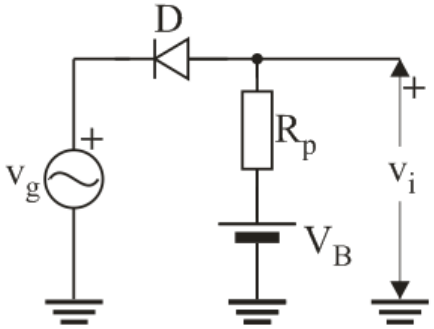
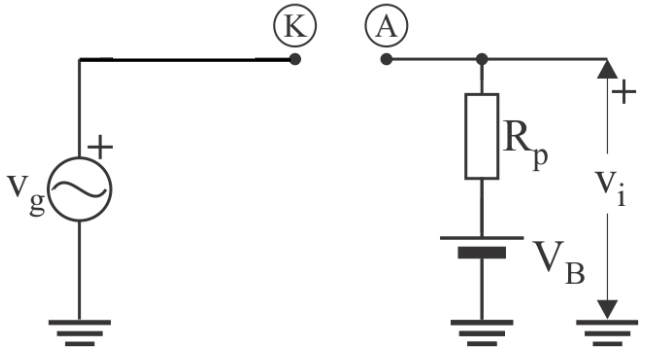
1) Nacrtati prenosnu karakteristiku, $v_i=f(v_g)$, kola sa slike za $-5\ V \le v_g \le 5\ V$, ako je poznato $R_p= 5\ k\Omega$; $V_B= 3\ V$. Parametri modela diode su: $r_f= 0\ \Omega$; $V_\gamma= 0{,}6\ V$.



- Dioda ne vodi. Opseg vrednosti vg za koji dioda ne vodi proverava se preko napona između anode i katode, Vak.

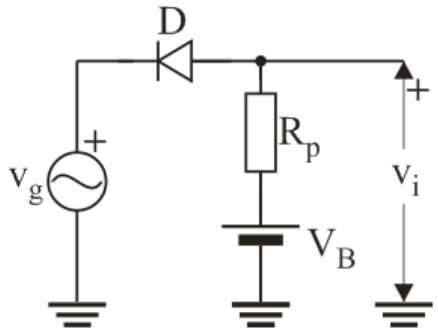


$$v_{AK} = V_B - v_g(t)$$

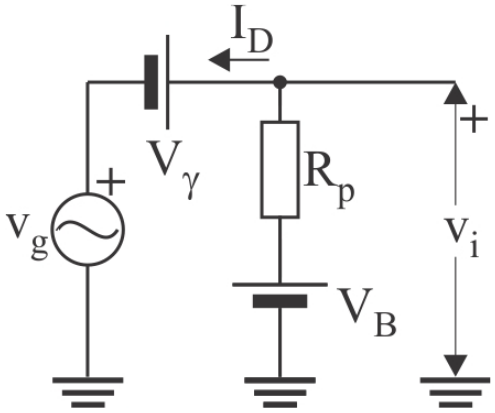
$$v_{AK} < V_\gamma$$

$$v_g(t) > V_B - V_\gamma = 2{,}4\ V$$

$$v_i = V_B$$



- Dioda vodi. Opseg vrednosti vg za koji dioda vodi proverava se preko smera struje, I_D.



