

בסיס קה וחלל - תחיל סור 5

$$R_{13} = R_1 + R_3 = 3K\Omega, R_2 = 3K\Omega$$

$$R_T = \frac{R_{13} \cdot R_2}{R_{13} + R_2} = \frac{3 \cdot 3}{3 + 3} = \frac{9}{6} = 1.5K\Omega$$

$$I_{R2} = I_{S2} \cdot \frac{R_{13}}{R_2 + R_{13}} = 3 \cdot \frac{3}{6} = 1.5mA$$

25W
N. נחלק את I_{S1} והמשך כאשר נתון $I = 3mA$

$$I_{R1} = I_{R3} = I_{S2} \cdot \frac{R_2}{R_{13} + R_2} = 3 \cdot \frac{3}{6} = 1.5mA$$

$$R_{12} = R_1 + R_2 = 2 + 3 = 5K\Omega, R_3 = 1K\Omega$$

$$R_T = \frac{R_{12} \cdot R_3}{R_{12} + R_3} = \frac{5 \cdot 1}{5 + 1} = \frac{5}{6} = 0.833K\Omega$$

$$I_{R1} = I_{R2} - I_{R3} = 1.5 - \frac{1}{3} = 1.1667mA$$

$$I_{R2} = I_{R1} + I_{R3} = 1.5 + \frac{1}{3} = 1.833mA$$

$$I_{R3} = 1.5 + \frac{1}{3} = 1.833mA$$

25W
N. נחלק את I_{S2} והמשך כאשר נתון $I = 2mA$

$$I_{R1} = I_{R2} = I_{S1} \cdot \frac{R_3}{R_{12} + R_3} = 2 \cdot \frac{1}{1+5} = \frac{2}{6}mA$$

$$I_{R2} = 2 \cdot \frac{5}{1+5} = \frac{10}{6}mA$$

$$I_{R3} = 1.5 + \frac{1}{3} = 1.833mA$$

$$P = I^2 \cdot R$$

$$P_{R1} = 1.361 \cdot 2 = 2.722V$$

$$P_{R2} = 3.359 \cdot 3 = 10.079V$$

$$P_{R3} = 10.027 \cdot 3 = 30.083V$$

$$P_{I_{S1}} = U_{I_{S1}} \cdot I_{I_{S1}} = 2.333 \cdot 2 = 4.666$$

$$P_{I_{S2}} = U_{I_{S2}} \cdot I_{I_{S2}} = 5.498 \cdot 3 = 16.494$$

$$P_T = P_1 + P_2 + P_3 = 2.722 + 10.079 + 30.083 = 42.884$$

$$\eta_{R2} = \frac{P_2}{P_T} = \frac{10.079}{42.884} = 0.235 = 23.5\%$$

25W
N. נחלק את I_{S1} והמשך כאשר נתון $I = 3mA$

$$U_{I_{S1}} = U_{R1} = \frac{P_{R1}}{I_{R1}} = \frac{2.722}{1.1667} = 2.33W$$

$$U_{I_{S2}} = U_{R2} = \frac{P_{R2}}{I_{R2}} = \frac{10.079}{1.833} = 5.498W$$

$$P_{I_{S1}} = U_{I_{S1}} \cdot I_{I_{S1}} = 2.333 \cdot 2 = 4.666$$

$$P_{I_{S2}} = U_{I_{S2}} \cdot I_{I_{S2}} = 5.498 \cdot 3 = 16.494$$

$$P_T = P_1 + P_2 + P_3 = 2.722 + 10.079 + 30.083 = 42.884$$

$$\eta_{R2} = \frac{P_2}{P_T} = \frac{10.079}{42.884} = 0.235 = 23.5\%$$

נחלק את I_{S1} והמשך כאשר נתון $I = 3mA$

25W

נחלק את I_{S1} והמשך כאשר נתון $I = 3mA$

$$1. E_1 = R_1 \cdot I_{11} + R_2 \cdot (I_{11} + I_{22}) + R_3 \cdot (I_{11} + I_{22})$$

$$10 = 12I_{11} + 4I_{22} + 3I_{33}$$

$$I_{11} = 0.916A$$

$$2. E_2 = R_5 \cdot (I_{22} + I_{33}) + R_3 \cdot (I_{22} - I_{11}) + R_4 \cdot I_{22}$$

