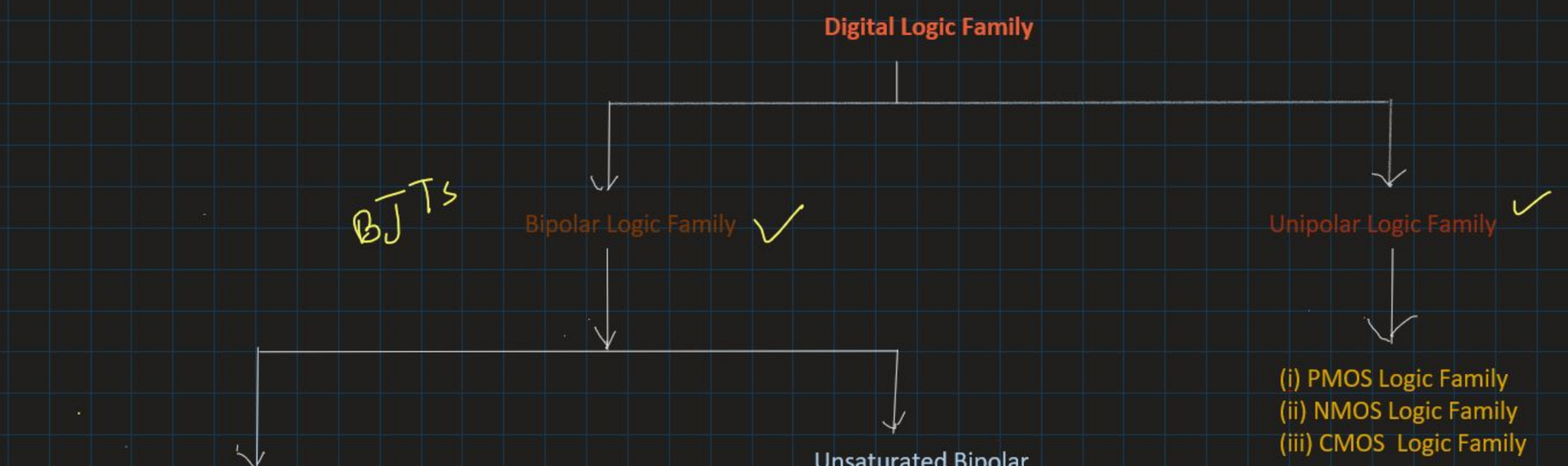
Lecture 3 part 2.png

Lecture 3 part 3.png

Lecture 3 part 4.png

Lecture 3 part 5.png

Lecture 3 Part 2
Thursday, May 27, 2021 2:42 PM



