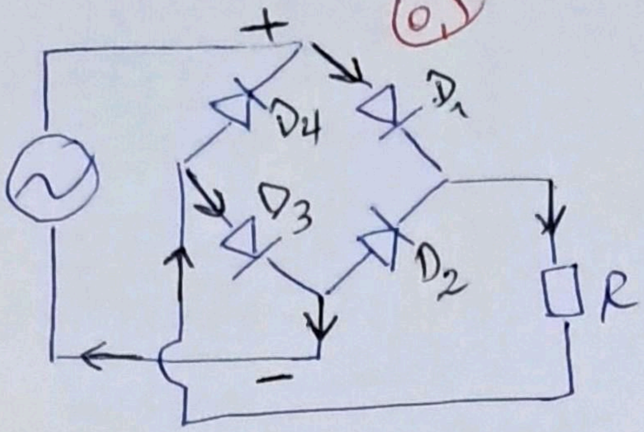
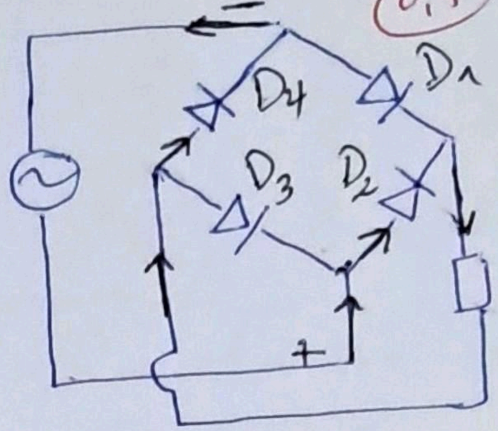
2^{nd} EXAM Solution

EXO1 :

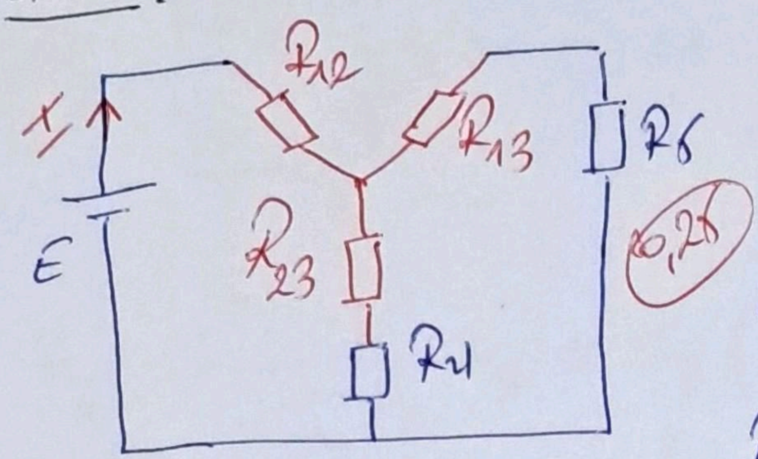
(0,5)



(0,5)



EXO2 :



(0,25)

$$R_{12} = \frac{R_1 R_2}{R_1 + R_2 + R_3} = 30\,\Omega$$ (0,25)

$$R_{13} = \frac{R_1 R_3}{R_1 + R_2 + R_3} = 30\,\Omega$$ (0,25)

$$R_{23} = \frac{R_2 R_3}{R_1 + R_2 + R_3} = 30\,\Omega$$ (0,25)

$$R_{12345} = \frac{(R_{23} + R_4)(R_{13} + R_5)}{(R_{23} + R_4) + (R_{13} + R_5)} = 60\,\Omega$$ (0,25)

