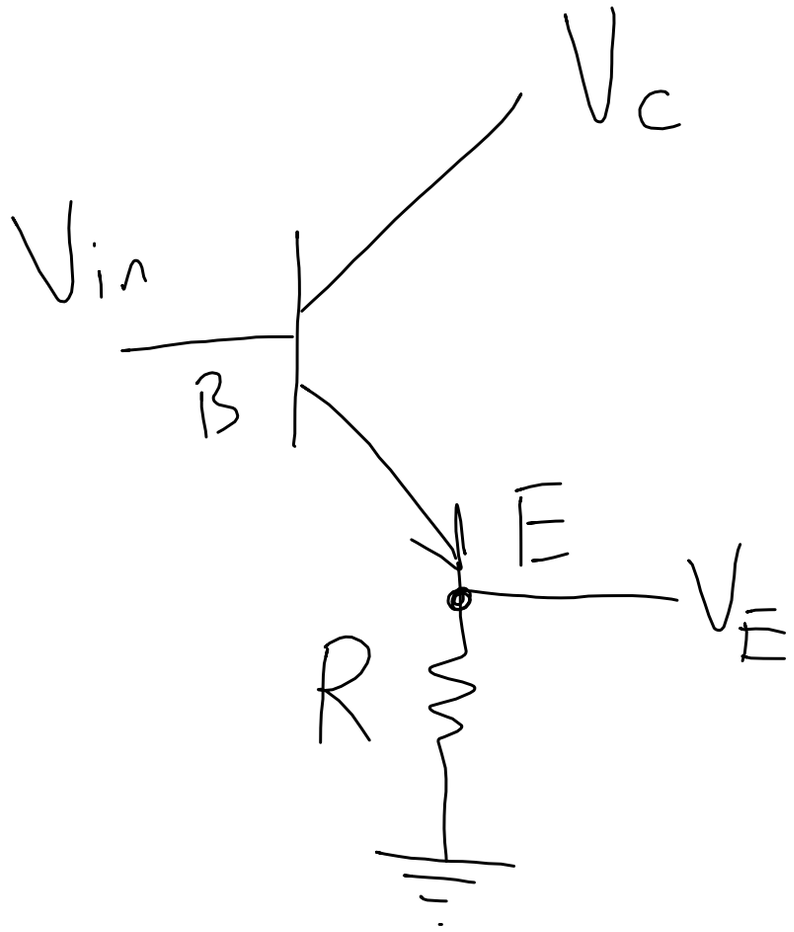
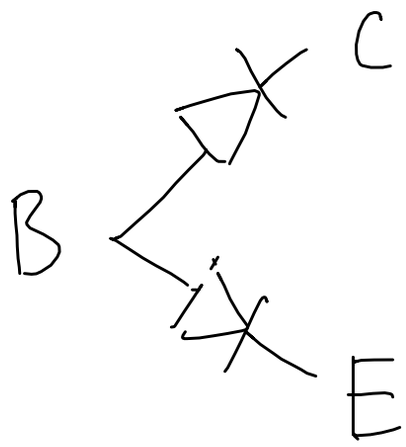