$$6 = -3I_{11} + 15I_{22} + 6I_{33}$$

$$I_{22} = 0.434A$$

$$3. E_3 = R_6 \cdot I_{33} + R_5 \cdot (I_{22} + I_{33}) + R_2 \cdot (I_{33} + I_{11})$$

$$8 = 4I_{11} + 6I_{22} + 14I_{33}$$

$$I_{33} = 0.106A$$

$$I_{11} = I_{11} = 0.916A$$

$$I_{22} = 0.916 + 0.106 = 1.022A$$

$$I_{33} = I_{11} - I_{22} = 0.916 - 1.022 = -0.106A$$

$$I_{R4} = I_{22} = 0.434A$$

$$I_{R5} = I_{22} + I_{33} = 0.434 + 0.106 = 0.54A$$

$$I_{R6} = I_{33} = 0.106A$$

נחלק את I_{S1} והמשך כאשר נתון $I = 3mA$

25W

נחלק את I_{S1} והמשך כאשר נתון $I = 3mA$

$$1. E_3 = R_5 \cdot I_{33} + R_4 \cdot (I_{33} - I_{11}) + R_3 \cdot (I_{33} + I_{22})$$

$$100 = 50I_{11} + 100I_{22} + 300I_{33}$$

$$-100 = -50I_{11} + 300I_{33}$$

$$2. E_6 = R_6 \cdot I_{11} + R_2 \cdot (I_{11} + I_{22}) + R_4 \cdot (I_{11} - I_{33})$$

$$100 = 350I_{11} + 200I_{22} - 50I_{33}$$

$$-300 = 350I_{11} - 50I_{33}$$

$$I_{11} = 0.926A$$

$$I_{22} = 2A$$

$$I_{33} = -0.4878A$$

$$I_{R1} = 2A$$

$$I_{R2} = I_{11} + I_{22} = 0.926 + 2 = 2.926A$$

$$I_{R3} = I_{22} + I_{33} = 2 - 0.4878 = 1.5122A$$

$$I_{R4} = I_{33} - I_{11} = -0.4878 - 0.926 = -1.4138A$$

$$I_{R5} = -0.4878A$$

$$* P_{Ri} = I_i^2 \cdot R_i$$

$$I_{R6} = -0.926A$$

$$P_{R1} = 2^2 \cdot 100 = 400W$$

$$P_{R2} = 2.926^2 \cdot 200 = 1716.95W$$

$$P_{R3} = 1.5122^2 \cdot 100 = 228.674W$$

$$P_{R4} = 0.437^2 \cdot 50 = 9.5922W$$

$$P_{R5} = (-0.4878)^2 \cdot 150 = 35.692W$$

$$P_{R6} = (-0.926)^2 \cdot 100 = 85.747W$$

$$P_{E3} = U \cdot I = 100 \cdot (-0.4878) = -48.78W$$

$$P_{E6} = 100 \cdot (-0.926) = -92.6W$$

$$P_T = P_1 + P_2 + P_3 + P_4 + P_5 + P_6 = 849.02W$$

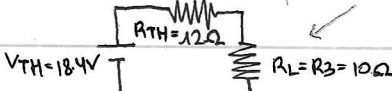
$$* A \quad E_1 = \frac{24}{20} = 1.2A$$

$$I_{R1} = R_1 = \frac{24}{20} = 1.2A$$

$$V_{Th} = \frac{E_1 \cdot R_2 + E_2 \cdot R_1}{R_1 + R_2} = \frac{24 \cdot 30 + 10 \cdot 20}{20 + 30} = \frac{1000}{50} = 20V$$

$$R_{Th} = R_1 + R_2 = \frac{20 \cdot 30}{20 + 30} = \frac{600}{50} = 12\Omega$$

$$R_L = R_3 = 10\Omega$$

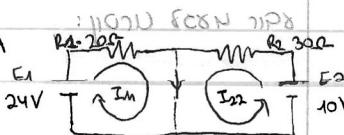


$$I \begin{cases} E_1 = R_1 \cdot I_{11} \\ E_2 = R_2 \cdot I_{22} \end{cases} \begin{cases} 24 = 20 \cdot I_{11} \\ 10 = 30 \cdot I_{22} \end{cases} \begin{cases} I_{11} = 1.2A \\ I_{22} = 0.333A \end{cases}$$

