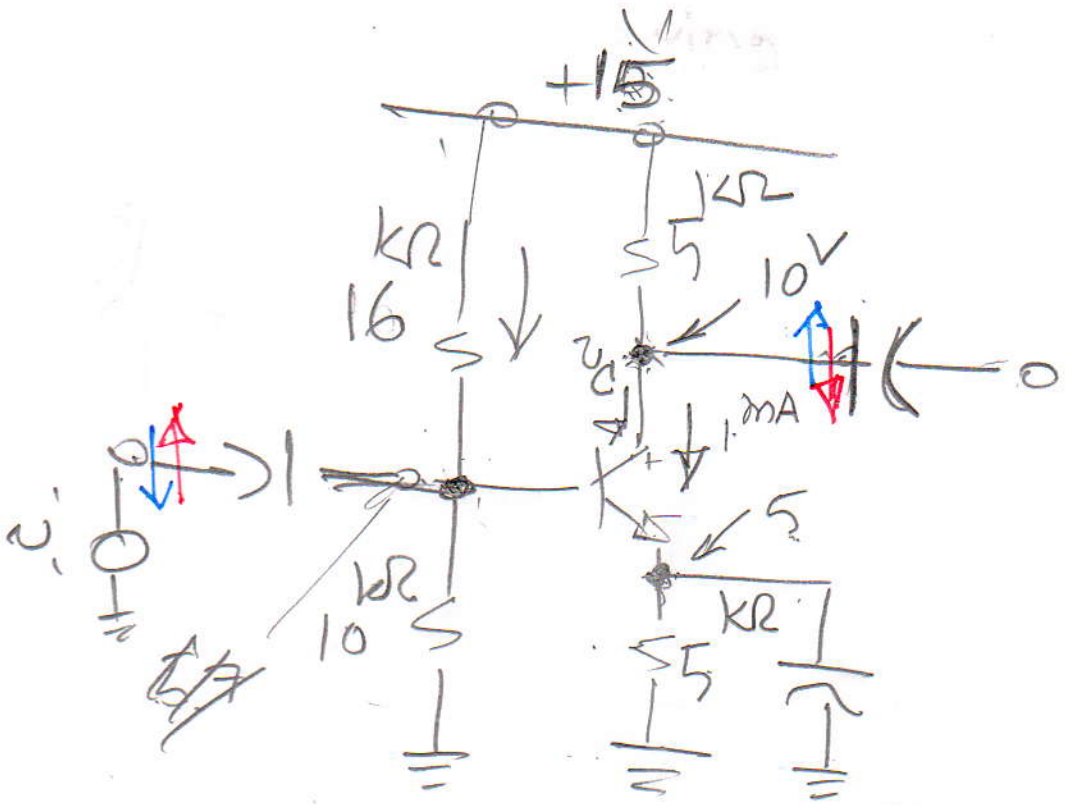
Voltage Swing Calculations

Example

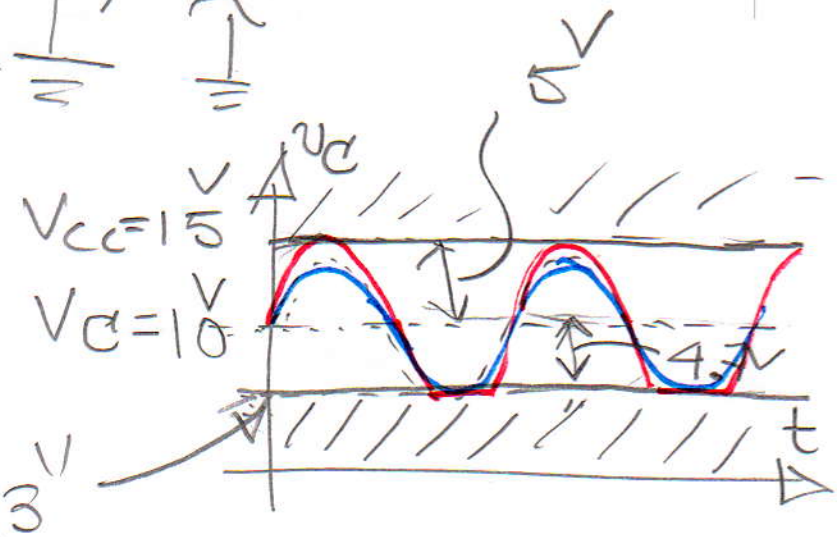


$V_A = \infty$

$\beta = 100$

$V_{BE,on} = 0.7\ V$

$V_{CE,sat} = 0.3\ V$



