

Adı Soyadı:

No:

İmza:

SÜRE: 30 dk.

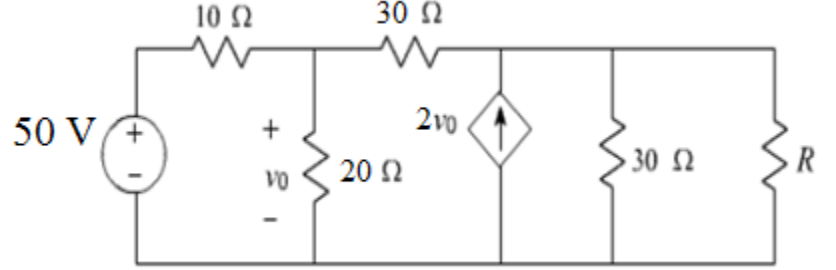
I. ÖĞRT. (A) ve (B) GRUBU,

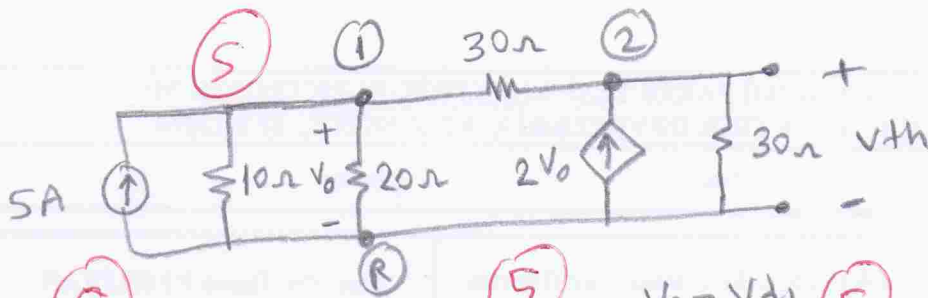
Başarılar Dilerim.

Doç. Dr. İhsan PEHLİVAN

SORU

Şekildeki devrede R direncinde
olabilecek maksimum gücü
hesaplayınız.





$$\begin{bmatrix} \frac{11}{60} & -\frac{1}{30} \\ -\frac{1}{30} & \frac{1}{15} \end{bmatrix} \begin{bmatrix} V_{d1} \\ V_{d2} \end{bmatrix} = \begin{bmatrix} 5 \\ +2V_0 \end{bmatrix}$$

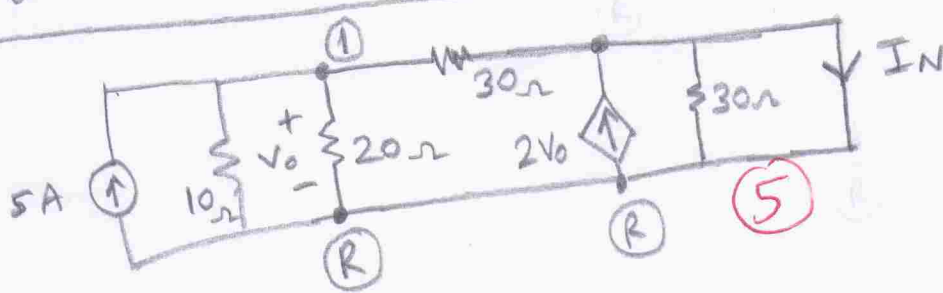
$$\begin{bmatrix} \frac{11}{60} & -\frac{1}{30} \\ -\frac{61}{30} & \frac{1}{15} \end{bmatrix} \begin{bmatrix} V_{d1} \\ V_{d2} \end{bmatrix} = \begin{bmatrix} 5 \\ 0 \end{bmatrix}$$

$$V_0 = V_{d1}, \quad 2V_0 = 2V_{d1}, \quad V_{d2} = V_{th}$$

1. denklemin 2 ile çarpıp, 2. denkleme eklersek,

$$\left(\frac{22}{60} - \frac{61}{30} \right) V_{d1} = 10, \quad V_{d1} = -6V$$

$$\frac{11}{60} \cdot (-6) - \frac{1}{30} V_{d2} = 5 \rightarrow V_{d2} = V_{th} = -183V$$



30Ω'nun ualari kısa devre, akın akmaz.