Operating Mode of BJT

(b) Active region
(c) Cutoff region
(d) Reverse Active region

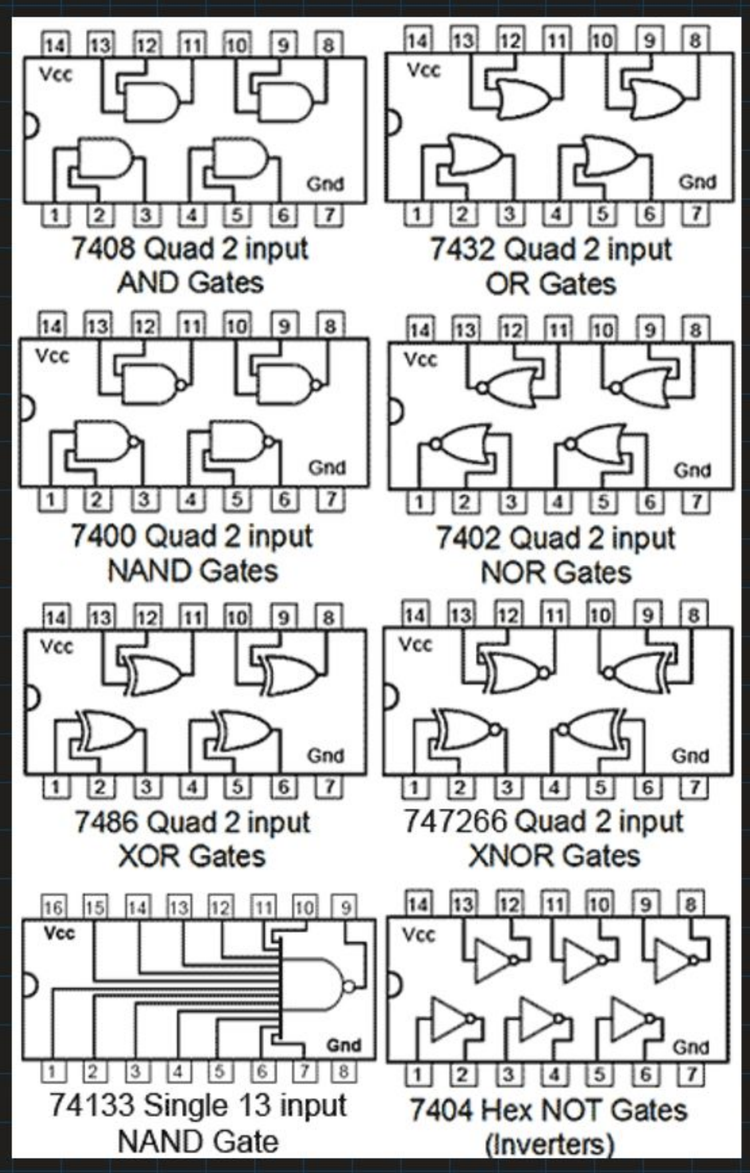
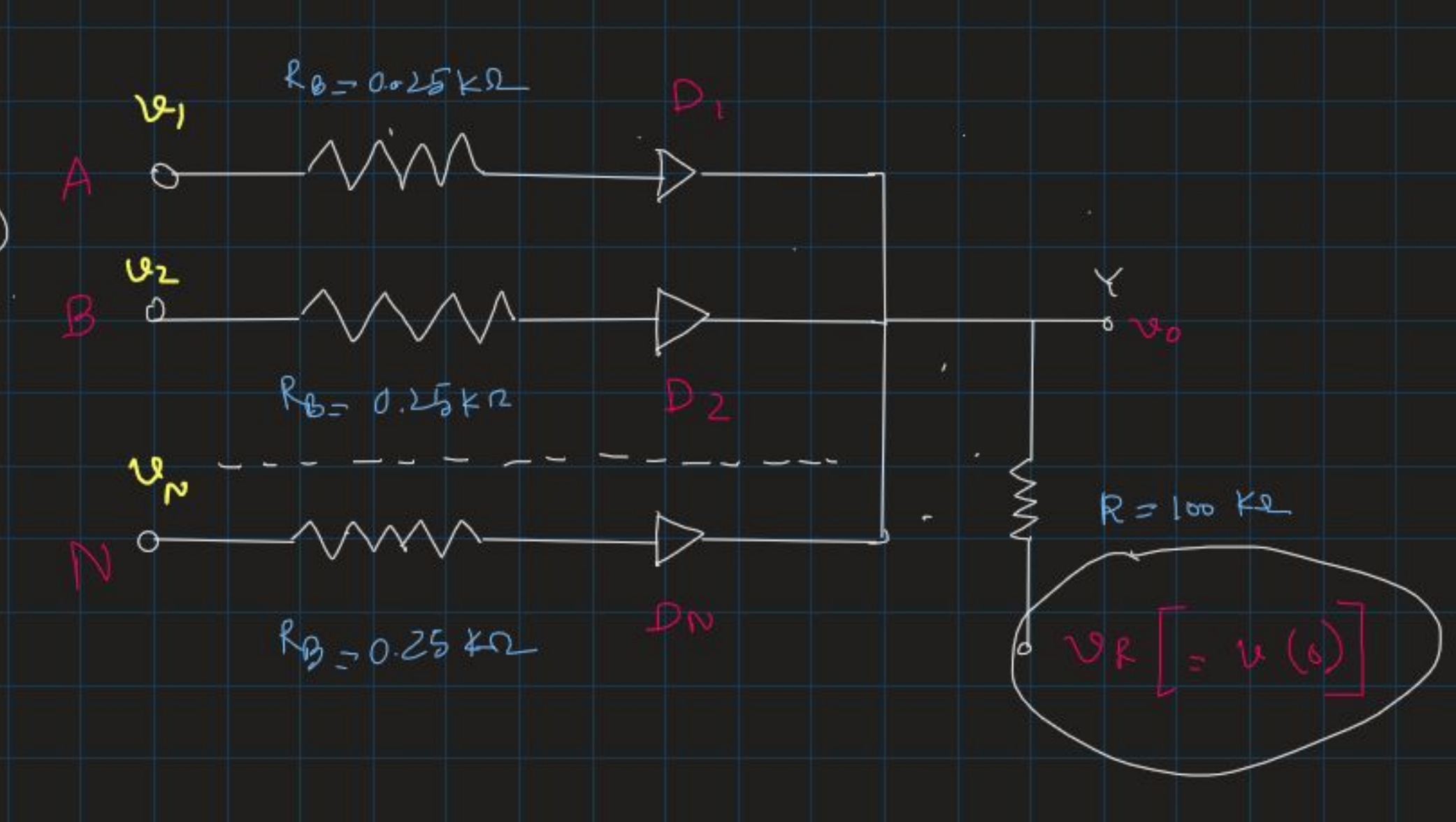


