



# VJEŽBE 2

OSNOVE ELEKTRONIKE, ETR, IV SEMESTAR

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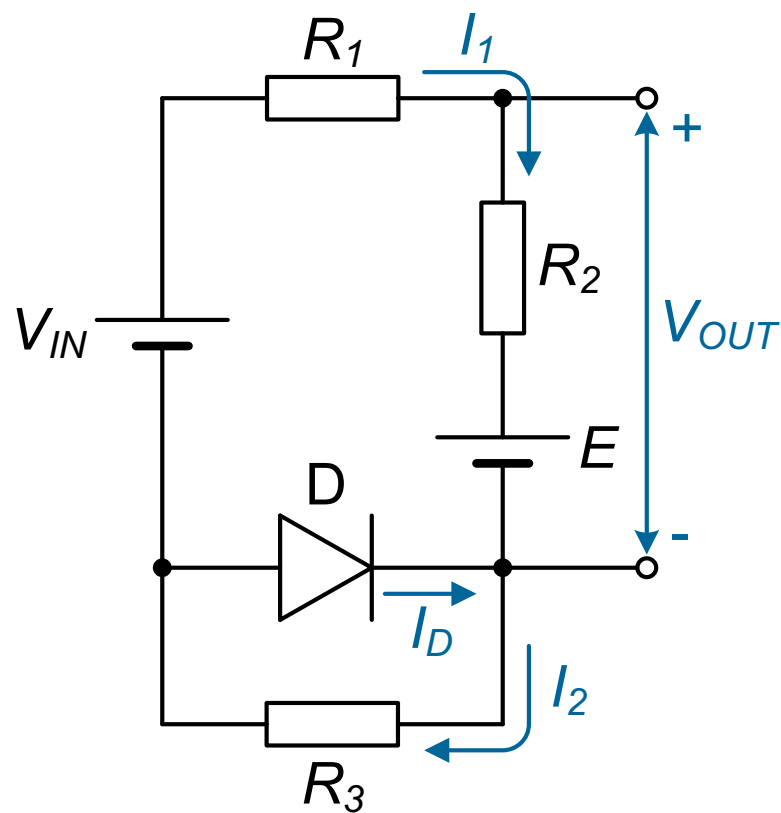
## ZADATAK 1

Za kolo prikazano na slici odrediti struje  $I_1$ ,  $I_2$ ,  $I_D$  i napon  $V_{OUT}$ .

Poznato je  $R_1=R_2=R_3=10\text{ k}\Omega$ ,  $V_{IN}=5\text{ V}$ ,  $E_D=0.7\text{ V}$  i:

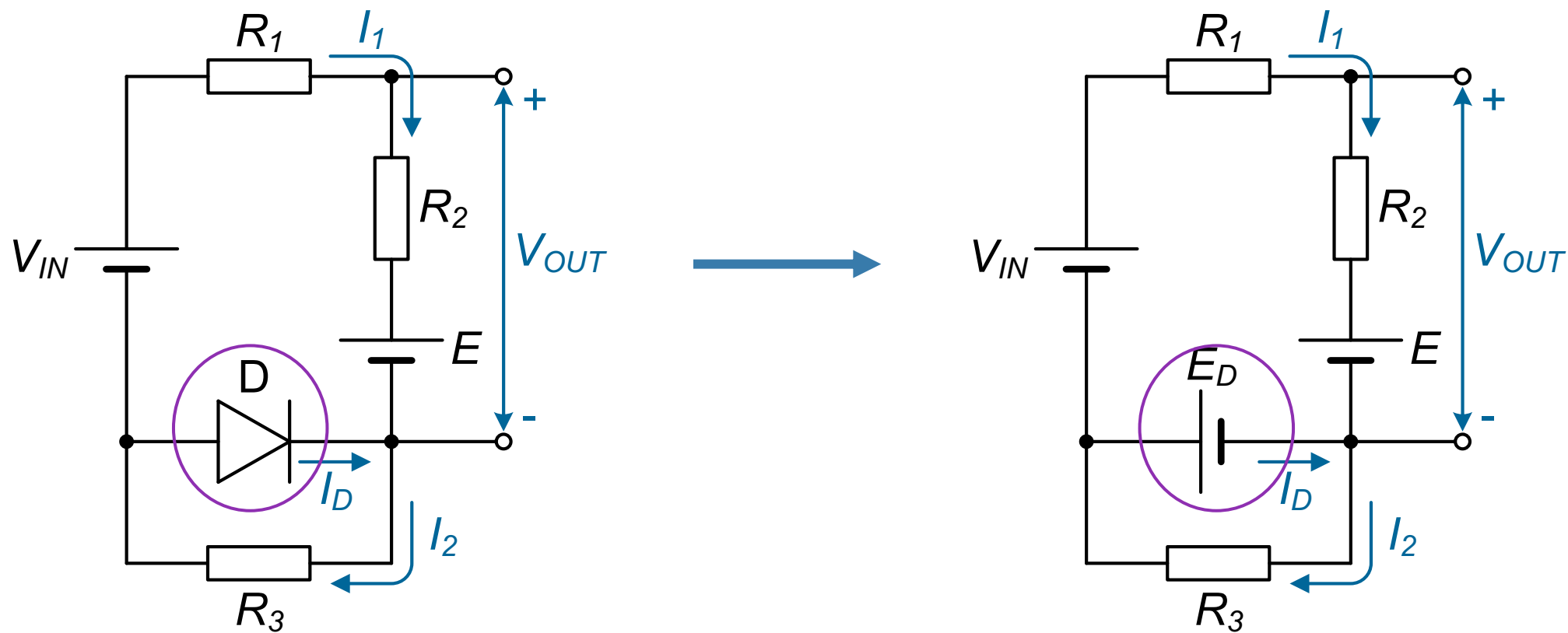
a)  $E=9\text{ V}$

b)  $E=1.5\text{ V}$ .



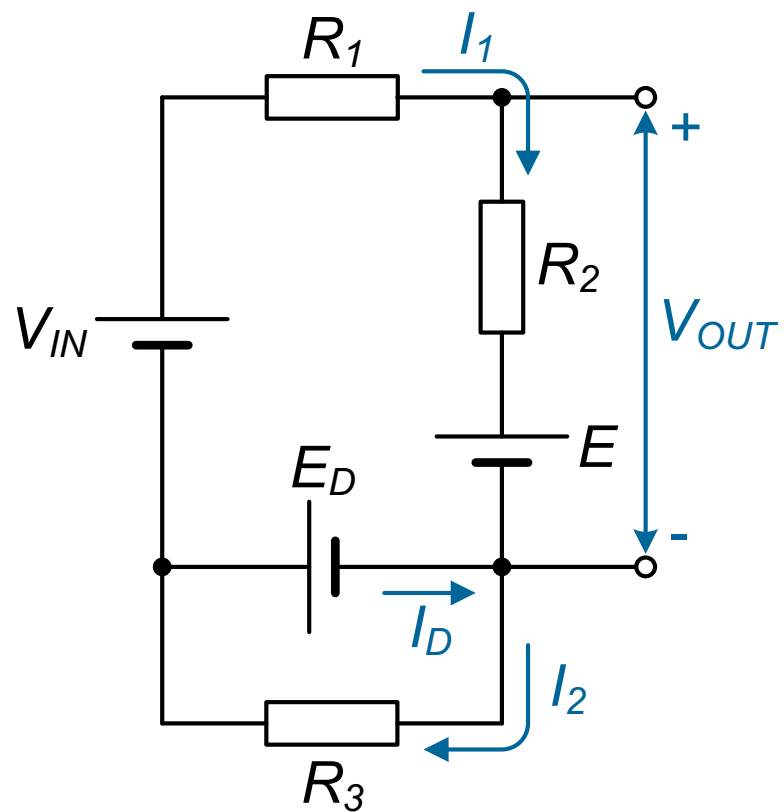
## ZADATAK 1

a) Uvodi se pretpostavka da dioda D provodi.



