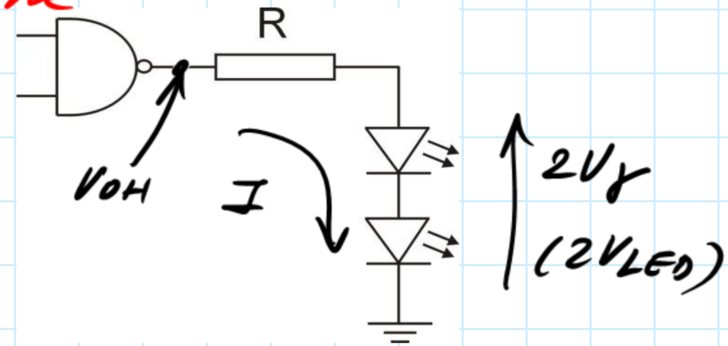
15. Given the following circuit with LEDs, signal the CORRECT answer between the following, taking into account the following parameters: For LEDs, V_{LED}=1.5V and I_{LED}= 10mA, and for NAND gate, V_{OL}=0.15V y V_{OH}=4.5V (V_{CC} = 5V).

[A] The LEDs will shine properly with a resistor higher than 150Ω. ✗ Pehaps don't shine

[B] The LEDs will shine properly with a resistor lesser or equal than 150Ω. ✗ We can destroy LEDs

[C] The LEDs will shine properly with a resistor of 150Ω. ✓

[D] The LEDs will not shine for any of the logic level outputs of the NAND gate. ✗

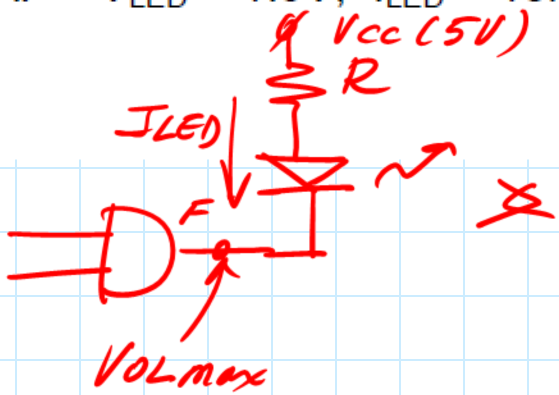


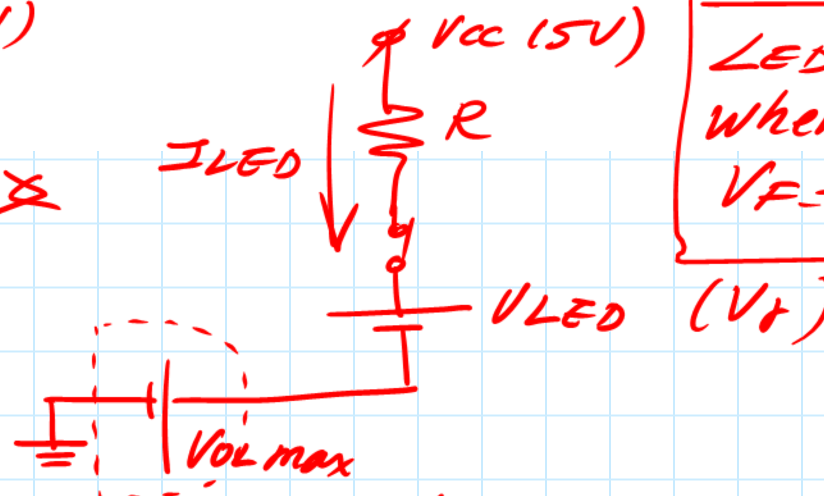
$$I_{LED} = \frac{V_{OH} - 2V_{LED}}{R} \Rightarrow R = \frac{V_{OH} - 2V_{LED}}{I_{LED}}$$

$$R = \frac{4.5 - 3}{10m} = 0.15\,K = 150\,\Omega$$

16. We have a TTL circuit (for example, an AND gate) that performs a generic function F. We want to light a LED when F = "0". Design a circuit for this purpose..

