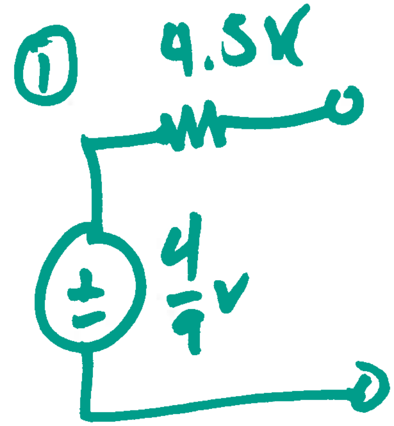
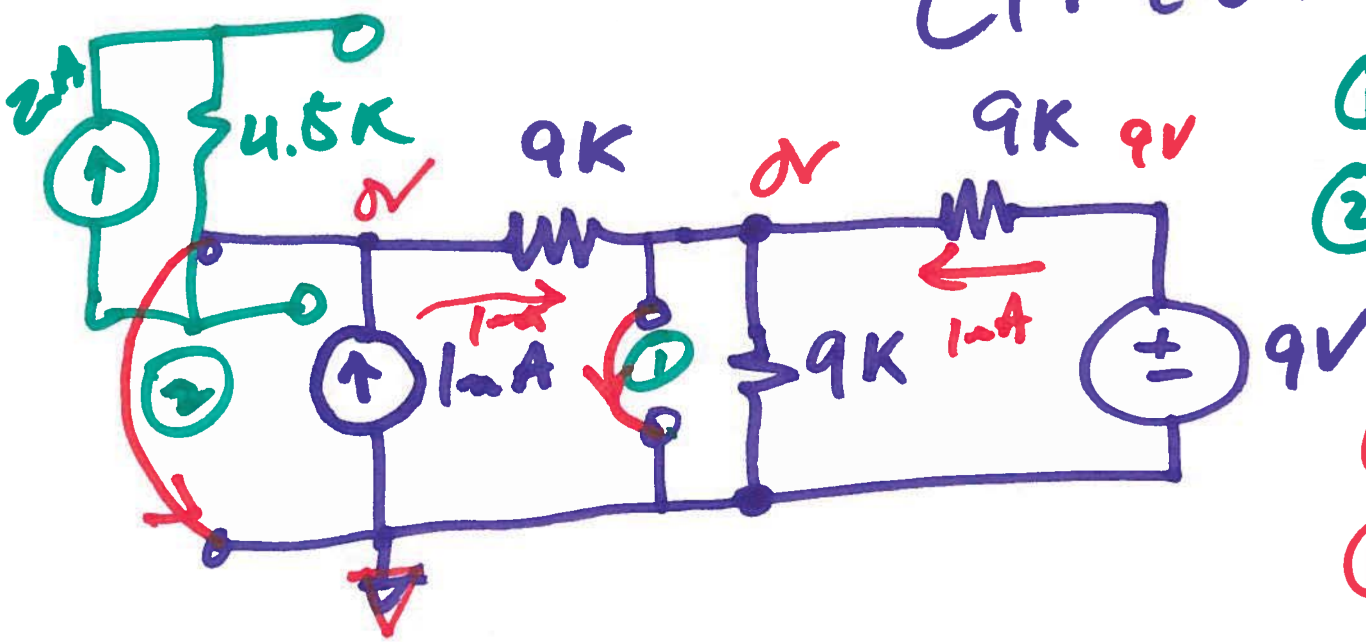