## ZADATAK 1

a)



$$I_1 = \frac{V_{IN} - E + E_D}{R_1 + R_2} = -165 \mu\text{A}$$

$$I_2 = \frac{-E_D}{R_3} = -70 \mu\text{A}$$

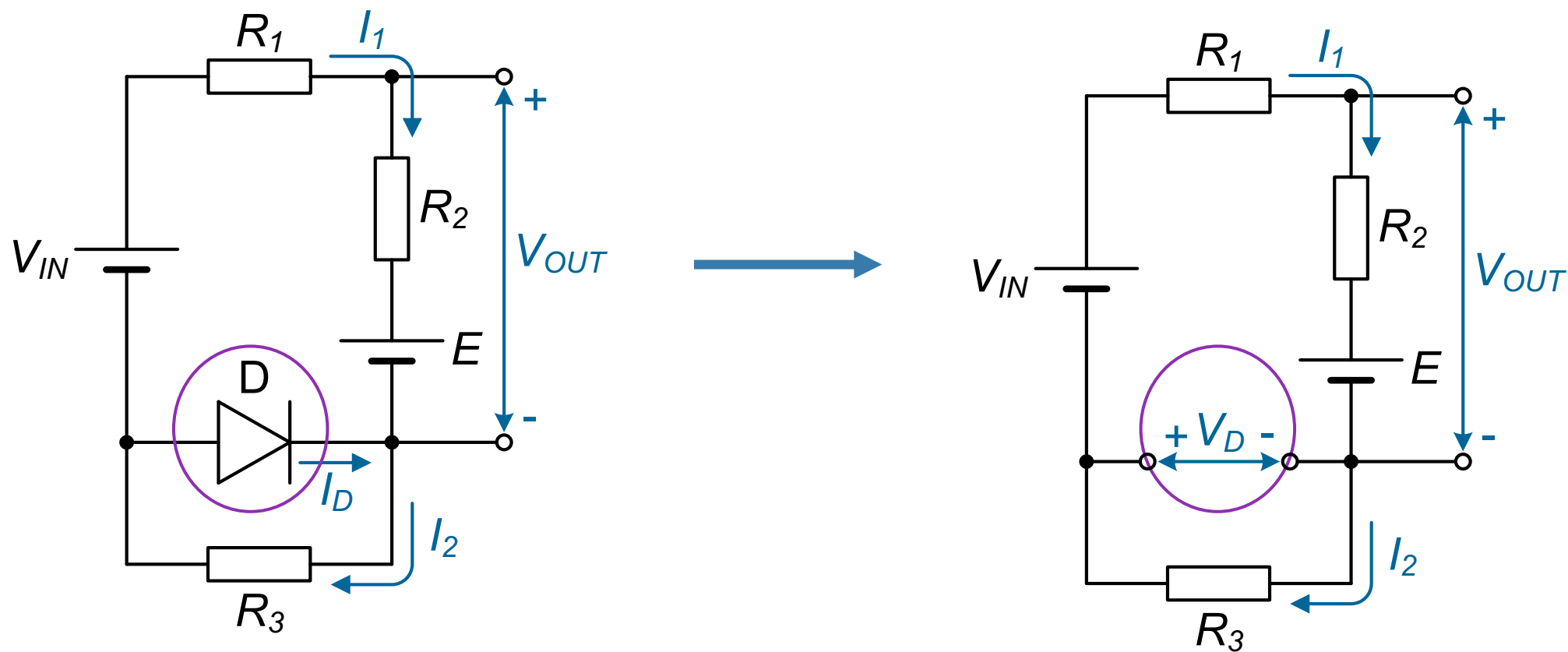
$$I_D = I_2 - I_1 = 95 \mu\text{A}$$

$I_D > 0 \text{ A} \Rightarrow$  pretpostavka o provođenju diode je tačna

$$V_{OUT} = R_2 I_1 + E = 7.35 \text{ V}$$

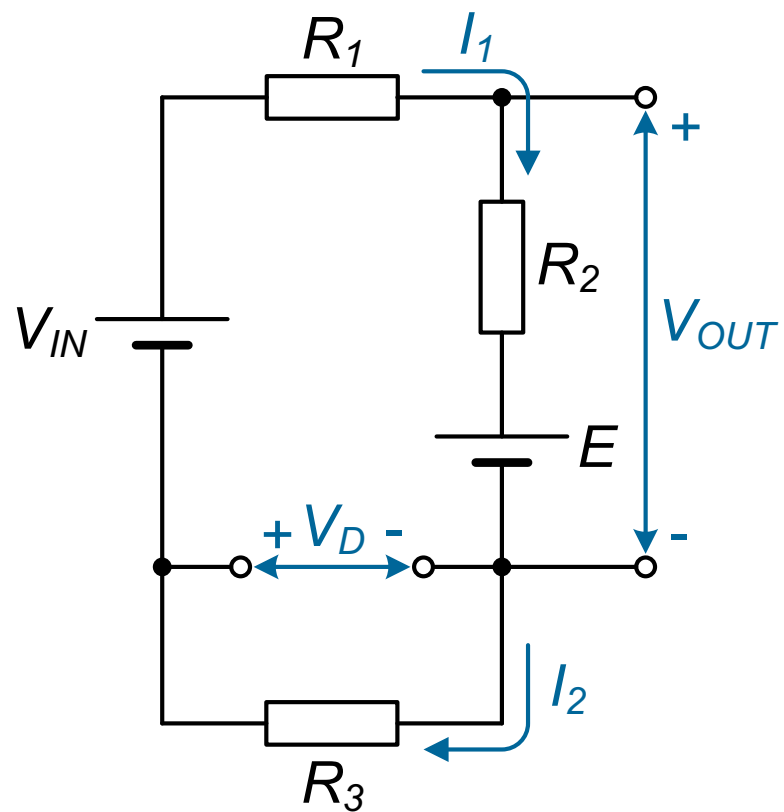
## ZADATAK 1

b) Uvodi se pretpostavka da dioda D ne provodi.



## ZADATAK 1

b)