DATA: $V_{LED} = 1.5V$; $I_{LED} = 10mA$; $V_{OHmín} = 2.4V$; $V_{OLmáx} = 0.5V$

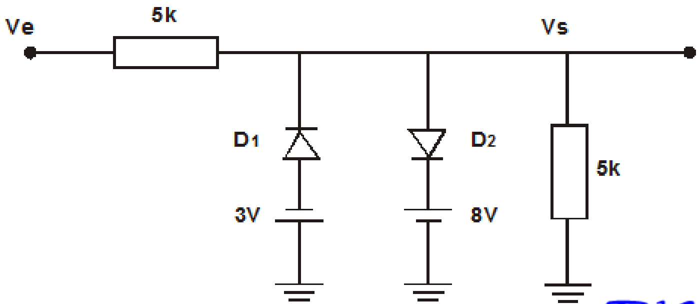




$\boxed{\text{LED brights when } F=0 \Rightarrow V_F = V_{OLmax}}$

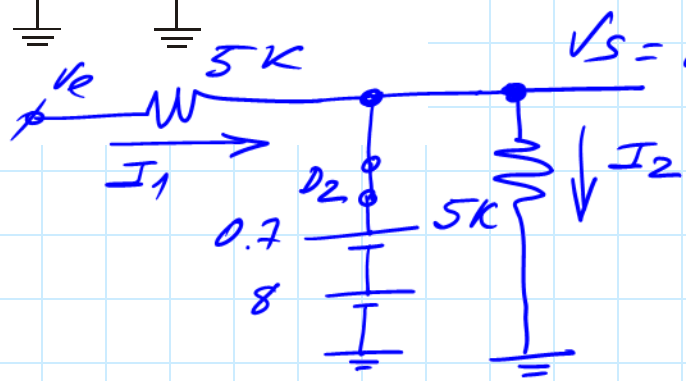
$$\underline{\underline{R}} = \frac{V_{cc} - V_{LED} - V_{OLmax}}{I_{LED}} = \frac{5 - 1.5 - 0.5}{10mA} = 0.3K = \underline{\underline{300\,\Omega}}$$

10. Given the following clipping circuit, and for $V\gamma$=0.7V for all diodes, calculate Vs when Ve = 6V.

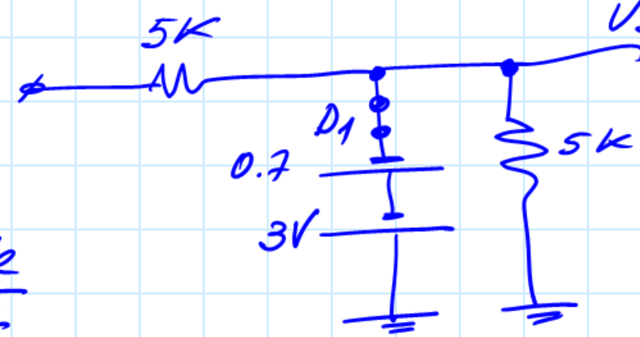


[A] 7.3V
[B] 3V
[C] 3.7V
[D] 6V

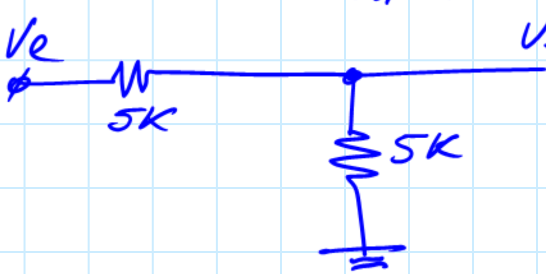
a) $V_s > 8 + 0.7 \Rightarrow D_2$ ON $\Rightarrow$
D_1 OFF