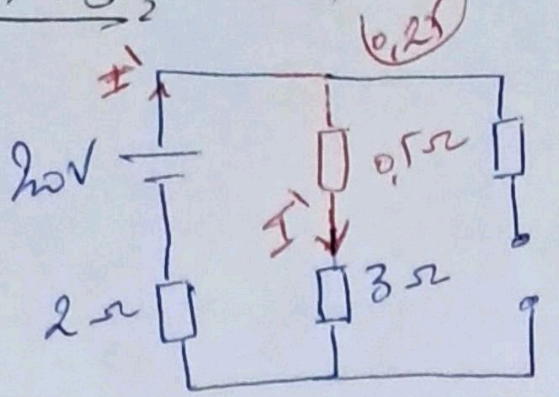
$$R_{eq} = R_{12} + R_{12345} = 30 + 60 = 90\,\Omega$$ (0,25)

$$I = \frac{E}{R_{eq}} = \frac{45}{90} = 0{,}5\,A$$

$\boxed{I = 0{,}5\,A}$ (0,25)

$$I_{234} = I_{135} = \frac{I}{2} = 0{,}25\,A$$ (0,25)

EX03 2



0,25

$R_{eq} = 0,5 + 3 + 2 = 5,5\,\Omega$

$\left(R = \frac{1.1}{1+1} = 0,5\,\Omega\right).$

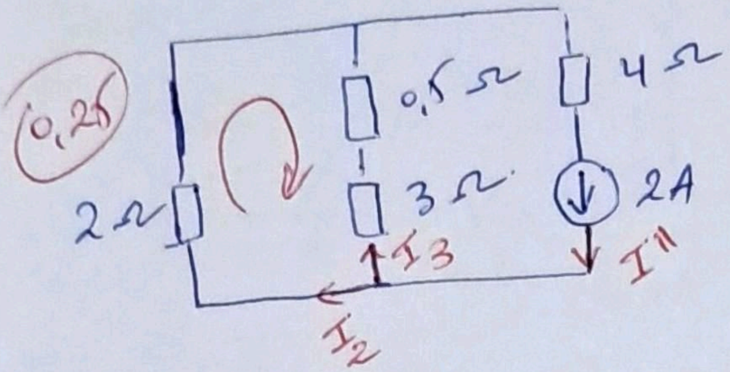
0,25

$I' = \frac{E}{R_{eq}} = \frac{20}{5,5} = 3,636\,A$

$V'_3 = R_3 I' = 3 . 3,636$ 0,25

$\boxed{V'_3 = 10,908\,V.}$ 0,25

$(R' = 0,5 + 3 = 3,5\,\Omega).$



$I' = I_3 + I_2.$ 0,25

$I_3 = I' - I_2.$

$+ R' I_3 - R_2 I_2 = 0$ 0,25

$I_2 = \frac{R'}{R_2} I_3.$

$I_3 = I' - \frac{R'}{R_2} I_3 \Rightarrow I_3 \left(1 + \frac{R'}{R_2}\right) = I'.$

$I_3 = \frac{I'}{1 + \frac{R'}{R_2}} = \frac{2}{1 + \frac{3,5}{2}} = 0,727\,A$ 0,25

0,25

$V''_3 = R_3 I_3 = 3 . 0,727 = 2,18\,V.$

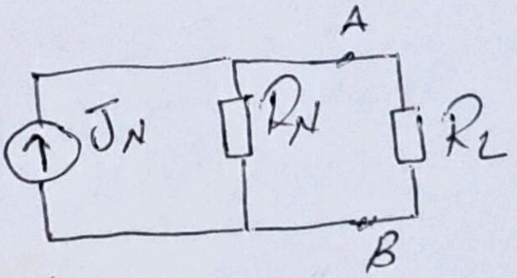
$\boxed{V''_3 = 2,18\,V.}$ 0,25

$V_3 = V'_3 - V''_3 = 8,727\,V.$ 0,25

EX04 2

$R_N = R_{th} =$ 0,25

$= (R + R_a) // R_b.$



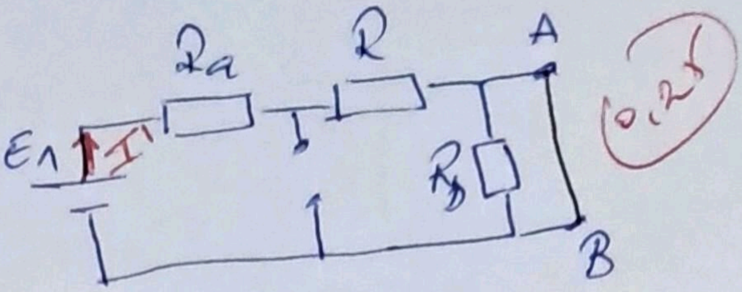
0,25

(02)

