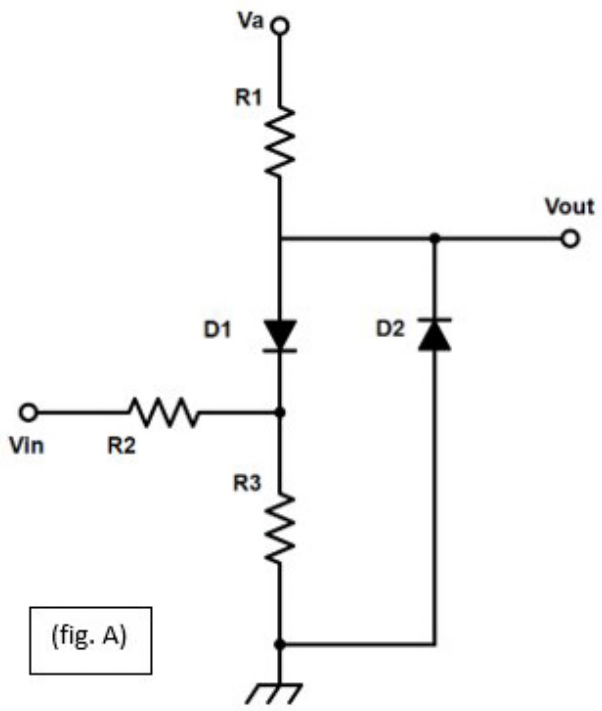
Esami Diodi

Esame 2017-04-19

Si calcoli la transcaratteristica (V_{out} in funzione di V_{in}) del circuito riportato in figura A.

Si considerino i diodi D_1 e D_2 ideali ($V_{on} = 0$ e $R_D = 0$).



(fig. A)

$Va = 5\ V$

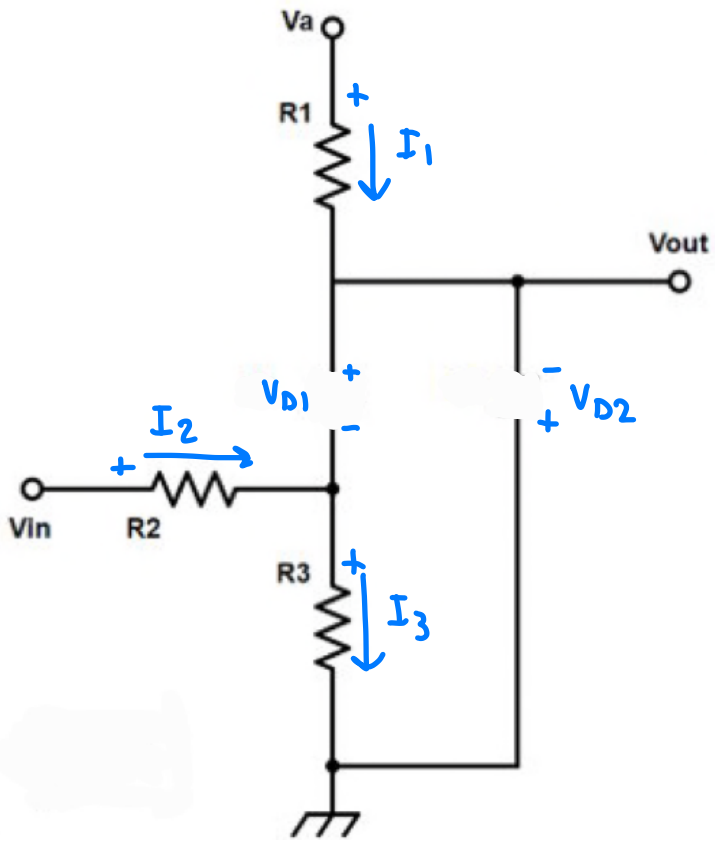
$R_1 = 4\ k\Omega$

$R_2 = 8\ k\Omega$

$R_3 = 8\ k\Omega$

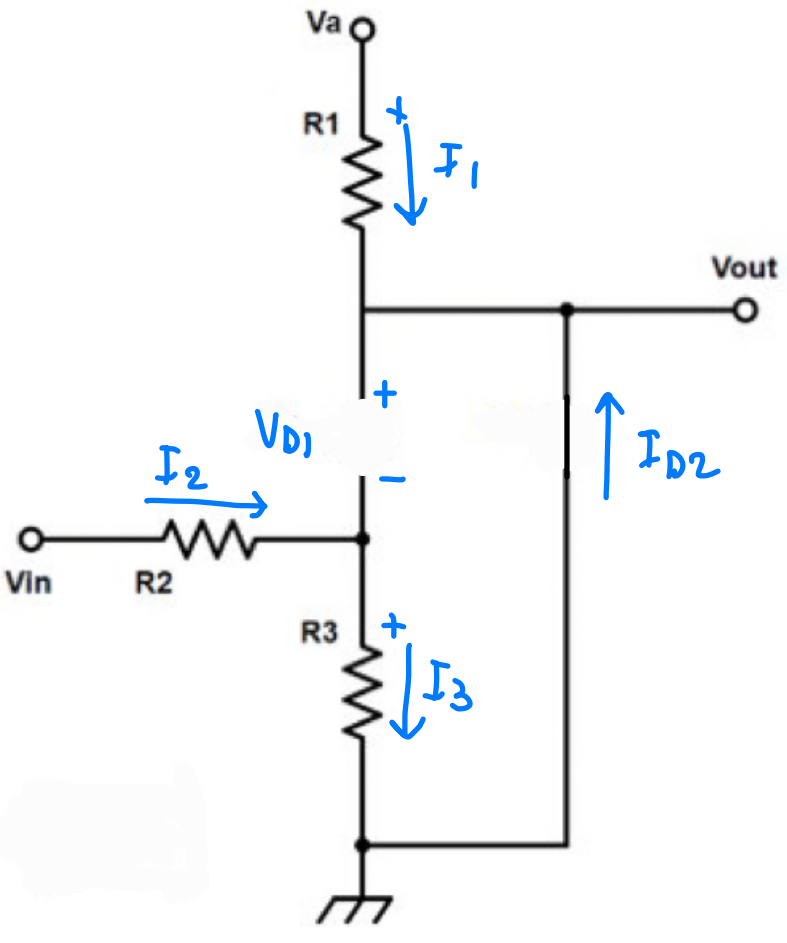
$-12\ V < V_{in} < 12\ V$

CASO 1: D_1 = OFF D_2 = OFF



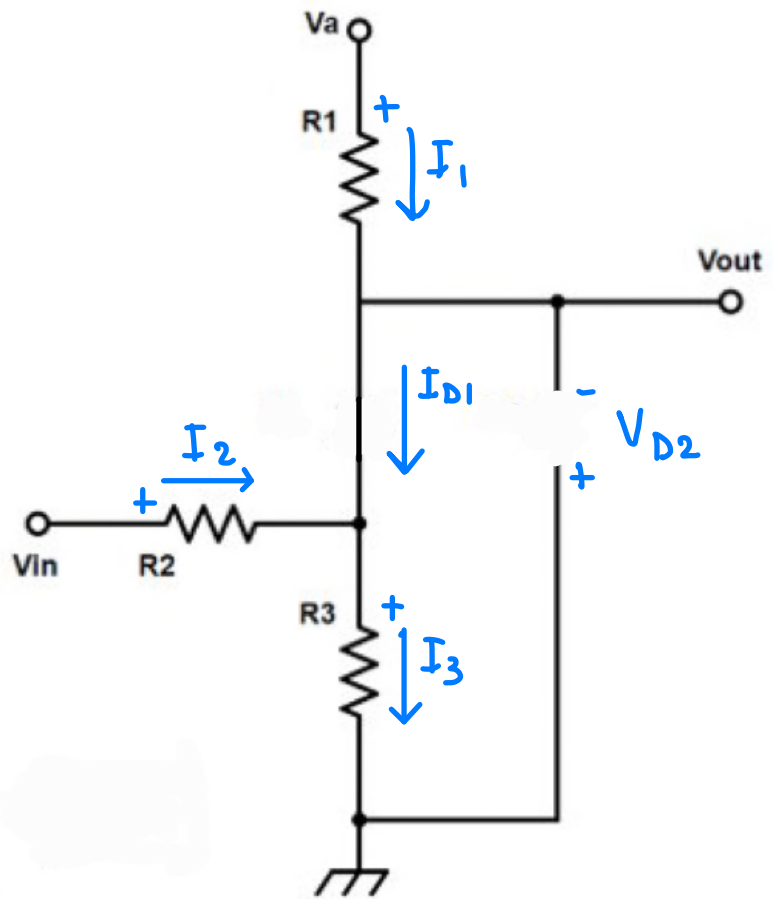
- $v_0 = V_a = \boxed{5\ V}$
- VERIFICO $V_{D1} < 0$ e $V_{D2} < 0$:
  - $V_{D1} = V_a - \frac{R_3}{R_2+R_3} v_i = 5 - \frac{1}{2} v_i < 0 \rightarrow \boxed{v_i > 10}$
  - $V_{D2} = 0 - V_a = -5V < 0$ OK

CASO 2: D_1 = OFF D_2 = ON



- $v_0 = 0$
- VERIFICO $I_{D2} > 0$ e $V_{D1} < 0$
  - $I_{D2} = -I_1 = -\frac{V_a - v_0}{R_1} < 0$ NON POSS!

CASO 3: D_1 = ON D_2 = OFF



- $\begin{cases} I_1 + I_2 = I_3 \\ v_0 = V_a - R_1 I_1 \\ v_0 = R_3 I_3 \\ v_0 = v_i - R_2 I_2 \end{cases} \rightarrow \begin{cases} v_0 = V_a - R_1 I_1 \\ v_0 = R_3 (I_1 + I_2) \\ v_0 = v_i - R_2 I_2 \end{cases}$

$$\rightarrow \begin{cases} v_0 = V_a - R_1 I_1 \\ v_0 = v_i - \frac{R_2}{R_3} v_0 + R_2 I_1 \end{cases}$$

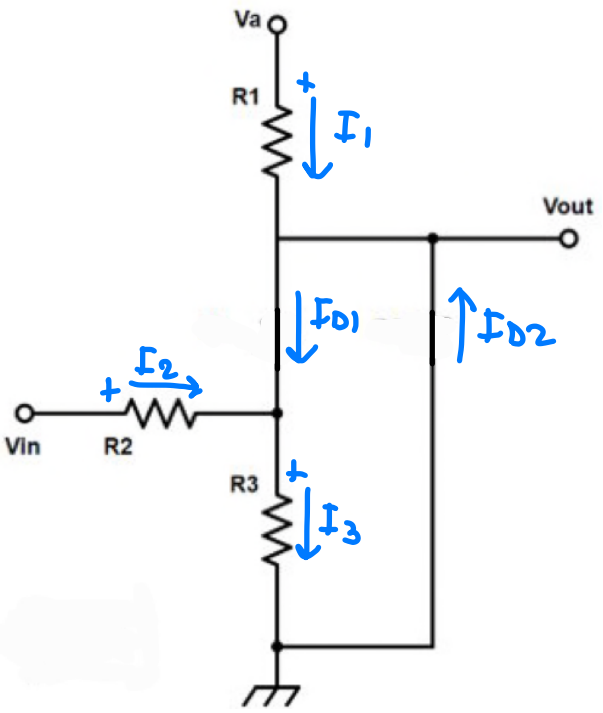
$$\rightarrow v_0 = v_i - \frac{R_2}{R_3} v_0 + \frac{R_2}{R_1} V_a - \frac{R_2}{R_1} v_0$$

$$\rightarrow v_0 \left(1 + \frac{R_2}{R_3} + \frac{R_2}{R_1}\right) = v_i + \frac{R_2}{R_1} V_a$$

$$\rightarrow \boxed{v_0 = \frac{5}{2} + \frac{v_i}{4}}$$

- VERIFICO $V_{D2} < 0$ e $I_{D1} > 0$
  - $V_{D2} = 0 - v_0 = -5/2 - v_i/4 < 0 \rightarrow \boxed{v_i > -10}$
  - $I_{D1} = I_{R1} = \frac{V_a - v_0}{R_1} = \frac{V_a}{R_1} - \frac{5}{2} \cdot \frac{1}{R_1} - \frac{1}{4R_1} \cdot v_i > 0 \rightarrow \boxed{v_i < 10}$