Study session 1

EE 220 circuits



① $R_{TH} = 4.5K$

② $R_{TH} = 13.5K$

① $I_{sc} = 2mA$

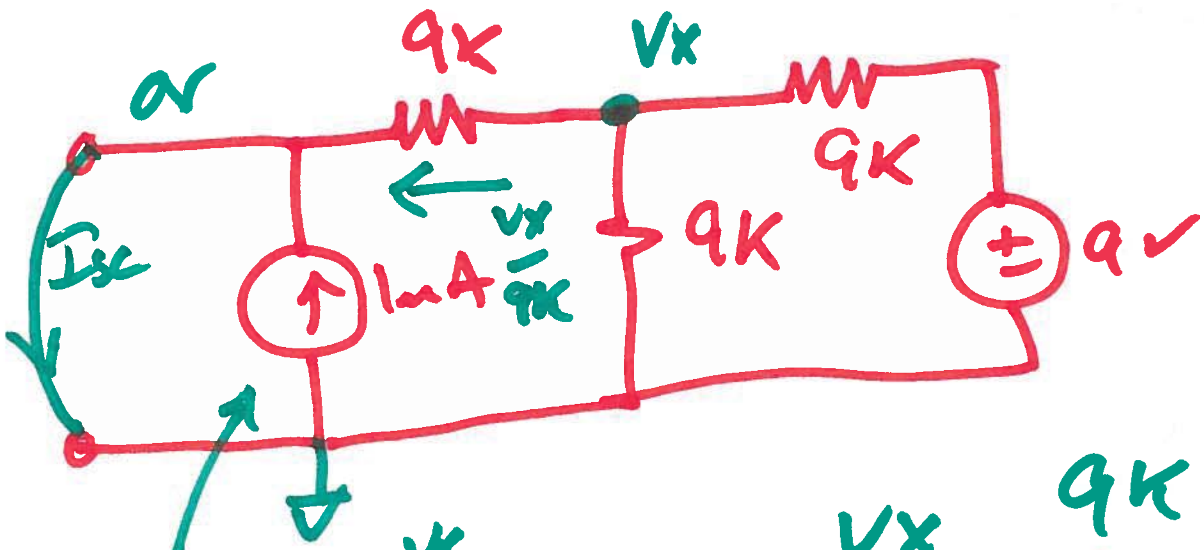
② I_{sc}

.4.5 mA

① $V_{oc} = I_{sc} \cdot R_{TH} = 2mA \cdot 4.5k$

V_{TH}

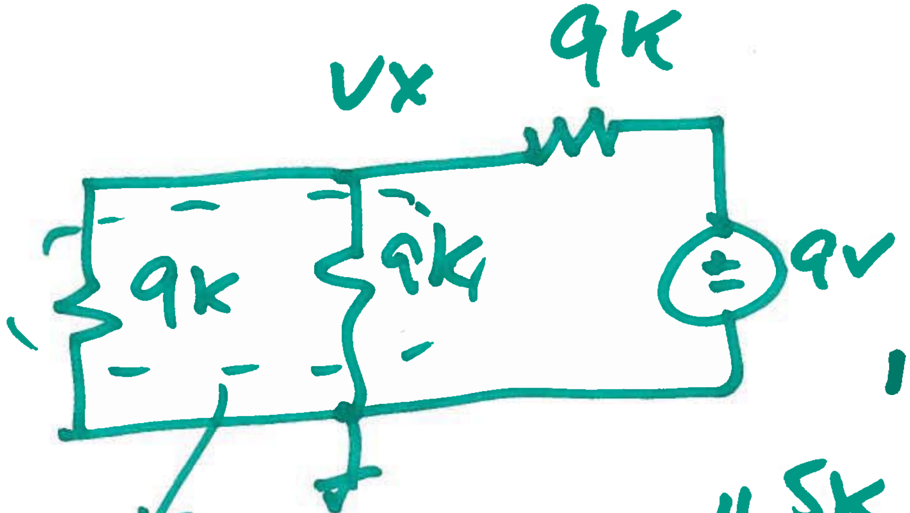