b) $V_s < -3 - 0.7 \Rightarrow D_2$ OFF
D_1 ON $\Rightarrow$



c) $-3.7 \le V_s \le 8.7 \Rightarrow D_2$ OFF
D_1 OFF



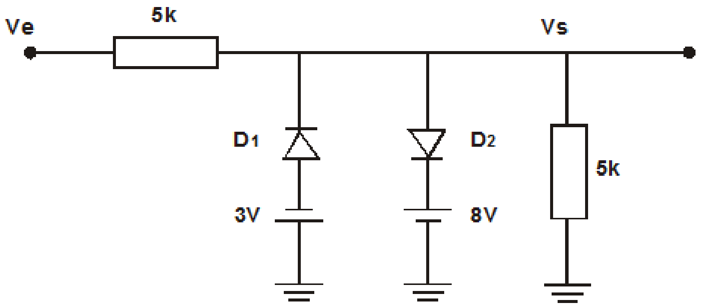
$V_s = \frac{V_e}{2}$

Resistor divider $\Rightarrow$

$\boxed{-7.4\,V \le V_e \le 17.4\,V \Rightarrow D_2 \text{ OFF},\ D_1 \text{ OFF}}$

10. Given the following clipping circuit, and for $V\gamma$=0.7V for all diodes, calculate Vs when Ve = 6V.

[A] 7.3V
[B] 3V
[C] 3.7V
[D] 6V



Then :

$-7.4 \le Ve \le 17.4 \rightarrow Vs = Ve/2$ (D_1 OFF, D_2 OFF)

$Ve < -7.4 \rightarrow Vs = -3.7$ (D_1 ON, D_2 OFF)

$Ve > 17.4 \rightarrow Vs = 8.7$ (D_1 OFF, D_2 ON)

Then sol is B : $Ve = 6V \rightarrow Vs = \frac{Ve}{2} = 3V$

8. a) Implement, using logic gates composed only by diodes and resistors, the logic equation F = AB + CD.

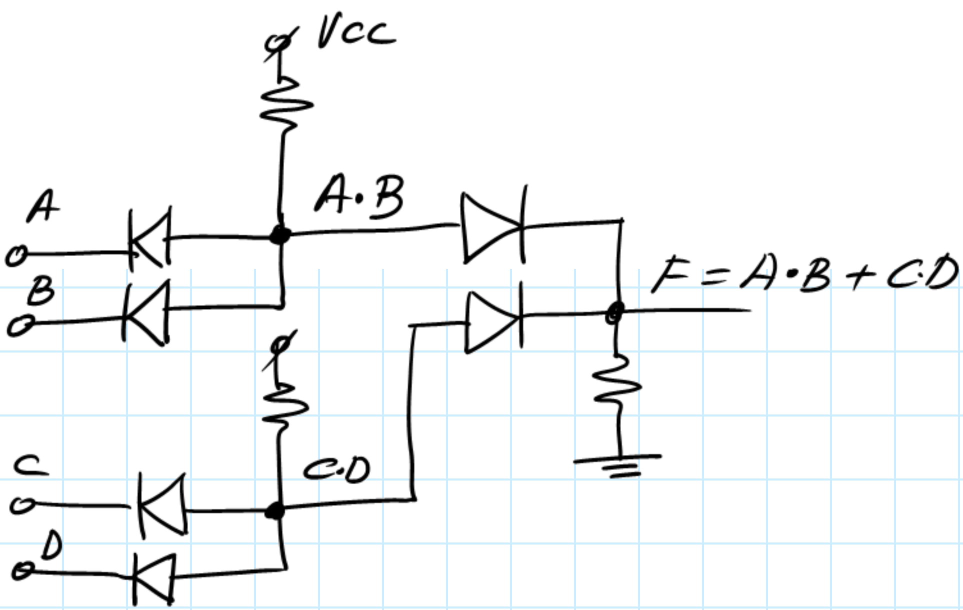
   b) Calculate the output voltage of the designed circuit, for the following input combinations (assume all resistors value as R and ideal diodes):

