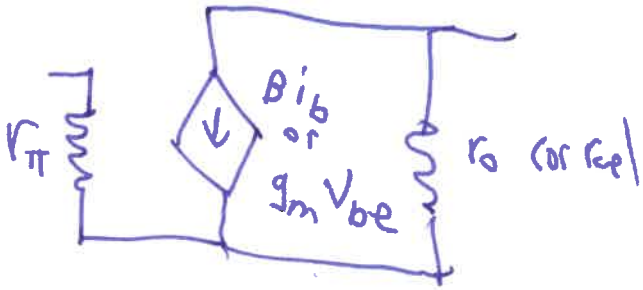


Early Voltage

$$r_o = \frac{V_A}{I_C}$$

r_o or r_{ce}

$$= \frac{dV_{CE}}{dI_C}$$ (inverse slope)

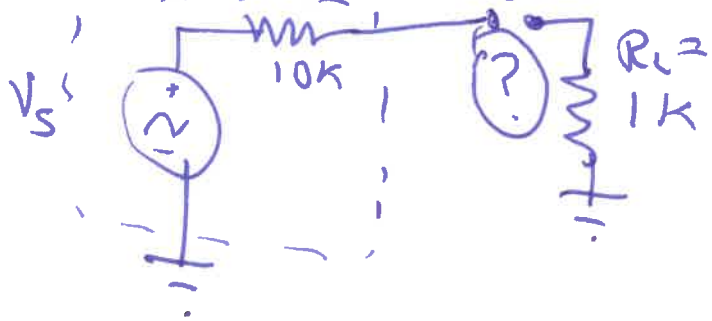


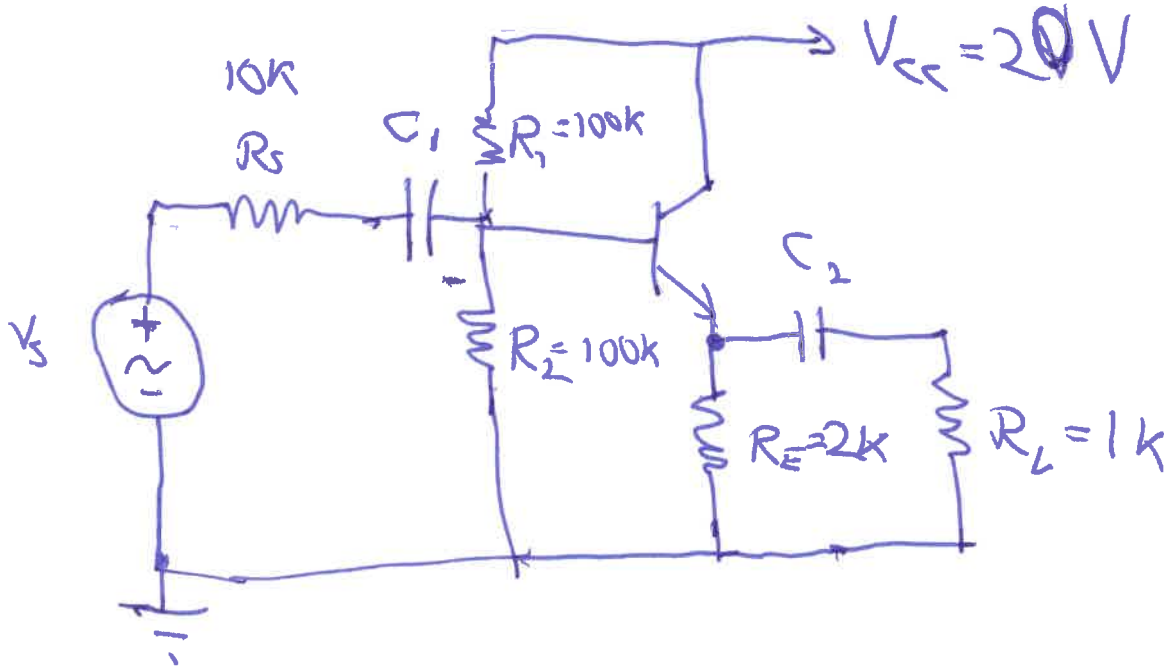
BJT Amplifiers

$$A_i \approx A_v \frac{R_{in}}{R_L}$$

	In	Out	
Common Emitter	B	C	Voltage Gain and Current Gain
Common Collector (Emitter Follower)	B	E	$A_V \approx 1$
Common Base	E	C	$A_i \approx 1$