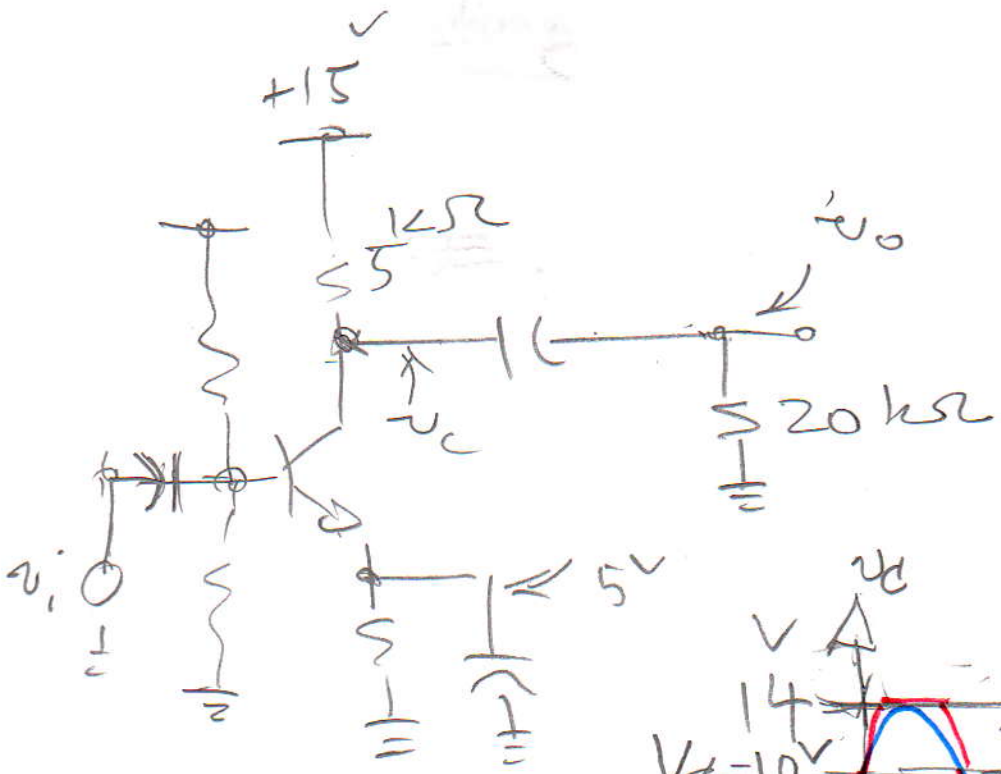
$V_E + V_{CE_{sat}} = 5.3\ V$

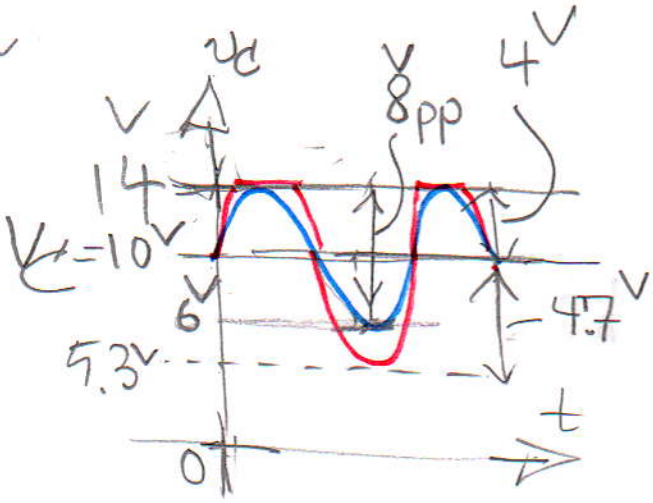
The maximum output voltage swing, then, is $2 \times 4.7 = 9.4\ V_{p-p}$.

