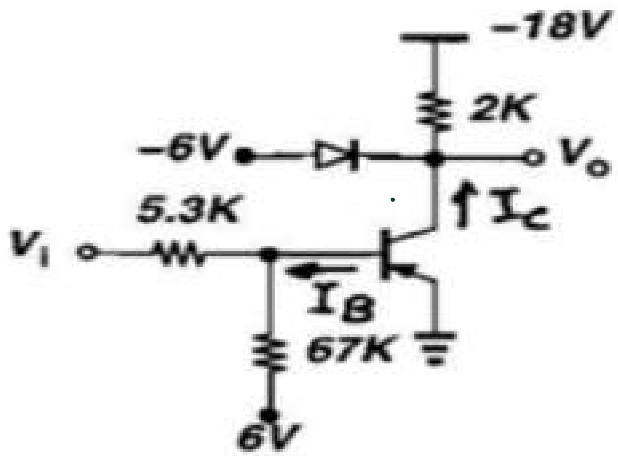
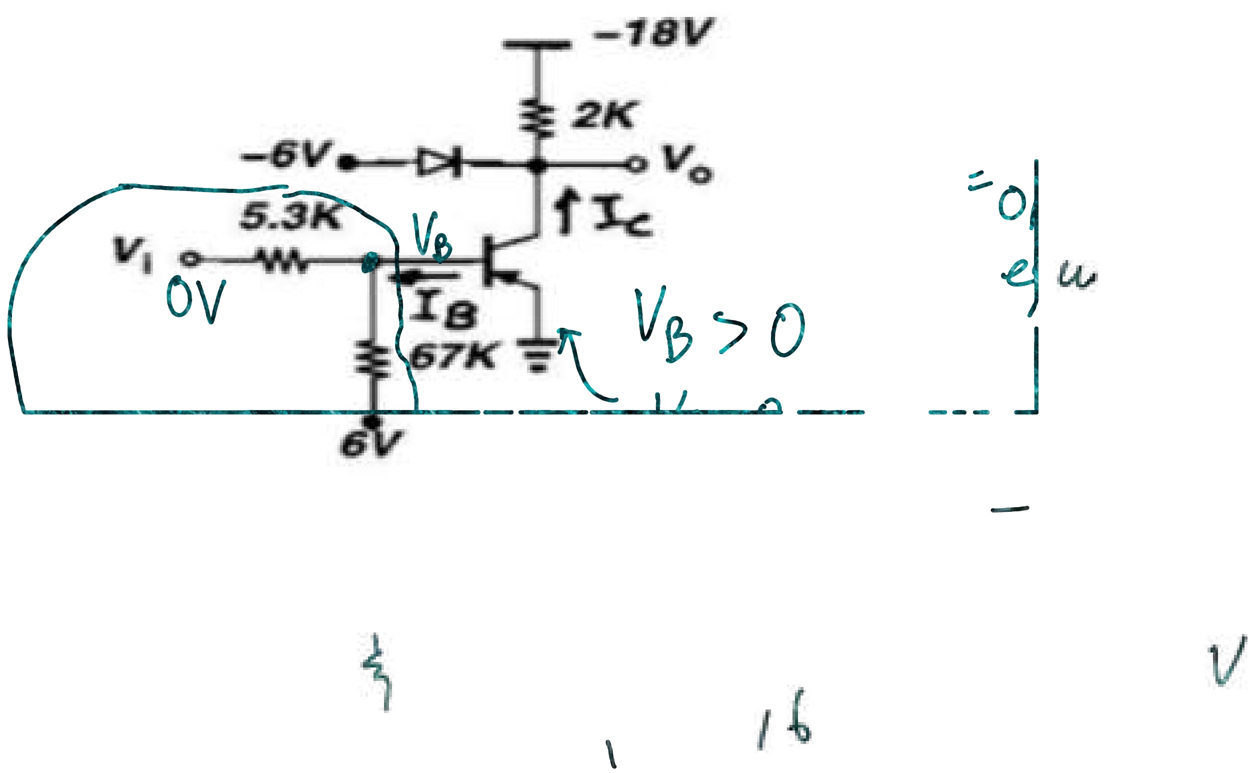
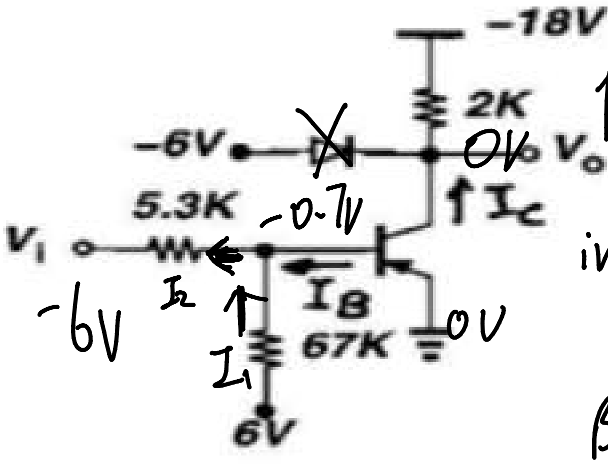
115A Week 6 Dis A