$$I_1 = I_2 = \frac{V_{IN} - E}{R_1 + R_2 + R_3} = 116.67 \mu\text{A}$$

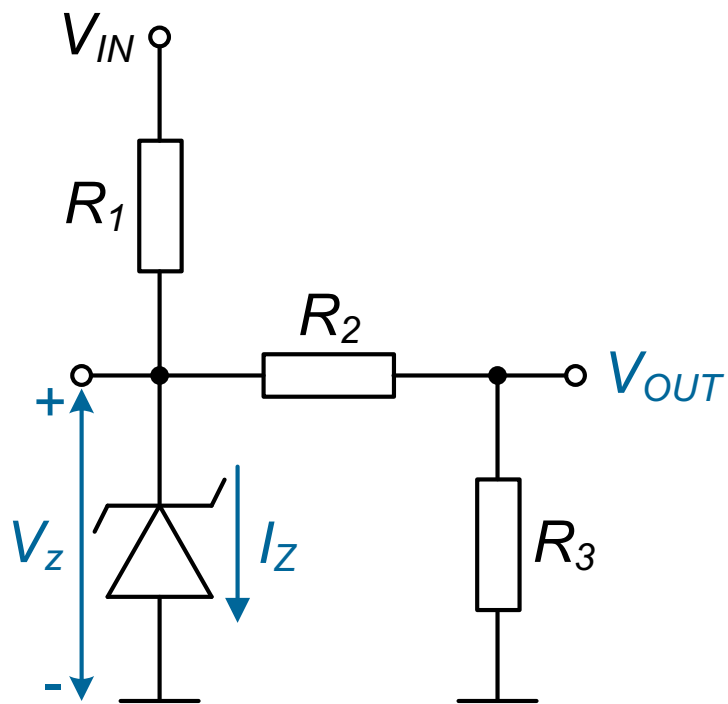
$$V_D = -R_3 I_2 = -1.167 \text{ V}$$

$V_D < E_D \Rightarrow$  pretpostavka da dioda ne provodi je tačna

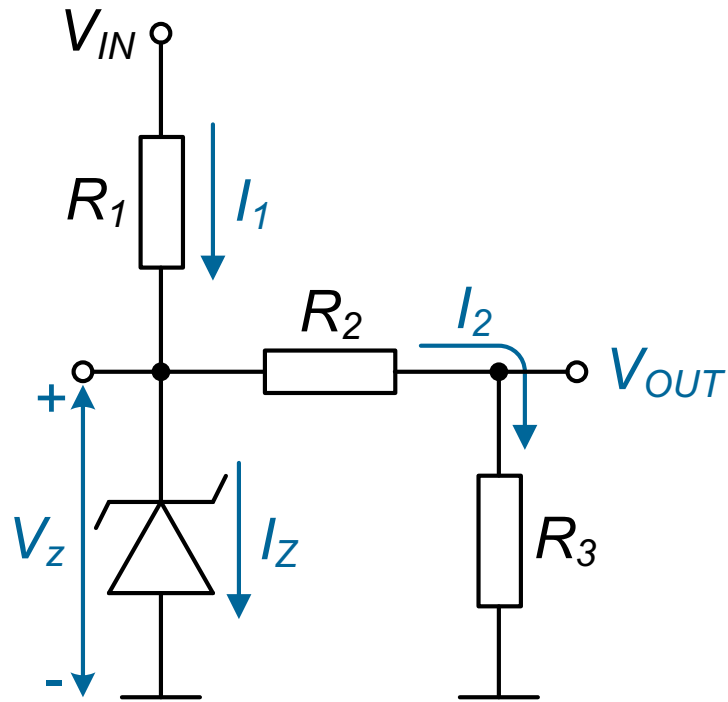
$$V_{OUT} = R_2 I_1 + E = 2.67 \text{ V}$$

## ZADATAK 2

Za kolo prikazano na slici odrediti otpornosti  $R_1$ ,  $R_2$  i  $R_3$ , tako da se na izlazu kola dobije napon  $V_{OUT}=1.2\text{ V}$  i da struja Zener diode bude veća od minimalne vrijednosti  $I_Z > 1\text{ mA} = I_{Zmin}$ . Poznato je:  $V_{IN}=5\text{ V}$  i  $V_Z=2.7\text{ V}$ .



## ZADATAK 2



$$V_{OUT} = \frac{R_3}{R_2 + R_3} V_Z \Rightarrow R_2 = R_3 \left( \frac{V_Z}{V_{OUT}} - 1 \right)$$

$$I_Z = I_1 - I_2 = \frac{V_{IN} - V_Z}{R_1} - \frac{V_{OUT}}{R_3} > I_{Z_{min}}$$

$$R_1 < \frac{V_{IN} - V_Z}{\frac{V_{OUT}}{R_3} + I_{Z_{min}}} = R_{1_{max}}$$

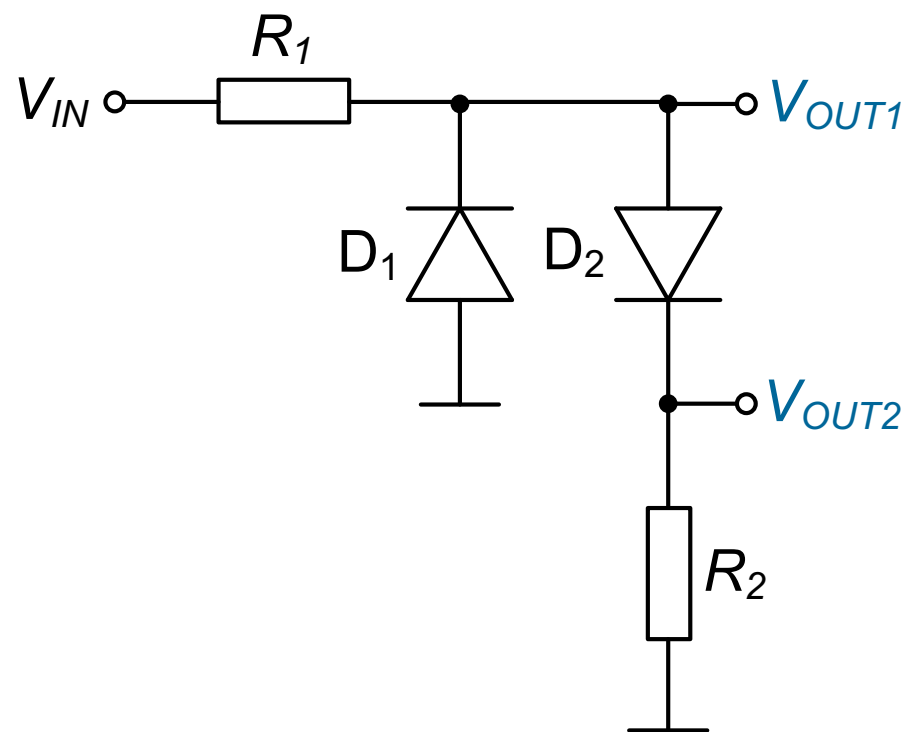
Za  $R_3 = 10 \text{ k}\Omega$ :  $R_2 = 12.5 \text{ k}\Omega$ ,  $R_1 < 2.054 \text{ k}\Omega$ .



### ZADATAK 3

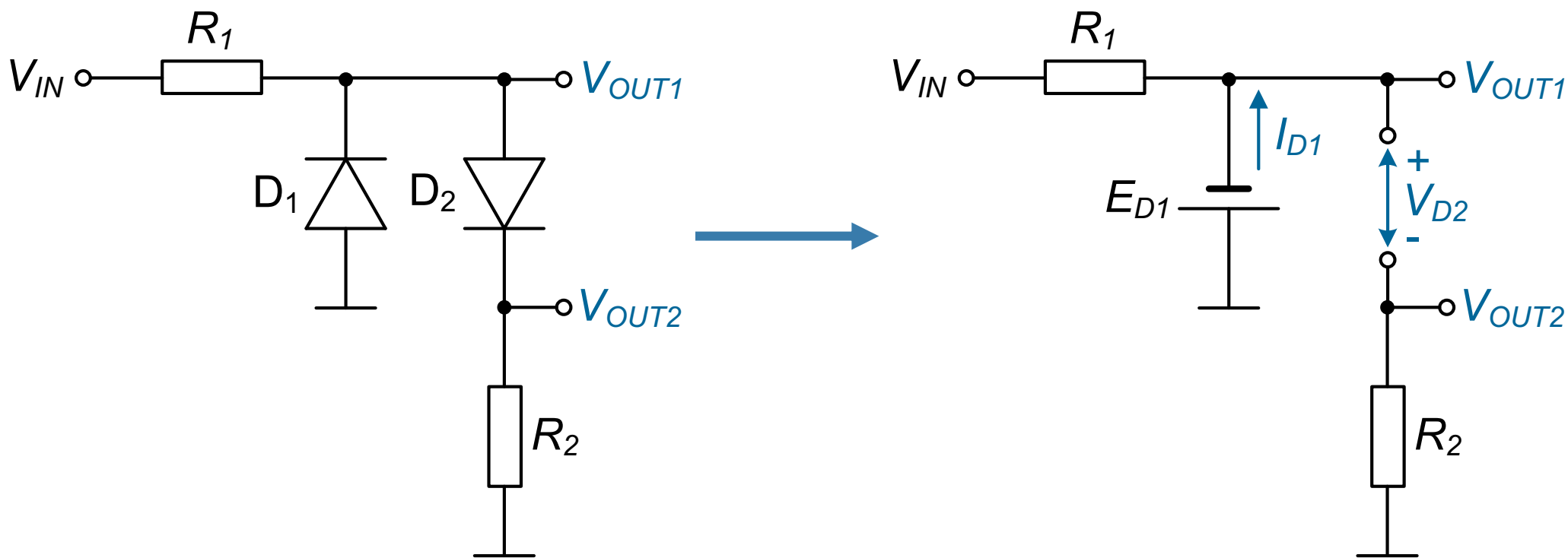
Za kolo prikazano na slici odrediti zavisnost izlaznih napona  $V_{OUT1}$  i  $V_{OUT2}$  od ulaznog napona  $V_{IN}$  za opseg ulaznog napona  $-3\text{ V} < V_{IN} < 3\text{ V}$ .