Make a voltage change at the base $\Rightarrow \Delta V_B$

Follower $\Rightarrow \Delta V_E = \Delta V_B$

Then $\Delta I_E = \frac{\Delta V_E}{R} = \frac{\Delta V_B}{R}$

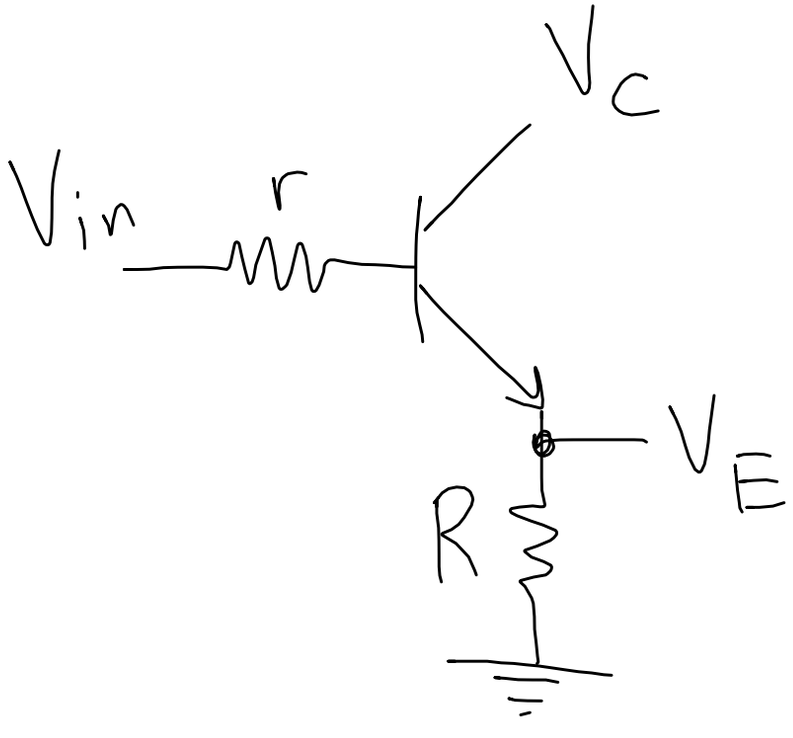
$$I_E = I_B + I_C = I_B + \beta I_B$$

$$I_E = (\beta + 1) I_B$$

$$\Delta I_B = \frac{\Delta I_E}{\beta + 1}$$

$$\Delta I_B = \frac{\Delta V_B}{R(\beta+1)} \Rightarrow \frac{\Delta V_B}{\Delta I_B} = R(\beta + 1)$$

input impedance of the transistor (follower)