Monday, November 9, 2020 1:00 PM







$\frac{18V}{2K} = 2mA$

in "forward active"

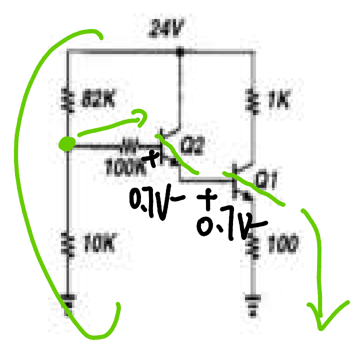
$\beta = I_C / I_B$

$\Rightarrow$ find I_B, I_C.

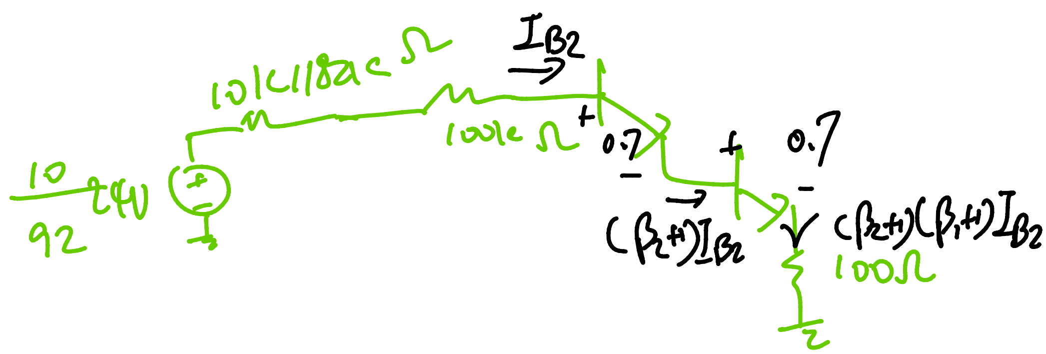
$I_B = I_1 - I_2$

Problem 7 (Bonus - 10 marks)

For the circuit shown, transistors Q_1 and Q_2 operate in the active mode region with $V_{BE1} = V_{BE2} = 0.7$ V, $\beta_1 = 100$ and $\beta_2 = 50$. Find I_{B1}, V_{C1} and V_{E2}.



include V_{BE}



Problem 2 (20 marks)

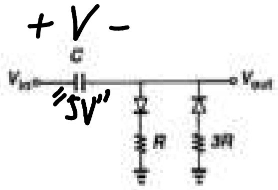
For the circuit shown, utilizing ideal diodes, sketch the output waveform for the input shown. Label the most positive and most negative output levels.

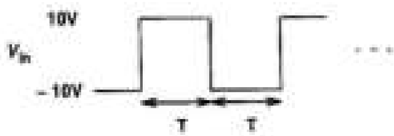
(a) CR >> T

(b) CR = 0.5 T

$+ V_c -$

(b) CR = 0.5 T





$V_{in} = 10V$, $V_{out} = 10 - V$

$V_{in} = -10V$, $V_{out} = -10 - V$

$$\frac{10-V}{R} + \frac{-10-V}{3R} = 0$$

(a) current discharging C ↓ ; current charging capacitor ↙

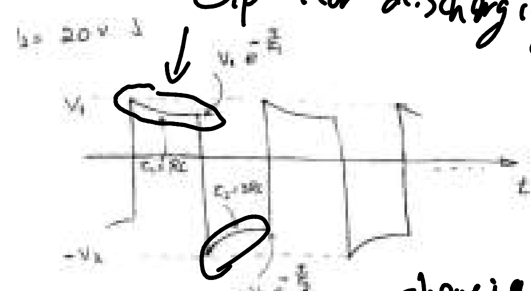
$$\frac{V_1}{R} = \frac{V_2}{3R}$$ and $V_1 + V_2 = 20V$ } → $V_1 = 5V$ and $V_2 = 15V$

↑ input swing = output swing

(b) vs. (a): in (b), cap voltage changes over +10V, −10V

but, after a whole period, cap voltage resumes,

capacitor discharging



capacitor charging

capacitor vol. when $V_{in} \to 10V$,

$V_1 = 10V - V_{CO}$

$+V_2 = +10V + V_{CO} \cdot e^{-\frac{T}{RC}}$

$\tau_1 = RC = \frac{T}{2}$, $\tau_2 = 3RC = \frac{3}{2}T$

$V_1 + V_2\, e^{-\frac{T}{\tau_2}} = 20 \rightarrow V_1 + e^{-\frac{2}{3}} V_2 = 20 \rightarrow V_1 + 0.5134\, V_2 = 20$ —①