$$V_0 = V_{d1}, \quad 2V_0 = 2V_{d1}$$

Tek düğümli devreye dönüştü. 1. node düğüm için akın denklemleri yazılırsa,

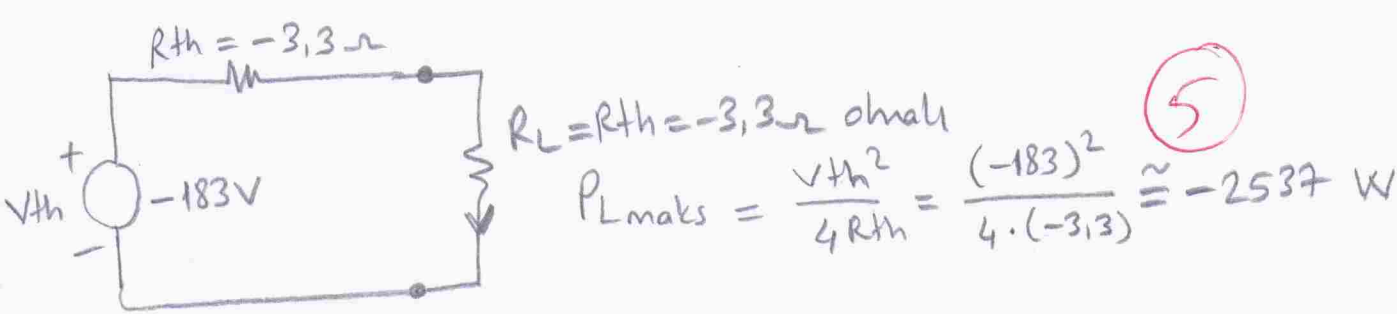
$$-5 + \frac{V_{d1}}{10} + \frac{V_{d1}}{20} + \frac{V_{d1}}{30} = 0 \rightarrow \frac{11}{60} V_{d1} = 5 \rightarrow V_{d1} = \frac{300}{11} V$$

üstteki düğümünden: $\frac{V_{d1}}{30} + 2V_{d1} = I_N$

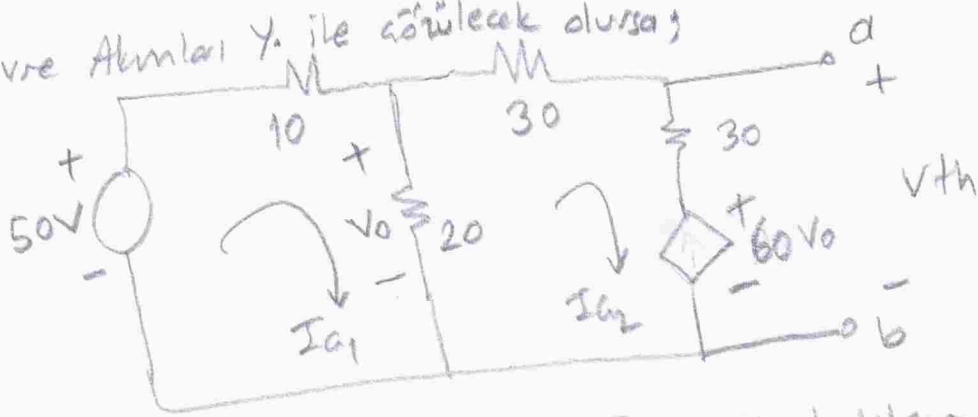
$$\frac{300}{11 \cdot 30} + \frac{2 \cdot 300}{11} = I_N$$

$$I_N = \frac{1830}{33} A$$

$$R_{th} = \frac{V_{th}}{I_N} = \frac{-183}{\frac{1830}{33}} = -\frac{33}{10} = -3,3\Omega$$



Gevre Akımları Y. ile ölçülecek olursa;



$$\begin{bmatrix} 30 & -20 \\ -20 & 80 \end{bmatrix} \begin{bmatrix} I_{a1} \\ I_{a2} \end{bmatrix} = \begin{bmatrix} 50 \\ -60V_o \end{bmatrix} \quad \text{Ek denklemler}$$

$$V_o = 20(I_{a1} - I_{a2})$$

$$-20I_{a1} + 80I_{a2} = -60 \cdot 20(I_{a1} - I_{a2})$$

$$1180I_{a1} - 1120I_{a2} = 0$$

$$\begin{bmatrix} 30 & -20 \\ 1180 & -1120 \end{bmatrix} \begin{bmatrix} I_{a1} \\ I_{a2} \end{bmatrix} = \begin{bmatrix} 50 \\ 0 \end{bmatrix}$$