Figure : 74XX series ICs

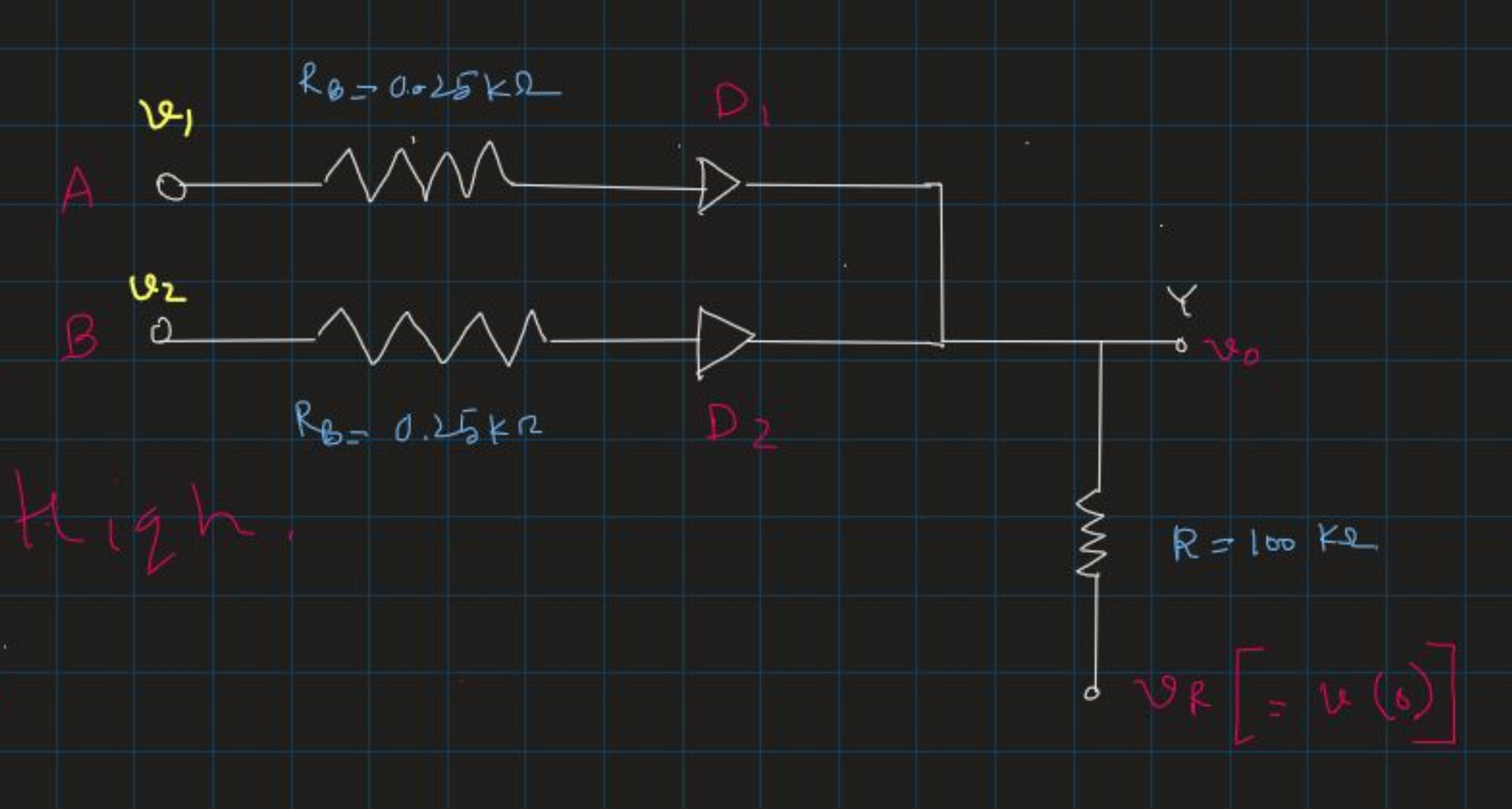
Diode Logic OR Gate:

Problem : If V(0) = 0 volt and V(1) = 5 volt and for a Fan In N=2
(a) Find out the output voltage levels.
(b) Find out the maximum power dissipation.



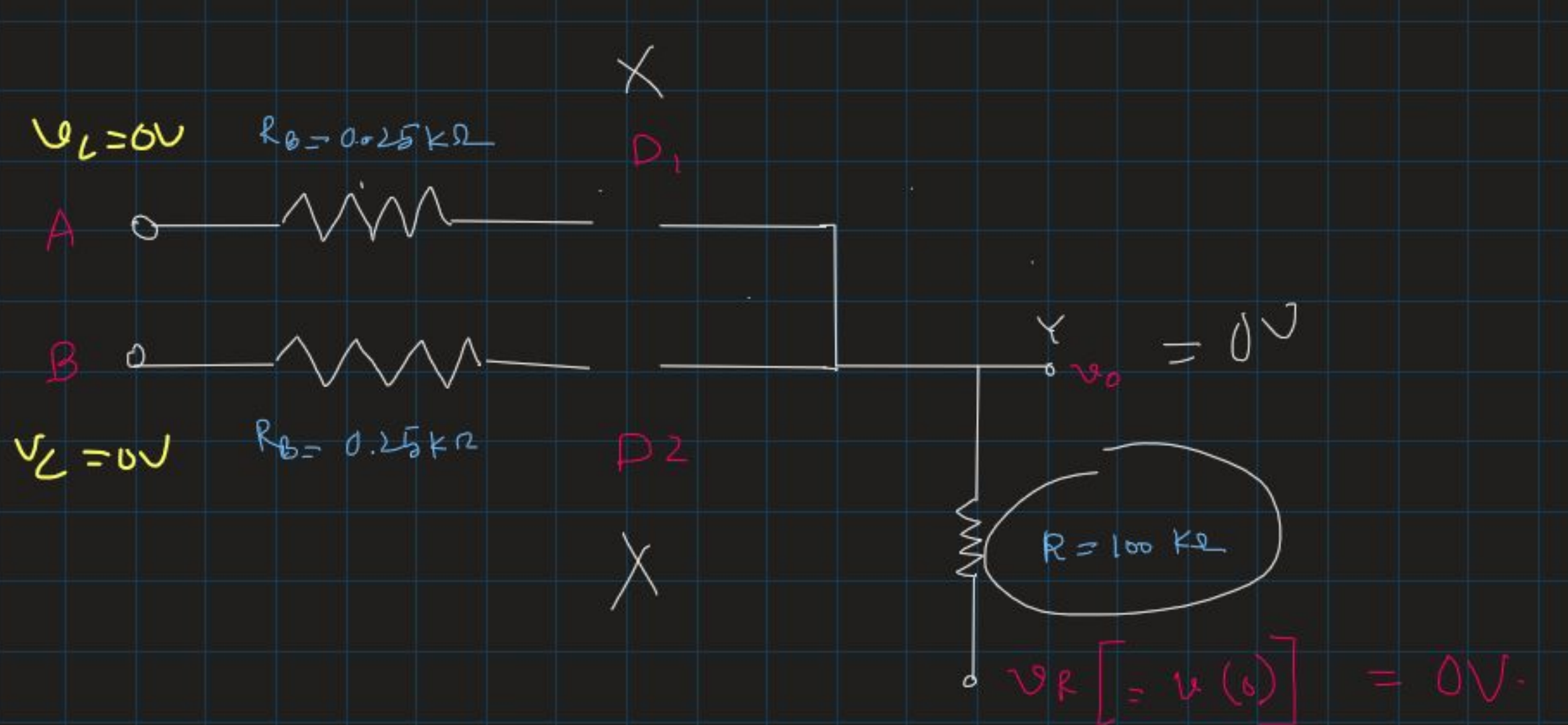
A	B	D_1	D_2	V_o
0V	0V	X	X	0V
5V	0V	✓	X	4.2893 V
0V	5V	X	✓	4.2893 V
5V	5V	✓	✓	4.2946 V