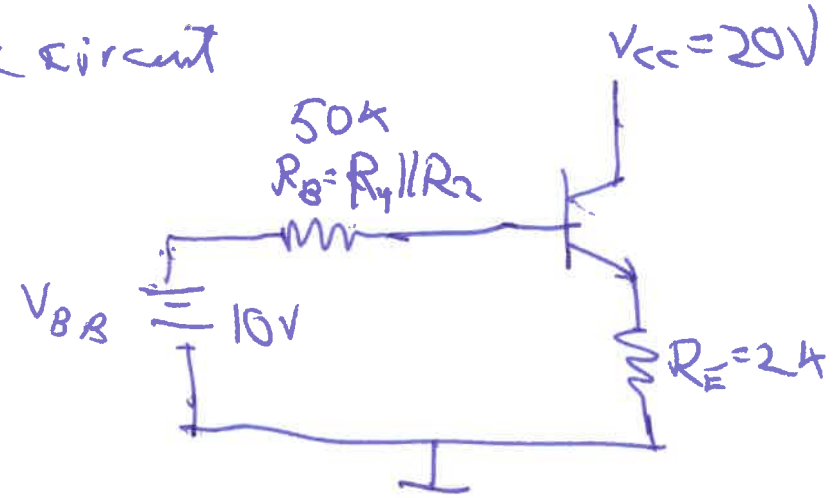
Why Common Collector





4 - Resistor circuit with $R_L=0$

DC circuit



$$V_{BB} = V_{cc}\frac{R_2}{R_1+R_2} = 10V \qquad i_{sc} = V_{cc}/R_1$$

$$R_B = R_1 \| R_2$$

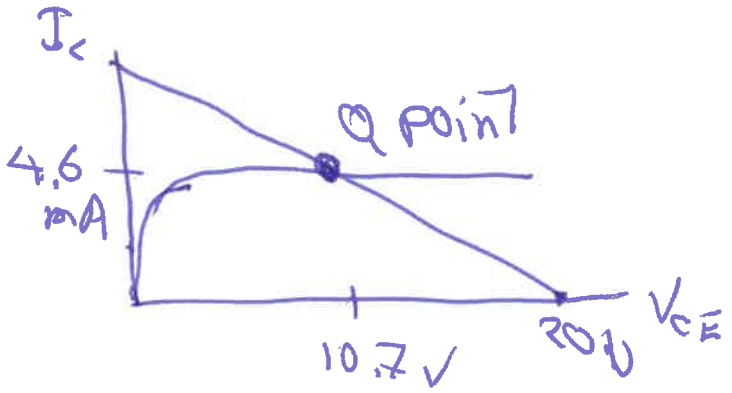
$$V_{BB} - I_B R_B - I_B(\beta+1)R_E = 0$$

($-0.7V$ above the I_B term)

$$I_B = \frac{V_{BB}-0.7V}{R_B+(\beta+1)R_E} = 46\mu A$$

$I_C = \beta I_B = 4.6\,mA$ (Good!)

$V_{CE} = V_C - (\beta+1) I_B R_E = 10.7\,V$

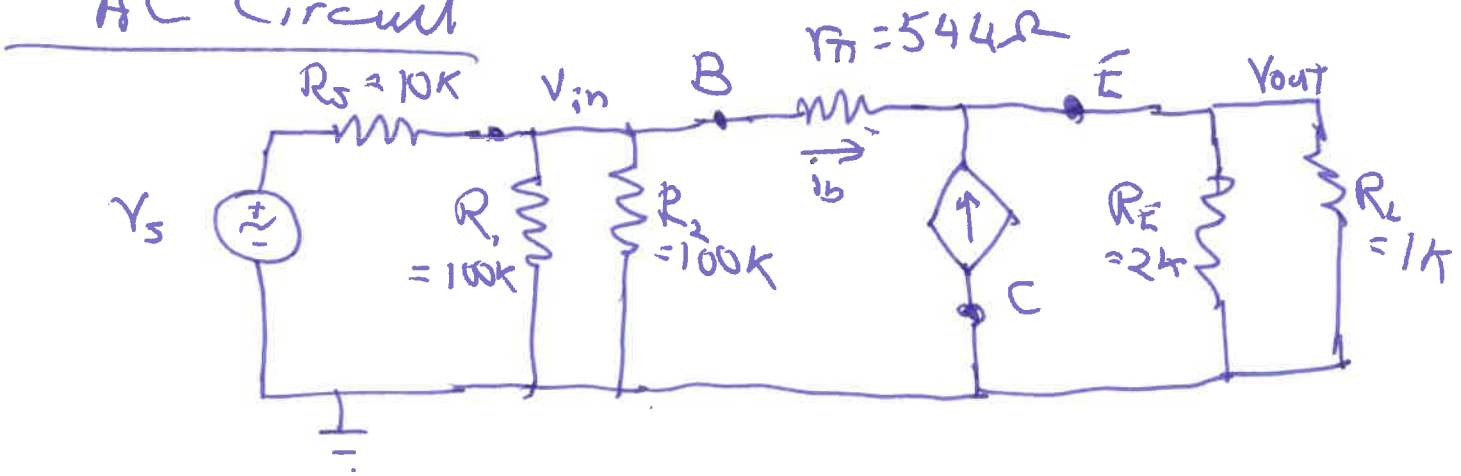


Small signal model

$$r_\pi = \frac{\beta V_t}{I_C} = \frac{100 \times 25mV}{4.6\,mA} = 544\,\Omega$$

$\beta = 100$

AC circuit

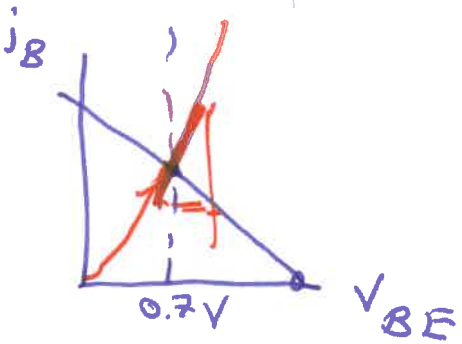


$$V_{in} = i_b r_\pi + (\beta+1) i_b (R_E \| R_L)$$

$$V_{out} = (\beta+1) i_b (R_E \| R_L)$$

$$A_V = \frac{V_{out}}{V_{in}} = \frac{R_E \| R_L}{R_E \| R_L + \frac{r_\pi}{\beta+1}} = \frac{666\,\Omega}{666\,\Omega \; \frac{544}{101}}$$

$$A_V = 0.992$$



input impedance

$$Z_{in} = \frac{V_{in}}{i_{in}} = \frac{V_{in}}{i_b} = r_\pi + (\beta+1)(R_E \| R_L)$$

$$= 544 + 101 \times 666 = 67.3k$$

Output impedance.

$$Z = R_E \| \frac{r_\pi + (R_S \| R_1 \| R_2)}{\beta+1} \approx 2k \| \frac{10k}{101}$$

$$Z \; 100\,\Omega$$

No Amp