$$v_g(t) + V_\gamma + R_P \cdot i_D - V_B = 0$$

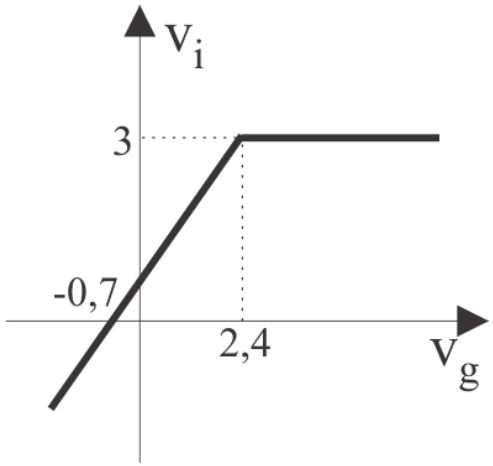
$$i_d > 0$$

$$i_d = \frac{V_B - V_\gamma - v_g(t)}{R_P} > 0$$

$$v_g(t) < V_B - V_\gamma = 2{,}4\,V$$

$$v_i(t) = v_g + V_\gamma$$

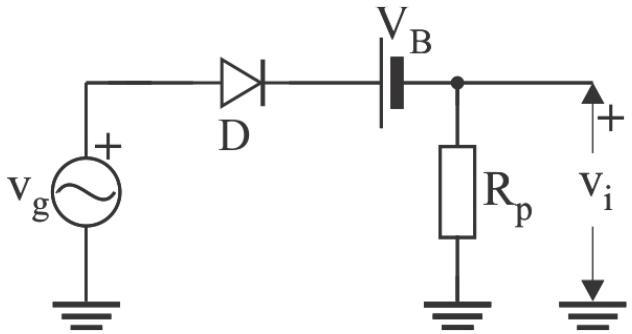
$$v_i = \begin{cases} v_g + 0{,}6 \quad za \quad v_g < 2{,}4\ V \\ 3\ V \qquad za \quad v_g > 2{,}4\ V \end{cases}$$



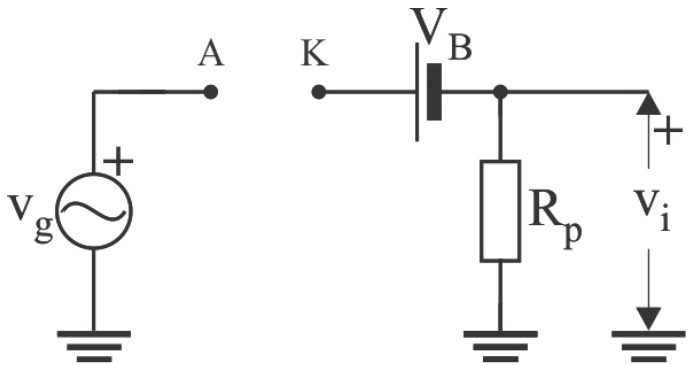
2) U kolu sa slike poznato je Rp= 1 kΩ; V_B= 5 V. Parametri modela diode su: r_f= 0 Ω; V_γ= 0,7 V.

a) Nacrtati prenosnu karakteristiku, $v_i=f(v_g)$, kola sa slike za -10 V≤ v_g ≤10 V.

b) Ukoliko je maksimalna snaga disipacije diode P=15 mW, koja je najveća dozvoljena vrednost ulaznog napona.