By KVL

$$V_{in} - I_B r - 0.7 - V_E = 0$$

$$V_{in} = I_B r + 0.7 + V_E$$

$$\Delta V_{in} = (\Delta I_B) r + \Delta V_E$$

Assume that $V_{in} = const \Rightarrow \Delta V_{in} = 0$

$$\Delta I_B = -\frac{\Delta V_E}{r}$$

$$\Delta I_B = -\frac{\Delta V_E}{r}$$

Recall $I_B = I_E - I_C$, with $I_C = \beta I_B$

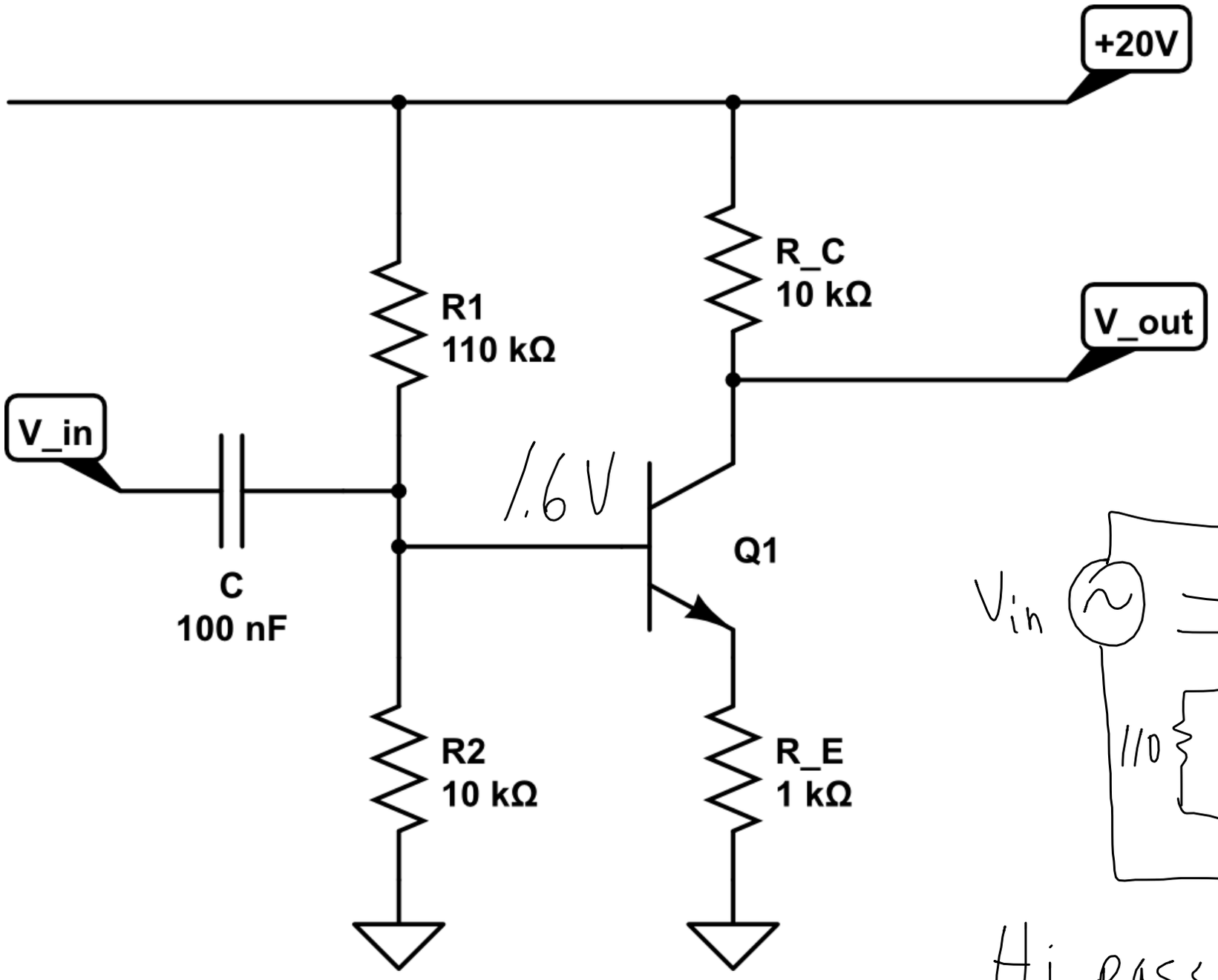
$$I_E = (\beta+1) I_B$$

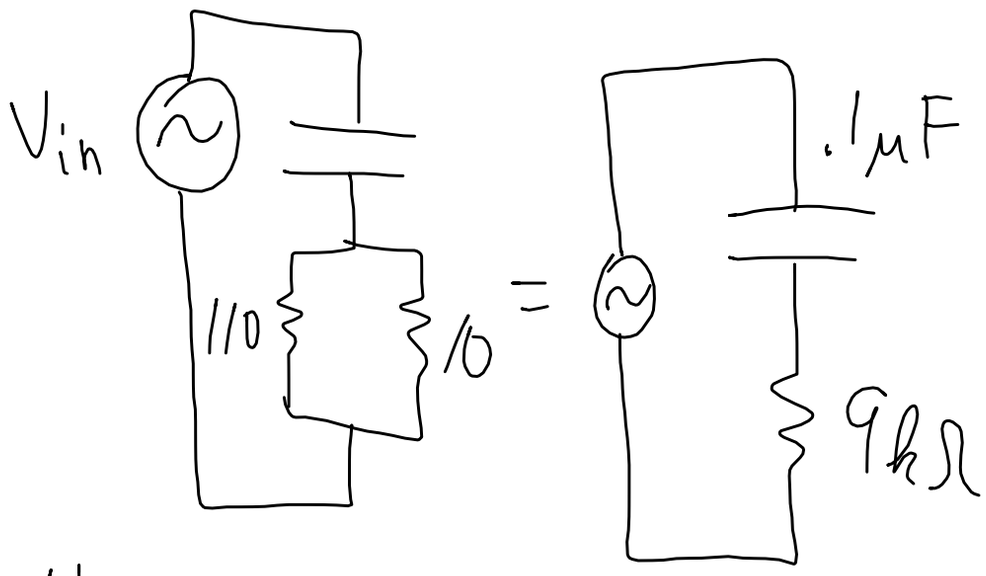
$$\Delta I_E = (\beta+1) \Delta I_B$$