CASO 4: D_1 = ON D_2 = ON

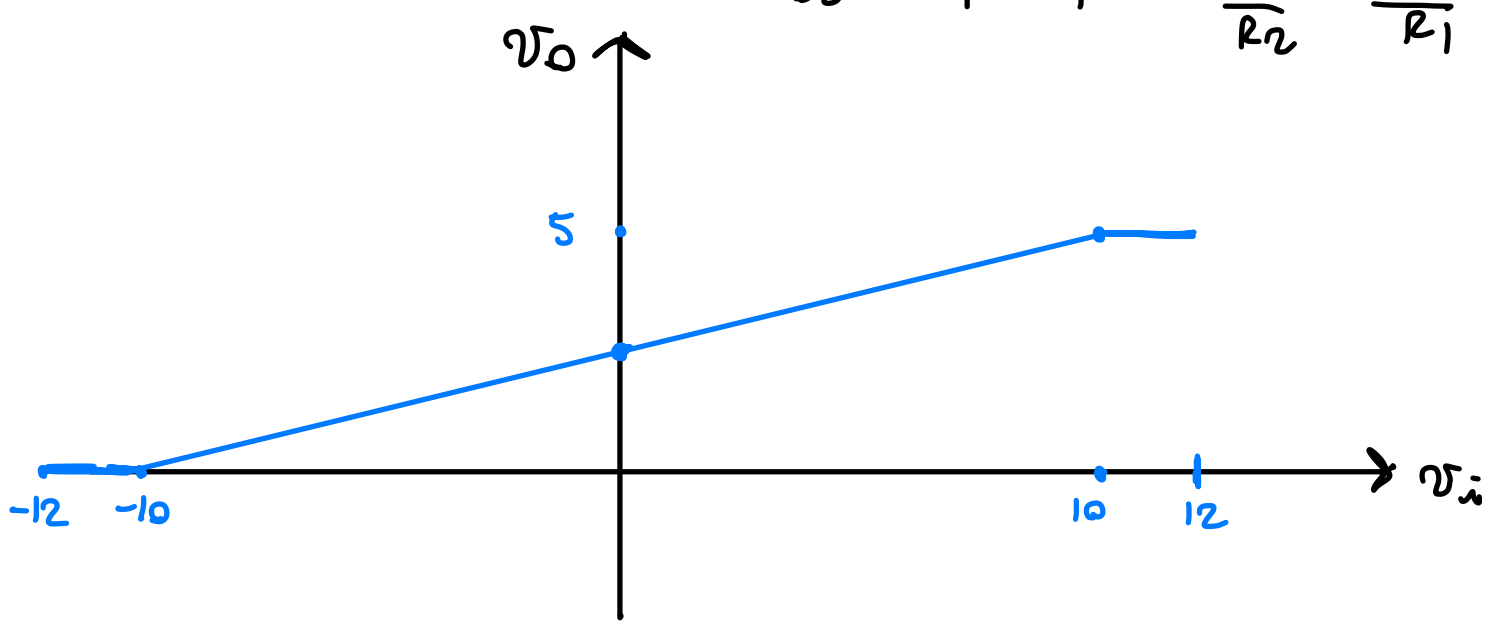


- $v_0 = 0$
- VERIFICO $I_{D1} > 0$ e $I_{D2} > 0$

  $I_1 = V_a / R_1 = 1.25$ mA

  $I_3 = 0$

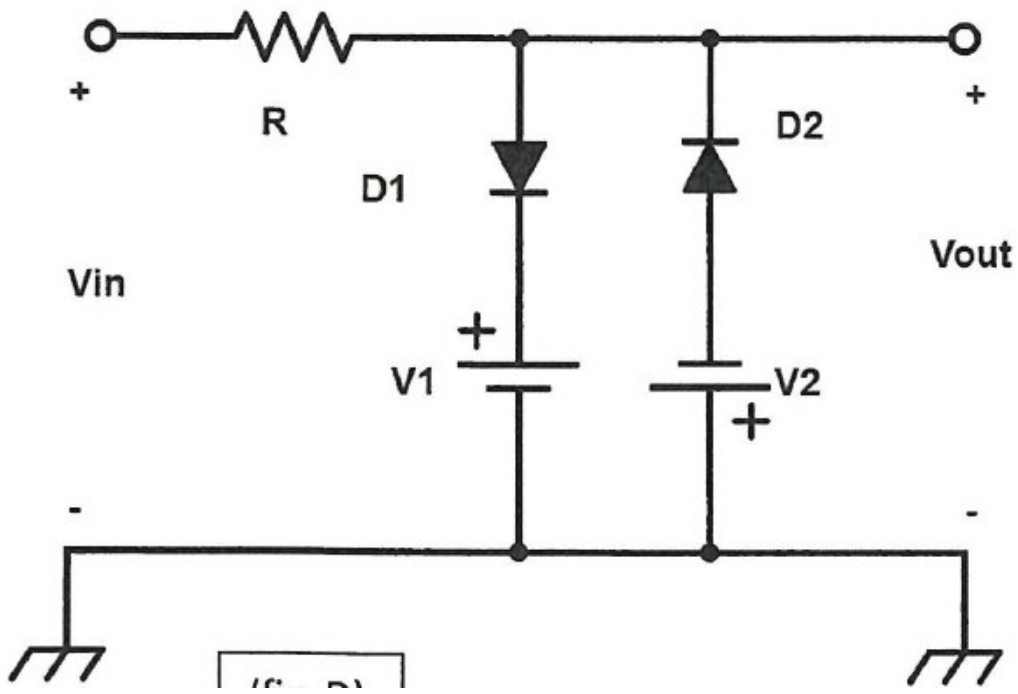
  $I_2 = v_i / R_2$
- $I_{D1} = -I_2 = -\frac{v_i}{R_2} > 0 \rightarrow \boxed{v_i < 0}$
- $I_{D2} = I_{D1} - I_1 = -\frac{v_i}{R_2} - \frac{V_a}{R_1} > 0 \rightarrow \boxed{v_i < -10}$



Esame 2017-06-15

Si calcoli la transcaratteristica (V_{out} in funzione di V_{in}) del circuito riportato in figura D.

Si considerino i diodi D_1 e D_2 ideali ($V_{on} = 0$ e $R_D = 0$).

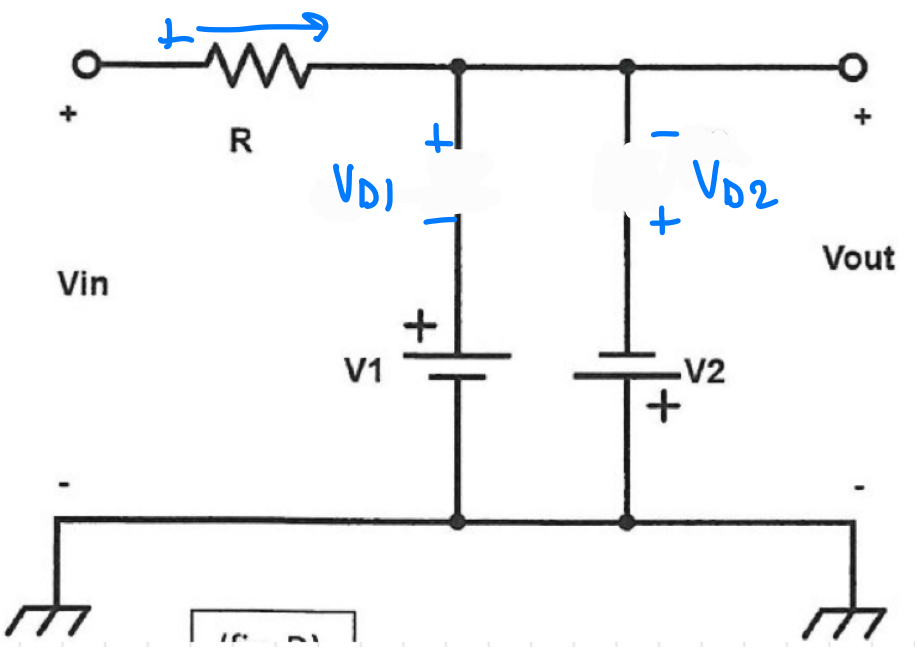


$V_1 = V_2 = 5\ V$

$R = 1\ k\Omega$

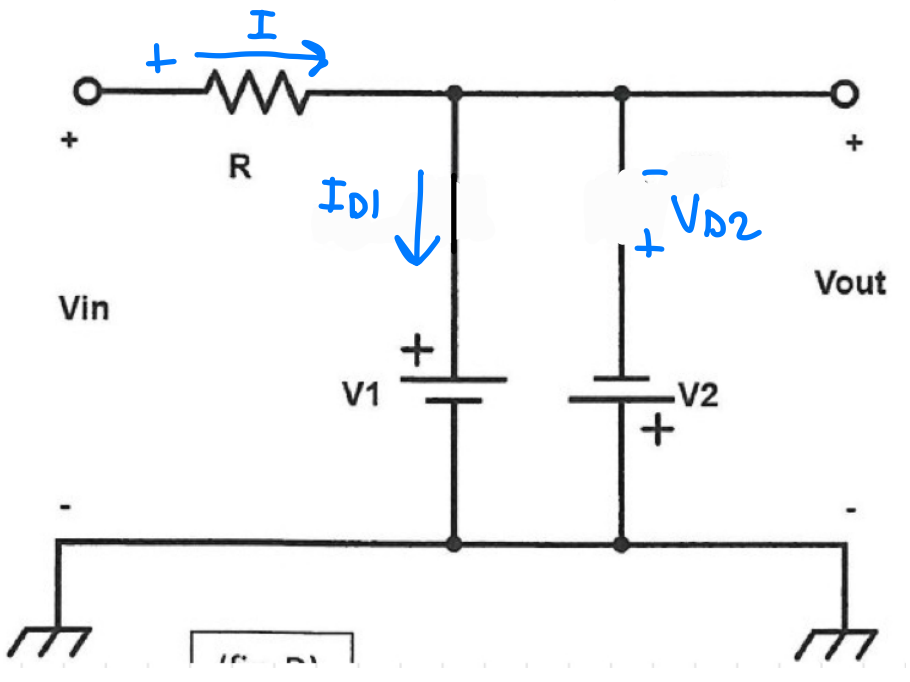
$-10\ V < V_{in} < 10\ V$

CASO 1: D_1 = OFF D_2 = OFF



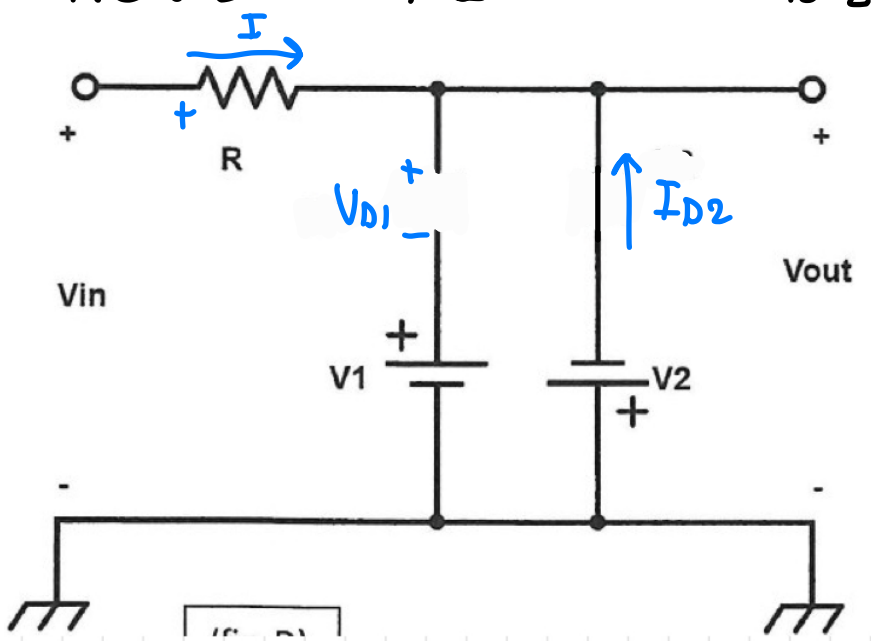
- $v_0 = v_i$
- VERIFICO $V_{D1} < 0$ e $V_{D2} < 0$
  - $V_{D1} = v_i - V_1 < 0 \rightarrow v_i < 5$
  - $V_{D2} = -V_2 - v_i < 0 \rightarrow v_i > -5$

CASO 2: D_1 = ON D_2 = OFF



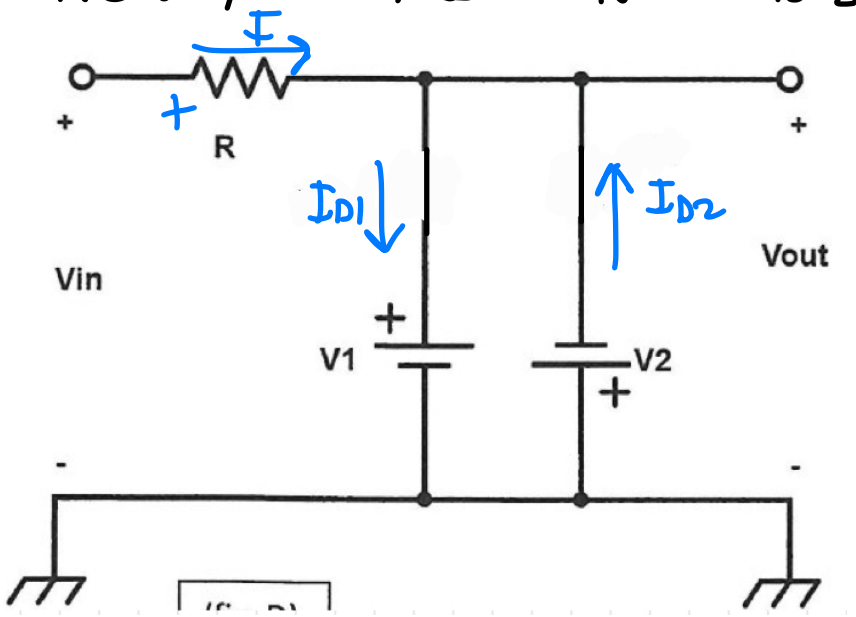
- $v_0 = V_1 = 5V$
- VERIFICO $I_{D1} > 0$ e $V_{D2} < 0$
  - $I_{D1} = I = \dfrac{v_i - V_1}{R} > 0 \rightarrow v_i > 5$
  - $V_{D2} = -V_2 - V_1 = -10 < 0$ ok

