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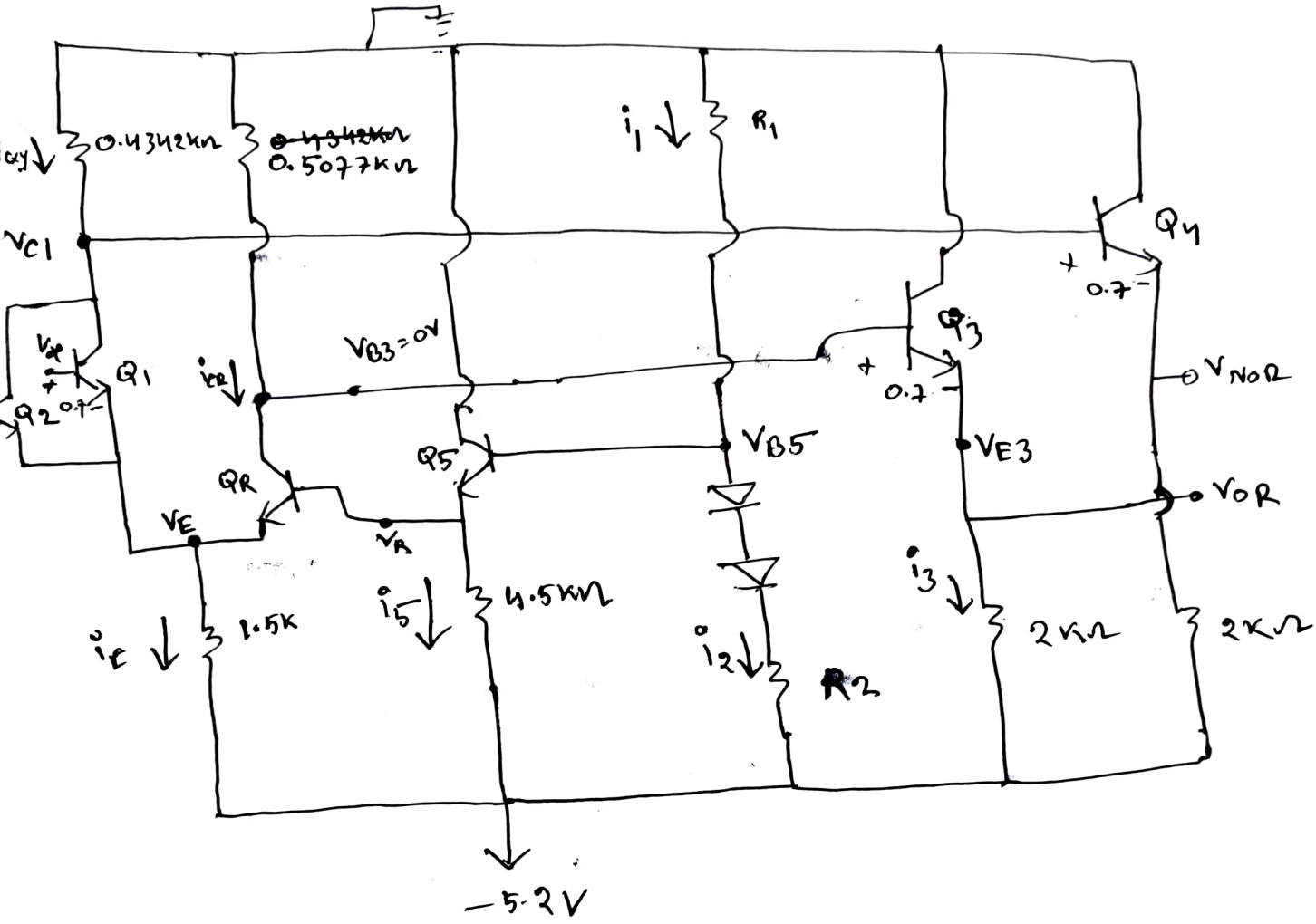
Sec: 12

Quiz: 3



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(a) $V_x, V_y \rightarrow$ logical high

then, Q_1, Q_2 would turn on. In forward active mode.

Now,

Q_R in cut off

$i_{CR} = 0mA$,

Q_3, Q_4 is in Forward active mode

So,

$V_{B3} - V_{E3} = 0.7$

$\Rightarrow V_{E3} = 0 - 0.7$

$\Rightarrow V_{E3} = -0.7V = V_{OR}$

As, V_x, V_y is in logical high,

V_{OR} = logical high

$= -0.7$

logical high voltage $= -0.7V$.

* Now, putting logical high $= -0.7V$ in the circuit

$V_x = V_y = -0.7V$

$Q_1, Q_2 \rightarrow$ Forward active

Now,

$V_x - V_E = 0.7$

$\Rightarrow V_E = -0.7 - 0.7$

$\Rightarrow V_E = -1.4V$

So, $i_E = \frac{-1.4-(-5.2)}{1.5k} = 2.53\ mA$

As, $Q_R \rightarrow$ Cut off

$i_{CR} = 0\ mA$

So, $i_E = i_{cxy} = 2.53\ mA$

So, $i_{cxy} = \frac{0 - V_{C1}}{0.4342}$

$\Rightarrow 2.53 \times 0.4342 = -V_{C1}$

$\Rightarrow V_{C1} = -1.098526\ V$

Now,

$V_{C1} = V_{B4} = -1.098526$

~~V_{NOR}~~

$V_{B4} - V_{NOR} = 0.7$

$\Rightarrow V_{NOR} = V_{B4} - 0.7$

$\Rightarrow V_{NOR} = -1.098526 - 0.7$

$= -1.798526$ [logical low]

(Ans)

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(b)

$i_1 = i_2 = i_5$

$$V_R = \frac{-0.7 - 1.798526}{2}$$

$$= -1.249\ V$$

$$i_5 = \frac{-1.249 + 5.2}{4.5K}$$

$$= \boxed{0.878\ mA}$$

$V_{B5} = -0.549$

So, $i_2 = \dfrac{-0.549 - 1.4 + 5.2}{R_2}$

$\Rightarrow \boxed{R_2 = 3.703\ k\Omega}$

$$R_1 = \frac{0 + 0.549}{.878}$$

$$= \boxed{0.625\ k\Omega}$$

Ans)