$\boxed{① \; V_{TH} = 9 \; V}$



$$I_{sc} = 1mA + \frac{V_x}{9K}$$

$$= 1mA + \frac{3}{9K}$$

$$I_{sc} = 1.33\,mA$$



4.5K

$$V_x = \frac{4.5K}{4.5K + 9K} \cdot 9V$$

$$\frac{1}{1 + 2}$$

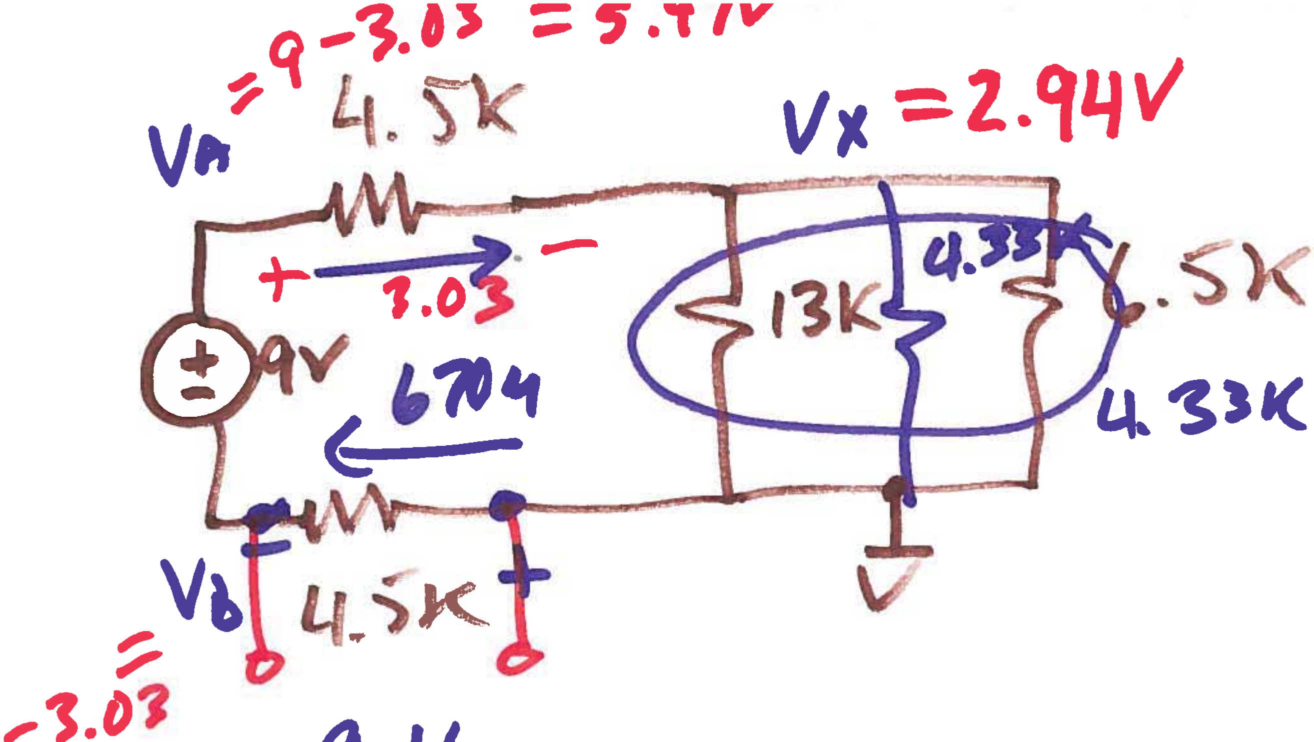
$$\frac{1}{3} \cdot 9V = \frac{9V}{3} = 3V$$