High.

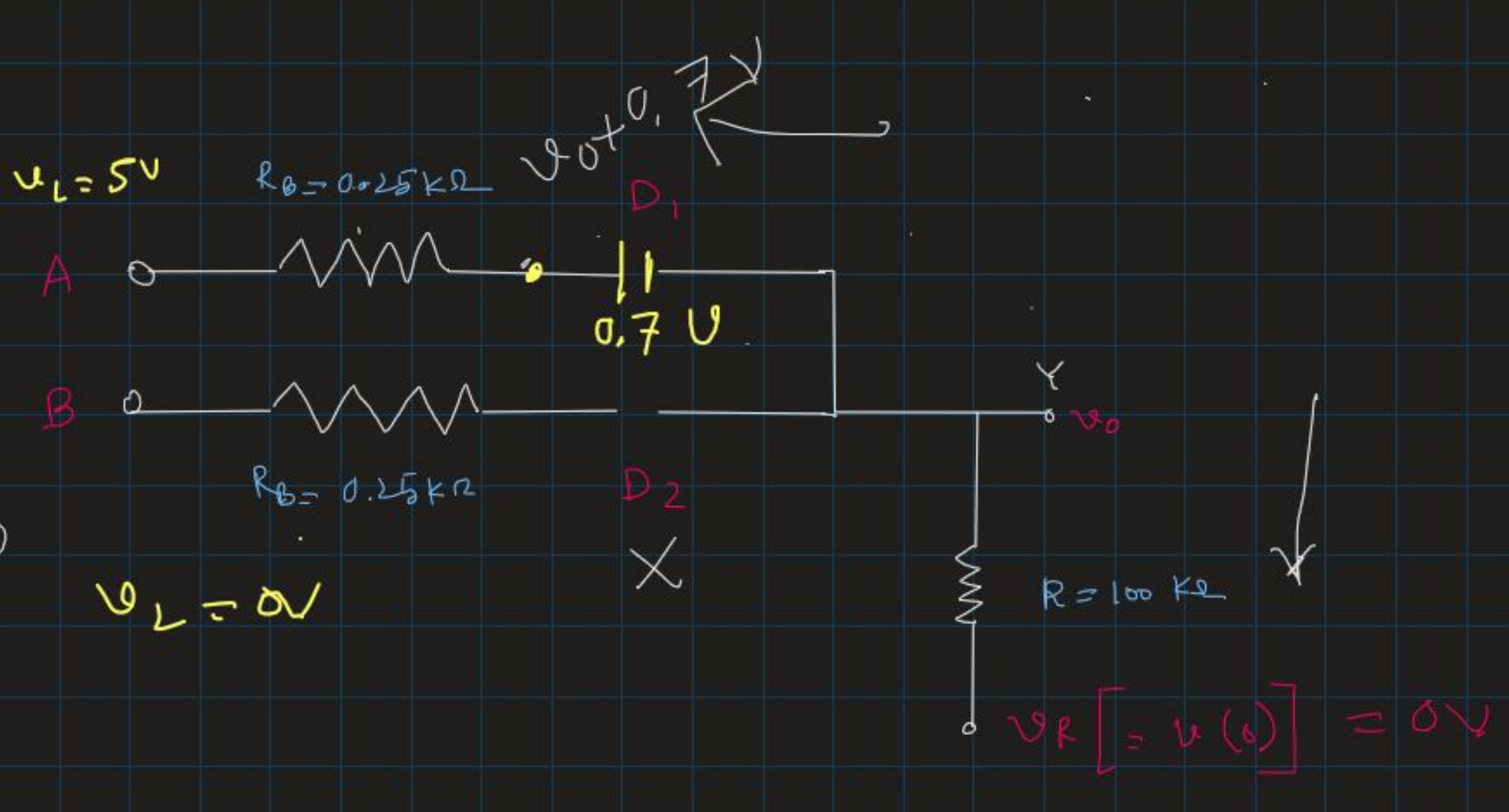


logic low → 0V
logic high → 4.2893 V

1st case:



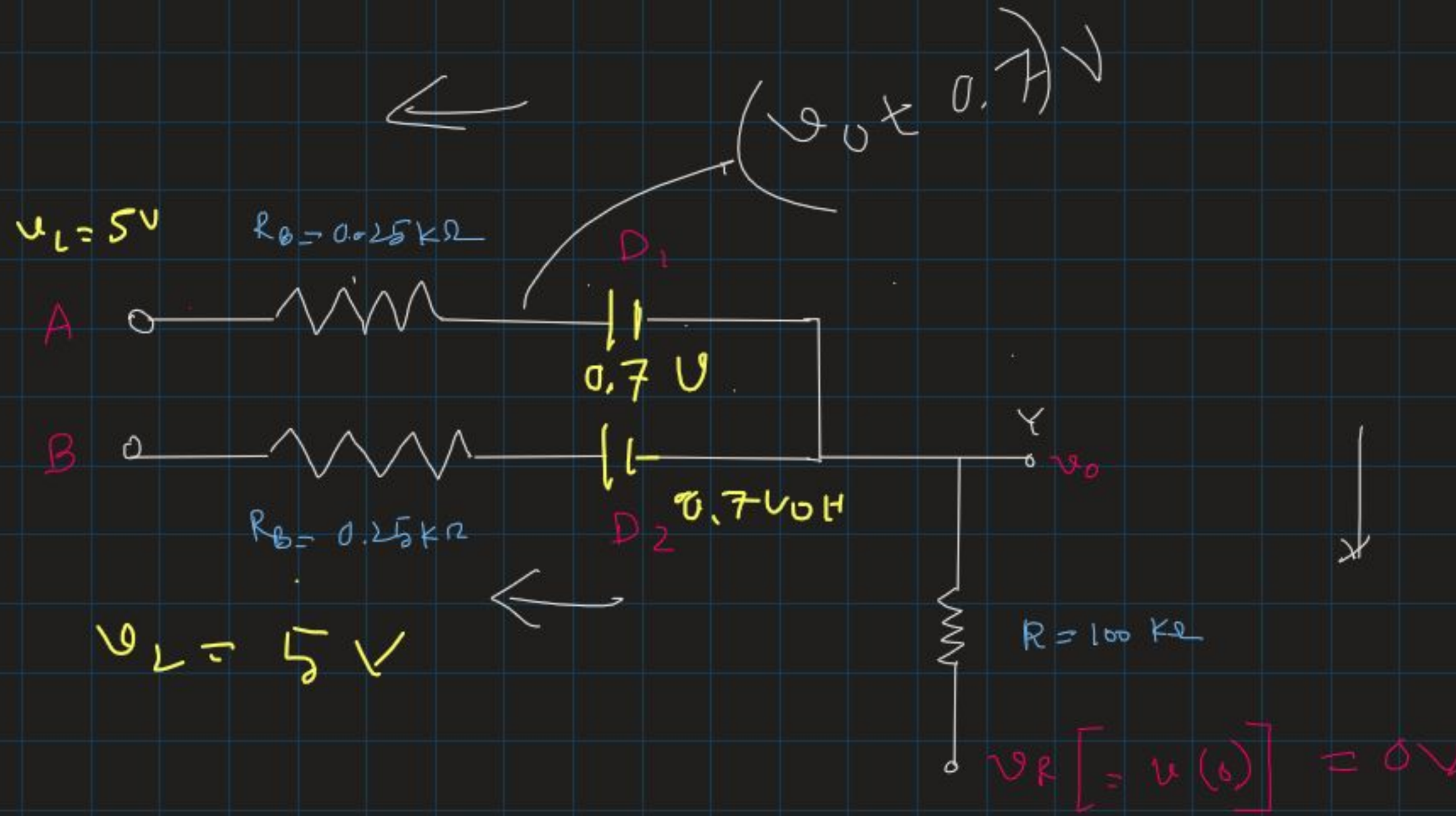
2nd case:



$$\frac{V_o - 0}{100k\Omega} + \frac{(V_o + 0.7) - 5V}{0.25k\Omega} = 0$$

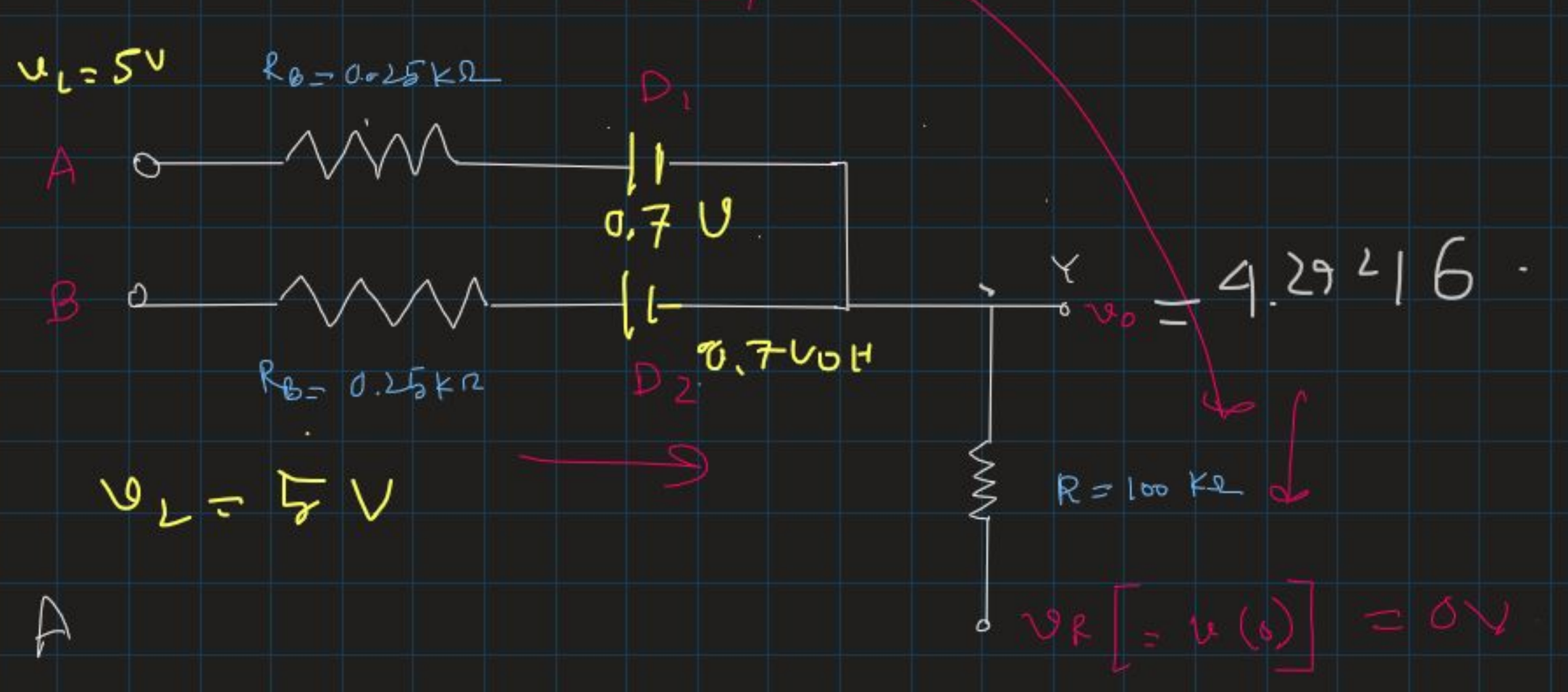
$V_o = 4.2893$ volt

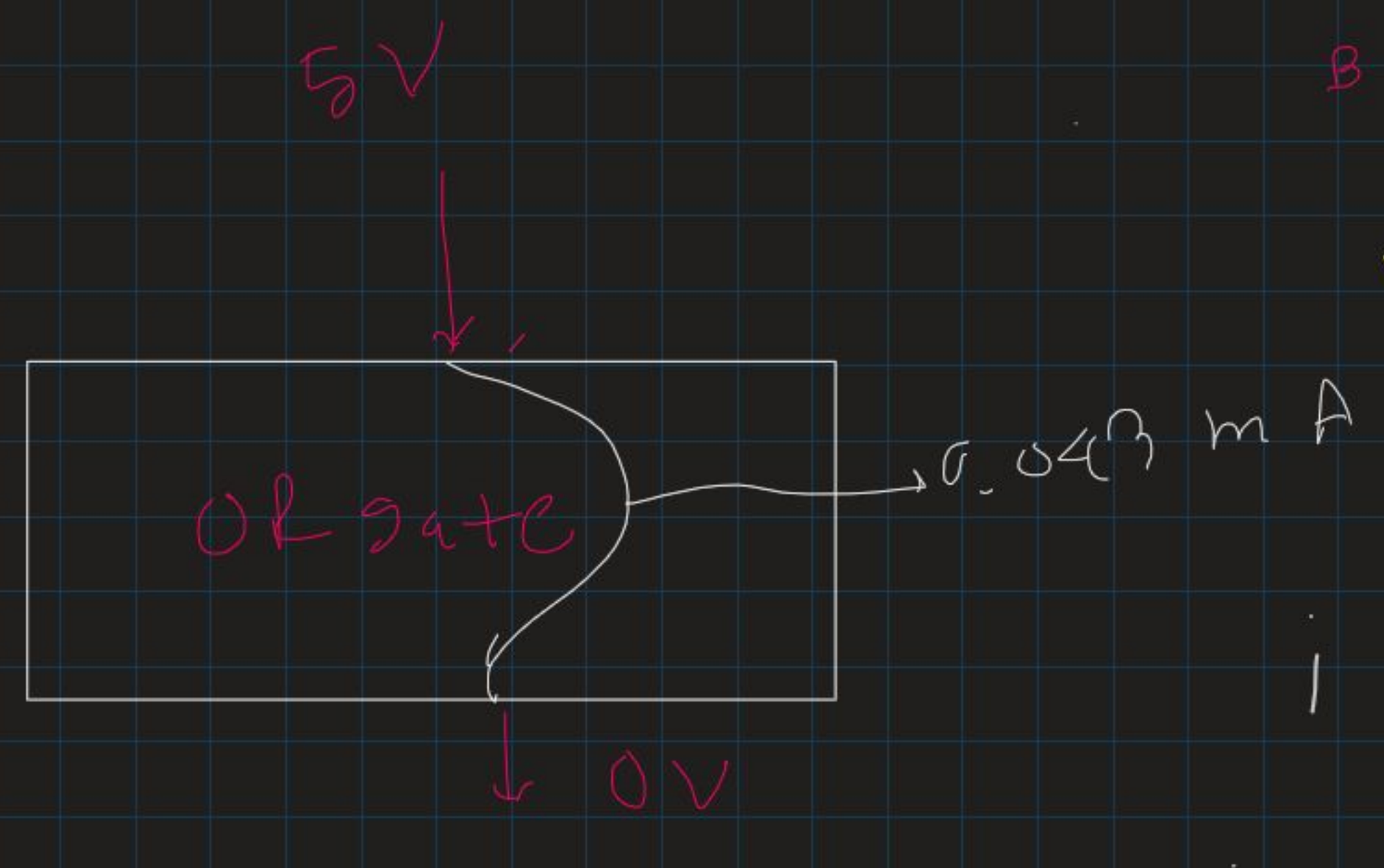
4th case:



$$\frac{V_o - 0}{100k\Omega} + 2 \times \frac{(V_o + 0.7) - 5}{0.25k\Omega} \Rightarrow V_o = 4.2946 \text{ volt}$$

maximum power dissipation:



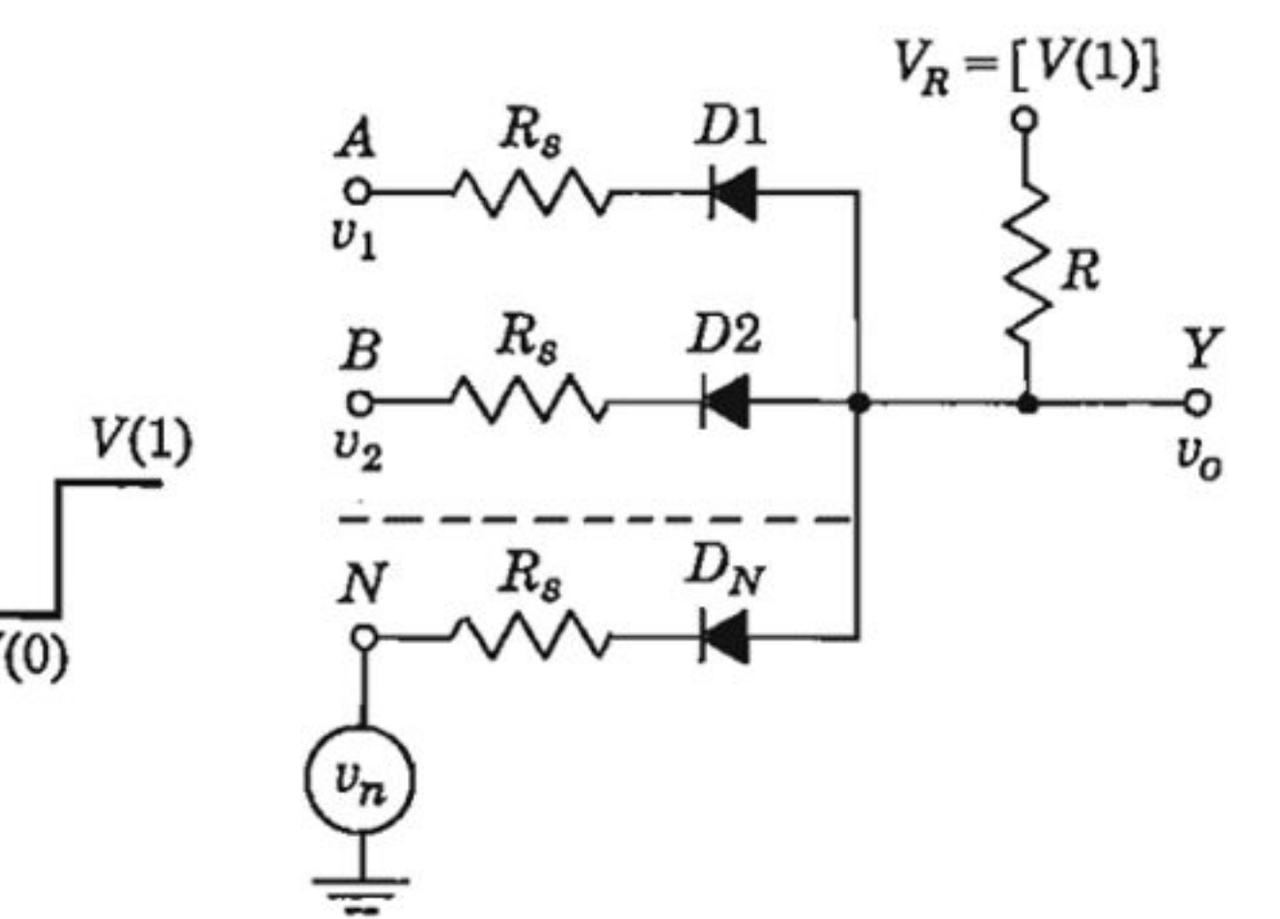


$$I = \frac{4.2946 - 0}{100k\Omega} = 0.043 \text{ mA}$$

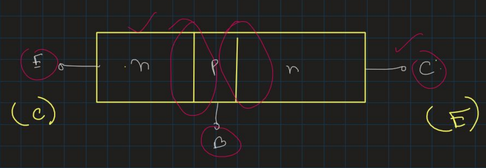
$P = V \times I$

$= (5 - 0)V \times 0.043 \text{ mA} = 0.215 \text{ mW}$

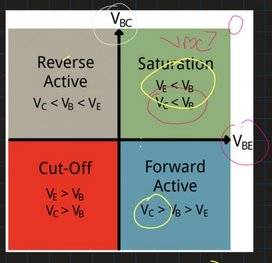
AND Gate: If $V(0) = 0V$ and $V(1) = 5V$,
ans $R_S = 0.25\ k\Omega, R = 100\ k\Omega$. Fan In N = 2
(a) Find out the output voltage levels.
(b) Find out the maximum power dissipation.