Poznato je:  $E_{D1} = E_{D2} = 0.7\text{ V}$  i  $R_1 = R_2$ .



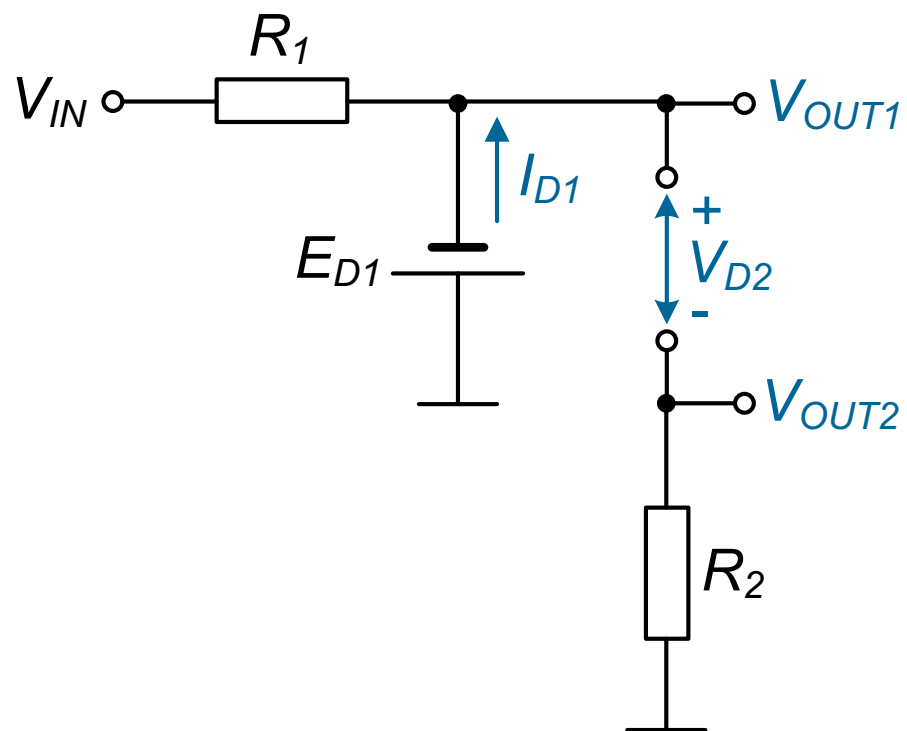
### ZADATAK 3

1° Uvodi se pretpostavka da dioda  $D_1$  provodi, dok dioda  $D_2$  ne provodi.



### ZADATAK 3

1°



$$I_{D1} = \frac{-E_{D1} - V_{IN}}{R_1} > 0 \text{ A} \Rightarrow V_{IN} < -E_{D1}$$

$$V_{D2} = -E_{D1}$$

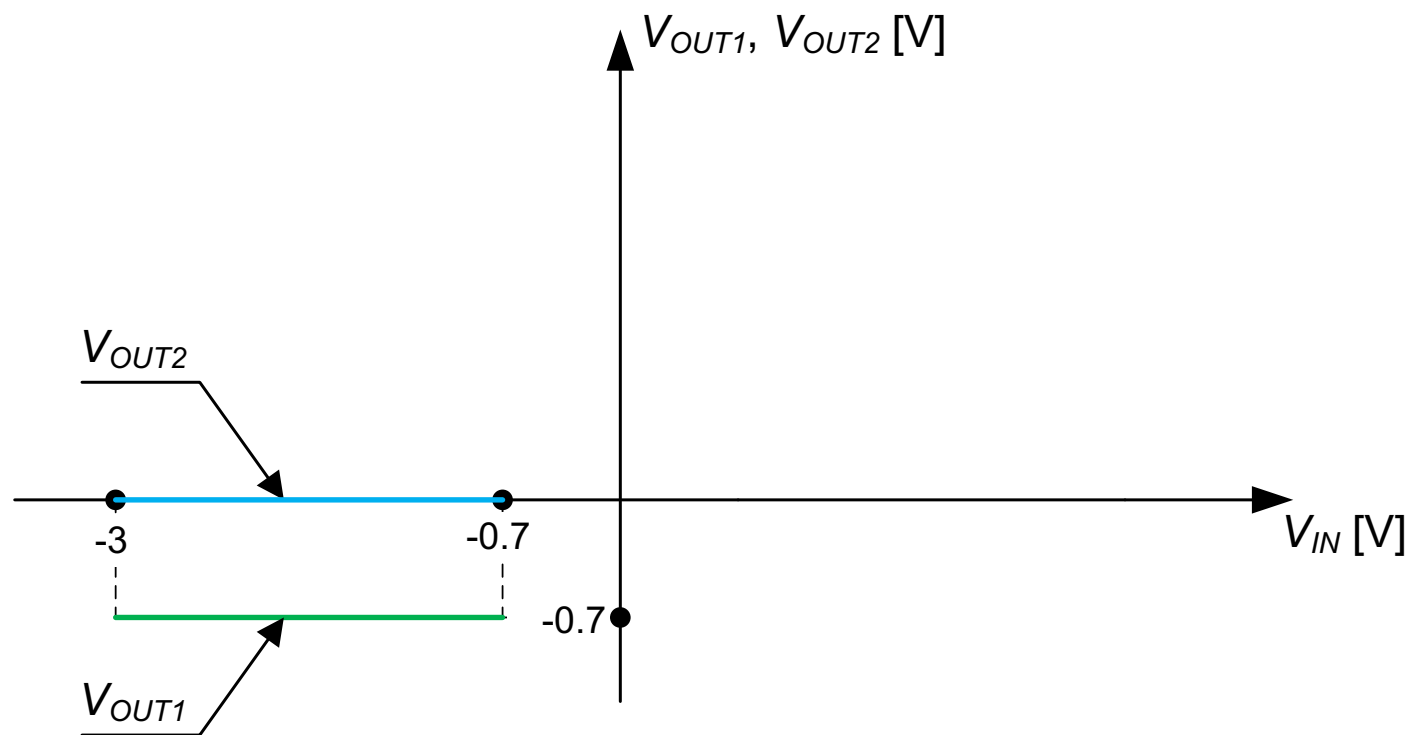
$V_{D2} < E_{D2} \Rightarrow$  pretpostavka da dioda  $D_2$  ne provodi je tačna