$$R_{TH} = 13.5K$$

$$V_{TH} = 13.5K \cdot 1.33mA$$

$$= 13.5V + \frac{\cancel{13.5}^{\,4.5}}{\cancel{3}}$$

$$= 18V$$



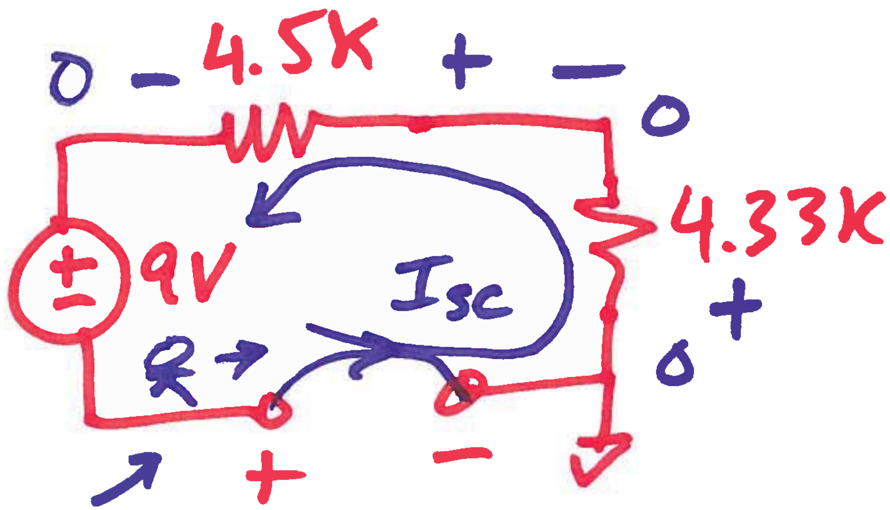
$$13k \parallel 6.5k$$

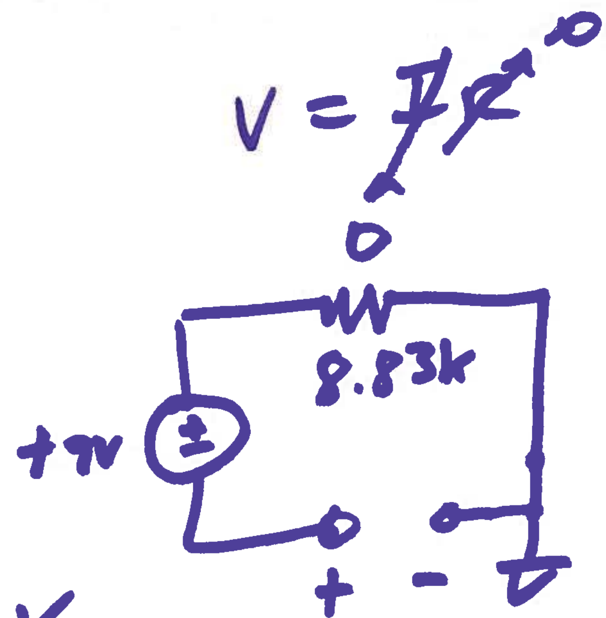
$$\frac{13k \cdot 6.5k}{13k + 6.5k} = \frac{13k}{2+1} = \frac{13k}{3}$$

$$13k \parallel 6.5k = 4.33k$$

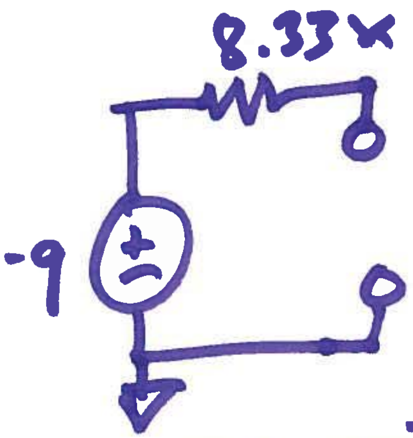
$$I = \frac{9V}{4.5K + 4.5K + 4.33k} = \frac{9V}{13.33K} = 0.67mA = 670\,\mu A$$