$R_N = \frac{(5+3)\cdot 3}{5+3+3} = 2,18\ \Omega$ (0,25)

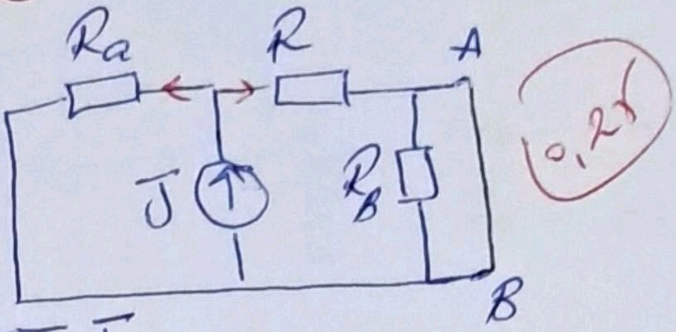
$\underline{E_1 = 100\ V}$:

$I' = \frac{E_1}{R_{eq}} = \frac{E_1}{R_a + R}$ (0,25)



$I' = \frac{100}{5+3} = 12,5\ A$ (0,5)

$\underline{J = 7A}$:



$J = I_{R_a} + I_R$ (0,25)

$= \frac{V}{R_a} + \frac{V}{R} \Rightarrow V = \frac{R_a R}{R_a + R} J$ (0,25)

$V = \frac{5\cdot 3}{5+3}\cdot 7 = 13,125\ V$ (0,25)

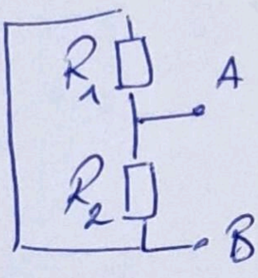
$I_R = \frac{V}{R} = \frac{13,125}{3} = 4,375\ A$ (0,25) (0,25)

$I_N = I' + I_R = 12,5 + 4,375 \Rightarrow I_N = 16,875\ A$ (0,5) (0,25)

$\underline{Exo\ 5}$:

$\underline{R_{th}}$: $R_1 // R_2$

$R_{th} = \frac{R_1 R_2}{R_1 + R_2}$ (0,25)



$R_{th} = \frac{6\cdot 10^3 \cdot 3\cdot 10^3}{(6+3)\cdot 10^3}$

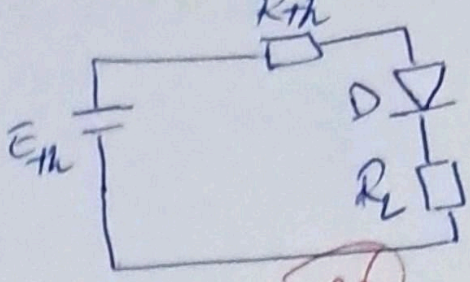
$R_{th} = 2\ K\Omega$ (0,25)

$\underline{E_{th}}$: $E - R_1 I - R_2 I = 0 \Rightarrow I = \frac{E}{R_1 + R_2} = \frac{12}{9\cdot 10^3}$ (0,25)

$I = 1,33\cdot 10^{-3}\ A$ (0,25)

$E_{th} = R_2 I = \frac{R_2}{R_1 + R_2} E \Rightarrow E_{th} = 4\,V$ (0,25)

<u>Ideal diode</u>:



(0,25)

$E_{th} - R_{th} I_I - R_L I_I = 0$ (0,25)

$I_I = \frac{E_{th}}{R_{th} + R_L} = \frac{4}{(2+1)10^3}$

$I_I = 1,33 \cdot 10^{-3} A$ (0,5)