& $V_1 (1 - e^{-\frac{T}{\tau_1}}) = V_2 (1 - e^{-\frac{T}{\tau_2}})$

∴ $V_1 (1 - e^{-2}) = V_2 (1 - e^{-\frac{2}{3}}) \rightarrow 0.86466\, V_1 = 0.48658\, V_2$ —②

from ① & ② → $V_1 = 10.458\, V$

$\tau_1 = RC = \frac{T}{2}$, $\tau_2 = 3RC = \frac{3}{2}T$

$V_1 + V_2\, e^{-\frac{T}{\tau_1}} = 20 \rightarrow V_1 + e^{-\frac{2}{3}}V_2 = 20 \rightarrow V_1 + 0.513\, V_2 = 20$ —①

& $V_1(1 - e^{-\frac{T}{\tau_1}}) = V_2(1 - e^{-\frac{T}{\tau_2}})$

$\therefore V_1(1 - e^{-2}) = V_2(1 - e^{-\frac{2}{3}}) \rightarrow 0.86466\, V_1 = 0.48658\, V_2$ —②

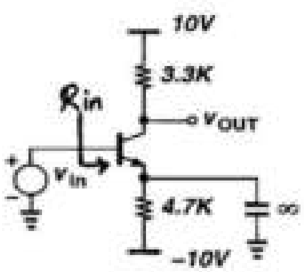
From ① & ② $\rightarrow$ $V_1 = 10.458$ V & $V_2 = 18.58$ V

Problem 3 (20marks)

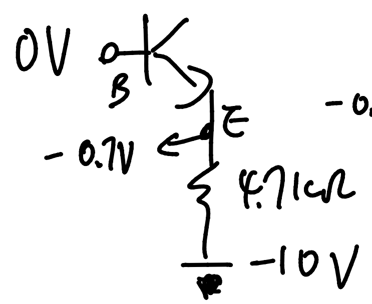
For the common-emitter amplifier circuit shown below:

- Find the dc collector current of the transistor and the output dc voltage.
- Find g_m and r_π.
- Find the voltage gain (v_{out}/v_{in}) and the input resistance.

Assume β=100



α

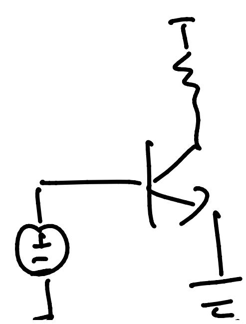


$-0.7V - (-10V) = I_E \cdot 4.7k\Omega$

$g_m = \frac{I_c}{\beta}$

$r_\pi = \beta / g_m$

(c) ;

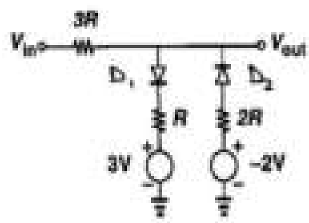


$g_m R_C$

r_π

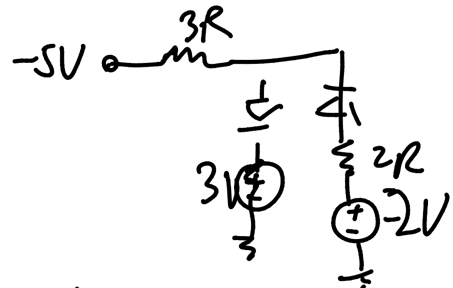
Problem 1 (20 marks)

For the shown circuit, sketch V_{out} vs. V_{in}. Let V_{in} changes from -5 V to 5 V. Label the important break points. Assume ideal diodes.



① $V_{in} = -5V$, assume D_1 OFF D_2 ON

equiv. ckt



$$V_{out} = \frac{2}{5}V_{in} - \frac{6}{5}V$$

verify { D_1 volt, D_2 current }

$$I_{D2} = \frac{-2 - \frac{2}{5}V_{in} + \frac{6}{5}}{2R}$$

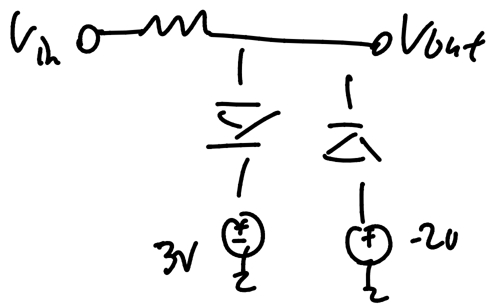
$$I_{D2} = \frac{-\frac{2}{5}V_{in} - \frac{4}{5}}{2R} \rightarrow V_{in}\uparrow\ I_{D2}\downarrow$$

$V_{in} = -2$

Vin = -2
I_D2 = 0

Th.

(just)
Vin > -2 , D1 OFF D2 OFF



Vin = 3V

D1 will be on

TH.

Vin > 3V, D1 on, D2 OFF