$$V_b = (0 - 670\mu) \cdot 4.5K = \underline{\underline{-3.03V}}$$



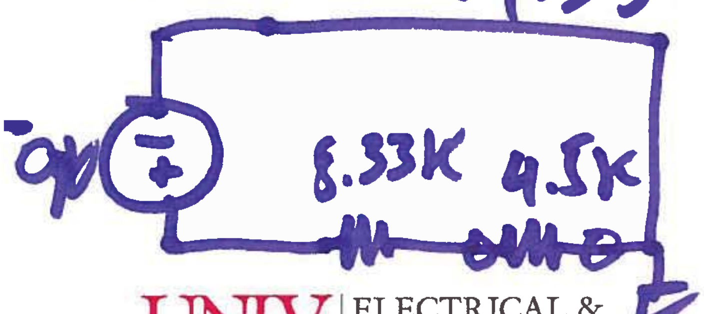


$$V_{TH} = V_{OC} = -9V$$



$$R_{TH} = 8.83K = \frac{V_{TH}}{I_{sc}} = \frac{-9}{\frac{-9}{8.83K}} = 8.83k$$

$$-4.33k \cdot I_{sc} - I_{sc} \cdot 4.5k - 9V$$



$$I_{sc} = \frac{9V}{-8.83k}$$

$$V_{4.5k} = -9 \cdot \frac{4.5k}{8.33k + 4.5k} = -\underline{\underline{3.03}}$$

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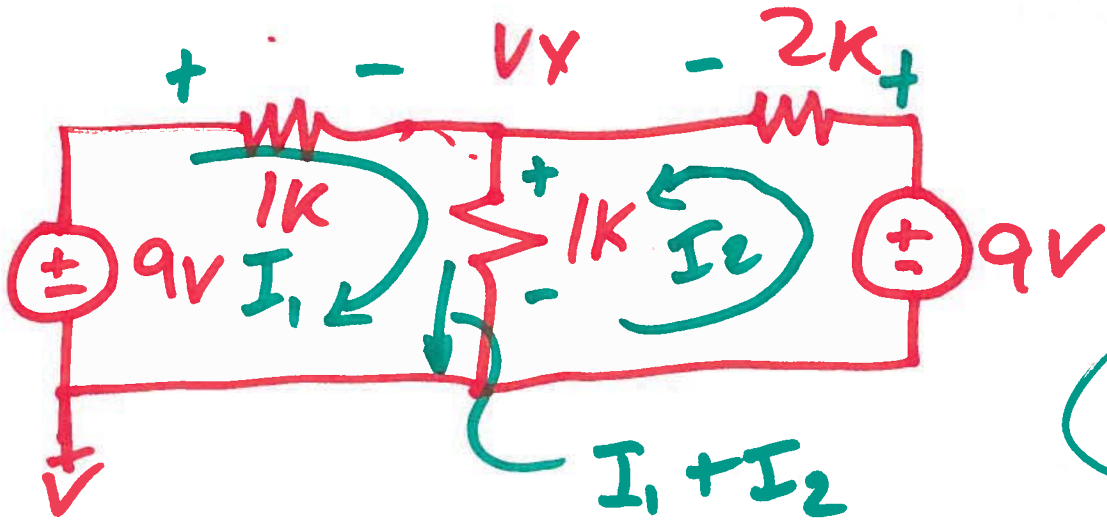


$$\boxed{I_2 = 1.8\,mA}$$

$$I_2 = 9\,mA - 7.2\,mA$$

$$I_2 = 9\,mA - 2I_1$$

$$I_2 = 1.8\,mA$$

$$9 - I_1 \cdot 1K - (I_1 + I_2)1K = 0 \Rightarrow 9\,mA - 2I_1 - I_2 \ldots$$

$$9 - I_2 \cdot 2k - (I_1 + I_2) \cdot 1K = 0 \Rightarrow 9\,mA - 3I_2 - I_1 \ldots$$