$$\Delta = -33600 + 23600$$

$$\Delta = -10000$$

$$\Delta_1 = \begin{vmatrix} 50 & -20 \\ 0 & -1120 \end{vmatrix} = -56000$$

$$I_{a1} = \frac{\Delta_1}{\Delta} = \frac{-56000}{-10000} = 5,6 \text{ A}$$

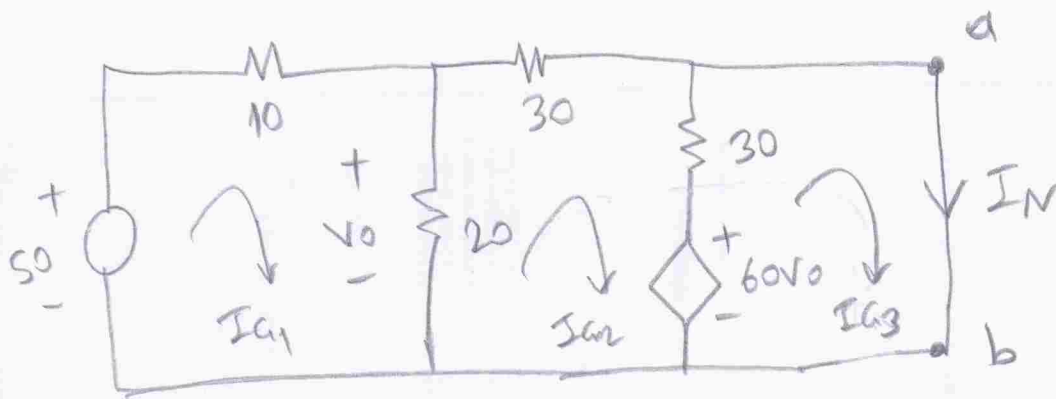
$$\Delta_2 = \begin{vmatrix} 30 & 50 \\ 1180 & 0 \end{vmatrix} = -59000$$

$$I_{a2} = \frac{\Delta_2}{\Delta} = \frac{-59000}{-10000} = 5,9 \text{ A}$$

$$V_o = 20 \cdot (5,6 - 5,9) = -6 \text{ V}$$

$$V_{th} = 30 \cdot I_{a2} + 60V_o = 30 \cdot 5,9 + 60 \cdot (-6) = 177 - 360 = -183 \text{ V}$$

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$$\begin{bmatrix} 30 & -20 & 0 \\ -20 & 80 & -30 \\ 0 & -30 & 30 \end{bmatrix} \begin{bmatrix} I_{a1} \\ I_{a2} \\ I_N \end{bmatrix} = \begin{bmatrix} 50 \\ -60V_o \\ 60V_o \end{bmatrix}$$

$$V_o = 20(I_{a1} - I_{a2})$$

$$\begin{bmatrix} 30 & -20 & 0 \\ 1180 & -1120 & -30 \\ -1200 & 1170 & 30 \end{bmatrix} \begin{bmatrix} I_{a1} \\ I_{a2} \\ I_N \end{bmatrix} = \begin{bmatrix} 50 \\ 0 \\ 0 \end{bmatrix}$$

$$\begin{aligned} \textcircled{2} + \textcircled{3} &\Rightarrow \begin{aligned} 1/ & -20 I_{a1} + 50 I_{a2} = 0 \\ 2/ & 30 I_{a1} - 20 I_{a2} = 50 \end{aligned} \end{aligned}$$

$$\begin{aligned} -60 I_{a1} + 150 I_{a2} &= 0 \\ +60 I_{a1} - 40 I_{a2} &= 100 \end{aligned}$$

$$110 I_{a2} = 100$$

$$I_{a2} = \frac{10}{11} \text{ A}$$

$$30 I_{a1} - 20 \cdot \frac{10}{11} = 50$$

$$30 I_{a1} = 50 + \frac{200}{11} = \frac{750}{11}$$

$$I_{a1} = \frac{750}{330} = \frac{25}{11} \text{ A}$$

$$1180 \cdot \frac{25}{11} - 1120 \cdot \frac{10}{11} - 30 I_N = 0$$

$$\frac{29500 - 11200}{11 \cdot 30} = I_N = \frac{1830}{33} \text{ A}$$

$$15$$

$$R_{th} = \frac{V_{th}}{I_N} = \frac{-183}{\frac{1830}{33}} = -3,3 \Omega$$

$$R_L = R_{th} = -3,3 \Omega \text{ ohm (5)}$$

$$P_{Lmax} = \frac{V_{th}^2}{4 R_{th}} = \frac{183^2}{-4 \cdot 3,3} = \frac{33489}{-13,2} = -2537 \text{ W (5)}$$