- Pretpostavka da dioda ne vodi



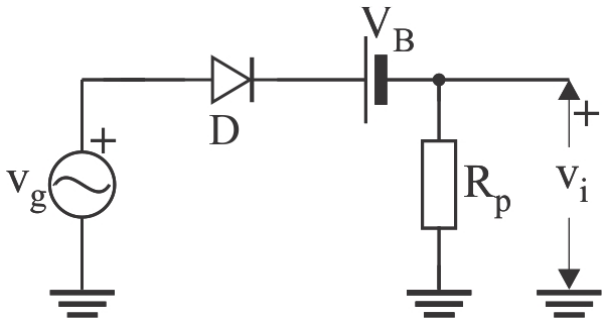
$$v_A = v_g$$

$$v_k = V_B$$

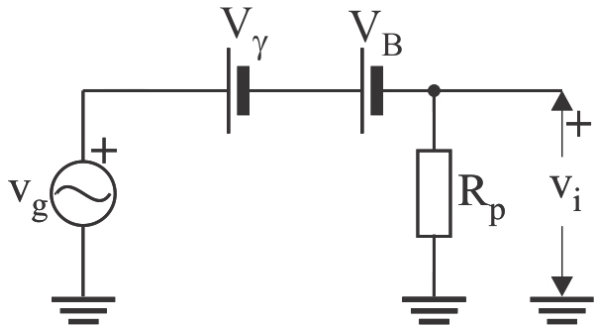
$$v_{AK} = v_g - V_B < V_\gamma$$

$$v_g < V_B + V_\gamma = 5{,}7\ V$$

$$v_i = R \cdot i_R = R \cdot 0 = 0$$



- Pretpostavka da dioda vodi

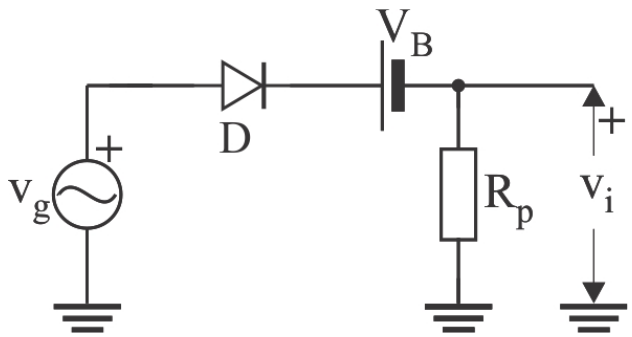


$$v_g(t) - V_\gamma - V_B - R_P \cdot i_D = 0$$

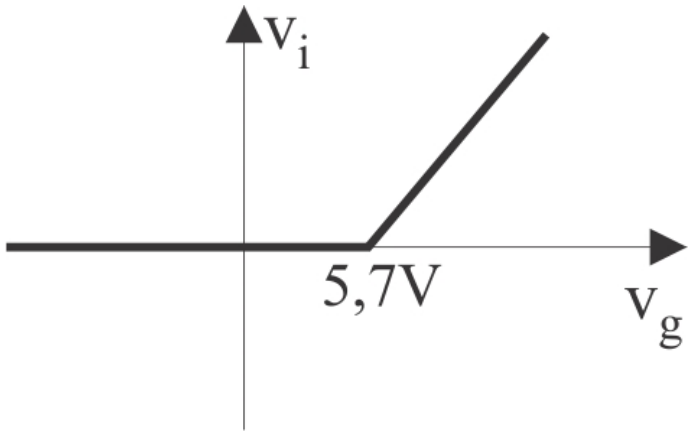
$$i_d > 0$$

$$i_d = \frac{V_g - V_\gamma - V_B}{R_P} > 0 \quad \Rightarrow \quad v_g > V_B + V_\gamma = 5{,}7\ V$$

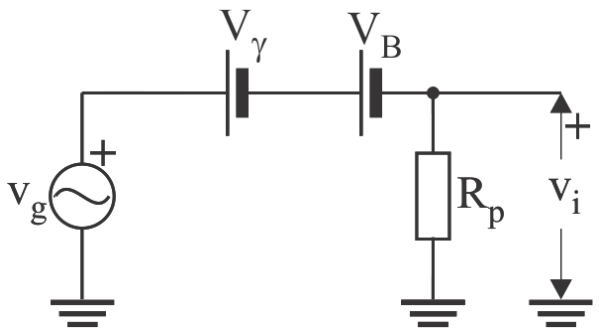
$$v_i = v_g - V_\gamma - V_B$$



$$v_i = \begin{cases} 0, & za \quad v_g < 5{,}7\ V \\ v_g - 5{,}7 & za \quad v_g > 5{,}7\ V \end{cases}$$



b) Snaga se disipira na diodi kada ona vodi.



$$v_D = V_\gamma \qquad i_D = \frac{v_g - V_\gamma - V_B}{R_P}$$

$$P_D = v_D \cdot i_D$$

$$P_D = V_\gamma \cdot \frac{v_g - V_\gamma - V_B}{R_P}$$

$$P_D < P_{Dmax}$$

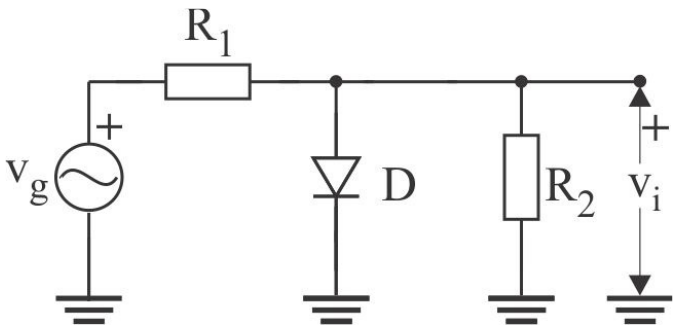
$$v_g < V_\gamma + V_B + P_{Dmax} \cdot \frac{R_P}{V_\gamma}$$

