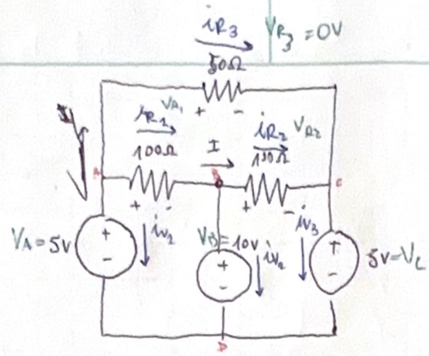
1) 


b) $V_{R_3} = V_A + V_C = 5V + -5V = 0V$

$V_{R_1} = V_A + V_B = 5V + (-10V) = -5V$

$V_{R_2} = V_B + V_C = 10V + (-5V) = +5V$

c) $i_{R_3} = \frac{V_{R_3}}{50\Omega} = \frac{0}{50} = 0A$

$i_{R_2} = \frac{5V}{100\Omega} = 50mA$

$i_{R_1} = \frac{-5V}{100\Omega} = -50mA$

d) ~~[illegible]~~

AT A: ~~[illegible]~~

$(i_{R_3} + i_{R_1} + i_{V_2}) = 0$

$i_{V_2} = -(i_{R_3} + i_{R_1}) = -(50mA + 0A)$

$i_{V_2} = +50mA$

AT B:

$(-i_{R_2} + i_{R_2} + i_{V_2}) = 0$

$i_{V_2} = -(-50mA) - 50mA$

$i_{V_2} = -100mA$

AT C:

$(i_{R_3} + i_{R_2} - i_{V_3}) = 0$

$i_{V_3} = i_{R_2} + i_{R_3}$

$i_{V_3} = 50mA$

e) $P = Vi$

$V_A$: $P = 5(0.05) = +0.25W$ ABSORBED

$V_B$: $P = 5(-0.1) = -0.5W$ DELIVERED

$V_C$: $P = 5(0.05) = +0.25W$ ABSORBED.

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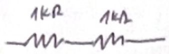
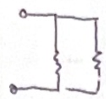
2) a) $R_{eq} = \left(10 + 10 + \frac{10 \cdot R_L}{10 + R_L}\right) k\Omega \Rightarrow 20 + \frac{10R_L}{10+R_L} = 25 \Rightarrow 5 = \frac{10R_L}{10+R_L}$

$\Rightarrow 50 + 5R_L = 10R_L \Rightarrow 50 = 5R_L = \boxed{R_L = 10k\Omega}$

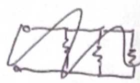
b) SINCE IN SERIES WITH 2 10kΩ RESISTORS, $R_L$ NEEDS TO BE 0kΩ

$\Rightarrow \frac{10 \cdot R_L}{10+R_L} = 0 \therefore R_L = 0k\Omega$

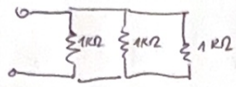
3) • 2kΩ:  ⇒ $1+1 = 2$kΩ

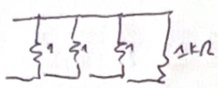
• 500Ω  → $\frac{1\cdot 1}{1+1} = 0.5$kΩ $= 500$Ω

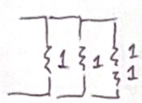
• 1.5kΩ →  → $1 + \frac{1\cdot1}{1+1} = 1.5$kΩ

• 333Ω →  ~~$\frac{1\cdot1\cdot1}{1+1+1} = \frac{1}{3}$kΩ~~ $\frac{1}{1}+\frac{1}{1}+\frac{1}{1} = \frac{3}{1} = \frac{1}{R_{eq}}$

$\Rightarrow R_{eq} = \frac{1}{3}$kΩ $\approx 333$Ω



• 250Ω  $\Rightarrow \frac{1}{R_{eq}} = \left(\frac{1}{1}\right)4 \Rightarrow R_{eq} = \frac{1}{4}$kΩ $= 250$Ω

• 400Ω  $\Rightarrow \frac{1}{R_{eq}} = \frac{1}{2} + \frac{1}{1} + \frac{1}{1} = \frac{1+2+2}{2} = \frac{5}{2} \Rightarrow R_{eq} = \frac{2}{5} = 0.4$kΩ $= 400$Ω

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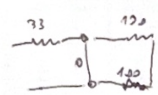
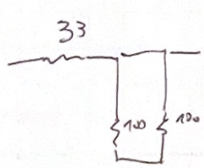
4) A-B: 33kΩ

A-C:  ⇒ SINCE $\frac{200\cdot 0}{0+200} = 0$ ⇒ 33kΩ

A-B: ~~(33+100)kΩ = 133 kΩ~~

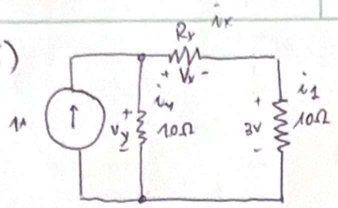
 ⇒ $(100 \parallel 100) + 33 = 50+33 = 83$kΩ

B-C: 0kΩ

B-D: $(100 \parallel 100) = 50$kΩ

C-D: " " = 50kΩ

5)