CASO 3: D_1 = OFF D_2 = ON

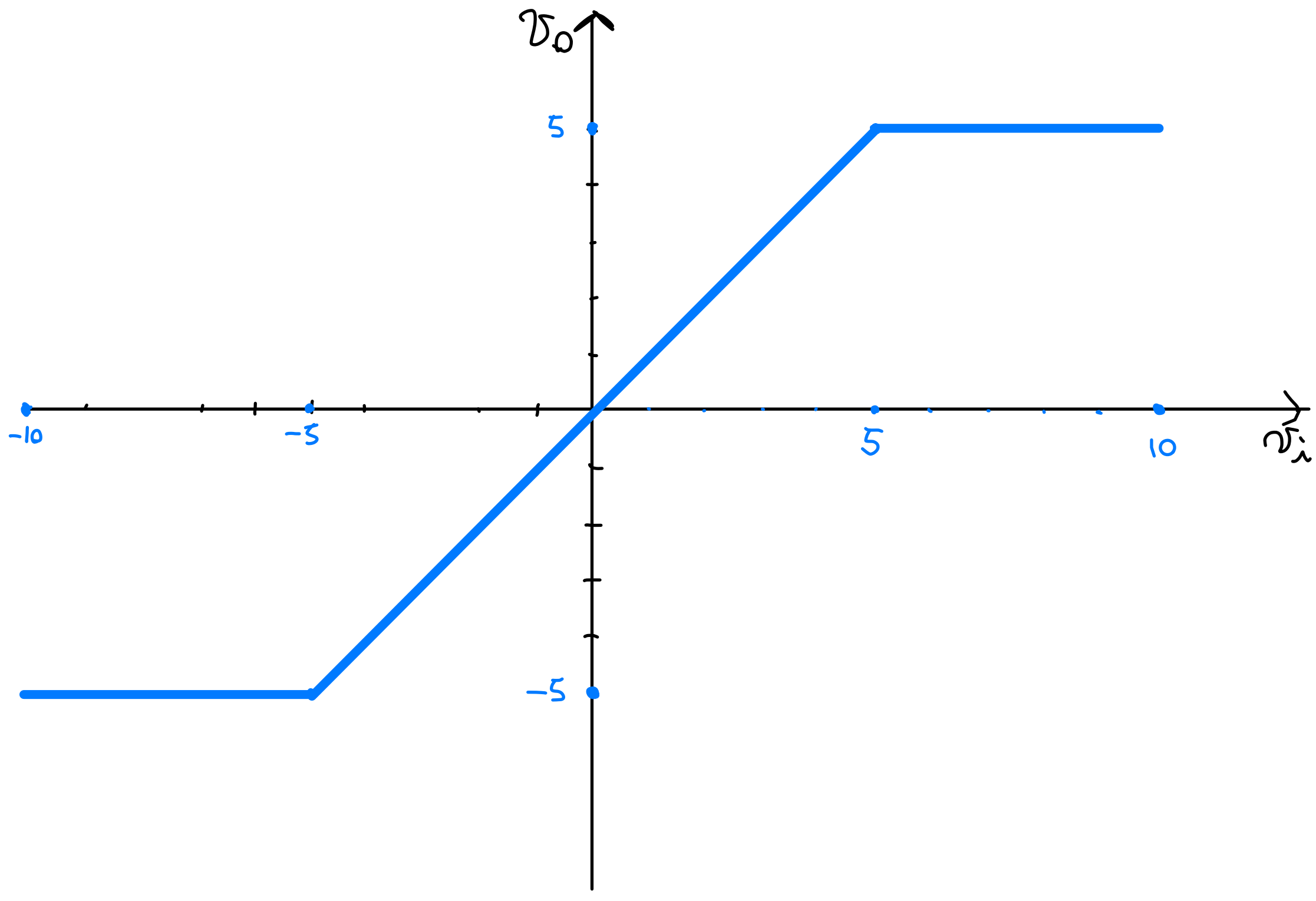


- $v_0 = -V_2 = -5\,V$
- VERIFICO $V_{D1} < 0$ e $I_{D2} > 0$
  - $V_{D1} = v_0 - V_1 = -10\,V < 0$ OK
  - $I_{D2} = -I = -\dfrac{v_i - v_0}{R} > 0 \rightarrow$ $v_i < -5\,V$

CASO 4: D_1 = ON D_2 = ON



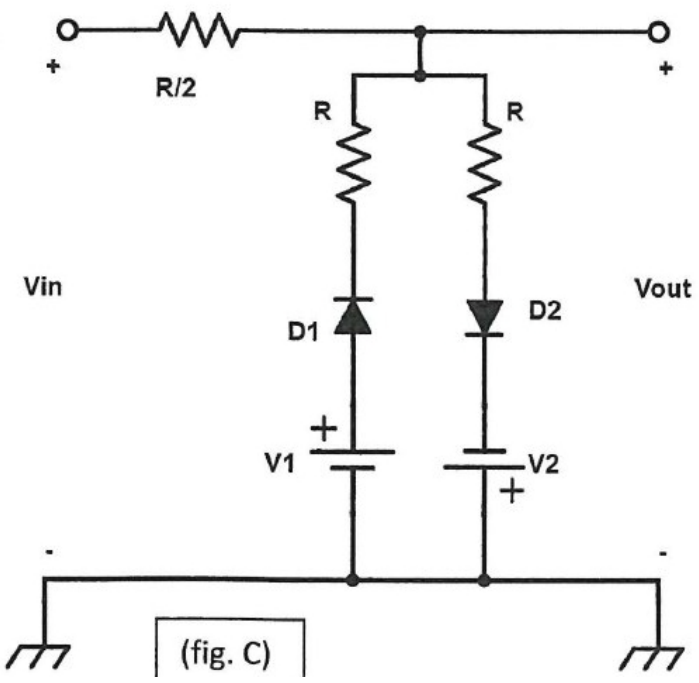
- $v_0 = V_1 = -V_2 = +5 = -5$ NON POSSIBILE



Esame 2017-07-13

Si calcoli e si disegni la transcaratteristica (V_{out} in funzione di V_{in}) del circuito riportato in figura C.

Si considerino i diodi D_1 e D_2 ideali ($V_{on} = 0$ e $R_D = 0$).

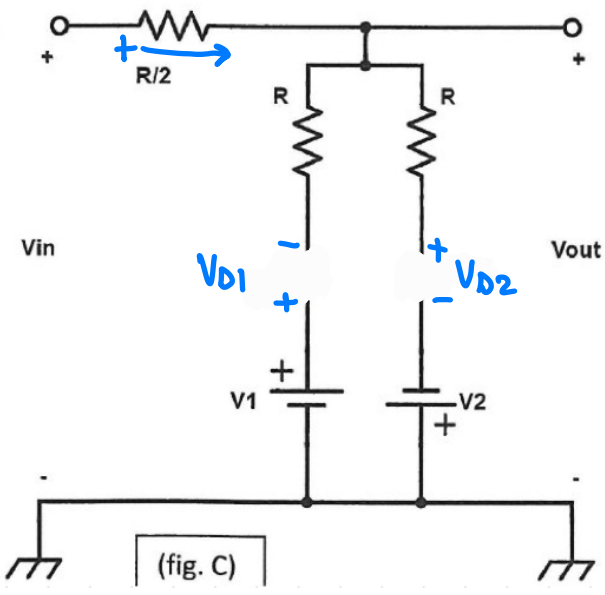


$V_1 = V_2 = 5\ V$

$R = 5\ k\Omega$

$-15\ V < V_{in} < 15\ V$

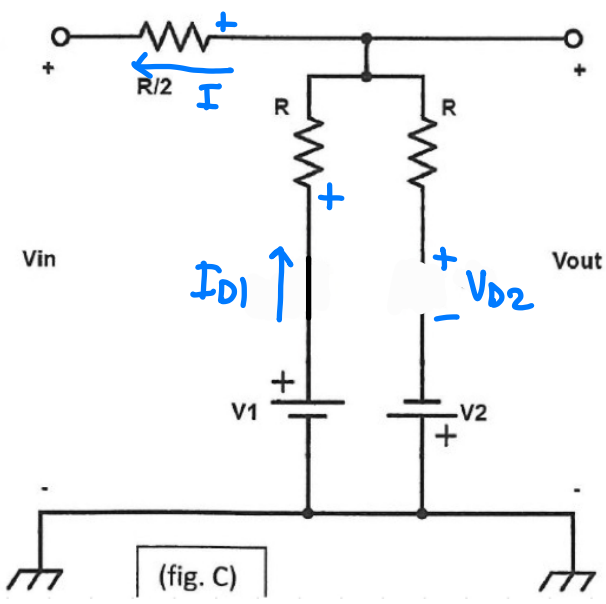
CASO 1: D_1 = OFF D_2 = OFF



- $v_o = v_i$
- VERIFICO $V_{D1} < 0$ e $V_{D2} < 0$
  - $V_{D1} = V_1 - v_i < 0 \rightarrow v_i > 5\ V$
  - $V_{D2} = v_i - (-V_2) < 0 \rightarrow v_i < -5\ V$

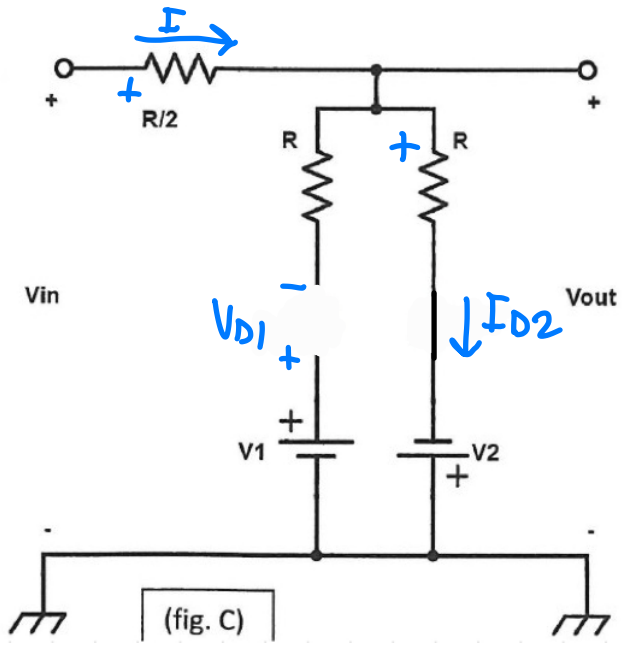
NON POSS

CASO 2: D_1 = ON D_2 = OFF



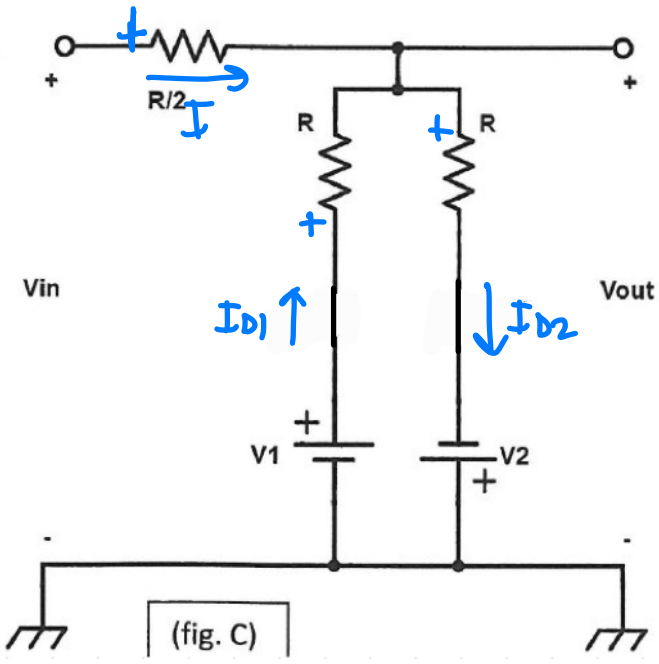
- $v_o = V_1 - R \cdot I_{D1} = V_1 - \frac{R}{R+R/2}(V_1 - v_i) = \boxed{\frac{2}{3} v_i + \frac{5}{3}}$
- VERIFICA $I_{D1} > 0$ e $V_{D2} < 0$
  - $I_{D1} = \frac{V_1 - v_i}{R + R/2} > 0 \rightarrow v_i < 5\ V$
  - $V_{D2} = v_o - (-V_2) = \frac{2}{3} v_i + \frac{5}{3} + 5 < 0 \rightarrow \boxed{v_i < -10\ V}$

CASO 3: D_1 = OFF D_2 = ON



- $v_0 = -V_2 + R I_{D2} = -V_2 + R \dfrac{v_i + V_2}{R + R/2} = \boxed{\dfrac{2}{3} v_i - \dfrac{5}{3}}$
- VERIFICO $V_{D1} < 0$ e $I_{D2} > 0$
  - $V_{D1} = V_1 - v_0 = -\dfrac{2}{3} v_i + \dfrac{20}{3} < 0 \rightarrow \boxed{v_i > 10\,V}$
  - $I_{D2} = \dfrac{v_i + V_2}{R + R/2} > 0 \rightarrow v_i > -5\,V$

CASO 4: D_1 = ON D_2 = ON



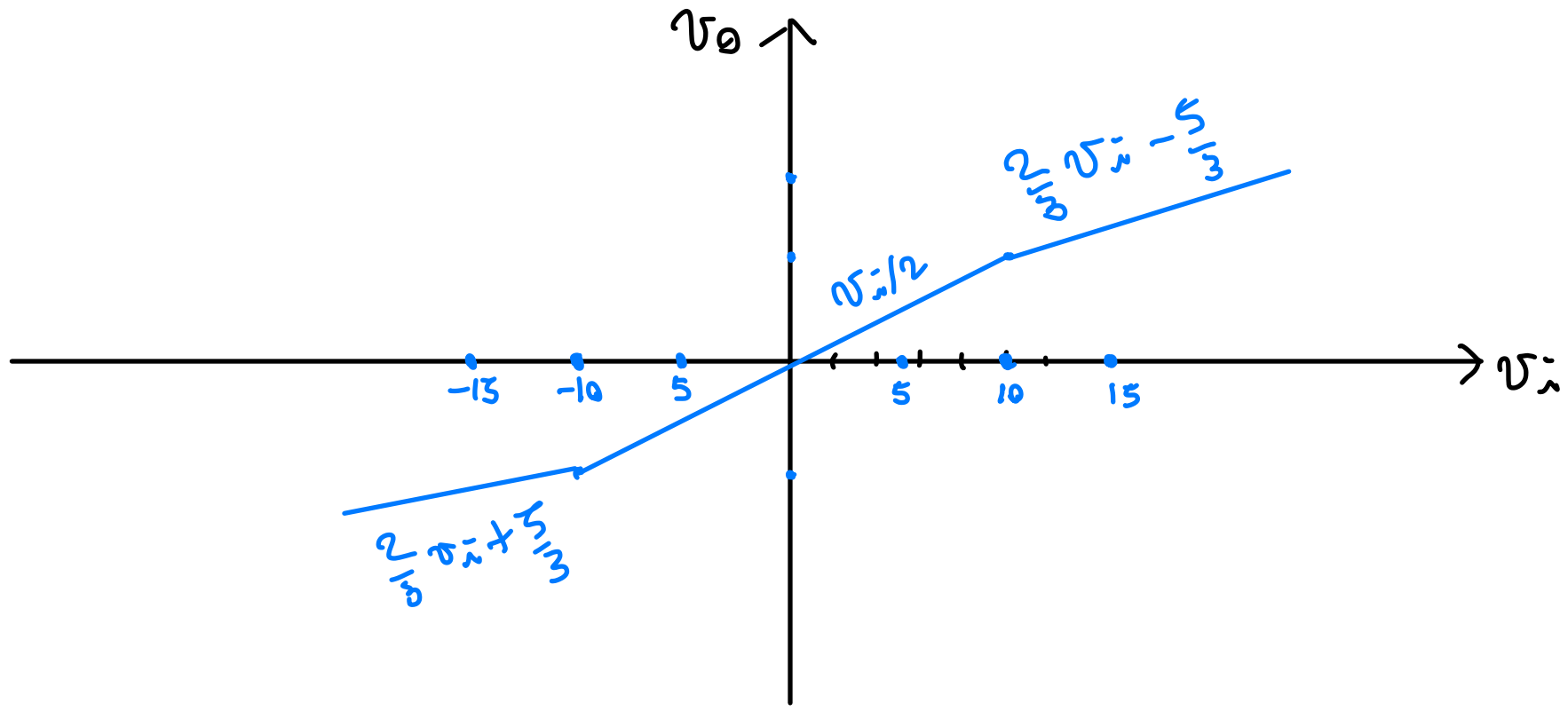
- $\begin{cases} v_0 = V_1 - R I_{D1} \\ I_{D2} = I + I_{D1} \\ v_0 = -V_2 + R I_{D2} \\ v_0 = v_i - \dfrac{R}{2} I \end{cases} \rightarrow \begin{cases} v_0 = V_1 - R I_{D1} \\ v_0 = v_i - R/2\, I \\ v_0 = -V_2 + R I + R I_{D1} \end{cases}$