The corresponding input voltage swing is

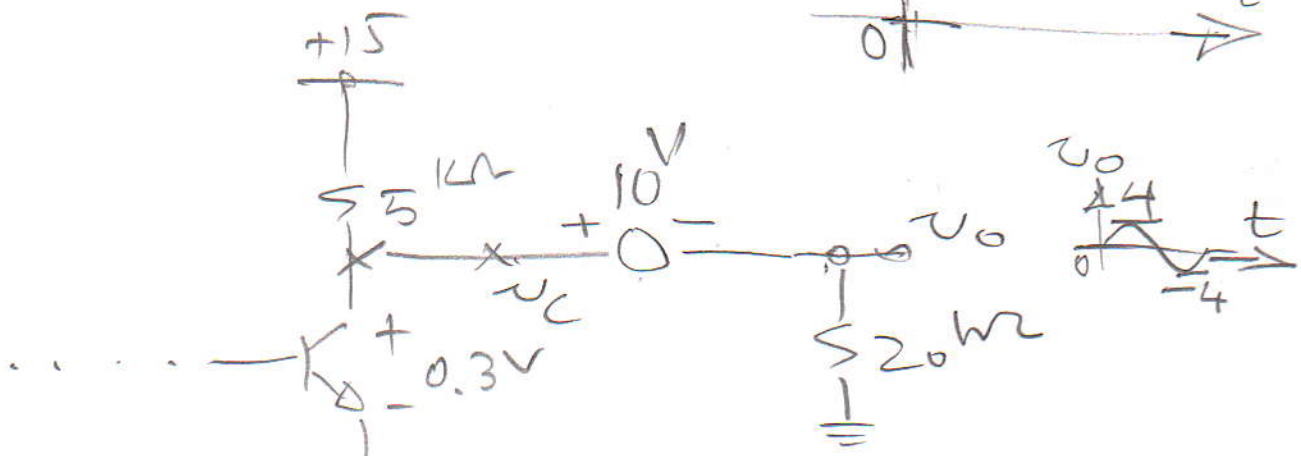
$$\frac{9.4\ V_{p-p}}{|A_{vo}|} = \frac{9.4\ V_{pp}}{40 \times 50} = 0.047\ V_{p-p} \text{ or } 47.\overline{3}\ mV_{pp}$$

LOADED CASE.

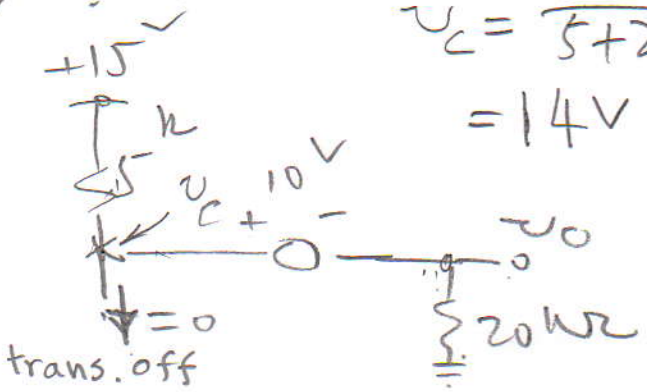




"When saturated":



"When off"