   b1. A = B = C = D = 0

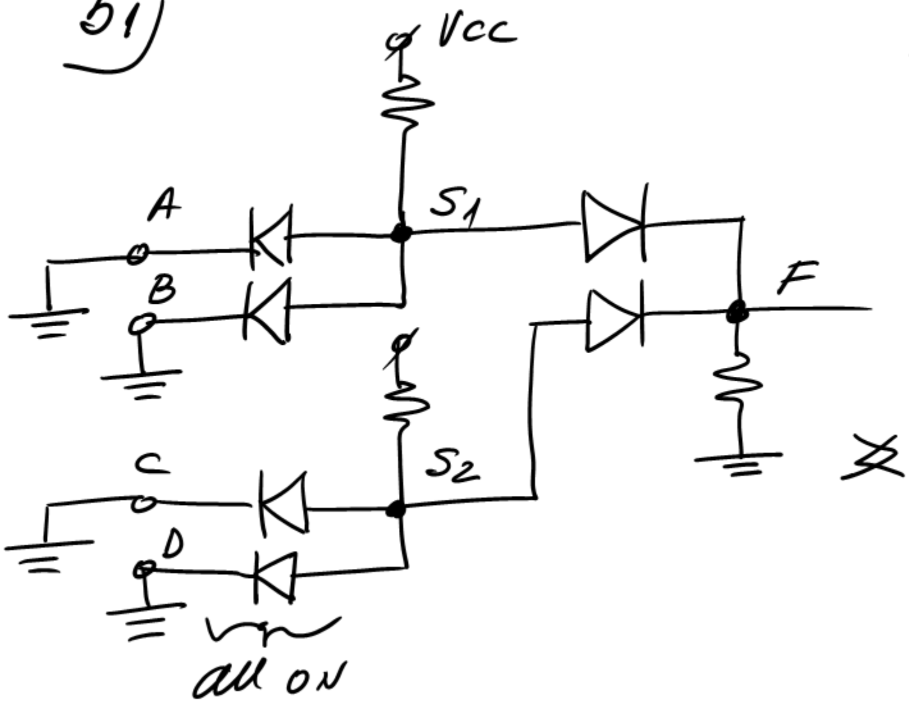
   b2. A = B =1; C = D = 0

   b3. A=B=C=D= 1

a)



b)