$$I_N = I_{11} + I_{22} = 1.2 + 0.333 = 1.533A$$

$$R_N = R_{Th} = 12\Omega$$

$$R_L = R_3 = 10\Omega$$



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המשך דפ"ר 5

$$R_T = R_{TH} + R_3 = 12 + 10 = 22 \Omega \quad \left| \quad I = \frac{V_{TH}}{R_T} = \frac{18.4}{22} = 0.836 A \quad \left| \quad I_{R_3} = I = 0.836 A \right. \right.$$

$$P_{R_3} = I^2 \cdot R_3 = 0.836^2 \cdot 10 = 6.99 W$$

כדי שההספק של R_3 יהיה מקסימלי צריך להיות שווה להתנגדות תחב"ן:

$$R_3 = R_{TH} = 12 \Omega \quad \left| \quad R_T = R_3 + R_{TH} = 24 \Omega \quad \left| \quad I = \frac{18.4}{24} = 0.766 A \quad \left| \quad I_{R_3} = I = 0.766 A \right. \right.$$

$$P_{R_3} = 0.766^2 \cdot 12 = 7.05 W$$

לפיכך: R_5 הוא התנגדות תחב"ן של R_5 ונמצא את R_5 כך שיהיה מקסימלי

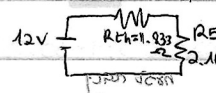
$$R_{TH} = \frac{R_1 \cdot R_2}{R_1 + R_2} + \frac{R_3 \cdot R_4}{R_3 + R_4} = \frac{1 \cdot 1}{1 + 1} + \frac{2 \cdot 4}{2 + 4} = \frac{1}{2} + \frac{8}{6} = \frac{11}{6} = 1.833 \Omega$$

$$U_{AB} + U_{R_2} + E_2 - U_{R_4} = 0 \quad \left| \quad U_{AB} = U_{R_4} - U_{R_2} - E_2 \quad \left| \quad U_{AB} = V_{th} - \text{מתח נע} \right. \right.$$

$$I_A = \frac{E_1 - E_2}{R_1 + R_2} = \frac{24 - 16}{1 + 1} = \frac{8}{2} = 4 A \quad \left| \quad U_{R_2} = I_A \cdot R_2 = 4 \cdot 1 = 4 V \quad \left| \quad I_B = \frac{E_3}{R_3 + R_4} = \frac{12}{2 + 4} = 2 A \quad \left| \quad U_{R_4} = 2 \cdot 4 = 8 V \right. \right.$$

$$U_{AB} = 8 - 4 - 16 = -12 V \Rightarrow V_{th} = 12 V$$

$$I_{R_5} = I = \frac{U}{R_T} = \frac{V_{th}}{R_5 + R_{th}} = \frac{12}{1.833 + 2.166} = \frac{12}{4} = 3 A$$

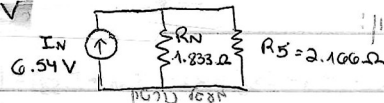


נמצא את V_{th} על ידי:

המתח הנמצא בין הנקודות A ו-B

$$R_N = R_{TH} = 1.833 \quad \left| \quad I_N = \frac{V_{th}}{R_{th}} = \frac{12}{1.833} = 6.54 V$$

$$I_{R_5} = I_N \cdot \frac{R_N}{R_N + R_5} = 6.54 \cdot \frac{1.833}{4} = 3 A$$



נמצא את R_N

התנגדות תחב"ן

$$R_{3,4} = \frac{R_3 + R_4}{R_3 + R_4} = \frac{2 + 4}{2 + 4} = \frac{8}{6} = \frac{4}{3} = 1.333 \Omega \quad \left| \quad R_{3,4,5} = R_{3,4} + R_5 = 1.33 + 2.166 = 3.5 \Omega \right.$$

$$R_{TH} = \frac{R_1 \cdot R_{3,4,5}}{R_1 + R_{3,4,5}} = \frac{1 \cdot 3.5}{1 + 3.5} = \frac{3.5}{4.5} = \frac{7}{9} = 0.77 \Omega \quad \left| \quad V_{th} = U_{AB} = E_1 \right.$$