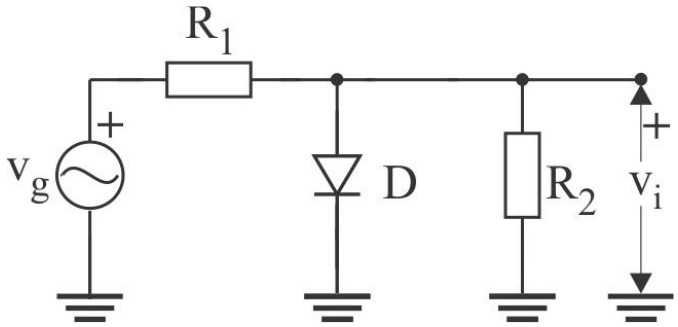
$$v_g < 27\ V$$

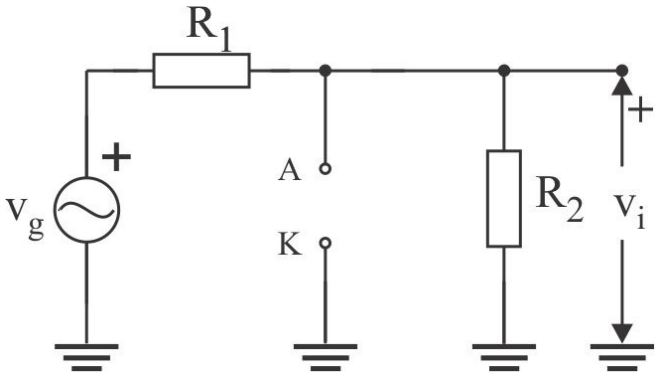
3) U kolu sa slike poznato je $R_1=R_2=$ 1kΩ. Parametri modela diode su: $r_f=$ 0 Ω; $V_\gamma=$ 0,7 V.

a) Nacrtati prenosnu karakteristiku, $v_i=f(v_g)$, kola sa slike za -10 V≤v_g≤10 V.

b) Ukoliko je maksimalna snaga disipacije diode P=10 mW, koja je najveća dozvoljena vrednost ulaznog napona.







Pretpostavka da dioda ne vodi

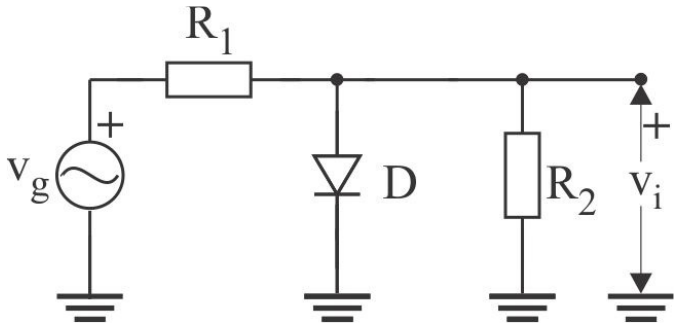
$$v_{AK} = \frac{R_2}{R_1 + R_2} \cdot v_g$$

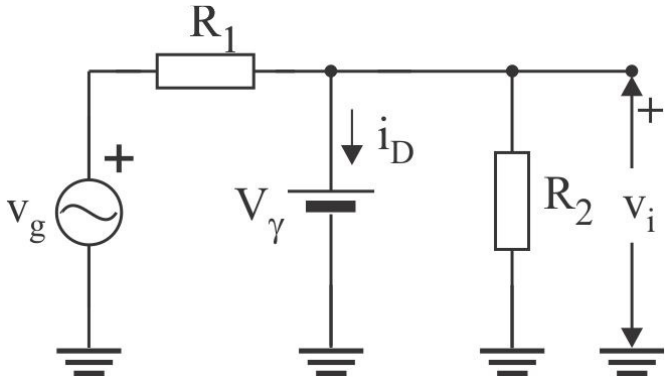
$$v_{AK} < V_\gamma$$

$$v_g < \left(1 + \frac{R_1}{R_2}\right) \cdot V_\gamma$$

$$v_g < 1{,}4\ V$$

$$v_i = \frac{R_2}{R_1 + R_2} \cdot v_g = \frac{v_g}{2}$$





Pretpostavka da dioda vodi

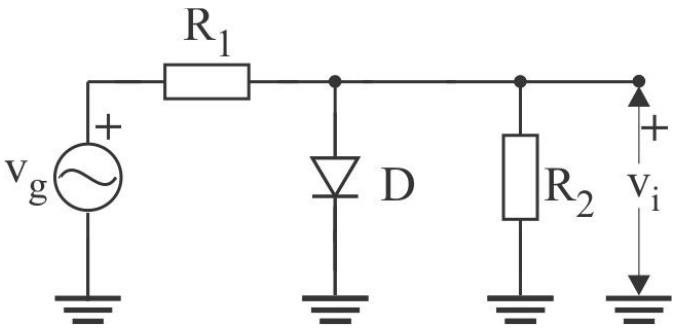
$$i_D + \frac{V_\gamma}{R_2} = \frac{v_g - V_\gamma}{R_1}$$

