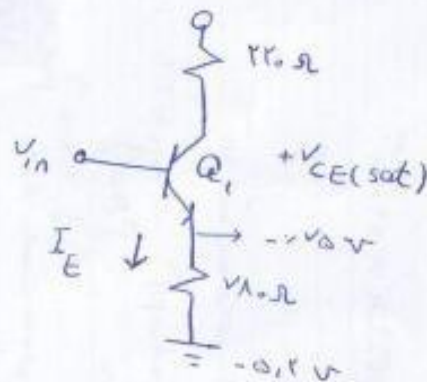


①

$$v_{in} = high = 0 \text{ V}$$

$$Q_1 = on, Q_R = off$$



$$I_E = \frac{-1.75 - (-5.2)}{18k} = 0.17 \text{ mA}$$

$$V_C = I_E \times 22k = -1.25 \text{ mV}$$

$$V_{CE} = -1.25 - (-1.75) = -0.5 \text{ V}$$

$V_{CE(sat)}$ باید صفر شود پس در این صورت فعلی نیست و در نهایت صفر است

$$V_C = V_{CE(sat)} - 1.75 = 0 - 1.75 = -1.75 \text{ V}$$

$$I_C = \frac{0 - (-1.75)}{22k} = 7.95 \text{ mA}$$

حالا دوم: $-5.2 \text{ V} = v_{in} = low$

$$Q_1 = off, Q_R = on \rightarrow I_{C1} = 0$$

$$I_{ER} = \frac{12 - (-5.2)}{18k} = 7.1 \text{ mA}$$

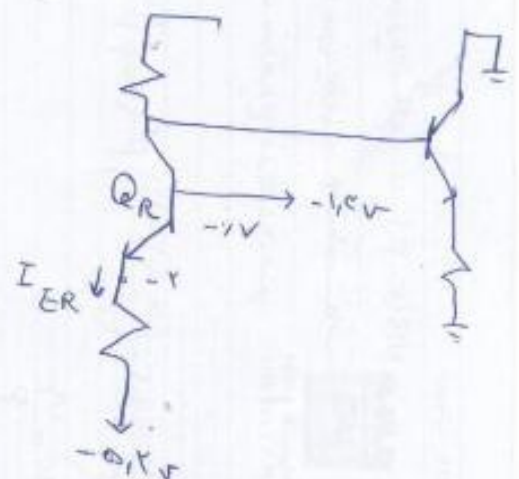
$$V_{CQR} = -12 \times 2.1 = -1.7 \text{ V}$$

$$V_{out} = -1.75 - (-1.7) = -0.05 \text{ V}$$

$$I_{CQR} = \frac{-1.75 - (-5.2)}{2} = 1.75 \text{ mA}$$

$$V_{CEQR} = -1 - (-1) = 0 \text{ V}$$

$$V_{CEQR} = 0 - (-1.7) = 1.7 \text{ V}$$



① $V_{in} = \text{high} \rightarrow Q_1 = \text{on}, Q_3 = \text{off}, Q_D = \text{off}, Q_0 = \text{off} \rightarrow Q_P = \text{on} \Rightarrow V_{out} = \text{high} = V_{CC}$

② $V_{C1} = V_{C(sat)} \rightarrow Q_3 = \text{off} \rightarrow Q_D, Q_0 = \text{off} \rightarrow V_{C3} = \text{high} \rightarrow Q_P = \text{on} \rightarrow V_{out} = V_{CC} = \text{high}$

: CS & CNO

$V_{in} = \text{low} = 0V \rightarrow Q_1 = \text{off}, V_{C1} = \text{high} \rightarrow Q_3 = \text{on}$

$\rightarrow Q_P = \text{on}$

$Q_0 = \text{on} \rightarrow Q_0 = \text{on} \rightarrow V_{C0} = V_{out} = \text{low} = V_{CE(sat)}$

③

V_{inA}	V_{inB}	Q_A	Q_B	Q_1	Q_P	Q_0	V_{out}
Low	Low	on	on	off	off	off	0
high	high	off	off	on	on	on	-1, 0, 1
high	Low	off	on	off	off	off	0
Low	high	on	off	off	off	off	0

④

V_{in}	N_{01}	P_{01}	V_{out1}	N_{02}	P_{02}	V_{out2}
high + 0V	on	off	0	on	off	-1, 0, 1, -V
low 0V	off	on	0V	on	off	-1, 0, 1, -V

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Case 1: $V_{in} = \text{Low} \rightarrow Q_1 = \text{OFF} \rightarrow Q_0 = \text{ON} \rightarrow V_{C1} = \text{high} \rightarrow V_{out} = V_{DD} = 5V$

Case 2: $V_{in} = \text{high} \rightarrow Q_1 = \text{ON} \rightarrow V_{C1} = \text{Low} \rightarrow Q_1 = \text{OFF} \rightarrow V_{out} = V_{DD}$

و چون که مدار است و انتقال سیگنال است حل شد.

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$V_{in} = \text{high} \rightarrow Q_1 = \text{ON} \rightarrow Q_R = \text{OFF} \rightarrow Q_0 = \text{ON} \rightarrow V_{out} = V_{CE}(\text{sat})$

$V_{in} = \text{Low} \rightarrow Q_1 = \text{OFF} \rightarrow Q_R = \text{ON} \rightarrow Q_0 = \text{OFF} \rightarrow V_{out} = V_{CC}$