<u>Perfect diode</u>

(0,25)

$E_{th} - R_{th} I_P - V_{th} - R_L I_P = 0 \Rightarrow I_P = \frac{E_{th} - V_{th}}{R_{th} + R_L}$

$I_P = 1,13 \cdot 10^{-3} A$ (0,5)

<u>EXO6</u>:

(0,5) $I = I_S \left(e^{\frac{V_d}{V_T}} - 1\right)$, $I \simeq I_S e^{\frac{V_d}{V_T}}$ (0,5)

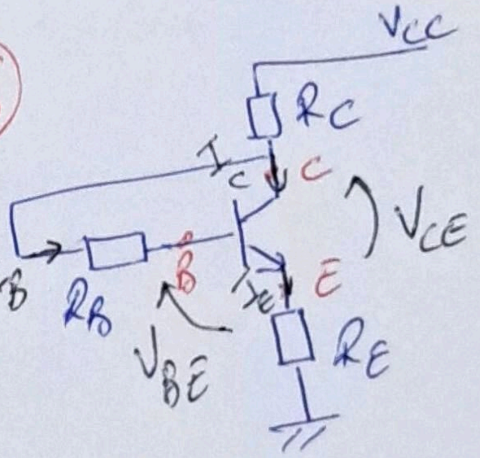
$V_d = V_T \ln\left(\frac{I}{I_S}\right)$ (0,5)

(0,5) $V_T = \frac{KT}{e} = \frac{1,38 \cdot 10^{-23} \cdot 300}{1,6 \cdot 10^{-19}} = 0,025\,V$ (0,5)

$V_d = 0,025 \ln\left(\frac{2 \cdot 10^{-3}}{2 \cdot 10^{-9}}\right) = 0,36\,V$ (0,5)

<u>EXO7</u>:

$I_C = \beta I_B \Rightarrow I_B = \frac{I_C}{\beta}$ (0,5)



(0,5)

$I_E = I_C + I_B = I_C\left(1 + \frac{1}{\beta}\right)$

(0,5)

1)

$$V_{CC} - R_C(I_C + I_B) - V_{CE} - R_E I_E = 0$$ 0,5

$$V_{CC} - V_{CE} = R_C\left(I_C + \frac{I_C}{\beta}\right) + R_E\left(I_C + \frac{I_C}{\beta}\right)$$

$$V_{CC} - V_{CE} = I_C\left(R_C\left(1 + \frac{1}{\beta}\right) + R_E\left(1 + \frac{1}{\beta}\right)\right)$$

$$I_C = \frac{V_{CC} - V_{CE}}{R_C\left(1 + \frac{1}{\beta}\right) + R_E\left(1 + \frac{1}{\beta}\right)}$$ 0,5

$$\beta \gg 1 \Rightarrow I_C = \frac{V_{CC} - V_{CE}}{R_C + R_E}$$ 0,25

The circuit is stable.

0,5

2)

$$V_{CC} - R_C(I_C + I_B) - R_B I_B - V_{BE} - R_E I_E = 0$$

$$V_{CC} - V_{BE} = R_C I_C\left(1 + \frac{1}{\beta}\right) + R_B \frac{1}{\beta} I_C + R_E I_C\left(1 + \frac{1}{\beta}\right)$$

$$V_{CC} - V_{BE} = I_C\left(R_C\left(1 + \frac{1}{\beta}\right) + R_B \frac{1}{\beta} + R_E\left(1 + \frac{1}{\beta}\right)\right)$$

$$I_C = \frac{V_{CC} - V_{BE}}{R_C\left(1 + \frac{1}{\beta}\right) + R_B \frac{1}{\beta} + R_E\left(1 + \frac{1}{\beta}\right)}$$ 0,5

$$\beta \gg 1 \quad I_C = \frac{V_{CC} - V_{BE}}{R_C + R_B \frac{1}{\beta} + R_E}$$ 0,25

The circuit is not stable.

0,5