$$i_d > 0$$

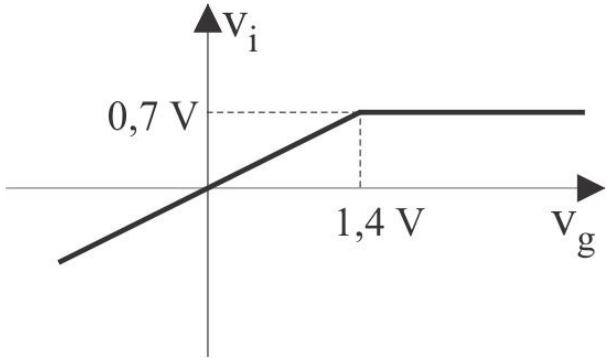
$$R_1 = R_2 = R$$

$$i_d = \frac{v_g - V_\gamma}{R_1} - \frac{V_\gamma}{R_2} > 0 \Rightarrow v_g > 2 \cdot V_\gamma = 1{,}4\ V$$

$$v_i = V_\gamma$$



$$v_i = \begin{cases} 0{,}5 \cdot v_g & za \quad v_g < 1{,}4\ V \\ 0{,}7\ V & za \quad v_g > 1{,}4\ V \end{cases}$$

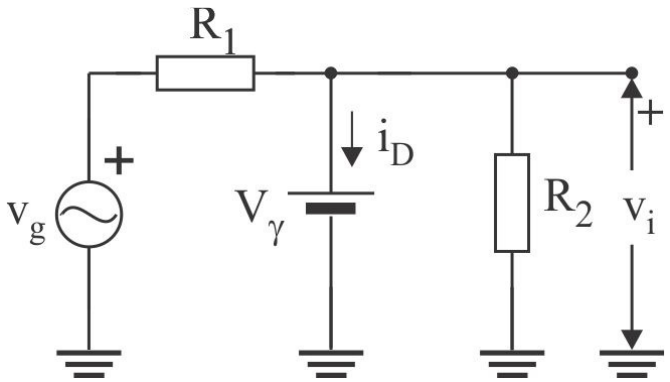


b) Snaga se disipira na diodi kada ona vodi.

$$P_D = v_D \cdot i_D$$

$$i_d = \frac{v_g - V_\gamma}{R_1} - \frac{V_\gamma}{R_2} = \frac{v_g - 2 \cdot V_\gamma}{R} \qquad v_D = V_\gamma$$

$$P_D = V_\gamma \cdot \frac{v_g - 2 \cdot V_\gamma}{R}$$

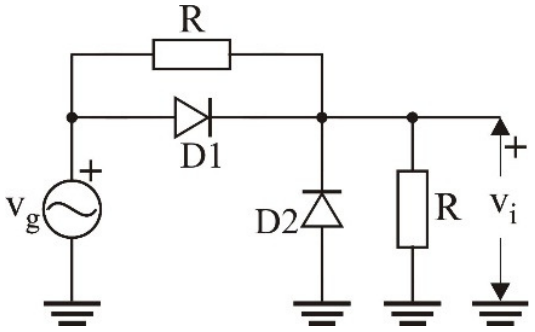


$$P_D < P_{Dmax}$$

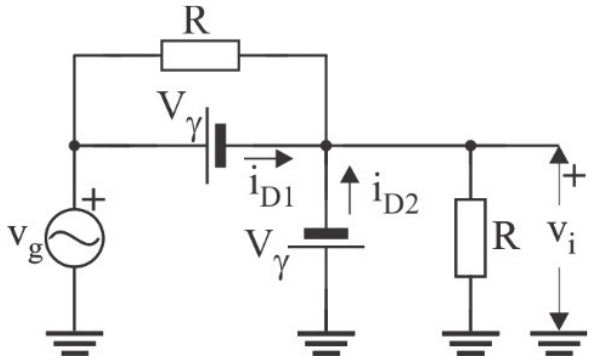
$$v_g < 2 \cdot V_\gamma + P_{Dmax} \cdot \frac{R}{V_\gamma}$$

$$v_g < 15{,}6\ V$$

4) Odrediti prenosnu karakteristiku, $v_i=f(v_g)$, kola sa slike. Poznato je$R_1= R_2=2$ kΩ. Parametri modela diodesu:$r_f= 0$ Ω; $V_\gamma= 0{,}7$ V.