$$V_{OUT1} = -E_{D1}$$

$$V_{OUT2} = 0 \text{ V}$$

### ZADATAK 3

1°



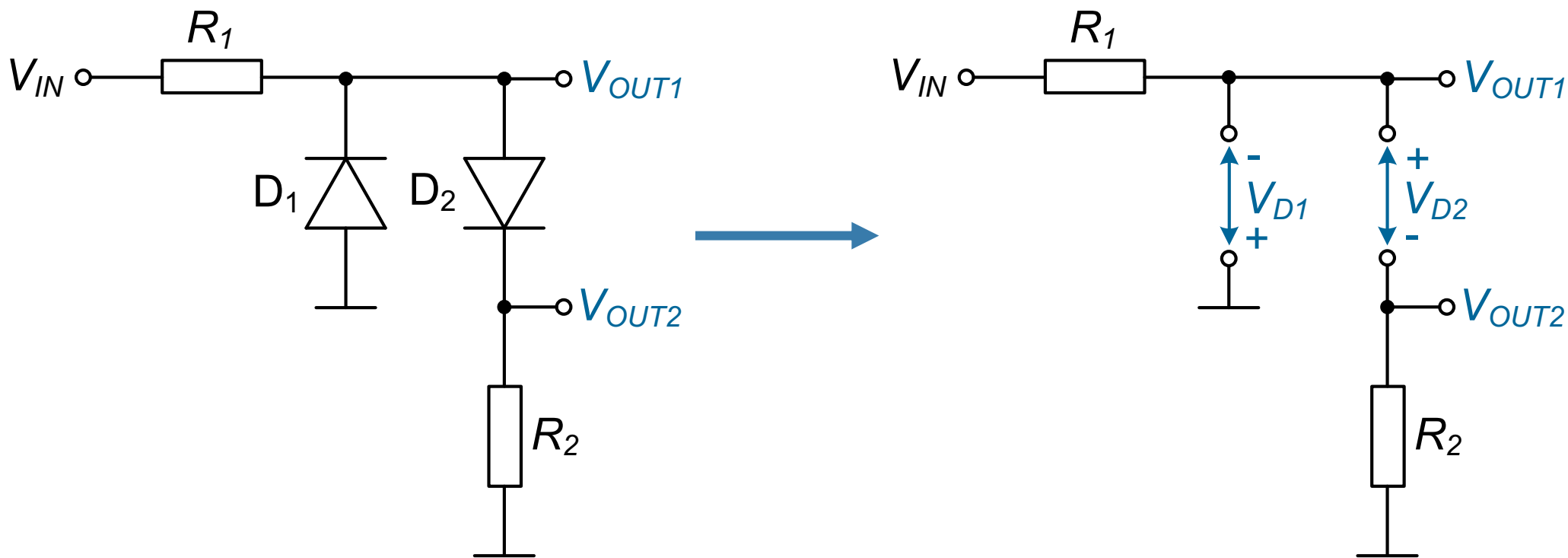
$$V_{IN} < -E_{D1}$$

$$V_{OUT1} = -E_{D1}$$

$$V_{OUT2} = 0 \text{ V}$$

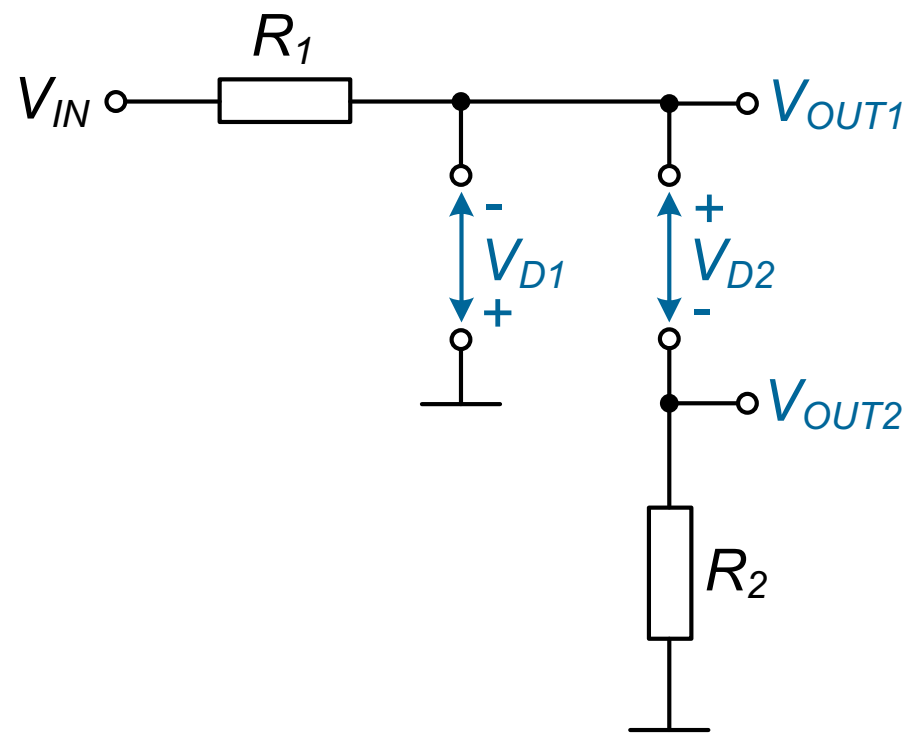
### ZADATAK 3

2° Uvodi se pretpostavka da diode  $D_1$  i  $D_2$  ne provode.



### ZADATAK 3

2°



$$V_{D1} = -V_{IN} < E_{D1}$$

$$V_{D2} = V_{IN} < E_{D2}$$

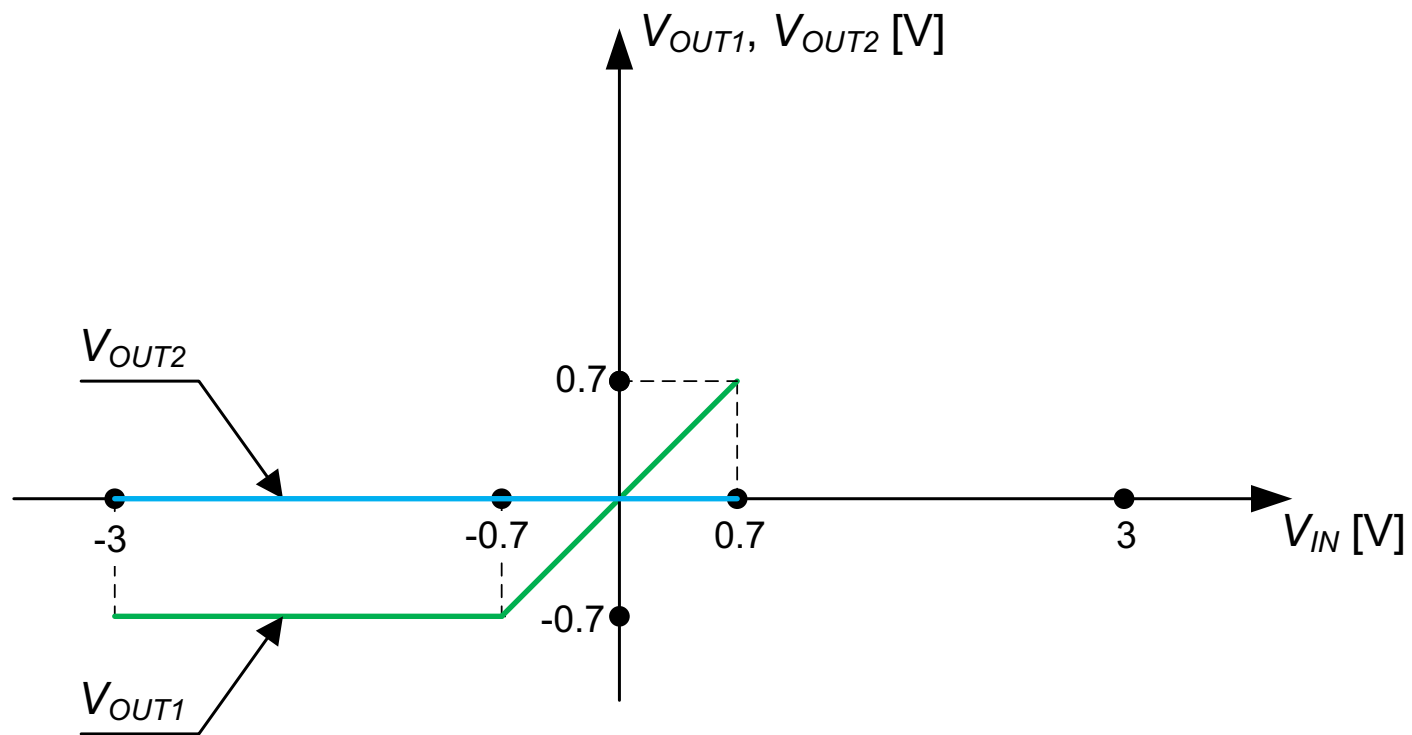
$$\Rightarrow -E_{D1} < V_{IN} < E_{D2}$$