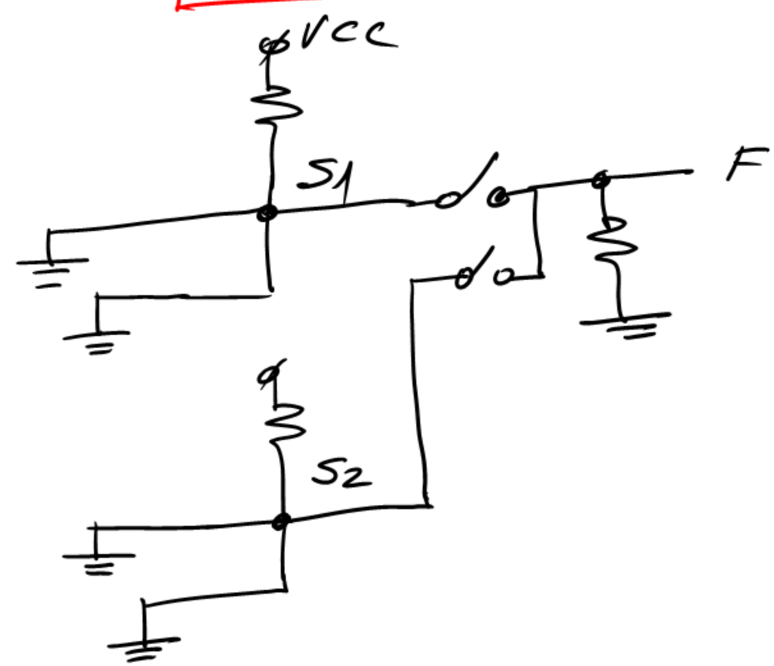


all AND gates diodes ON

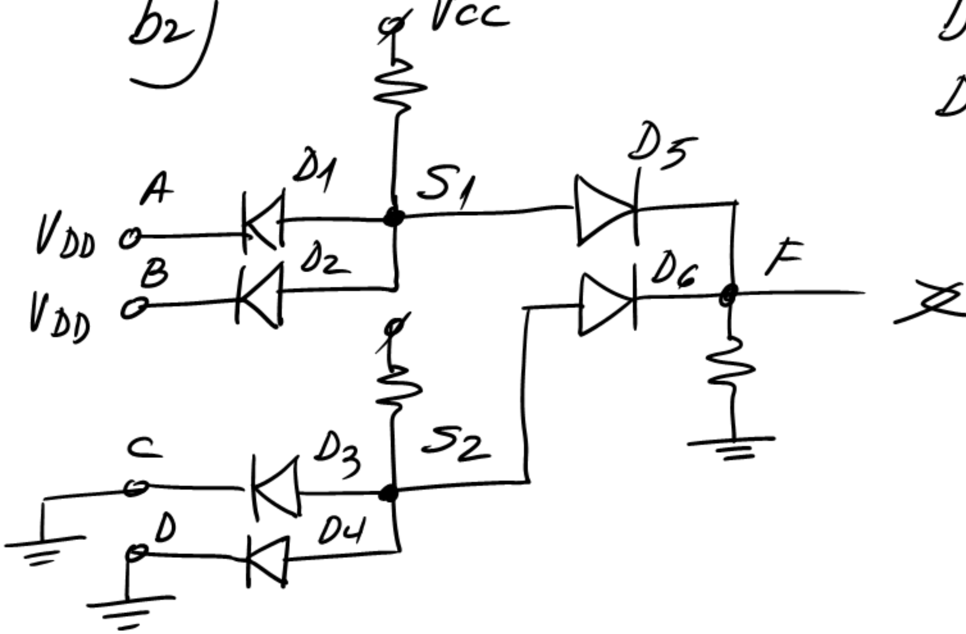
$\Rightarrow V_{S1} = V_{S2} = 0V \Rightarrow$

Diodes OR gate OFF

$\Rightarrow \boxed{V_F = 0V} \Rightarrow \boxed{F = 0}$

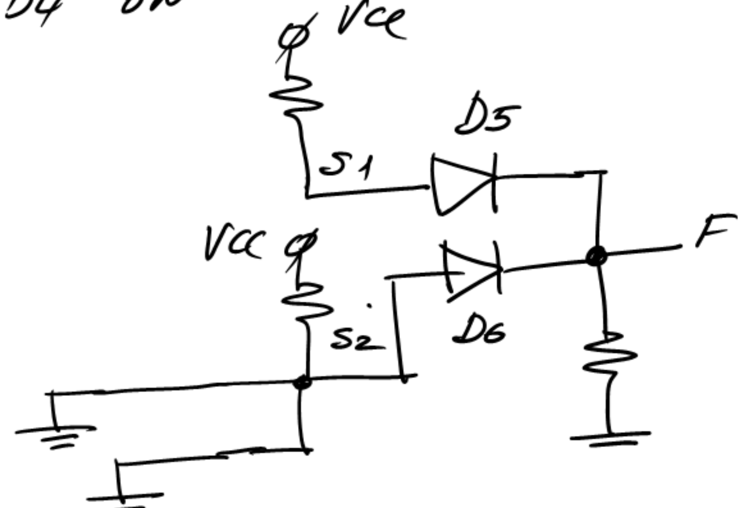


b2)



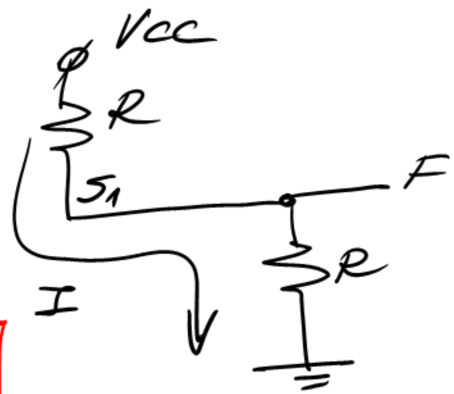
D_1, D_2 OFF $\Rightarrow V_{S1} = V_{cc}$; $S_1 = 1$