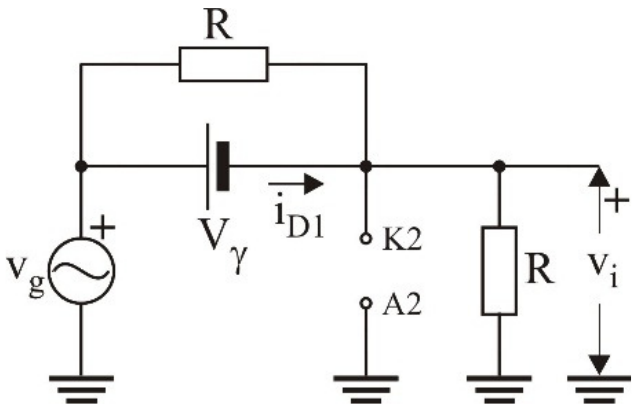
Dioda D1 vodi i dioda D2 vodi



Ova situacija nije moguća jer struje sve četiri grane povezane sa izlaznim čvorom utiču u čvor.

$$\frac{V_\gamma}{R}+\frac{V_\gamma}{R}+I_{D1}+I_{D2}=0$$

Dioda D1 vodi i dioda D2 ne vodi



$$\frac{V_\chi}{R} + i_{D1} = \frac{v_i}{R}$$

$$v_i = v_g - V_\chi$$

$$i_{D1} > 0$$

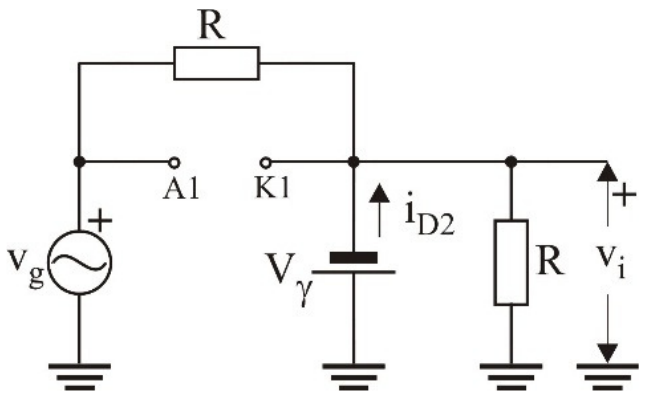
$$v_{AK2} < V_\chi$$

$$\frac{V_\chi}{R} + i_{D1} = \frac{v_g - V_\chi}{R} \quad | \qquad V_{AK2} = -v_g + V_\gamma$$

$$i_{D1} > 0 \implies v_g > 2 \cdot V_\gamma \qquad V_{AK2} < V_\gamma \implies v_g > 0$$

Za $v_g > 2 \cdot V_\gamma$ $v_i = v_g - V_\chi$

Dioda D1 ne vodi i dioda D2 vodi



$$\frac{v_g + V_\chi}{R} + i_{D2} = \frac{v_i}{R}$$

$$v_i = -V_\chi$$

$$i_{D2} > 0$$

$$v_{AK1} < V_\chi$$

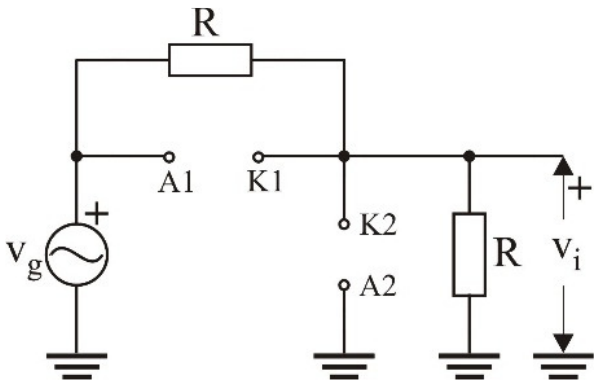
$$\frac{v_g + V_\chi}{R} + i_{D2} = -\frac{V_\chi}{R} \qquad V_{AK1} = v_g + V_\gamma$$

$$i_{D2} > 0 \;\Rightarrow\; v_g < -2V_\chi \qquad V_{AK1} < V_\gamma \;\Rightarrow\; v_g < 0$$