$$V_{OUT1} = V_{IN}$$

$$V_{OUT2} = 0 \text{ V}$$

# ZADATAK 3

2°



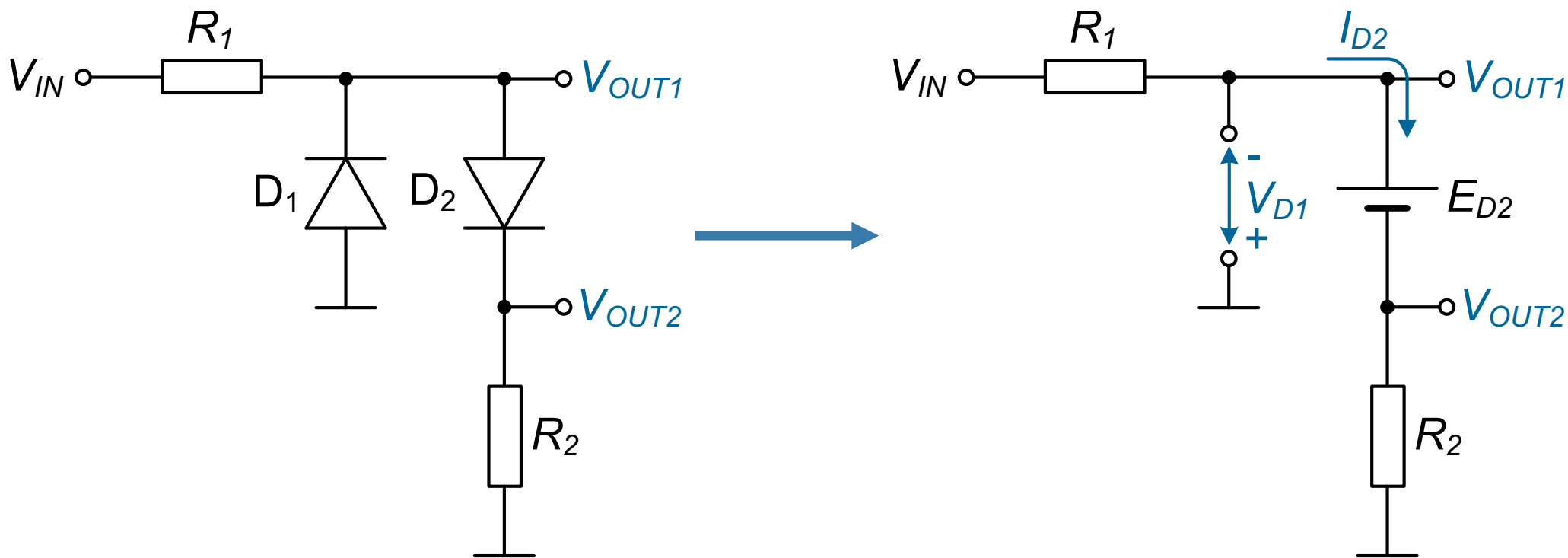
$$-E_{D1} < V_{IN} < E_{D2}$$

$$V_{OUT1} = V_{IN}$$

$$V_{OUT2} = 0 \text{ V}$$

### ZADATAK 3

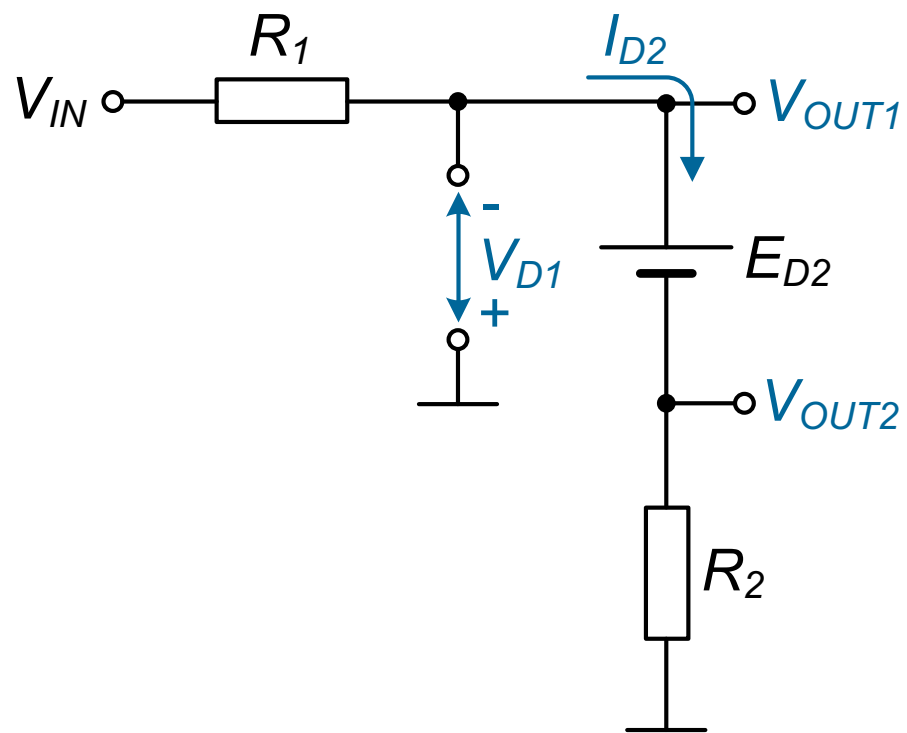
3° Uvodi se pretpostavka da dioda  $D_1$  ne provodi, dok dioda  $D_2$  provodi.