Operating Mode of BJT



(a) Saturation region
(b) Active region
(c) Cutoff region
(d) Reverse Active region



$V_{BE} > 0$ V_B
V_C

cutin voltage

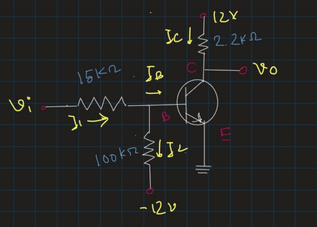
Region	V_{BE} (V)	V_{CE}(V)	Current Relationships	Test
Cutoff	< cut in	0.2	$I_B = I_C = I_E = 0$	$V_{BE} < 0.5$
forward active	0.7	> 0.2	$I_C = \beta_F I_B$, $I_E = I_B$	$V_{CE} \geq 0.2$
Satu-ration	0.8	0.2/0.1	$I_B > \frac{I_C}{\beta_F}$	$I_B \geq \frac{I_C}{\beta_F}$
Reverse active	< -0.6V (V_{BC} = 0.7V)	< -0.2	$I_E = \beta_R I_B$	$V_C < V_B < V_E$

β_F = Forward active current gain

Beta R = Reverse active current gain

RTL Inverter : If the value of beta = 30 , Find the output voltage levels considering the input voltage levels to be 0 v and 12 v

12V 0.2V



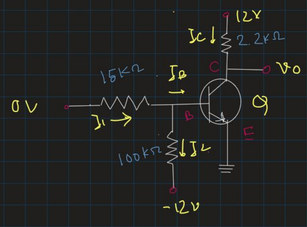
first case :

$V_i > 0.5$

Q → Cutoff

$I_C = I_E = I_B = 0$

$V_o = 12V$



$$I_1 = I_2 = \frac{0-(-12)}{(100+15)k\Omega} = 0.1043\,mA$$

$$I_1 = \frac{0-V_B}{15k\Omega} = 0.1043\,mA$$

$$V_B = -0.1043 \times 15 = -1.565V$$

$V_B < 0.5$ Volt.

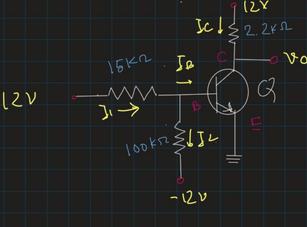
second case :

Q → saturation.

$V_{BE} = 0.8V$, $V_{CE} = 0.2V$ ⇒ $V_E = 0V$

$V_B = 0.8V$

$V_C = 0.2V$



$$I_1 = \frac{12-0.8}{15k\Omega} = 0.746\,mA$$

$$I_2 = \frac{0.8-(-12)}{100k\Omega} = 0.128\,mA$$

$$I_C = \frac{12-0.2}{2.2k\Omega} = 5.36\,mA$$

$I_1 = I_2 + I_B$

$I_B = I_1 - I_2$

$= 0.746 - 0.128$

$= 0.619\,mA$

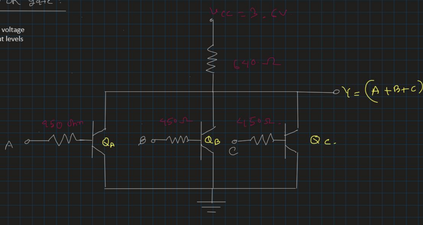
$$\beta_{forced} = \frac{I_C}{I_B} = \frac{5.36}{0.619} = 8.659 < \beta(30)$$

RTL (Resistor - Transistor Logic) Family

1. High logic voltage level for circuit - 1 to 3.6 volt.
2. low logic voltage level for circuit - 0.2 volt.
3. power dissipation of the RTL gate = 12 mW
4. Propagation delay averages 25 ns

3 input RTL NOR gate :

Problem : Calculate the output voltage level for different possible input levels



Truth table :

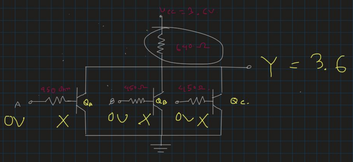
A	B	C	QA	QB	QC	Y
Low	Low	Low	off	off	off	3.6V
Low	Low	High	off	off	on	0.2V
Low	High	Low	off	on	off	0.2V
High	low	Low	on	off	on	0.2V
Low	High	High	off	on	on	0.2V
High	low	High	on	off	on	0.2V
High	High	Low	On	on	off	0.2V
High	High	High	On	On	On	0.2V

★ All three inputs are low

QA → X

QB → X

QC → X



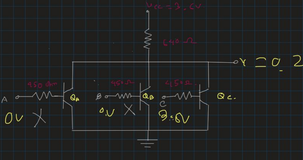
2nd case :

★ Input A and B are low, input C is high.

QA → X

QB → X

QC → Saturation



Bmin calculation

$V_{BE} = 0.8V$

But since $V_E = 0$

$V_B = 0.8V$

$I_B = \frac{3.6 - 0.8}{4500\text{ohm}} = 6.22\text{ mA}$

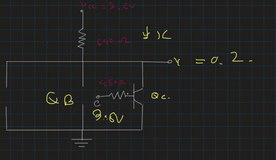
$I_C = \frac{3.6 - 0.2}{640\text{ohm}} = 5.3125\text{ mA}$

$\beta_{forced} = \frac{I_C}{I_B}$

$= \frac{5.3125}{6.22}$

$= 0.853$

$\beta_{min} = 0.853$



5th case :

★ input A is low

and input B and C are high

QA → Cut off

QB → } saturation

QC → }

V_{CE} → same for all of them

$i_{640} = \frac{3.6 - 0.2}{640} = 5.3125\text{ mA}$

$I_{CB} = I_{CC} = \frac{5.3125}{2} = 2.65\text{ mA}$