$$\begin{cases} v_0 = v_i - R/2\, I \\ v_0 = -V_2 + R I + V_1 - v_0 \end{cases}$$

$$\rightarrow v_0 = -V_2 + 2 v_i - 2 v_0 + V_1 - v_0$$

$$\rightarrow \boxed{v_0 = v_i / 2}$$

- VERIFICO $I_{D1} > 0$ e $I_{D2} > 0$
  - $I_{D1} = (V_1 - v_0)/R = \dfrac{V_1 - v_i/2}{R} > 0 \rightarrow \boxed{v_i < 10\,V}$
  - $I_{D2} = I + I_{D1} = \dfrac{v_i}{R} + \dfrac{V_1 - v_i/2}{R} = \dfrac{V_1 + v_i/2}{R} > 0 \rightarrow \boxed{v_i > -10}$

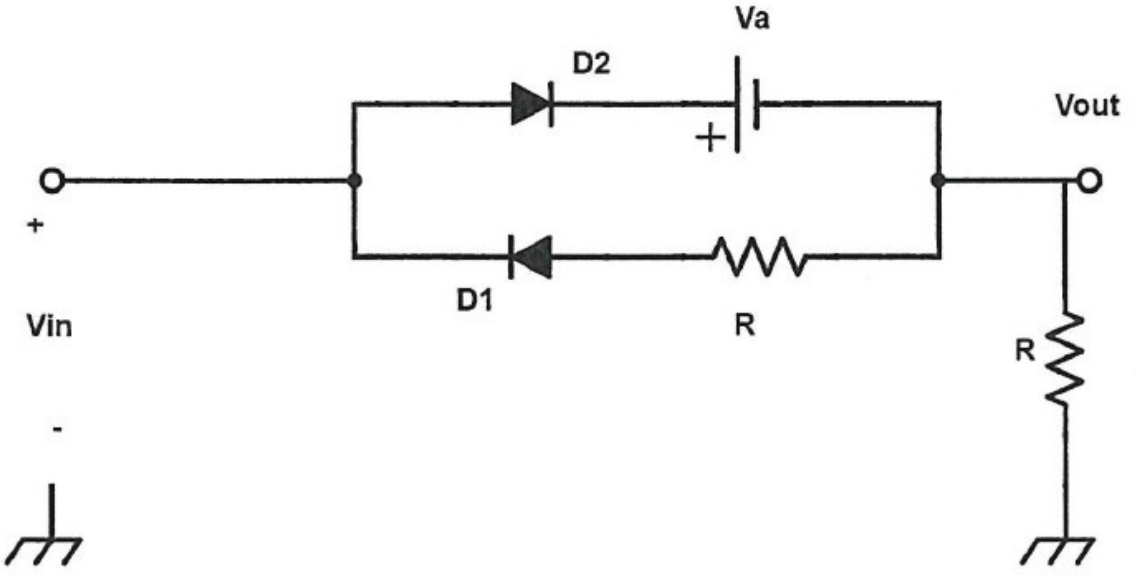


Esame 2017-07-25

Si calcoli la transcaratteristica (V_{out} in funzione di V_{in}) del circuito riportato in figura C.

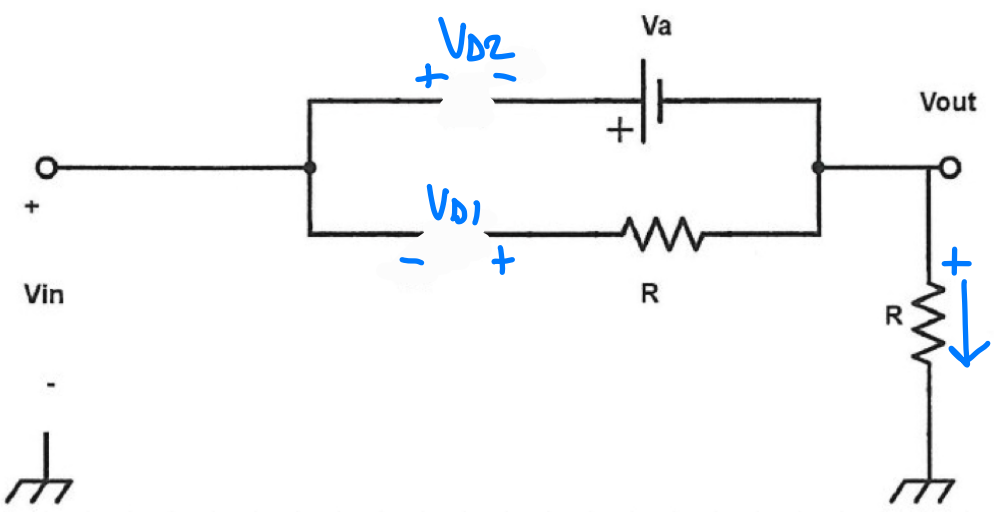
-10 V < Vin < 10 V; Va = 5 V; R = 1kΩ

Si considerino i diodi D_1 e D_2 con modello a caduta di tensione costante $V_\gamma = 0.7$ V, $R_d = 0\ \Omega$.

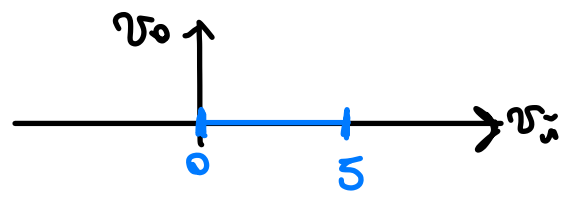


(fig. C)

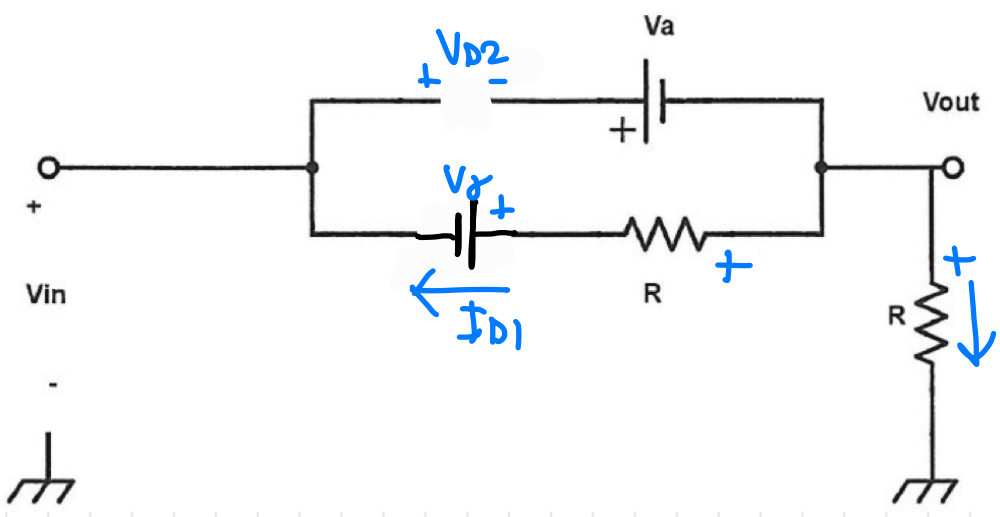
CASO 1: D_1 = OFF D_2 = OFF



- $v_o = 0$
- VERIFICO $V_{D1} < V_\gamma$ e $V_{D2} < V_\gamma$
  - $V_{D1} = 0 - v_i < 0 \rightarrow \boxed{v_i > 0}$
  - $V_{D2} = v_i - V_a < 0 \rightarrow \boxed{v_i < 5\ V}$

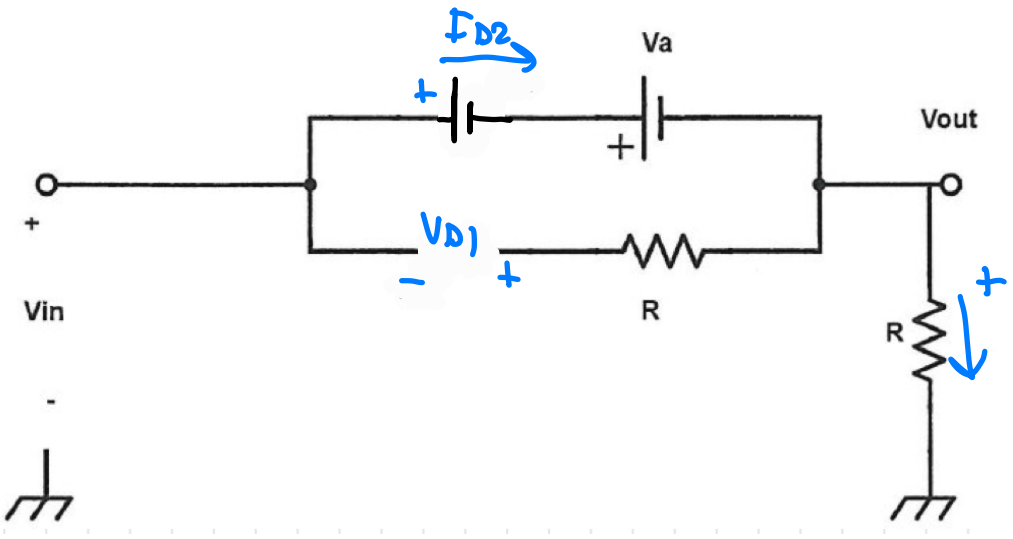


CASO 2: D_1 = ON D_2 = OFF



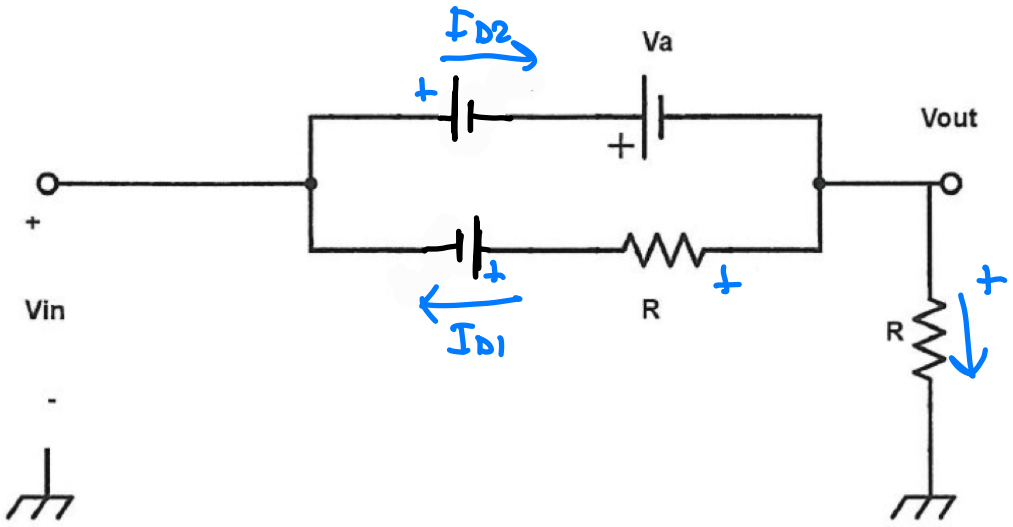
- $v_o = R\left(\frac{v_i + V_\gamma}{2R}\right) = \boxed{\frac{v_i}{2} + \frac{V_\gamma}{2}}$
- VERIFICO $I_{D1} > 0$ e $V_{D2} < V_\gamma$
  - $I_{D1} = \frac{v_o - V_\gamma - v_i}{R} > 0 \rightarrow \boxed{v_i < -2V_\gamma}$
  - $V_{D2} = v_i - V_a - v_o < V_\gamma$
    $\rightarrow v_i < 3V_\gamma + 2V_a$