$$\Delta I_B = \frac{\Delta I_E}{\beta+1} = -\frac{\Delta V_E}{r}$$

$$\frac{\Delta V_E}{\Delta I_E} = -\frac{r}{\beta+1}$$

output impedance of our follower





Hi pass filter

$f > 170\ Hz$ will pass

$$\omega_0 \simeq \frac{1}{(9\times10^3)(.1\times10^{-6})} \simeq 1\,kHz$$

Suppose "wiggle" V_B appears at base

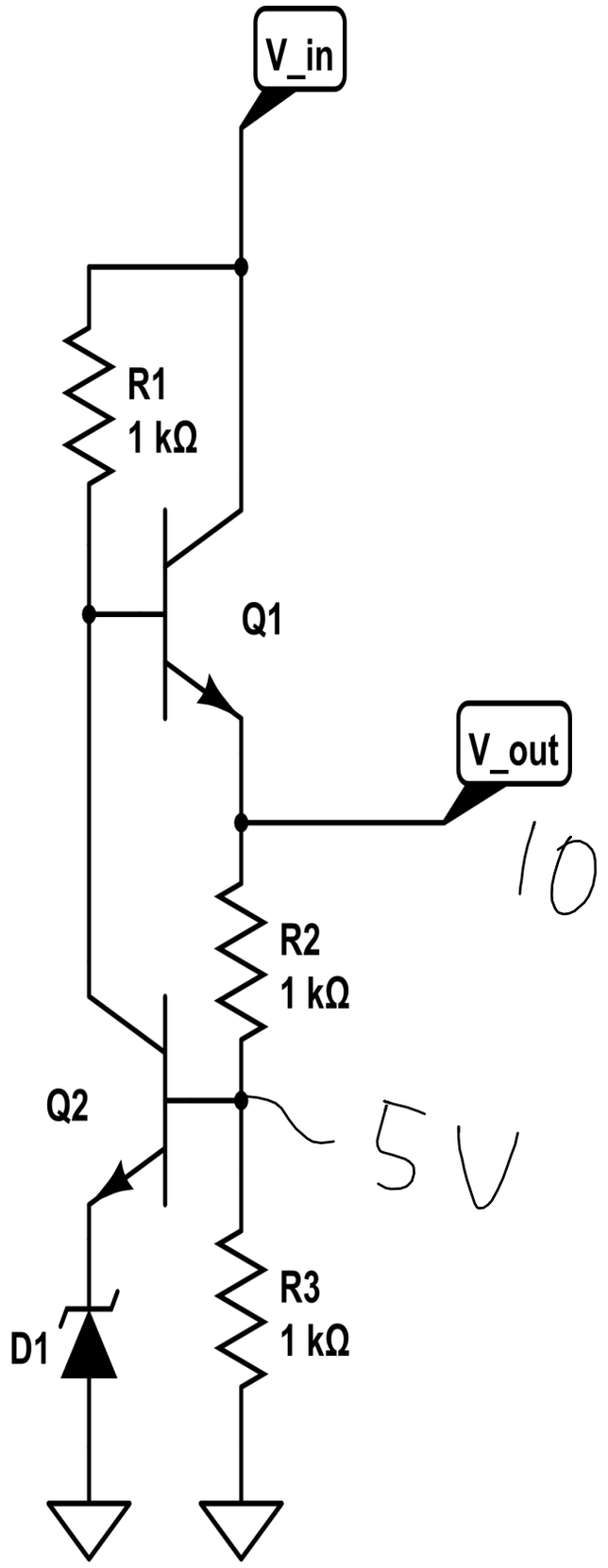
Emitter follower $\Rightarrow$ same V_E

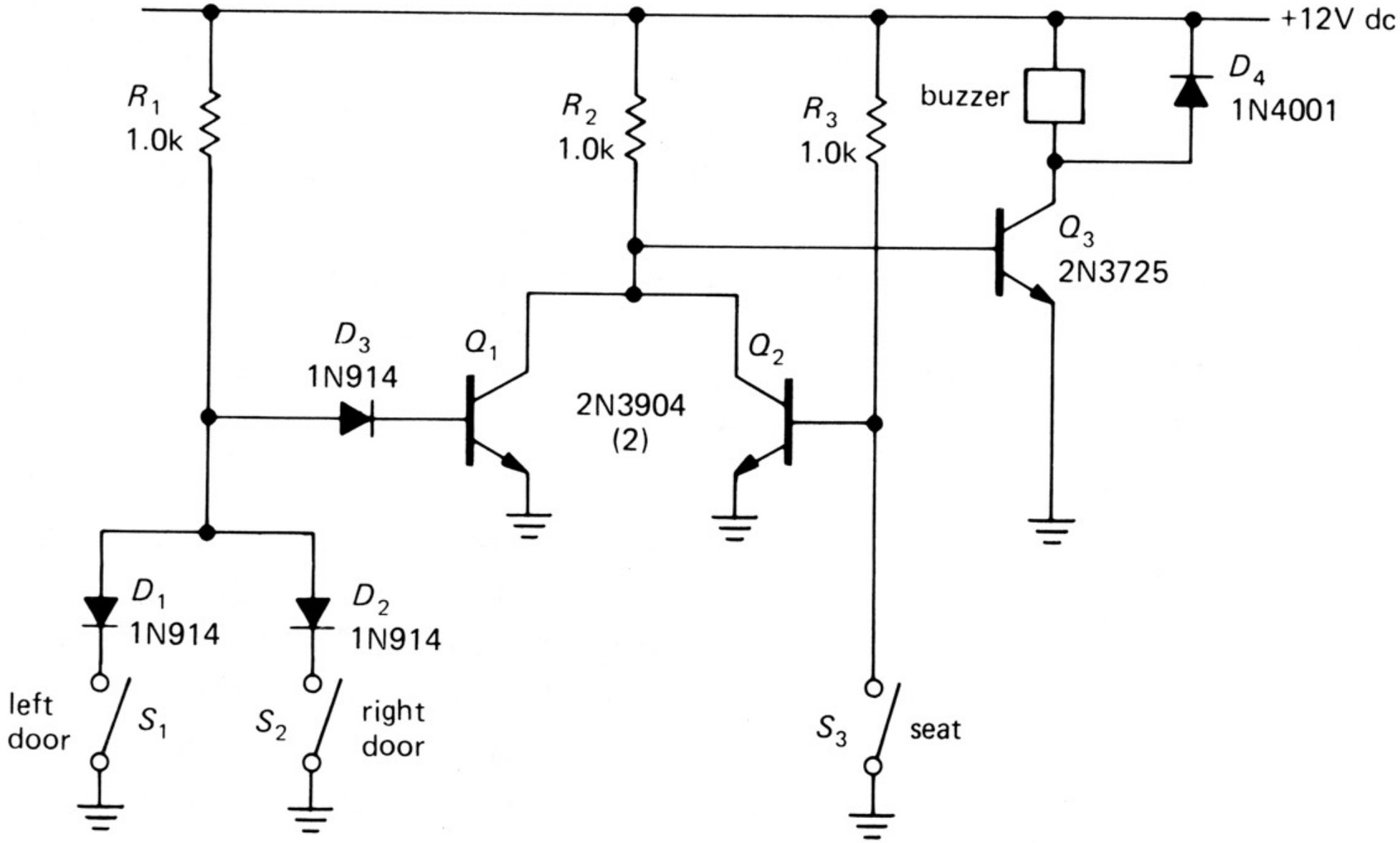
Emitter current $\Rightarrow$ $i_E = \frac{V_E}{R_E} = \frac{V_B}{R_E}$

