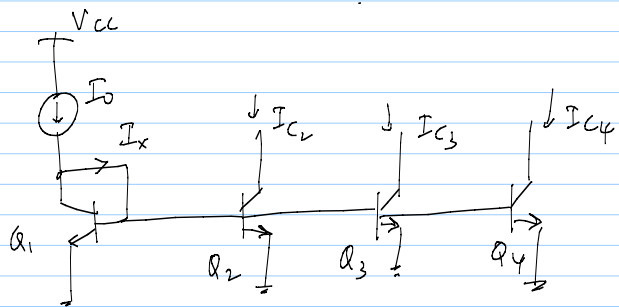


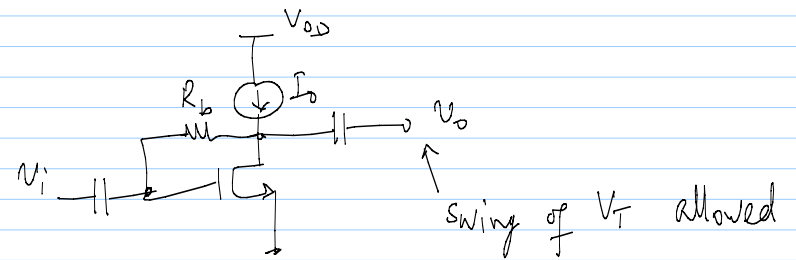
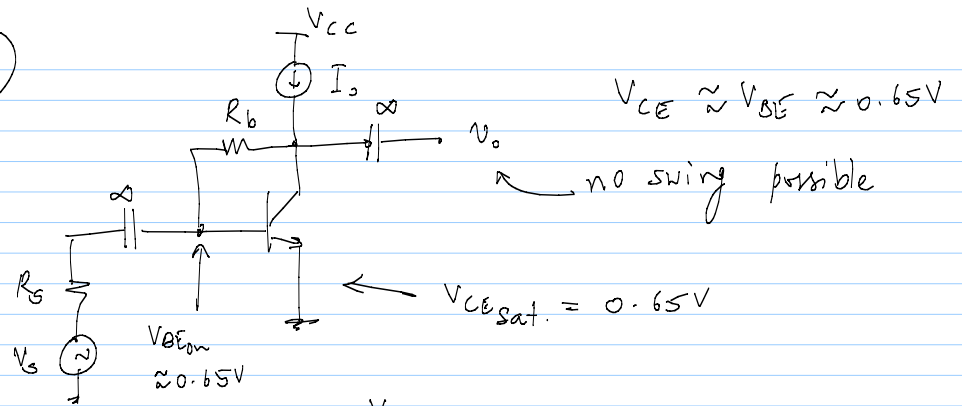
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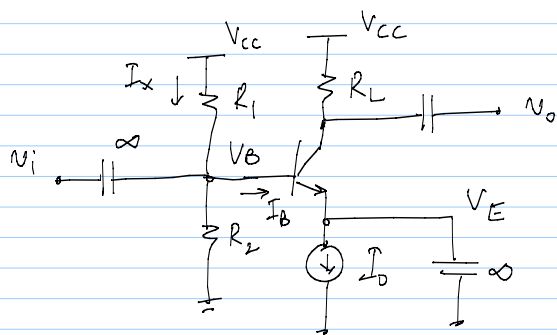


$I_x = 4 I_B$  ← cannot mirror many times

1)



2) Common Emitter Amplifier



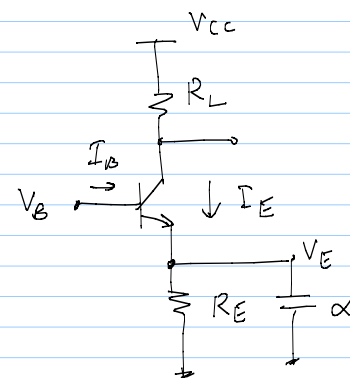
$$V_B \approx \frac{V_{CC} \cdot R_2}{R_1 + R_2}$$

$$V_E = V_B - V_{BEon} = V_B - 0.65V$$

\*  $I_x \gg I_B$

gain  $\approx -g_m R_L$

3)



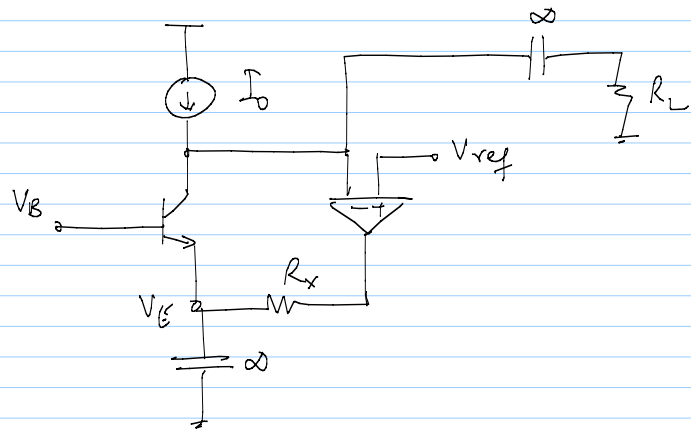
$$I_E = \frac{V_E}{R_E} = \frac{V_B - 0.65}{R_E}$$

$$I_E = I_C + I_B = I_C \cdot \left[ 1 + \frac{1}{\beta} \right] = I_C \cdot \left( \frac{\beta + 1}{\beta} \right)$$

$$I_C = \frac{\beta}{\beta + 1} I_E = \alpha I_E$$

$\alpha \approx 1$

4)



Swing limits ;  $v_s = V_A \sin \omega t$

a) Saturation limit

$$V_{CEsat.} = 0.65V ; \text{Base voltage} = V_B + V_A \sin \omega t$$

$$V_C = V_{CC} - I_C R_L - g_m R_L V_A \sin \omega t$$

$$V_{CB} = 0 \Rightarrow V_C = V_B$$

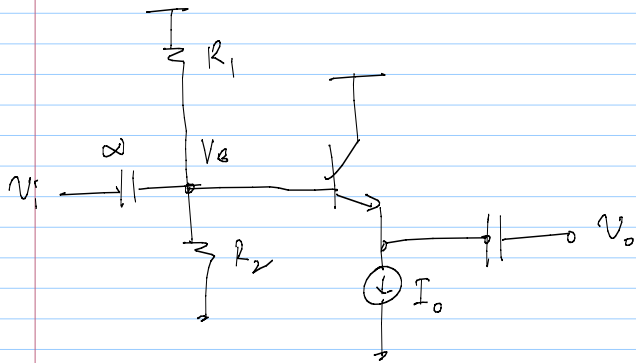
$$V_{CC} - I_C R_L - g_m R_L V_A = V_B + V_A$$

find  $V_{A1}$

b) Cutoff limit:

$$I_C + g_m V_A \sin \omega t = 0 \Rightarrow V_{A2}$$

### Common Collector / Emitter Follower



### Common Base