CASO 3: D_1 = OFF D_2 = ON

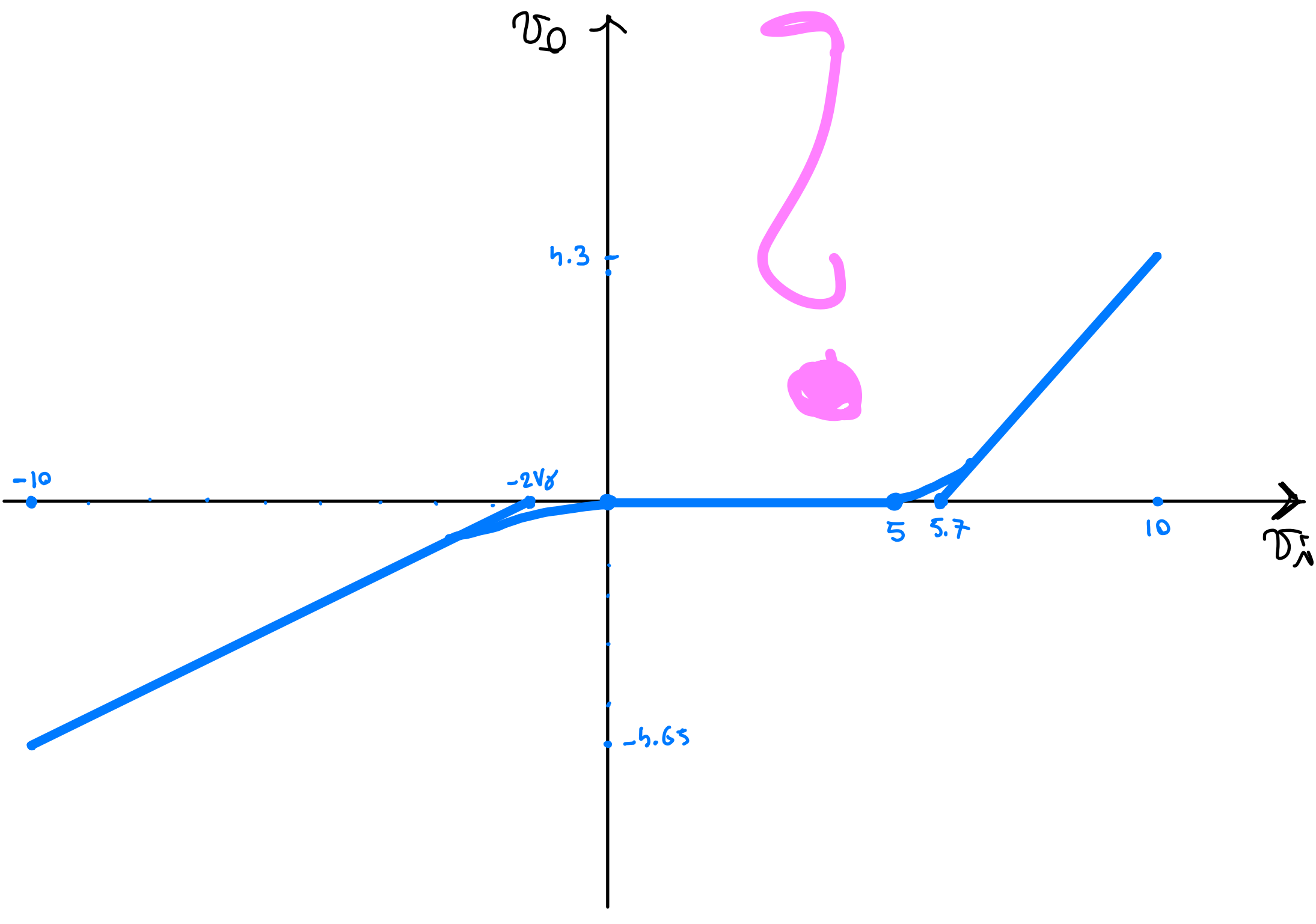


- $v_0 = R\,\dfrac{v_i - v_\gamma - V_a}{R} = \boxed{v_i - 5.7}$
- VERIFICO $V_{D1} < V_\gamma$ e $I_{D2} > 0$
  - $V_{D1} = v_0 - v_i = -5.7 < V_\gamma$ Ok
  - $I_{D2} = \dfrac{v_i - v_\gamma - V_a}{R} > 0 \rightarrow \boxed{V_i > 5.7}$

CASO 4: D_1 = ON D_2 = ON



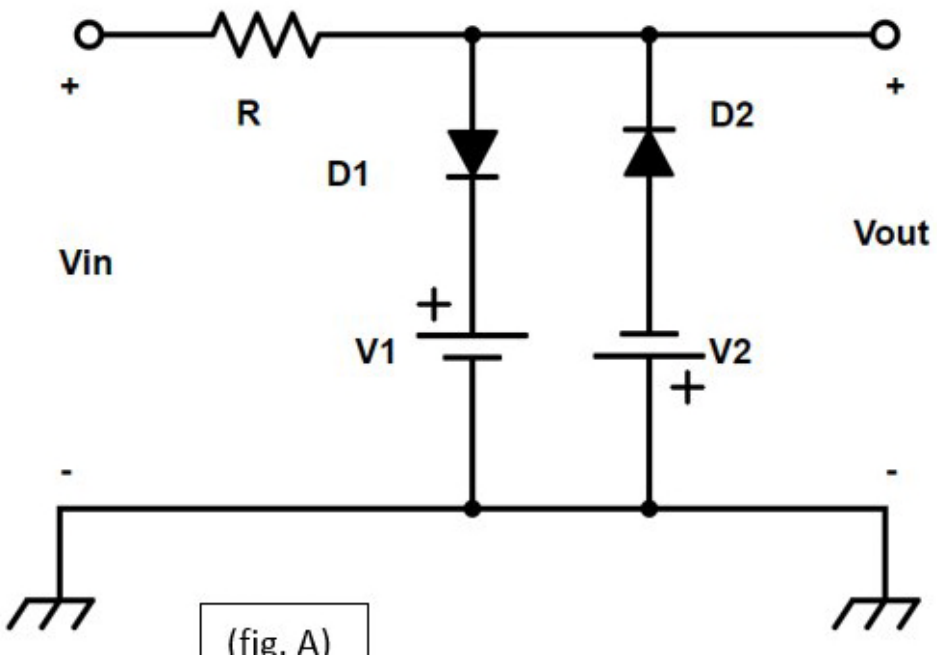
- $v_0 = v_i - v_\gamma - V_a = v_i - 5.7$
- VERIFICA $I_{D1} > 0$ e $I_{D2} > 0$
  - $I_{D1} = \dfrac{v_0 - V_\gamma - v_i}{R} = -6.4\,mA < 0$ NON POS



Esame 2018-05-25

Si calcoli e si disegni la transcaratteristica (V_{out} in funzione di V_{in}) del circuito riportato in figura A.

Si considerino i diodi D_1 e D_2 ideali ($V_{on} = 0$ e $R_D = 0$).



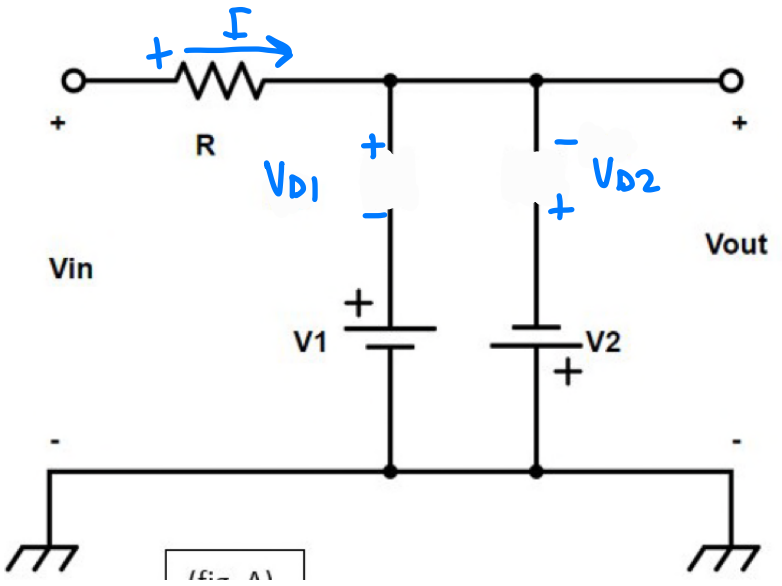
$V_1 = 5\ V$

$V_2 = 7\ V$

$R = 1\ k\Omega$

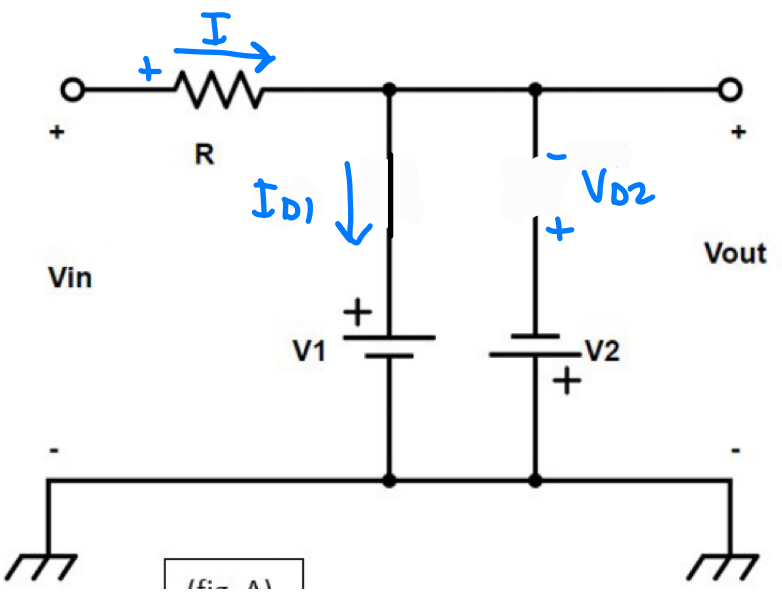
$-10\ V < V_{in} < 10\ V$

CASO 1: D_1 = OFF D_2 = OFF



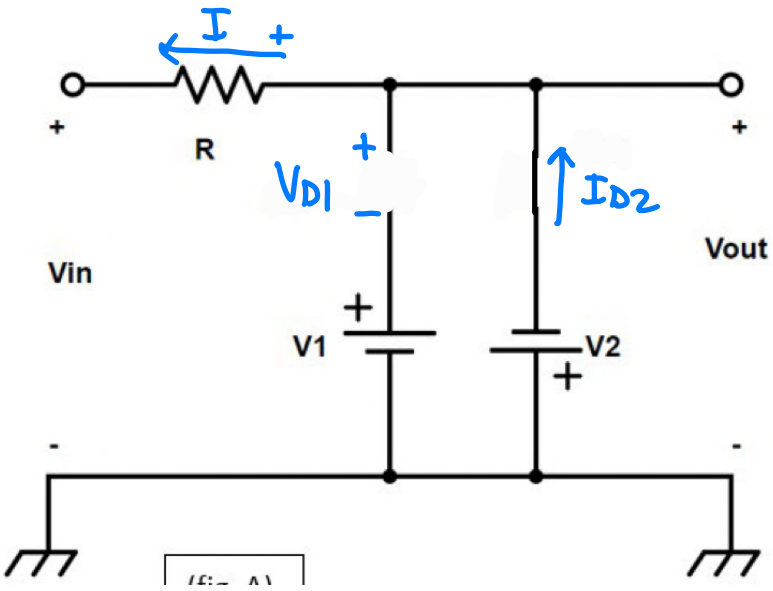
- $v_o = v_i$
- VERIFICO $V_{D1} < 0$ e $V_{D2} < 0$
  - $V_{D1} = v_i - V_1 < 0 \rightarrow v_i < 5V$
  - $V_{D2} = -V_2 - v_i < 0 \rightarrow v_i > -7V$

CASO 2: D_1 = ON D_2 = OFF



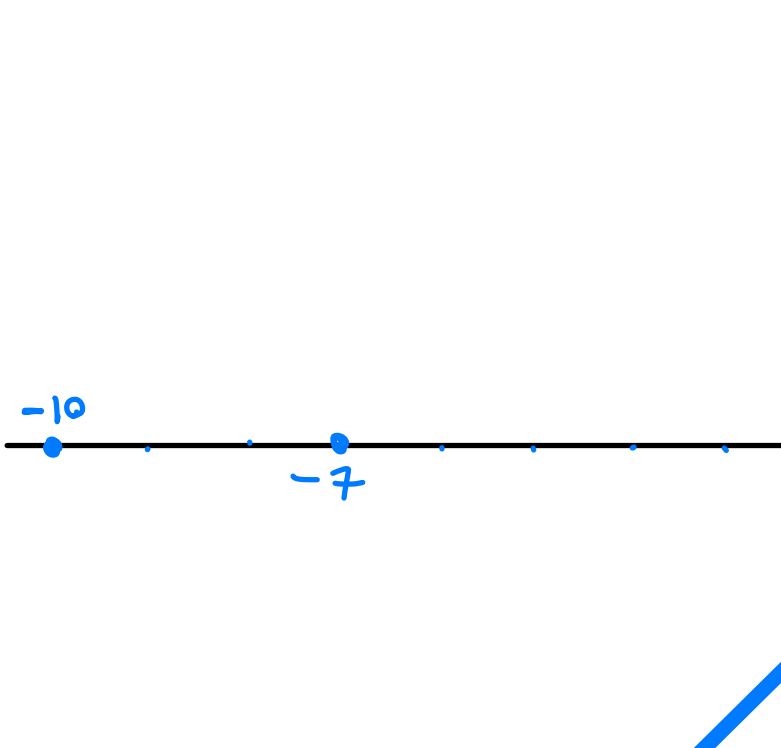
- $v_o = V_1 = 5V$
- VERIFICO $I_{D1} > 0$ e $V_{D2} < 0$
  - $V_{D2} = -V_2 - V_1 = -12V < 0$ Ok
  - $I_{D1} = I = \frac{v_i - V_1}{R} > 0 \rightarrow v_i > 5V$