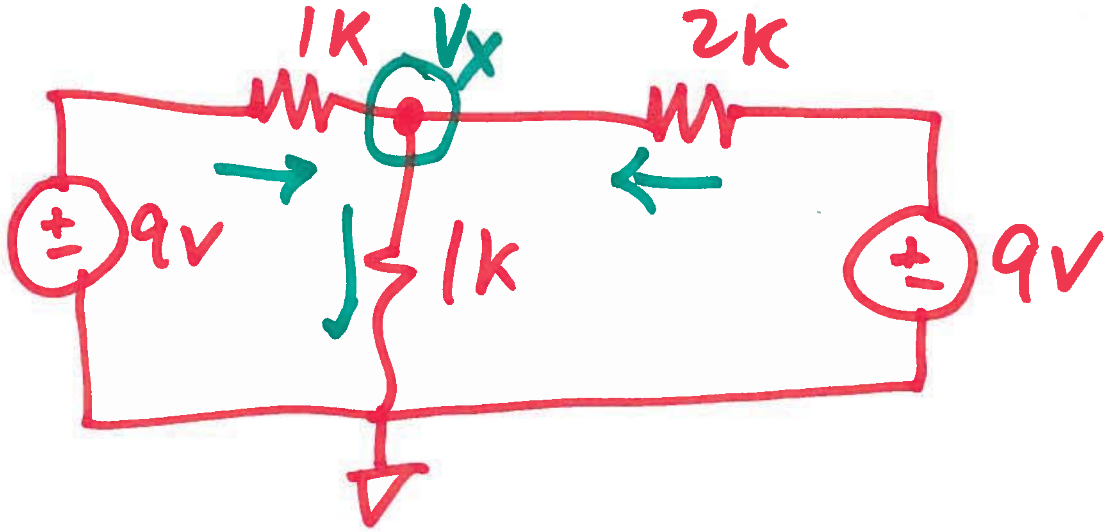
$$\boxed{I_1 = 3.6\,mA}$$

$$9\,mA - 27\,mA + 6I_1 - I_1 = 0$$

$$5I_1 = 18\,mA$$

$$I_1 = \frac{18\,mA}{5} = \underline{\underline{3.6\,mA}}$$

$$V_x = (I_1 + I_2)1K = \underline{\underline{5.4V}}$$