D_3, D_4 ON



$V_{S2} = 0V \Rightarrow D_6$ OFF

D_5 ON $\Rightarrow$

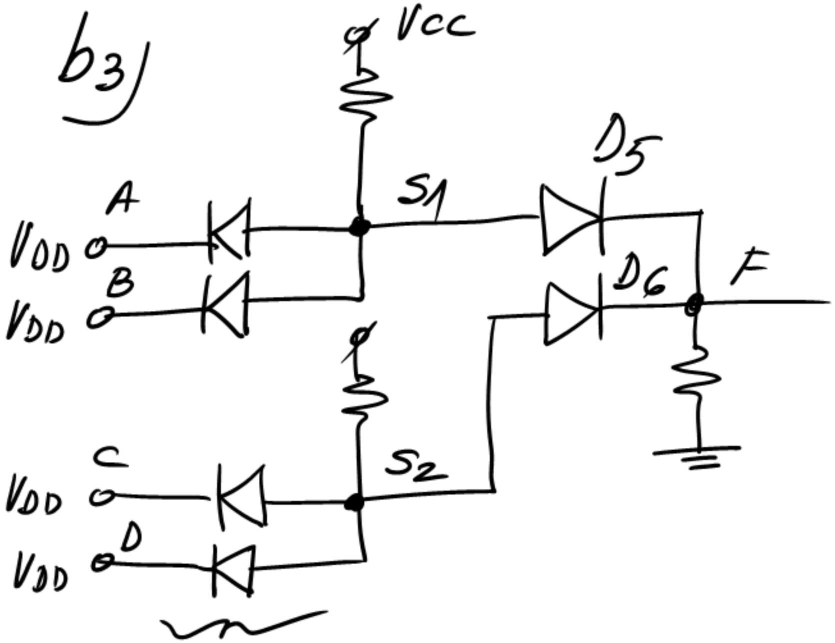


$I = \dfrac{V_{cc}}{2R}$

$\boxed{V_F = RI = \dfrac{V_{cc}}{2}}$

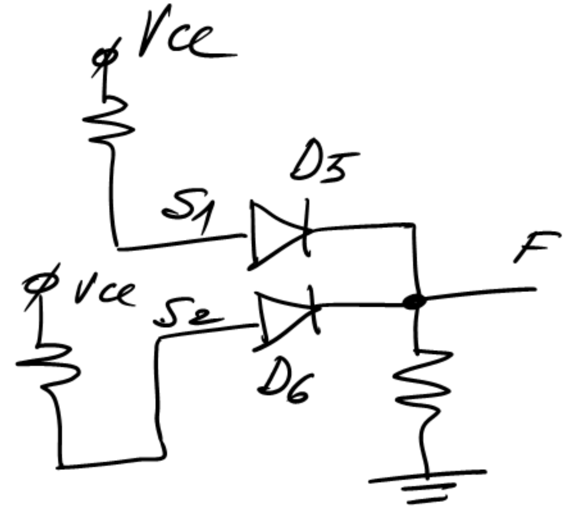
$\rightarrow$ F = 1, but we have 1/2 Vcc at the output!!

b3)

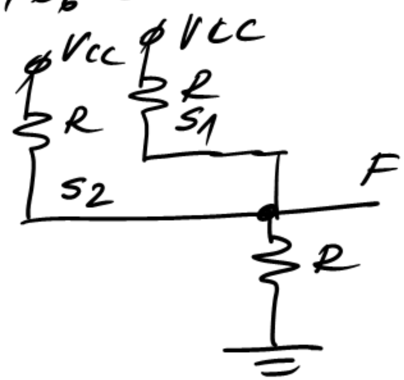


all OFF

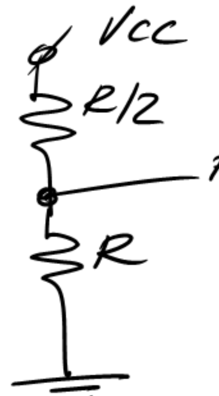
$\neq$



D5, D6 ON :