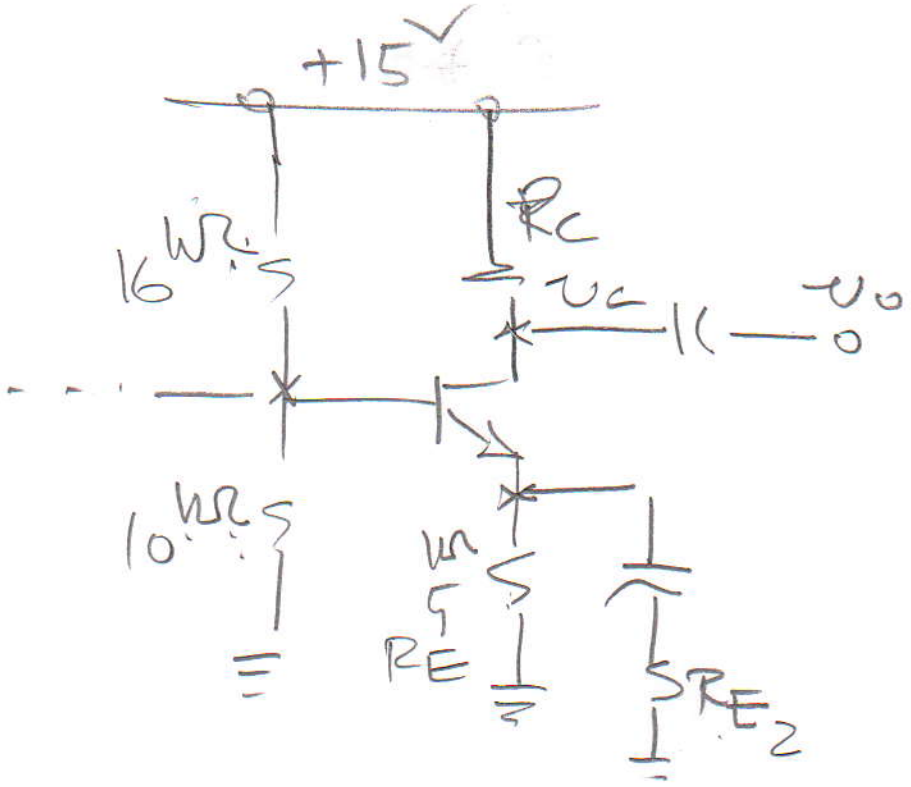


$$v_c = \frac{15-10}{5+20} \times 20 + 10$$

$$= 14V$$

Insertion of Emitter Degen.

let us need A_{v_0} of -10 :



$$A_{v_0} = \frac{-g_m R_C}{1 + g_m (R_E \| R_{E_2})}$$

$(R_E \| R_{E_2}) \approx R_{E_2}$

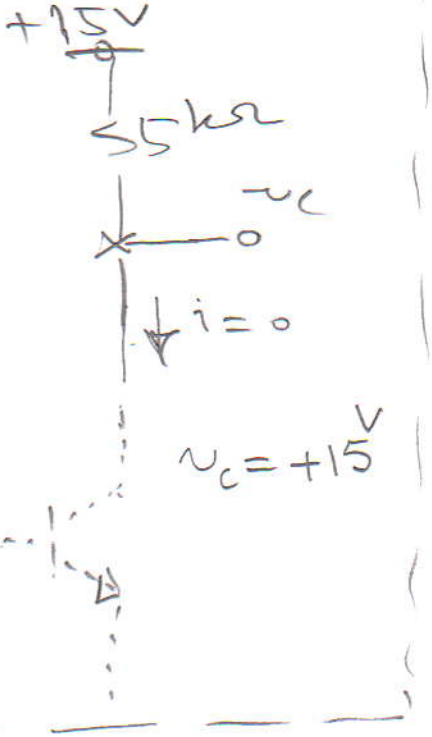
$$-10 = \frac{-200}{1 + 40 (R_E \| R_{E_2})} \Rightarrow R_E \| R_{E_2} \simeq 0.475 \text{ kΩ}$$