---

za $\quad v_g < -2V_\chi \quad v_i = -V_\chi$

Obe diode ne vode



$$\frac{v_g - v_i}{R} = \frac{v_i}{R}$$

$$v_{AK1} < V_\chi$$

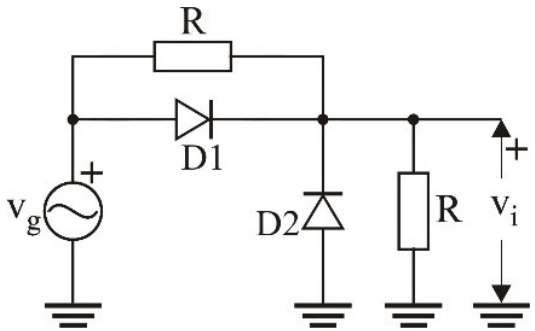
$$v_{AK2} < V_\chi$$

$$v_i = \frac{v_g}{2}$$

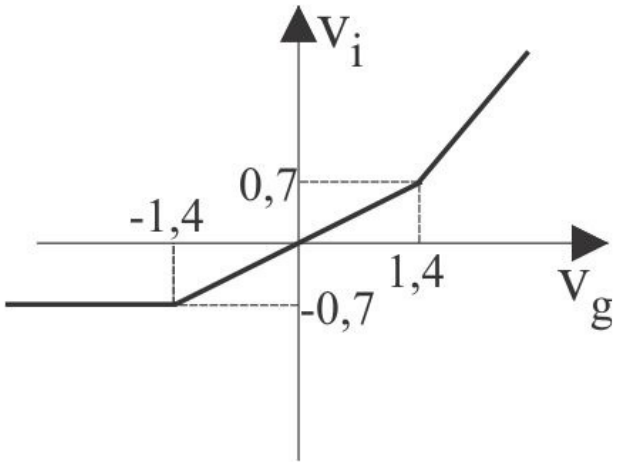
$$v_{AK1} = v_g - v_i = \frac{v_g}{2} \qquad v_{AK2} = -v_i = -\frac{v_g}{2}$$

$$v_{AK1} < V_\chi \quad \Rightarrow \quad v_g < 2 \cdot V_\chi \qquad v_{AK2} < V_\chi \quad \Rightarrow \quad v_g > -2 \cdot V_\chi$$

Za $\quad -2 \cdot V_\chi < v_g < 2 \cdot V_\chi \qquad v_i = \frac{v_g}{2}$



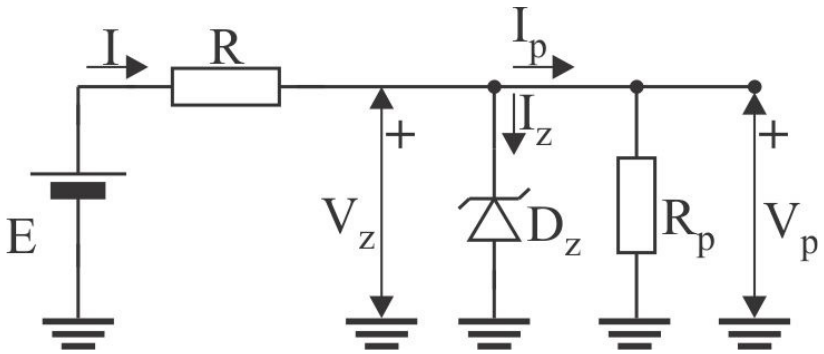
$$v_i = \begin{cases} -0{,}7V \quad za \quad v_g < -1{,}4V \\ 0{,}5 \cdot v_g \quad za \quad -1{,}4V > v_g > 1{,}4V \\ v_g - 0{,}7V \quad za \quad v_g > 1{,}4V \end{cases}$$

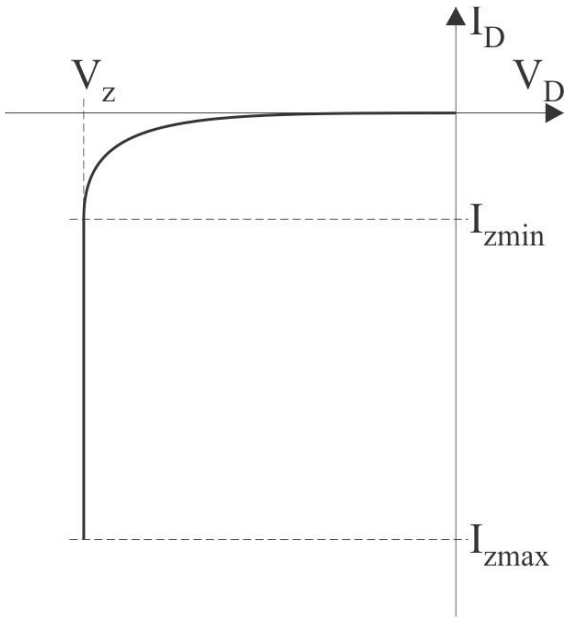


5) Zener dioda u kolu sa slike 1 definisana je sa V_z=-V_P= 50 V ako se struja diode nađe u opsegu $I_{zmin} \leq I_z \leq I_{zmax}$, gde je I_{zmin}= 5 mA; I_{zmax}= 40 mA. Napon izvora za napajanje je E = 200 V.