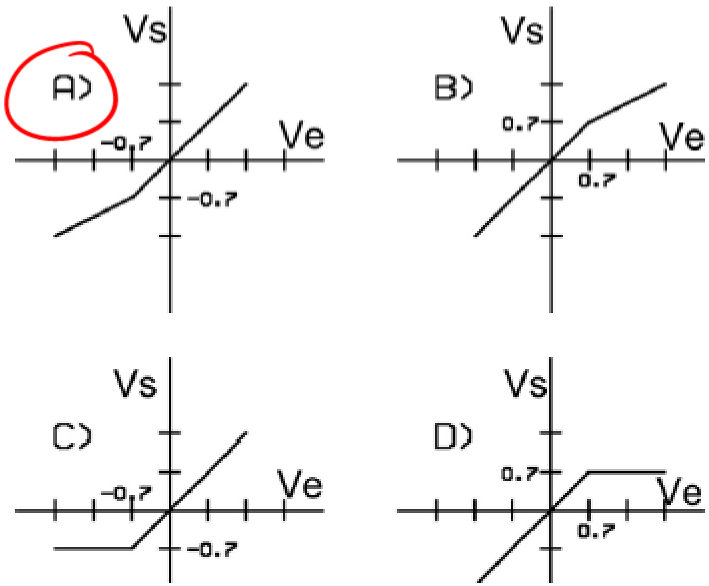
$\neq$

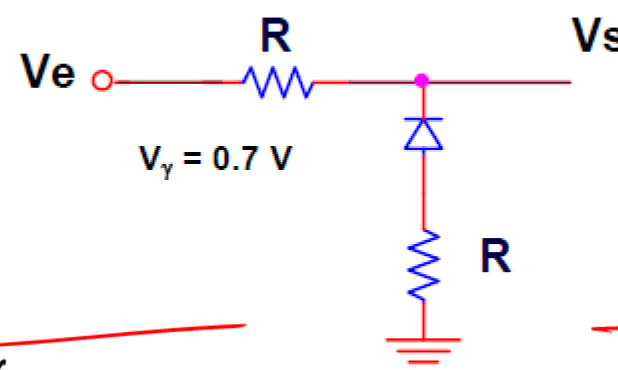


; $\boxed{V_F = V_{cc}\,\frac{R}{R+R/2} = \frac{2}{3}V_{cc}}$

F = 1; but we have also voltage drop at the output $V_F \Rightarrow$ We need an active element!

11. Given the circuit of the figure, determine which of the following curves (A,B,C,D) is its corresponding transference curve.

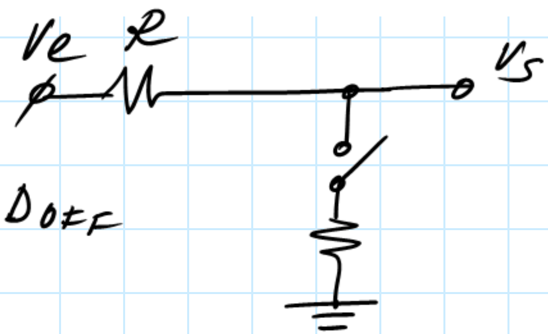




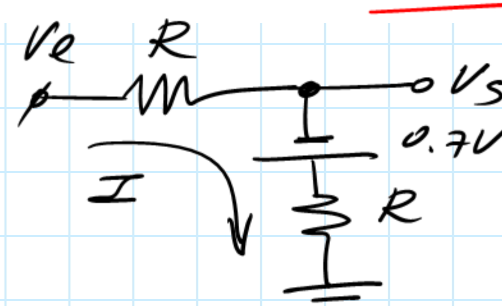
$V_\gamma = 0.7$ V

$$\boxed{\begin{array}{l} V_e \geq -0.7V \Rightarrow D_{OFF} \Rightarrow V_s = V_e \ (1) \\ V_e < -0.7V \Rightarrow D_{ON} \Rightarrow V_s = \dfrac{V_e - 0.7}{2} \ (2) \end{array}}$$

(1)



(2) DON



$$I = \frac{V_e + 0.7}{2R}$$

$$V_s = V_e - RI = V_e - \frac{V_e + 0.7}{2} = \frac{V_e - 0.7}{2}$$