CASO 3: D_1 = OFF D_2 = ON

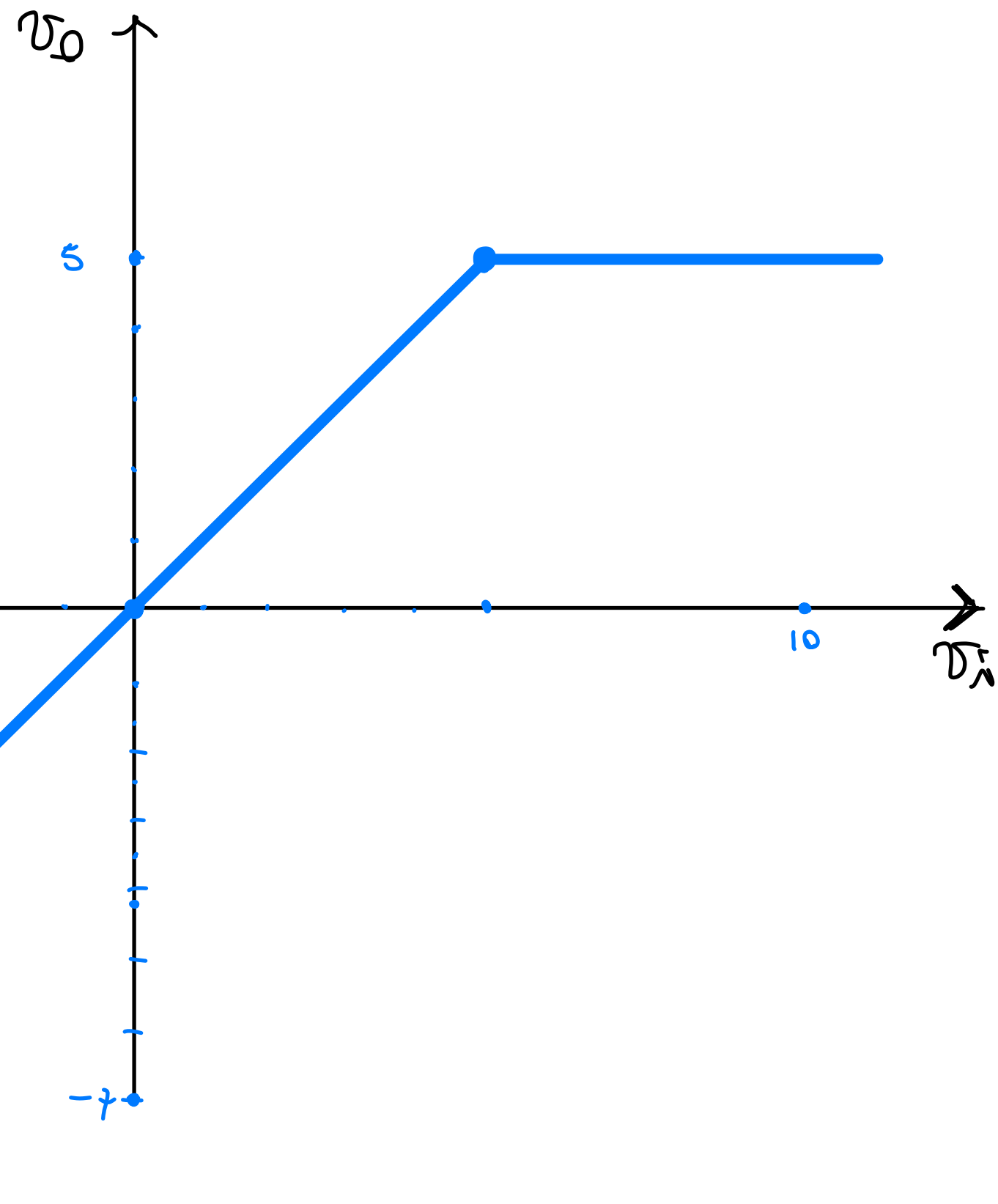


- $v_0 = -V_2 = -7V$
- VERIFICO $I_{D2} > 0$ e $V_{D1} < 0$
  - $V_{D1} = -V_2 - V_1 = -12V < 0$ OK
  - $I_{D2} = I = \frac{v_0 - v_i}{R} > 0 \rightarrow \boxed{v_i < -7V}$

CASO 4: D_1 = ON D_2 = ON



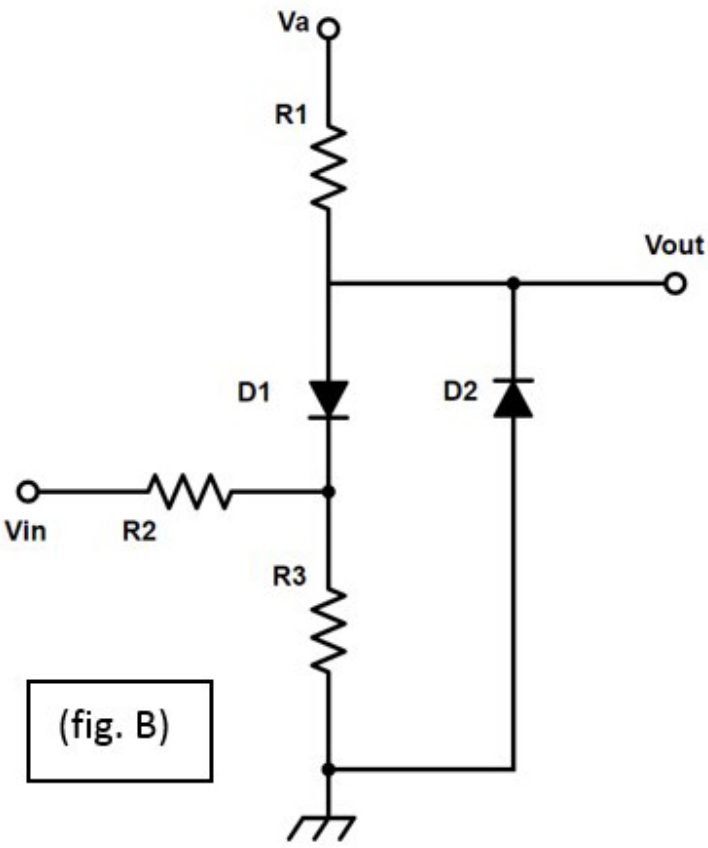
- $v_0 = +V_1 = -V_2 = 5 = -7$ NON POSSIBILE



Esame 2018-06-19

Si calcoli la transcaratteristica (V_{out} in funzione di V_{in}) del circuito riportato in figura B.

Si considerino i diodi D_1 e D_2 ideali (V_{on} = 0 e R_D = 0).



(fig. B)

V_a = 4 V

R_1 = 2 kΩ

R_2 = 4 kΩ

R_3 = 4 kΩ

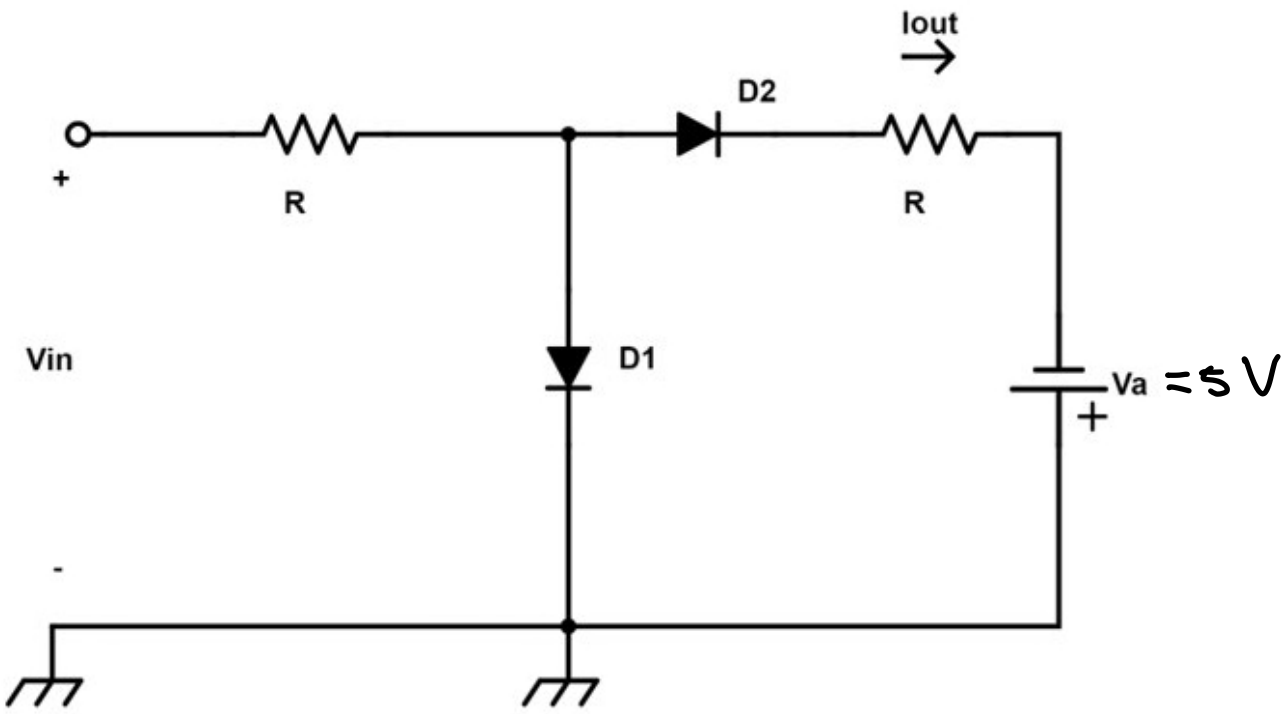
-12 V < V_{in} < 12 V

CAME 2017-05-19

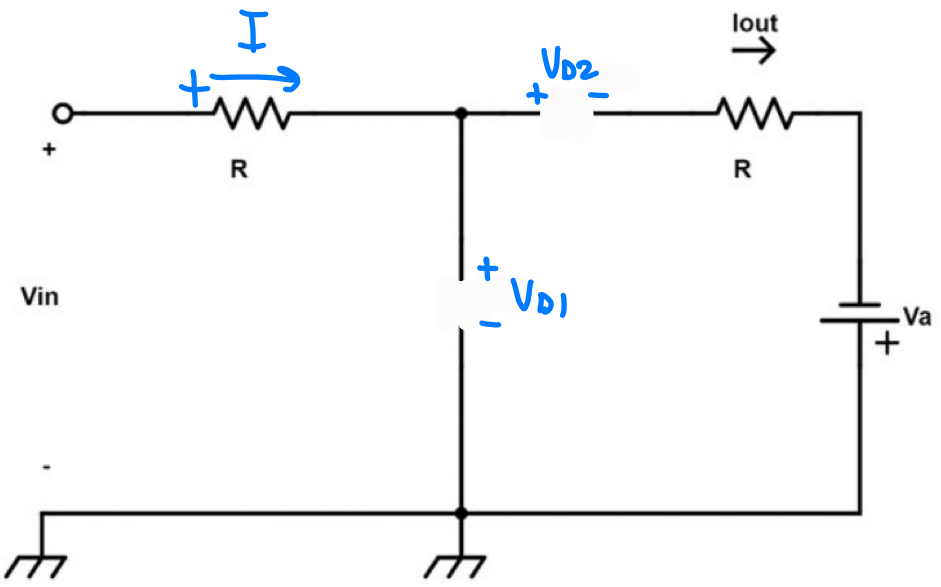
Esame 2018-07-04

Si consideri il circuito riportato in figura dove i diodi D1 e D2 sono con modello a V_{Don}=1V e R_s=0 Ω

Si calcoli la transcaratteristica Iout in funzione di Vin (si riporti la caratteristica nello spazio sottostante)

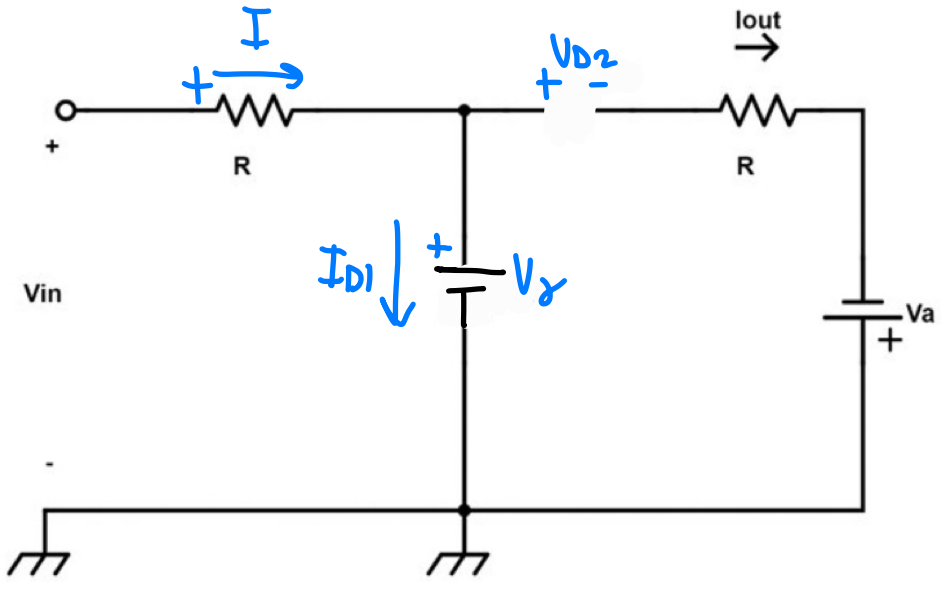


CASO 1: D_1 = OFF D_2 = OFF



- $i_Q = 0$
- VERIFICO $V_{D1} < V_\gamma$ e $V_{D2} < V_\gamma$
  - $V_{D1} = v_i < 1\,V$
  - $V_{D2} = v_i - (-V_a) < V_\gamma \rightarrow v_i < -5\,V$