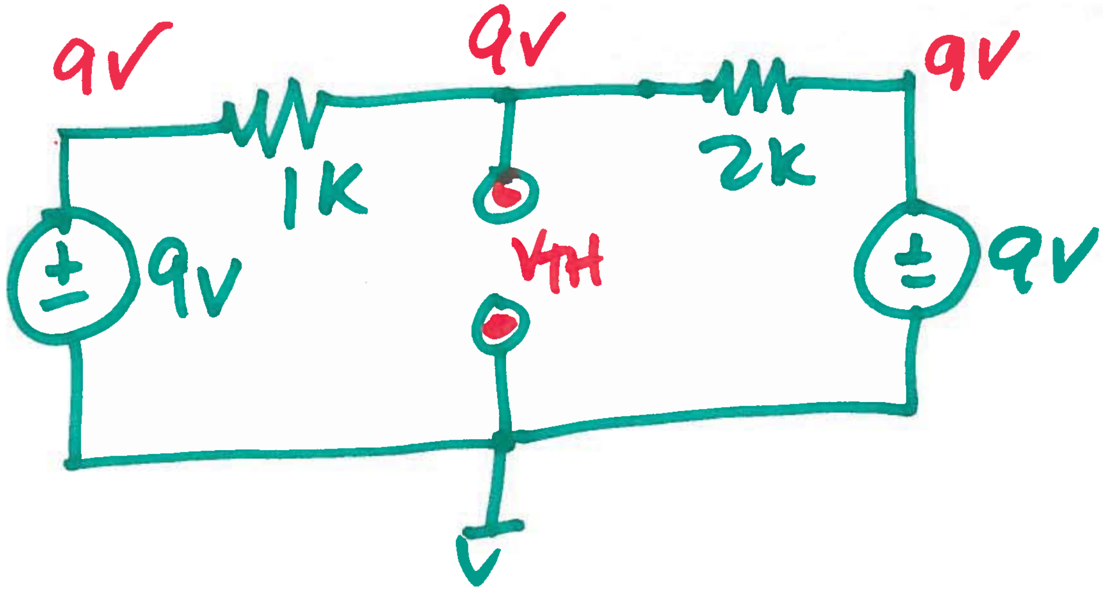


$$\frac{9 - V_x}{1K} + \frac{9 - V_x}{2K} = \frac{V_x}{1K}$$

$$18 - 2V_x + 9 - V_x = 2V_x$$

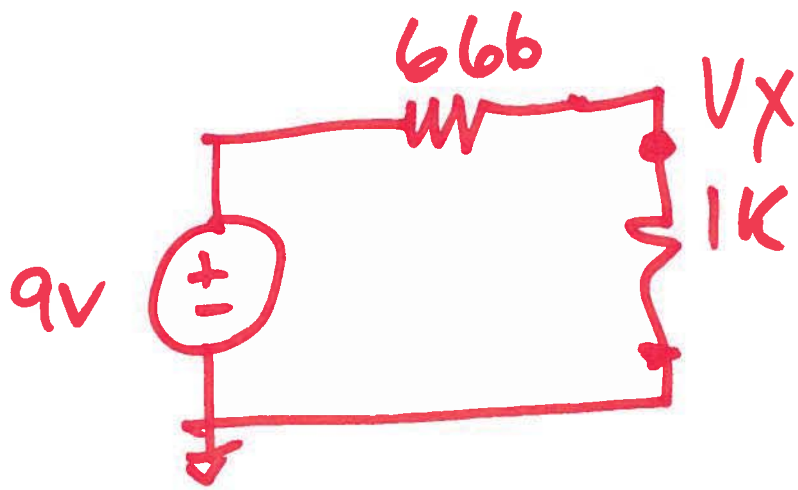
$$27 = 5V_x$$

$$V_x = \frac{27}{5} = \underline{5.4V}$$



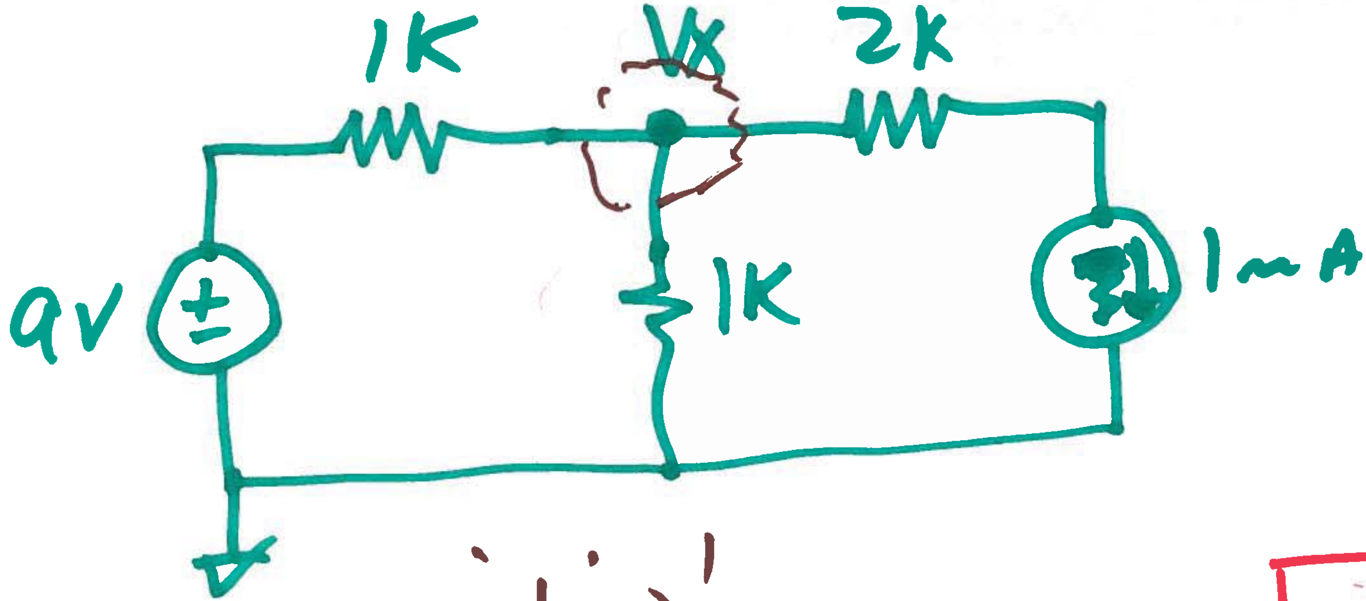