### ZADATAK 3

3°



$$I_{D2} = \frac{V_{IN} - E_{D2}}{R_1 + R_2} > 0 \text{ A}$$

$$\Rightarrow V_{IN} > E_{D2}$$

$$V_{OUT1} = R_2 I_{D2} + E_{D2} = \frac{1}{2} (V_{IN} + E_{D2})$$

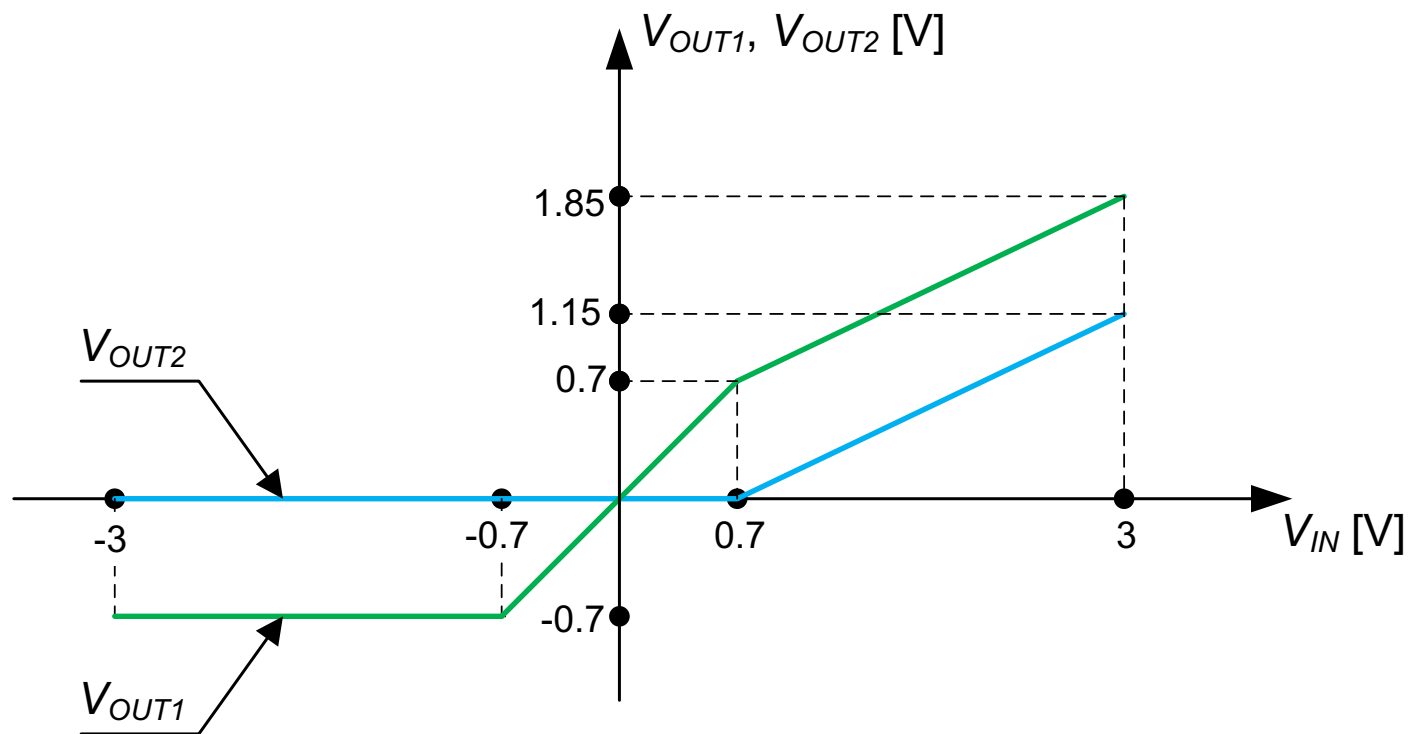
$$V_{OUT2} = R_2 I_{D2} = \frac{1}{2} (V_{IN} - E_{D2})$$

$$V_{D1} = -V_{OUT1} = -\frac{1}{2} (V_{IN} + E_{D2}) < E_{D1} \Rightarrow$$

$\Rightarrow$  pretpostavka da dioda  $D_1$   
ne provodi je tačna

# ZADATAK 3

3°



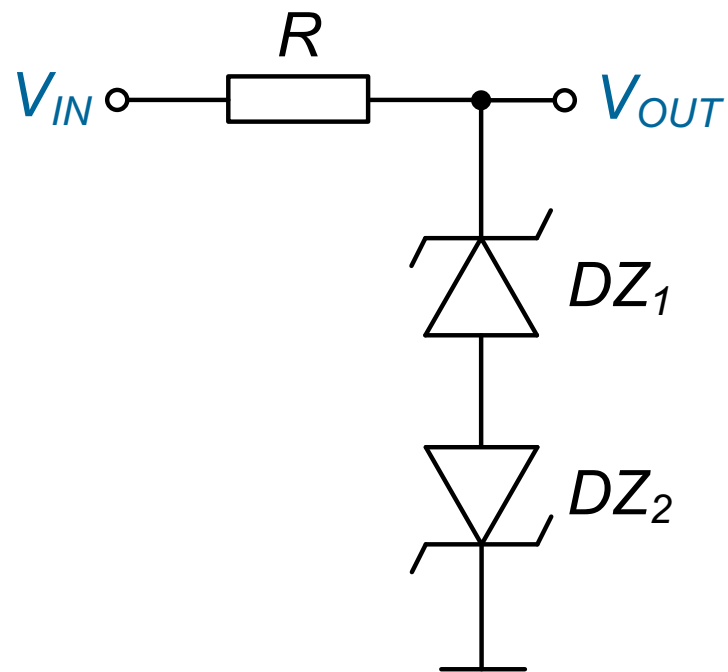
$$V_{IN} > E_{D2}$$

$$V_{OUT1} = \frac{1}{2}(V_{IN} + E_{D2})$$

$$V_{OUT2} = \frac{1}{2}(V_{IN} - E_{D2})$$

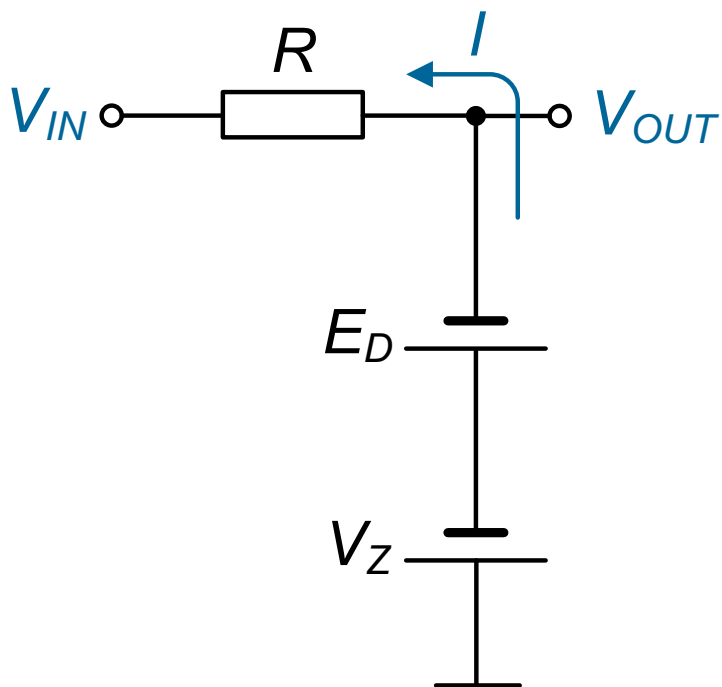
## ZADATAK 4

Za kolo na slici izračunati i nacrtati prenosnu karakteristiku  $V_{OUT}=f(V_{IN})$  za opseg ulaznog napona  $-6\text{ V} < V_{IN} < 6\text{ V}$ . *Zenner* diode su identičnih karakteristika sa  $E_D=0.7\text{ V}$  i  $V_Z=3.3\text{ V}$  dok im se otpornost može zanemariti.