~~VOLTAGE IS THE SAME IN PARALLEL SO $V_y$ IS ALSO~~

$$R_{EQ} = \frac{(R_x+10)\cdot 10}{(R_x+10)+10} = \frac{10R_x+100}{R_x+20}$$

$I = \frac{V}{R} \Rightarrow i_1 = \frac{3V}{10\Omega} = 0.3\,A$

THEN SINCE $\Sigma I$ AT NODE $=0$, $i_y = 0.7$ AND THEREFORE

$V_y = I \cdot R = 10\Omega \cdot 0.7A = 4V$

THEREFORE $i_x$ IS ALSO $0.3\,A$. BUT SINCE VOLTAGE IS THE SAME IN PARALLEL THEN $V_x = 7-3 = 4V$

THEN $R_x = \frac{V}{I} = \frac{4}{0.3} = 13.\bar{3}\,\Omega$

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6) READS 3.81 V ~~on Req~~ $10-3.81V$ IS OTHER RESISTOR

$$\frac{4.7\,M\Omega}{R_{eq}} = \frac{10-3.81}{10} \Rightarrow R_{eq} = \frac{4.7}{10-3.81}\cdot 10 = 7.5928\,\Omega$$

$$R_{eq} = 4.7 + \frac{6.3\cdot R_m}{6.3+R_m} = 7.59.. \Rightarrow \cancel{(4.7)(6.3)+4.7R_m = 6.3}$$

$$\Rightarrow \cancel{(7.5928)(6.3)} \Rightarrow (7.598-4.7)(6.3) + (7.5928-4.7)(R_m) = 6.3R_m$$

$$\Rightarrow \frac{(2.8928)(6.3) = (6.3-2.8928)R_m}{6.3-2.8928} \Rightarrow R_m = 5.349 \approx 5.35M\Omega$$

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7) $R(V_T) = 0.5V_T^2+1$


$i_L = 100mA$

$$i_L = \frac{V}{R} = \frac{V_t}{R(V_t)+10} = \frac{V_t}{0.5V_t^2+1+10} = 100mA$$

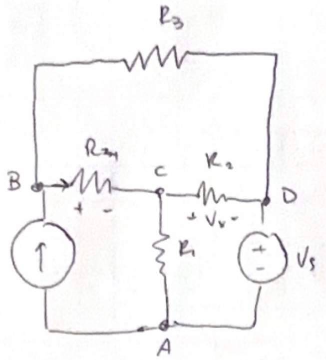
$$\cancel{(100\cdot 10^{-3})\,0.5\,V_t^2 + 100\cdot 10^{-3} - V_t = 0}$$

$\cancel{V_t = 0.105263}$

$\Rightarrow V_t = 0.05V_t^2 + 1.1$

$0.05V_t^2 + 1.1 - V_t = 0$

$\boxed{V_t = 1.16824V \text{ OR } 18.8318\,V}$




a) $V_D = V_S$ (D)

(B) $i_s = \dfrac{V_B - V_C}{R_4} + \dfrac{V_B - V_D}{R_3}$

(C) $\dfrac{V_C - V_B}{R_4} + \dfrac{V_C - V_D}{R_2} + \dfrac{V_C}{R_1} = 0$

b) USING $R_n = \dfrac{1}{G_n}$ , $x = \begin{bmatrix} V_B \\ V_C \end{bmatrix}$

$G_4(V_B - V_C) + G_3(V_B - V_s) = i_s \Rightarrow (G_3 + G_4)V_B - (G_4)V_C = i_s + G_3 v_s$ (1)

$G_4(V_C - V_B) + G_2(V_C - v_s) + (G_1)V_C = 0 \Rightarrow (-G_4)V_B + (G_1 + G_2 + G_4)V_C = G_2 V_s$ (2)

$$\Rightarrow \begin{bmatrix} (G_4 + G_3) & (-G_4) \\ (-G_4) & (G_1 + G_2 + G_4) \end{bmatrix} \begin{bmatrix} V_B \\ V_C \end{bmatrix} = \begin{bmatrix} i_s + G_3 v_s \\ G_2 V_s \end{bmatrix}$$

c) $R_n = 1k\Omega \rightarrow G_n = 1 \cdot 10^{-3}\,\Omega$ $\quad v_s = 20\,V$ , $i_s = 1 \cdot 10^{-3} A$

$$\Rightarrow \begin{bmatrix} 0.002 & -0.001 \\ -0.001 & 0.003 \end{bmatrix} \begin{bmatrix} V_B \\ V_C \end{bmatrix} = \begin{bmatrix} 0.021 \\ 0.020 \end{bmatrix} \xrightarrow{\cdot 10^3} \begin{bmatrix} 2 & -1 \\ -1 & 3 \end{bmatrix} \begin{bmatrix} V_B \\ V_C \end{bmatrix} = \begin{bmatrix} 21 \\ 20 \end{bmatrix}$$

$$\Rightarrow (A|b) = \begin{bmatrix} 2 & -1 & 21 \\ -1 & 3 & 20 \end{bmatrix} \rightarrow \begin{bmatrix} 2 & -1 & 21 \\ 0 & 5 & 61 \end{bmatrix}$$

FROM $R_2 \rightarrow 5V_C = 61 \rightarrow V_C = \dfrac{61}{5} = 12.2\,V$

$R_1 \rightarrow 2V_B - V_C = 21 \Rightarrow 2V_B = 21 + 12.2 = 33.2$

$\rightarrow V_B = \dfrac{33.2}{2} = 16.6\,V$

THEN

$$\boxed{\begin{aligned} V_x &= V_C - V_D = 12.2 - 20 = -7.8V \\ i_x &= \frac{V_D - V_B}{R_3} = \frac{20 - 16.6}{1 \cdot 10^3} = 3.4 \cdot 10^{-3} A = 3.4\,mA \end{aligned}}$$