$$R_{E_2} \simeq 0.52 \text{ kΩ}$$

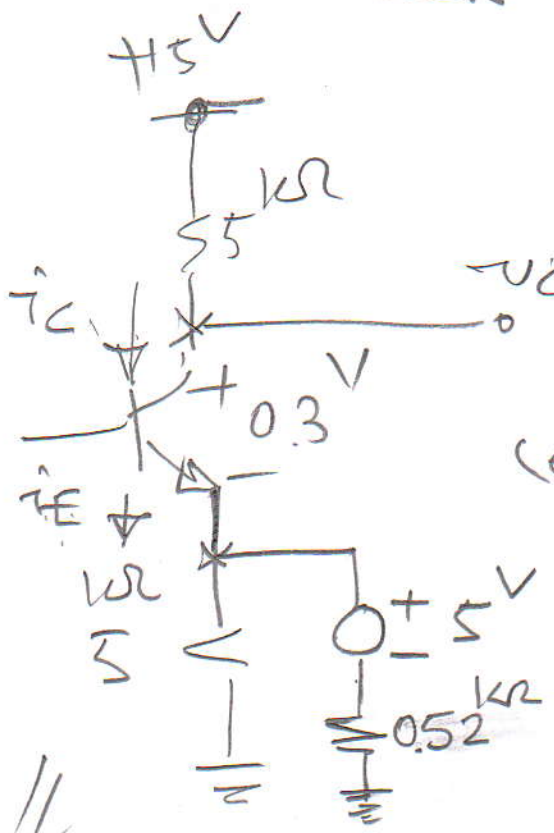
Recalculate the Swing

No-load Case

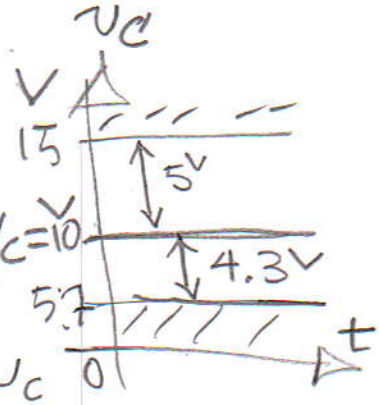
off

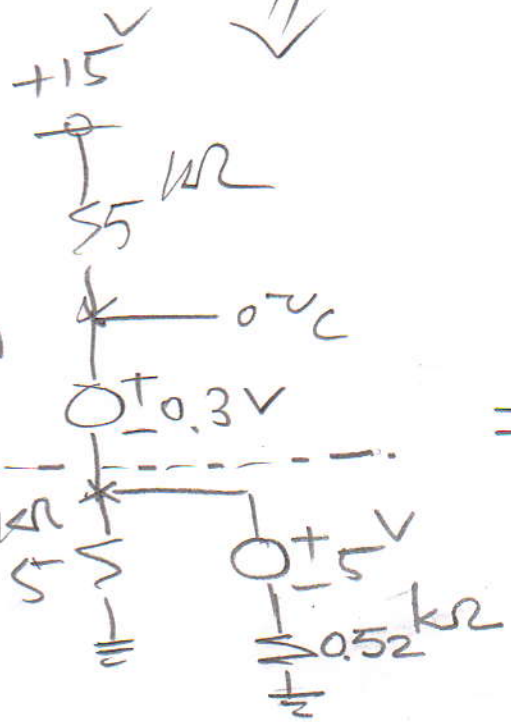


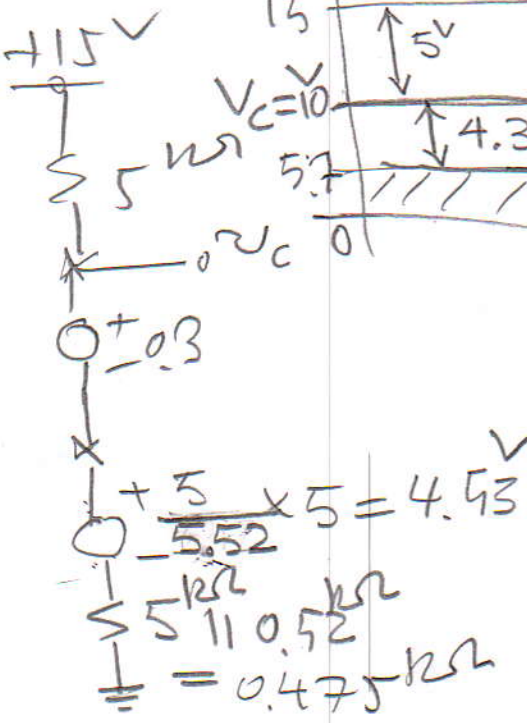
Sat.



$i_C \simeq i_E$ (edge of saturation)