## ZADATAK 4

1° Uvodi se pretpostavka da dioda  $DZ_1$  provodi u direktnom režimu, dok dioda  $DZ_2$  provodi u probojnom režimu.



$$V_{OUT} = -E_D - V_Z = -4 \text{ V}$$

$$I = \frac{V_{OUT} - V_{IN}}{R} > 0$$

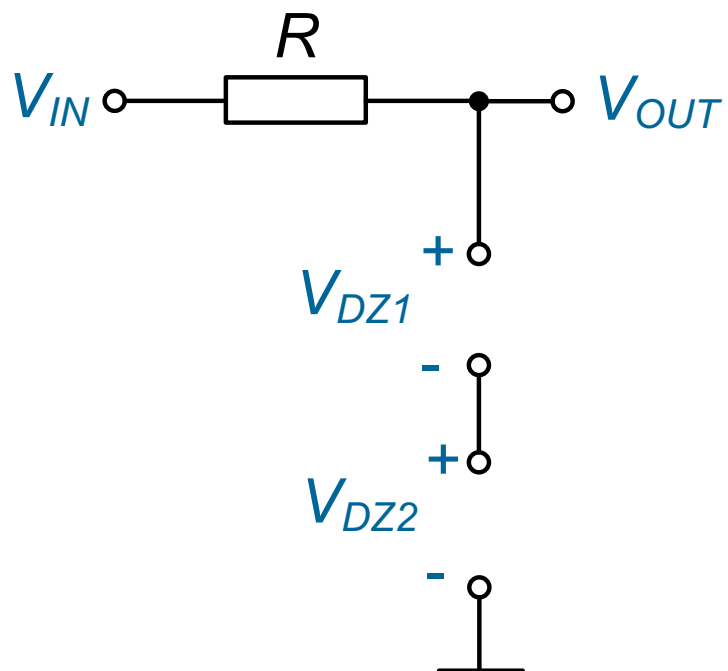
$$V_{OUT} - V_{IN} > 0$$

$$V_{IN} < V_{OUT}$$

$$V_{IN} < -4 \text{ V}$$

## ZADATAK 4

2° Uvodi se pretpostavka da diode ne provode.



$$V_{OUT} = V_{IN}$$

$$V_{DZ1} + V_{DZ2} > -E_D - V_Z$$

$$V_{IN} > -E_D - V_Z = -4 \text{ V}$$

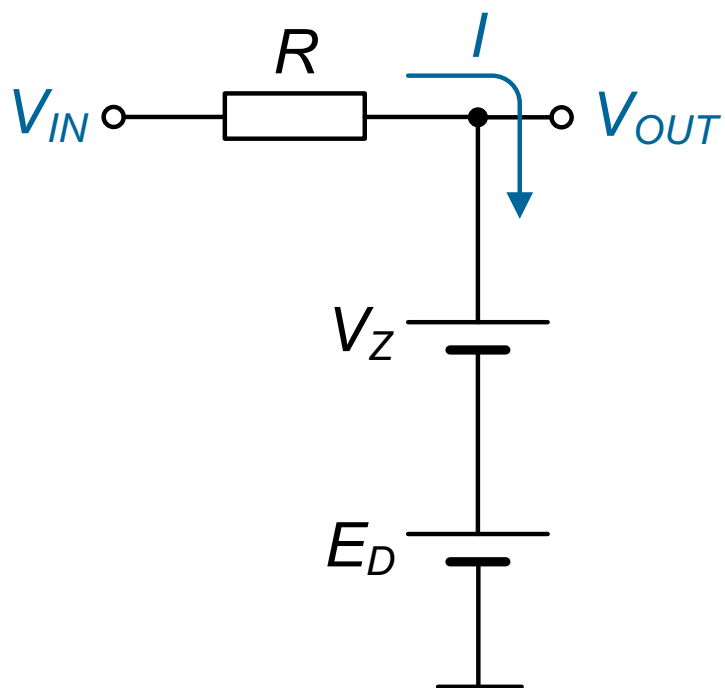
$$V_{DZ1} + V_{DZ2} < E_D + V_Z$$

$$V_{IN} < E_D + V_Z = 4 \text{ V}$$

$$-4 \text{ V} < V_{IN} < 4 \text{ V}$$

## ZADATAK 4

3° Uvodi se pretpostavka da dioda  $DZ_1$  provodi u probojnom režimu, dok dioda  $DZ_2$  provodi u direktnom režimu.



$$V_{OUT} = E_D + V_Z = 4 \text{ V}$$

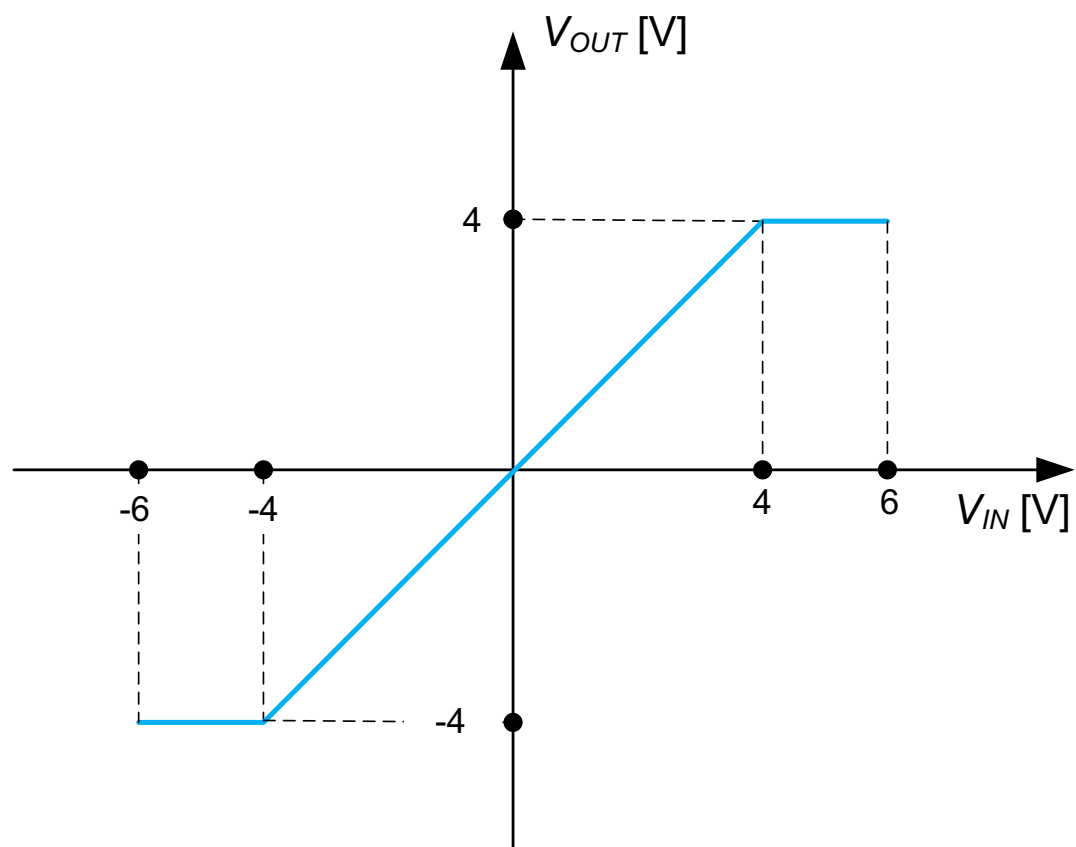
$$I = \frac{V_{IN} - V_{OUT}}{R} > 0$$

$$V_{IN} - V_{OUT} > 0$$

$$V_{IN} > V_{OUT}$$

$$V_{IN} > 4 \text{ V}$$

## ZADATAK 4



$$V_{IN} < -4 \text{ V}$$

$$V_{OUT} = -E_D - V_Z = -4 \text{ V}$$

$$-4 \text{ V} < V_{IN} < 4 \text{ V}$$

$$V_{OUT} = V_{IN}$$

$$V_{IN} > 4 \text{ V}$$

$$V_{OUT} = E_D + V_Z = 4 \text{ V}$$