$\searrow$ $\approx i_C$

$$V_C = -i_C R_C = -\frac{V_B}{R_E} R_C = -V_B \frac{R_C}{R_E}$$

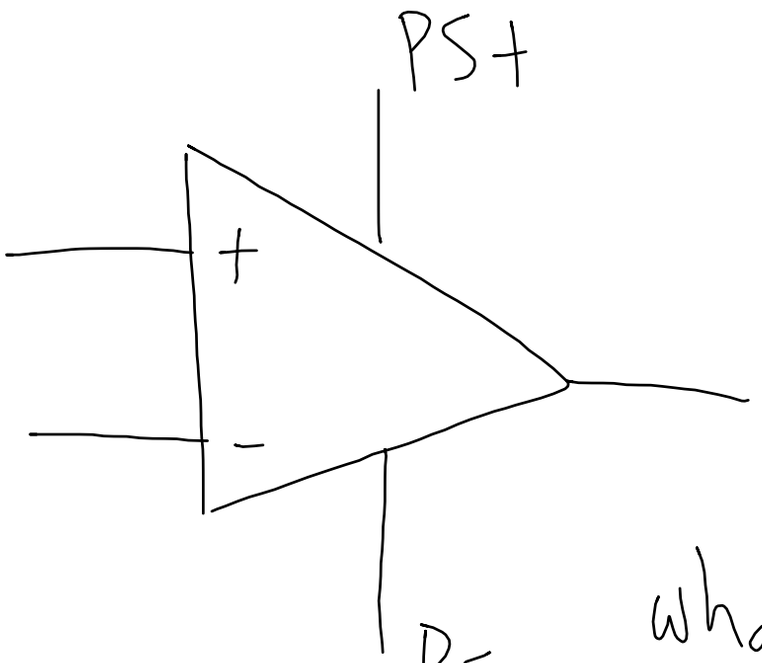
$$\frac{V_C}{V_B} = \frac{-R_C}{R_E}$$


V_in
R1
1 kΩ
Q1
V_out
10
R2
1 kΩ
Q2
5V
R3
1 kΩ
D1


+12V dc
R_1
1.0k
R_2
1.0k
R_3
1.0k
buzzer
D_4
1N4001
Q_3
2N3725
D_3
1N914
Q_1
Q_2
2N3904
(2)
D_1
1N914
D_2
1N914
left
door
S_1
S_2
right
door
S_3
seat

The Promised Land....

Operational Amplifiers



Rule #1. No current flows into inputs

Rule #2: Output does whatever it can to make input voltages equal