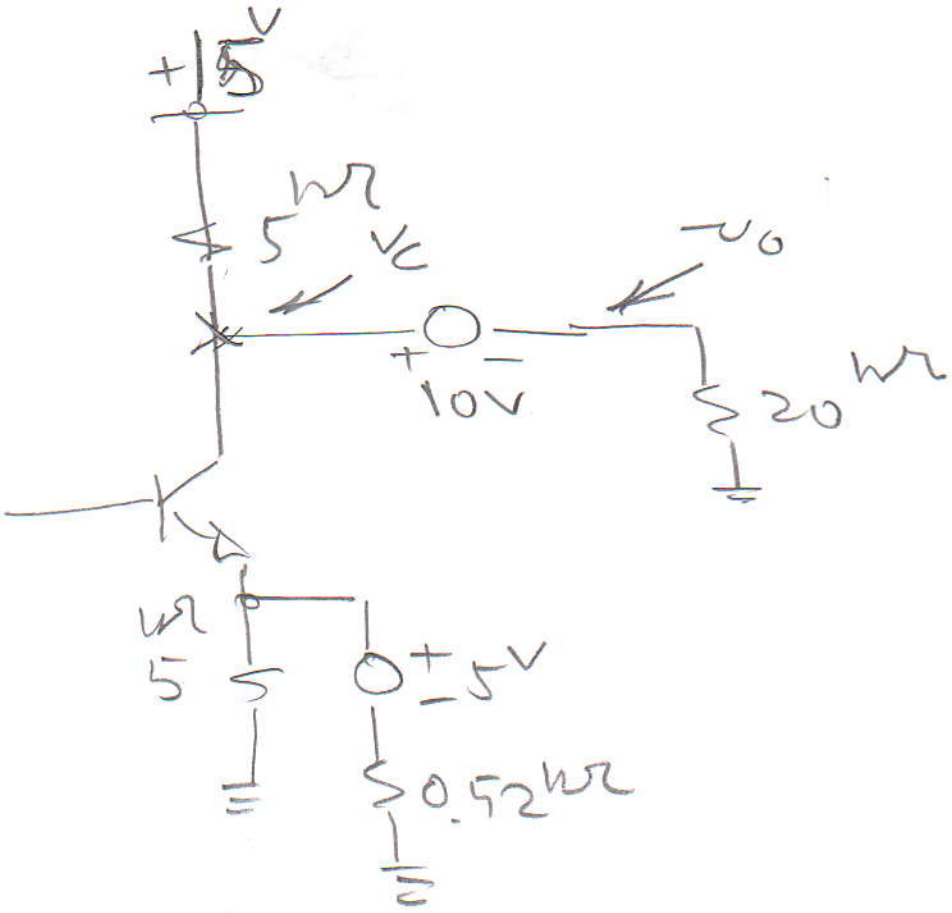




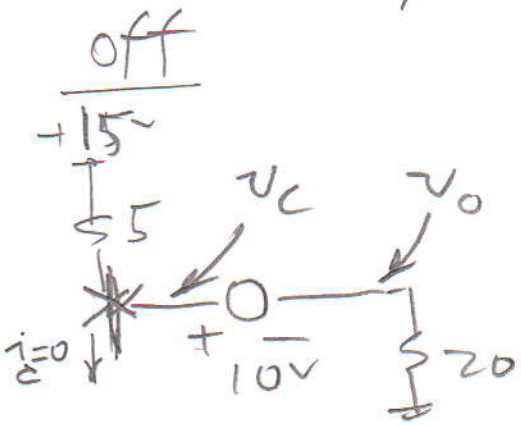


$$v_c = \frac{15-(4.53+0.3)}{5+0.475} \times 0.475 + 4.53 + 0.3 = 5.7\text{V}$$

LOADED case

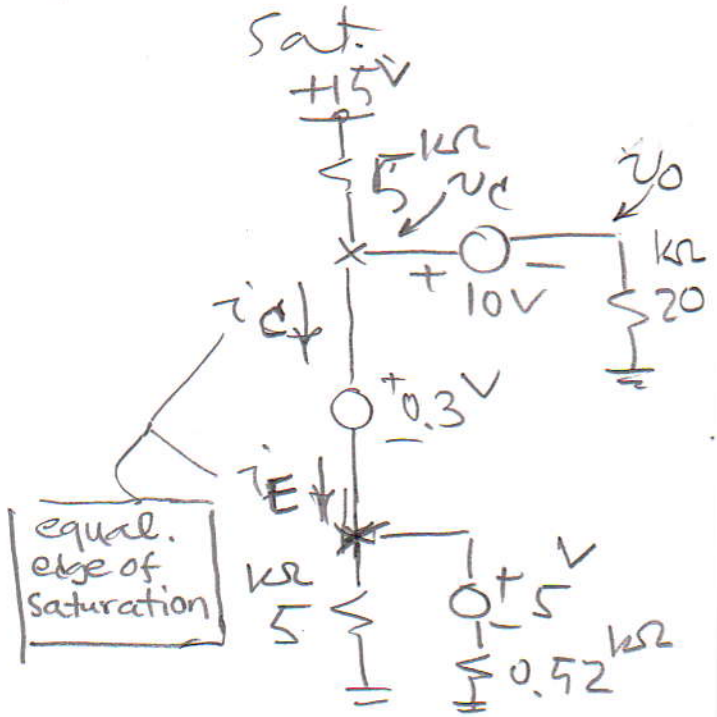


off