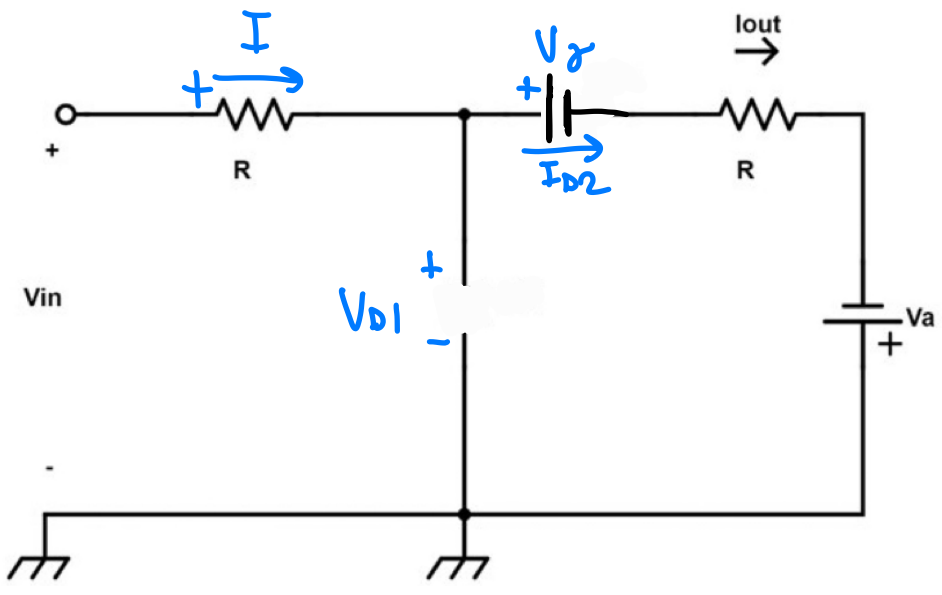
CASO 2: D_1 = ON D_2 = OFF



- $i_Q = 0$
- VERIFICO $I_{D1} > 0$ e $V_{D2} < V_\gamma$
  - $I_{D1} = \dfrac{v_i - V_\gamma}{R} > 0 \rightarrow v_i > 1\,V$
  - $V_{D2} = V_\gamma - (-V_a) = V_\gamma + V_a < V_\gamma$

NON POSSIB

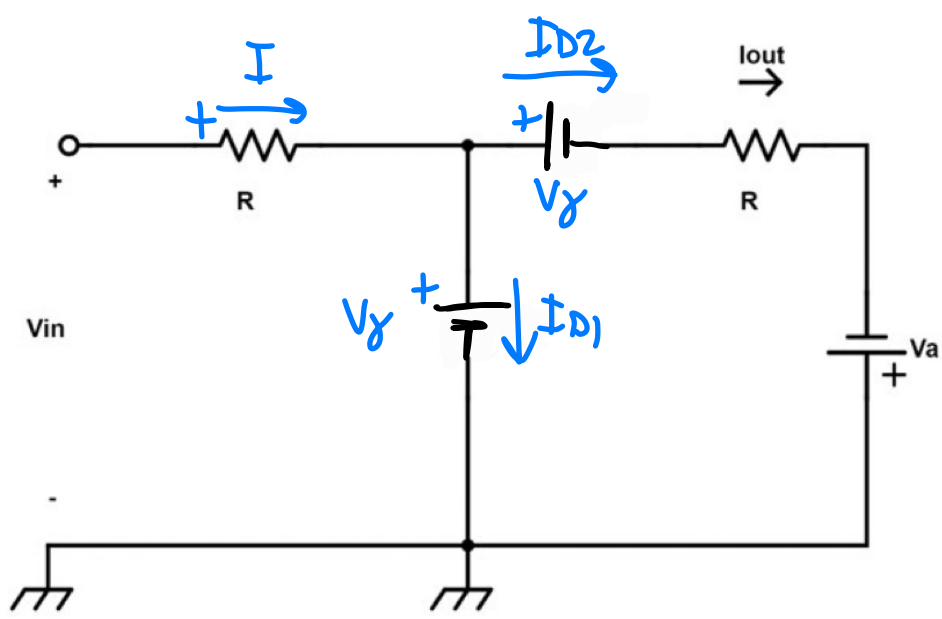
CASO 3: D_1 = OFF D_2 = ON



- $i_0 = I_{D2} = I = \dfrac{v_i - V_\gamma + V_a}{2R} = \boxed{\dfrac{v_i - 4}{2R}}$
- VERIFICO $V_{D1} < V_\gamma$ e $I_{D2} > 0$
  - $V_{D1} = v_i - RI = v_i - \dfrac{v_i}{2} - \dfrac{4}{2} < V_\gamma$

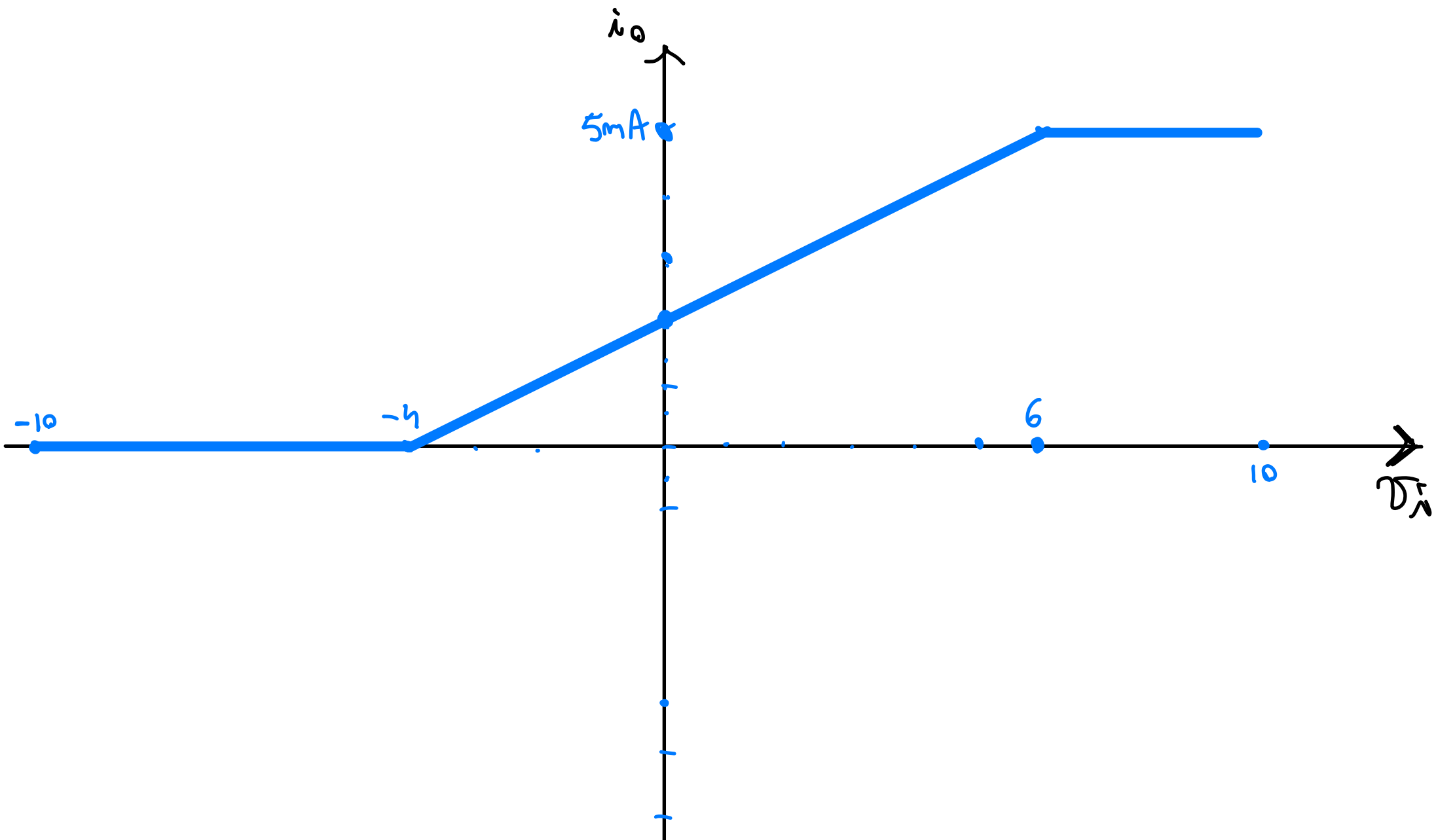
    $\rightarrow \boxed{v_i < 6\ V}$
  - $I_{D2} = \dfrac{v_i - V_\gamma + V_a}{2R} > 0 \rightarrow \boxed{v_i > -4\ V}$

CASO 4: D_1 = ON D_2 = ON



- $i_0 = I_{D2} = \dfrac{V_\gamma - V_\gamma + V_a}{R} = \boxed{V_a/R}$
- VERIFICO $I_{D1} > 0$ e $I_{D2} > 0$
  - $I_{D2} = V_a/R > 0$ OK
  - $I_{D1} = I - I_{D2} = \dfrac{v_i - V_\gamma}{R} - \dfrac{V_a}{R} > 0$

    $\rightarrow \boxed{v_i > 6\ V}$

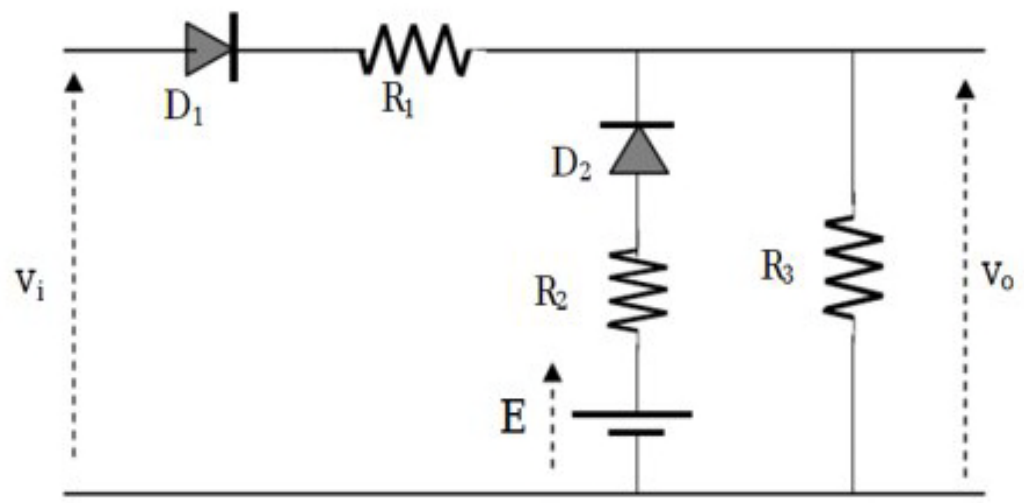


Esame 2018-07-18

Si calcoli la transcaratteristica (V_{out} in funzione di V_{in}) del circuito riportato in figura C.

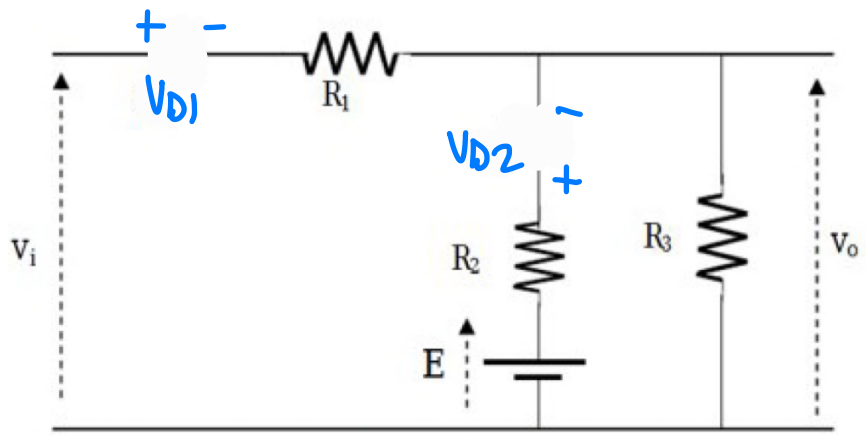
$-12\ V < Vin < 12\ V$; $Va = 5\ V$; $R1 = R2 = R3 = 1k\Omega$

Si considerino i diodi D_1 e D_2 ideali



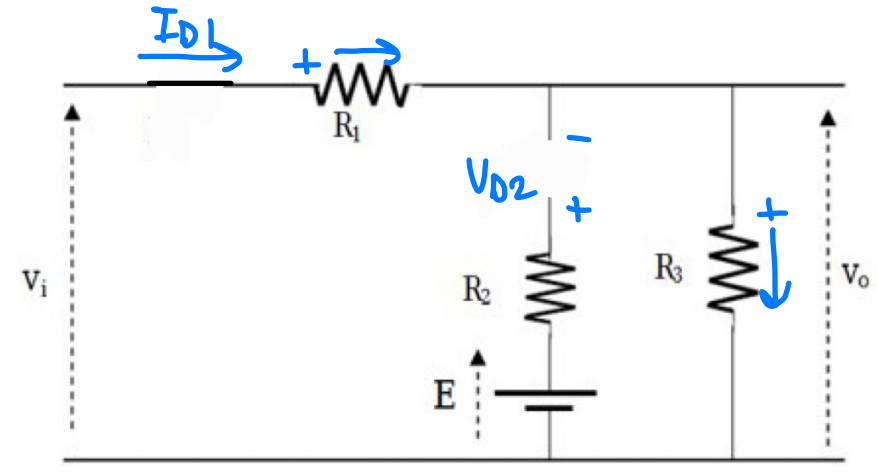
(fig. C)

CASO 1: D_1 = OFF D_2 = OFF



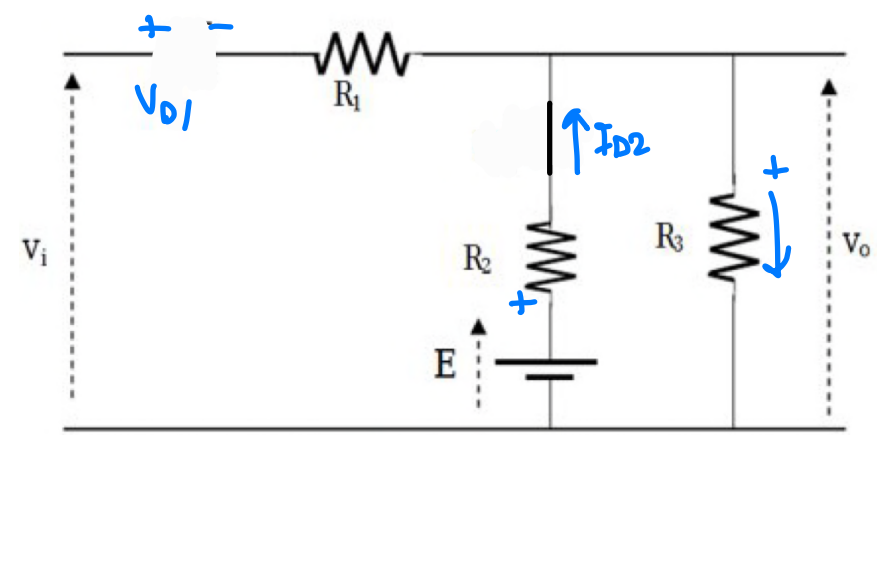
- $v_0 = 0$
- VERIFICO $V_{D1} < 0$ e $V_{D2} < 0$
  - $V_{D1} = v_i - v_0 = v_i < 0$
  - $V_{D2} = E - v_0 = 5V > 0$ NON POSSIBILE