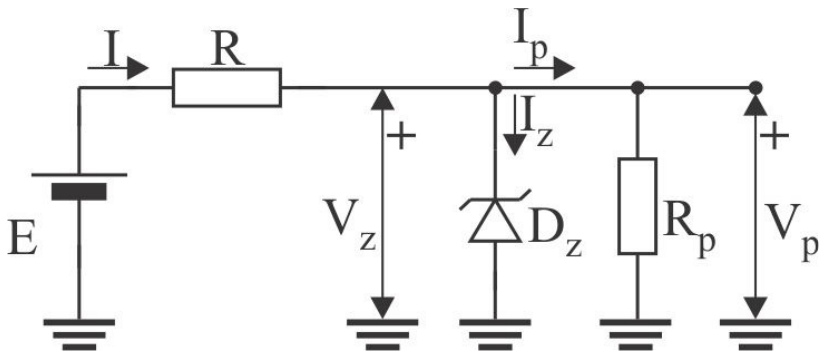
a) Odrediti vrednost otpornosti R koja obezbeđuje linearnu promenu struje potrošača u opsegu regulacije od I_{pmin}= 0 do I_{pmax}. Kolika je I_{pmax}?

b) Ako se za R usvoji vrednost izračunata u prethodnom delu zadatka i ako je struja potrošača I_P=25 mA , u kojim granicama može varirati napon izvora za napajanje, a da kolo ostane u opsegu regulacije?





a) Situcija kada je otpornost potrošača promenjiva a ostali elemenit zadati.



$$I = \frac{E - V_z}{R} = const$$

$$I = I_z + I_p$$

$$I = I_{z\min} + I_{p\max} = I_{z\max} + I_{p\min} = const$$

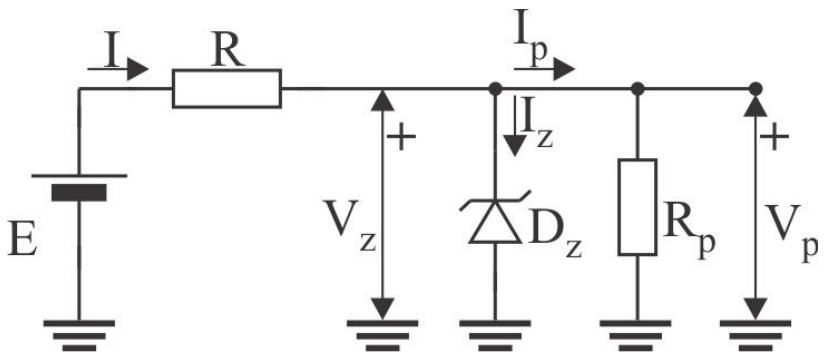
$$I = I_{z\max} + I_{p\min} = 40\ mA + 0 = 40\ mA$$

$$R = \frac{E - V_z}{I} = 3{,}75 k\Omega$$

$$\mathrm{I_{p\,max} = I - I_{z\,min} = 35\ mA}$$

$$R_{p\min} = \frac{V_Z}{I_{p\max}} = 1{,}4\ k\Omega$$

b) Svi elementi su konstantni sem ulaznog napona.To praktično znači da je struja I kroz otpornik R promenjiva, a da je struja kroz potrošač IP konstantna.



$$I_p = 25\,mA$$
$$I_{z\min} = 5\,mA$$
$$I_{z\max} = 40\,mA$$
$$I = I_z + I_p$$

$$\mathrm{I_{min} = I_p + I_{z\,min} = 30\ mA}$$
$$\mathrm{I_{max} = I_p + I_{z\,max} = 65\ mA}$$
$$E_{\min} = R \cdot I_{\min} + V_z = 162{,}5V$$
$$E_{\max} = R \cdot I_{\max} + V_z = 293{,}75V$$