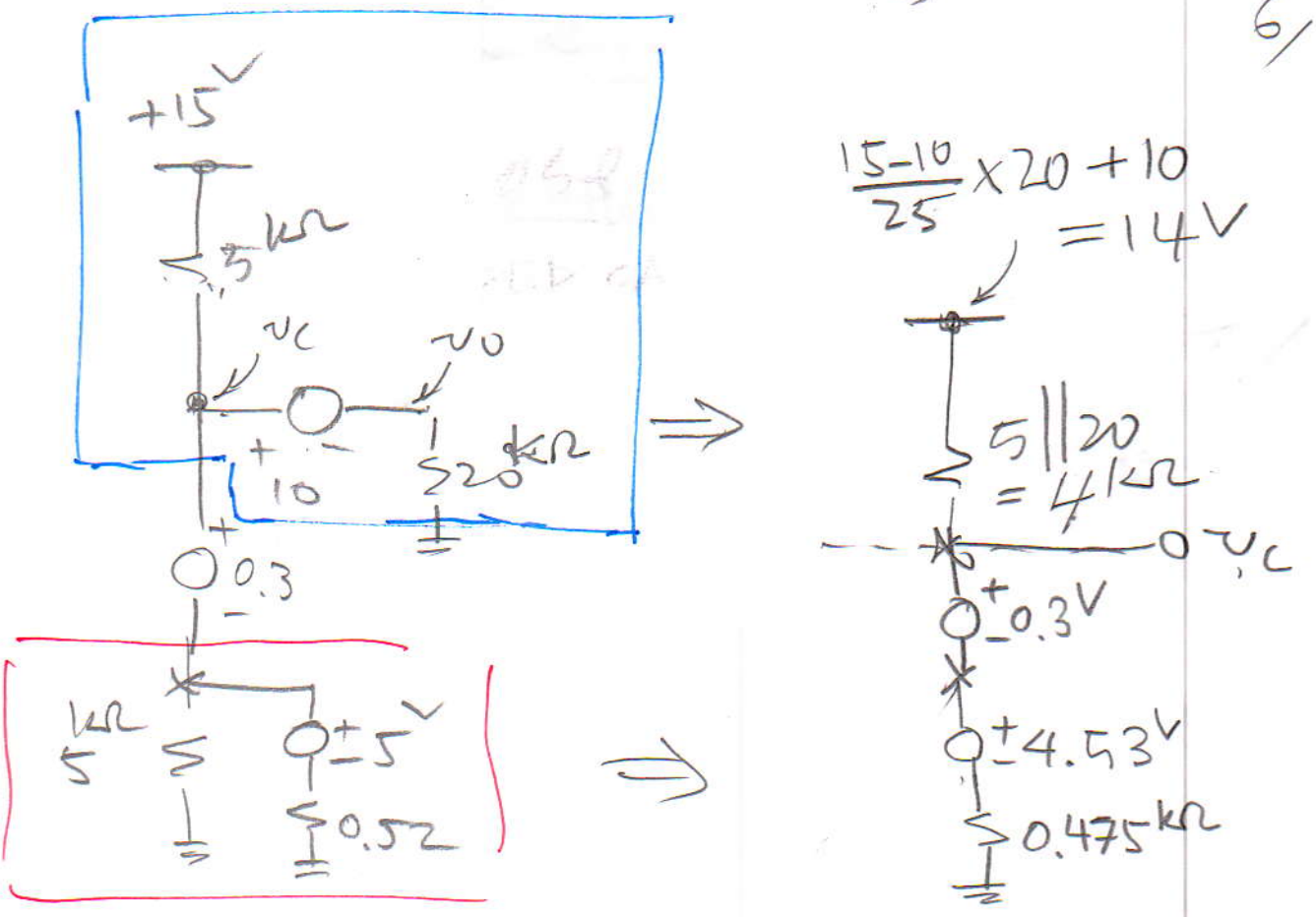


$$v_c = \underbrace{\frac{15-10}{25} \times 20 + 10}_{v_o} = 14\text{V}$$

sat.

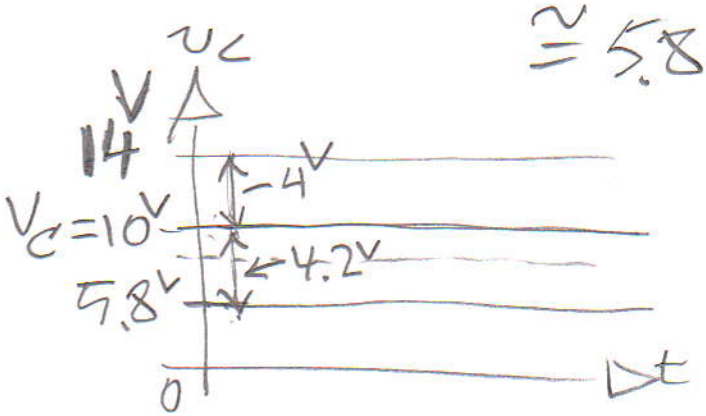


LOADED CASE (cont.)



$$v_c = \frac{14-(4.53+0.3)}{4+0.475} \times 0.475 + 4.53 + 0.3$$

$$\simeq 5.8$$



Max. output swing:
$2 \times 4 = 8\ V_{pp}$

$$A_v = \frac{-40 \times (5\|20)}{1+40 \times (5\|0.52)} \simeq -8\ V/V$$

$$\text{Max. input swing} = \frac{8\ V_{pp}}{|-8|} = 1\ V_{pp}$$