CASO 2: D_1 = ON D_2 = OFF



- $v_0 = R_3 I_{D1} = \frac{R_3}{R_1+R_3} v_i = \boxed{v_i/2}$
- VERIFICO $I_{D1} > 0$ e $V_{D2} < 0$
  - $I_{D1} = \frac{v_1}{R_1+R_3} > 0 \longrightarrow v_i > 0$
  - $V_{D2} = E - v_0 = E - \frac{v_i}{2} < 0 \rightarrow \boxed{v_i > 10\ V}$

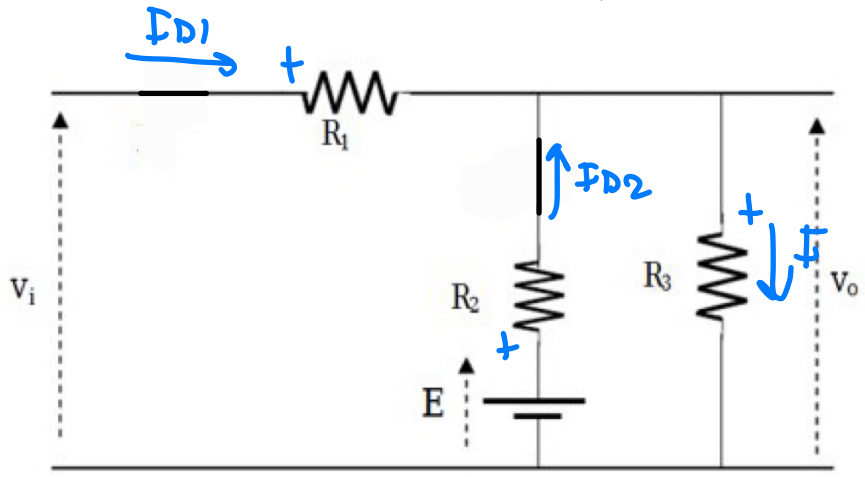
CASO 3: D_1 = OFF D_2 = ON



- $v_0 = R_3 I_{D2} = \frac{R_3}{R_2+R_3} E = \boxed{2.5\ V}$
- VERIFICO $V_{D1} < 0$ e $I_{D2} > 0$
  - $I_{D2} = \frac{E}{R_2+R_3} > 0$ ok
  - $V_{D1} = v_i - E + R_2 I_{D2} = v_i - E + \frac{R_2}{R_2+R_3} E < 0$

$\rightarrow \boxed{v_i < 2.5}$

CASO 4: $D_1 = ON$ $D_2 = ON$

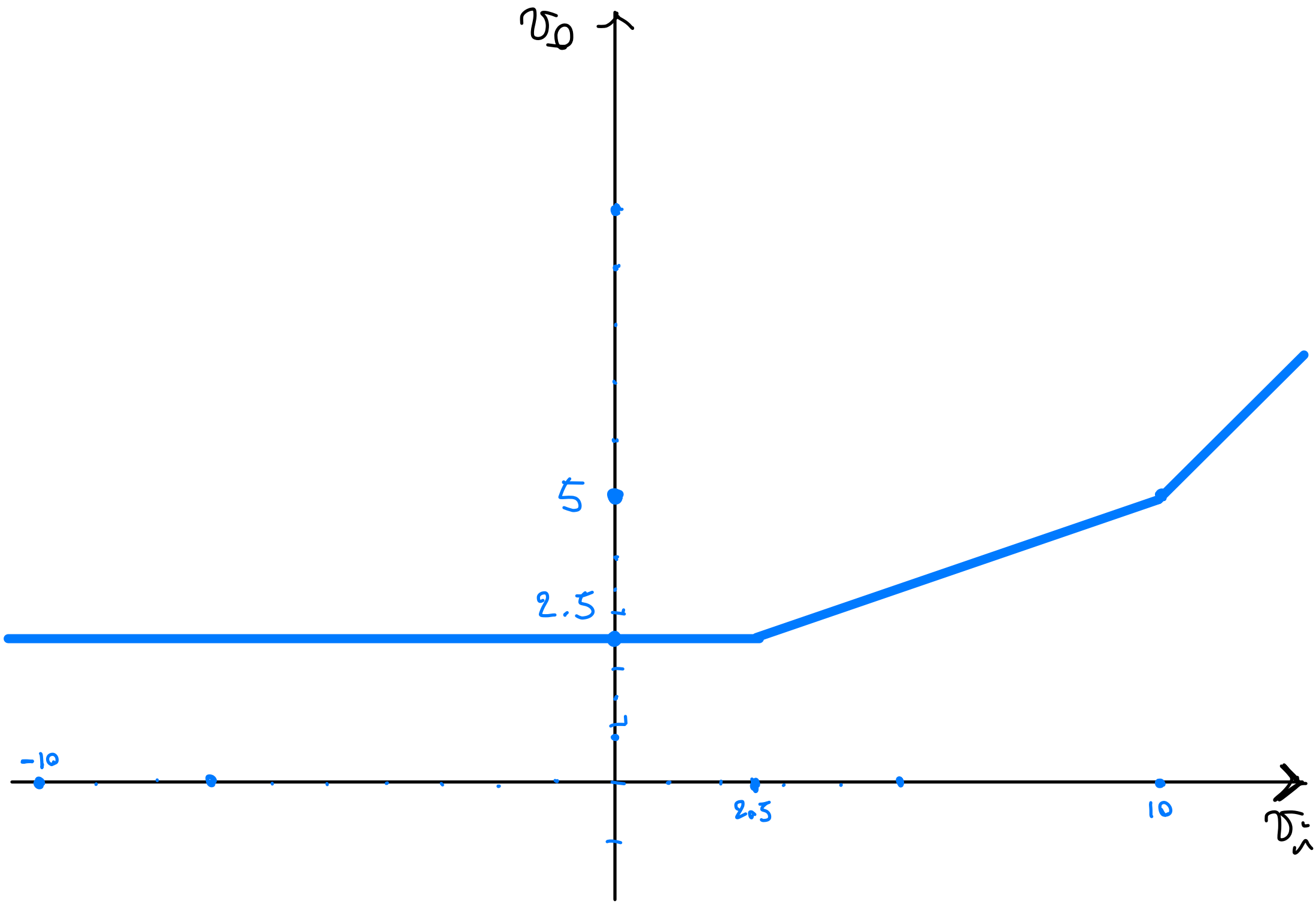


- $\begin{cases} v_0 = R_3 I \\ v_0 = E - R_2 I_{D2} \\ v_0 = v_i - R_1 I_{D1} \\ I = I_{D1} + I_{D2} \end{cases}$ $\begin{cases} v_0 = R_3 I_{D1} + R_3 I_{D2} \\ I_{D2} = (E - v_0)/R_2 \\ I_{D1} = (v_i - v_0)/R_1 \end{cases}$

$\rightarrow v_0 = E - v_0 + v_i - v_0$

$\rightarrow 3v_0 = v_i + E \rightarrow$ $\boxed{v_0 = \frac{v_i}{3} + \frac{E}{3}}$

- VERIFICO $I_{D1} > 0$ e $I_{D2} > 0$
  - $I_{D1} = (v_i - v_0)/R_1 \rightarrow v_i - v_i/3 - E/3 > 0 \rightarrow \boxed{v_i > 2.5}$
  - $I_{D2} = (E - v_0)/R_2 \rightarrow E - v_i/3 - E/3 > 0 \rightarrow \boxed{v_i < 10}$



Esame 2018-09-17

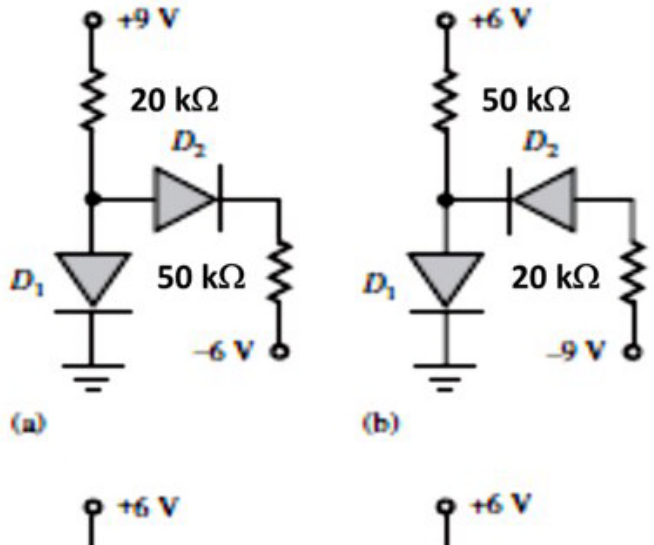
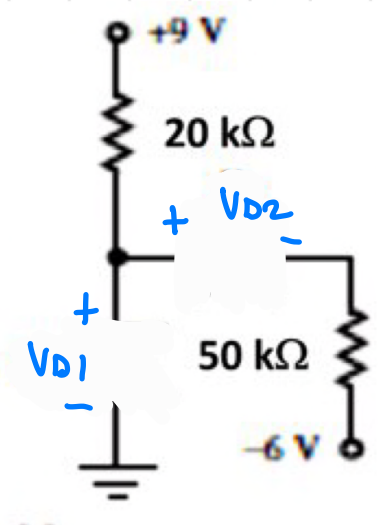


Figura 2

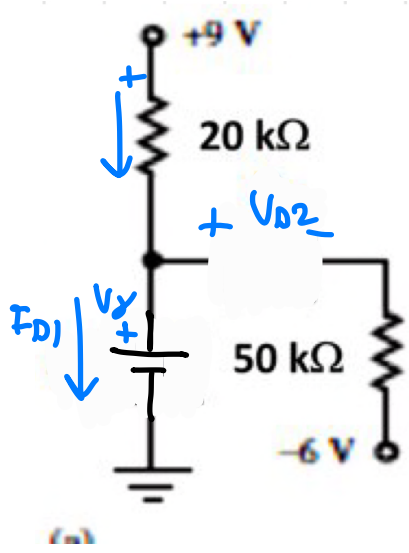
Calcolare la corrente che scorre nei diodi D1 e D2 dei circuiti in figura 2, nell'ipotesi che la caduta di tensione diretta ai capi dei diodi sia $V_\gamma = +0.5$ V.

a) CASO 1: D_1 = OFF D_2 = OFF



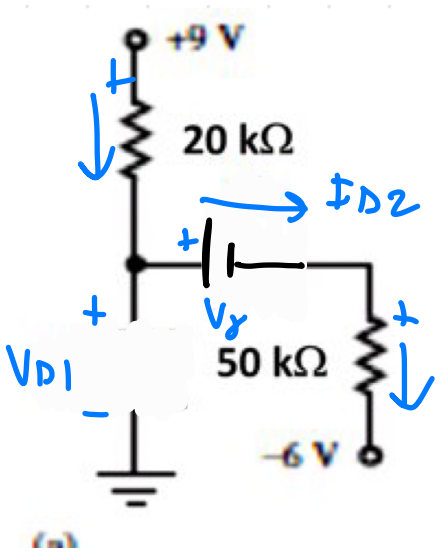
- $I_{D1} = 0$ e $I_{D2} = 0$
- VERIFICO $V_{D1} < V_\gamma$ e $V_{D2} < V_\gamma$
  - $V_{D1} = 9 - 0 > V_\gamma$ NON POSSIBILE

CASO 2: D_1 = ON D_2 = OFF



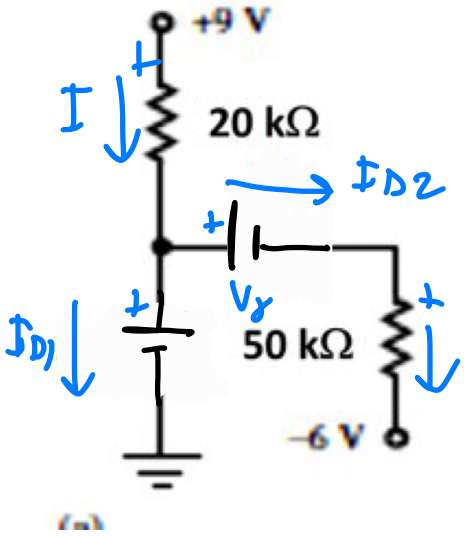
- $I_{D1} = \frac{9 - V_\gamma}{20k} = 425\,\mu A$ $I_{D2} = 0$
- VERIFICO $I_{D1} > 0$ e $V_{D2} < V_\gamma$
  - I_{D1} OK
- $V_{D2} = V_\gamma - (-6V) = 6.5 > V_\gamma$ NON POSSIB

CASO 3: D_1 = OFF D_2 = ON



- $I_{D1} = 0$ $\quad I_{D2} = \frac{9 - 0.5 + 6}{20k + 50k} = 207\ \mu A$
- VERIFICO $V_{D1} < V_\gamma$ e $I_{D2} > 0$
  - I_{D2} OK
  - $V_{D1} = 9 - 20k \cdot I_{D2} = 5.86 > V_\gamma$ NON VA BENE

CASO 4: D_1 = ON D_2 = ON



- $I = \frac{9 - V_\gamma}{20k} = 425\ \mu A$

  $I_{D2} = \frac{V_\gamma - V_\gamma + 6}{50k} = 120\ \mu A$

  $I_{D1} = I - I_{D2} = 305\ \mu A$
- VERIFICO $I_{D1} > 0$ $\quad I_{D2} > 0$ $\longrightarrow$ OK