$V_{TH} = 9V$

$R_{TH} = 666\Omega$

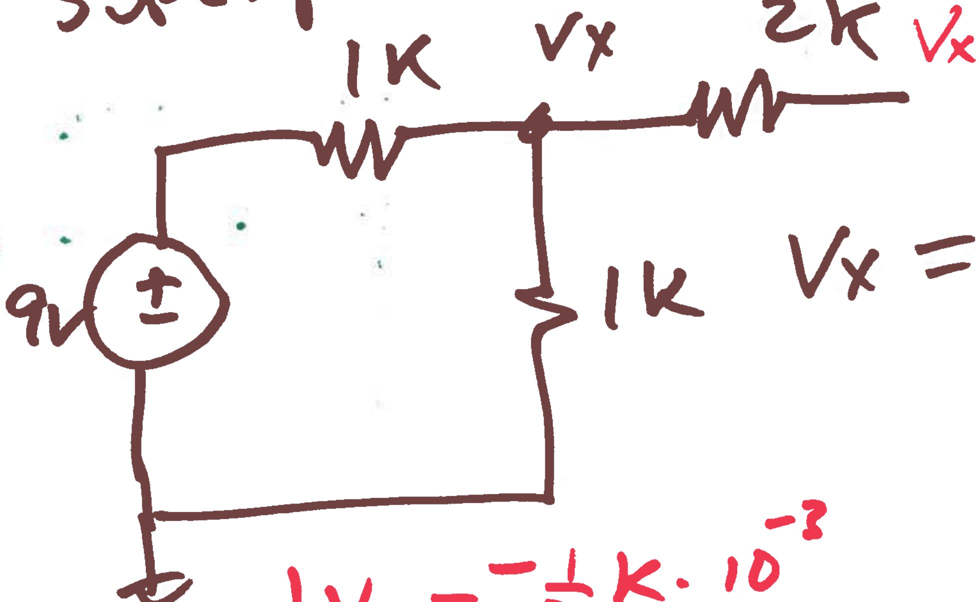


$$V_X = \frac{1K}{1K+666} \cdot 9V = \frac{9000}{1666}$$

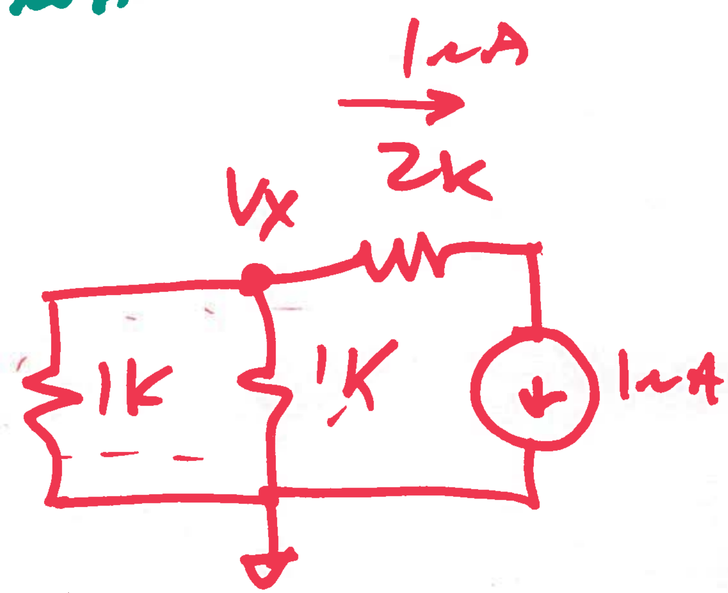
$$= \underline{\underline{5.4V}}$$



superposition!



$V_x = 4.5V$

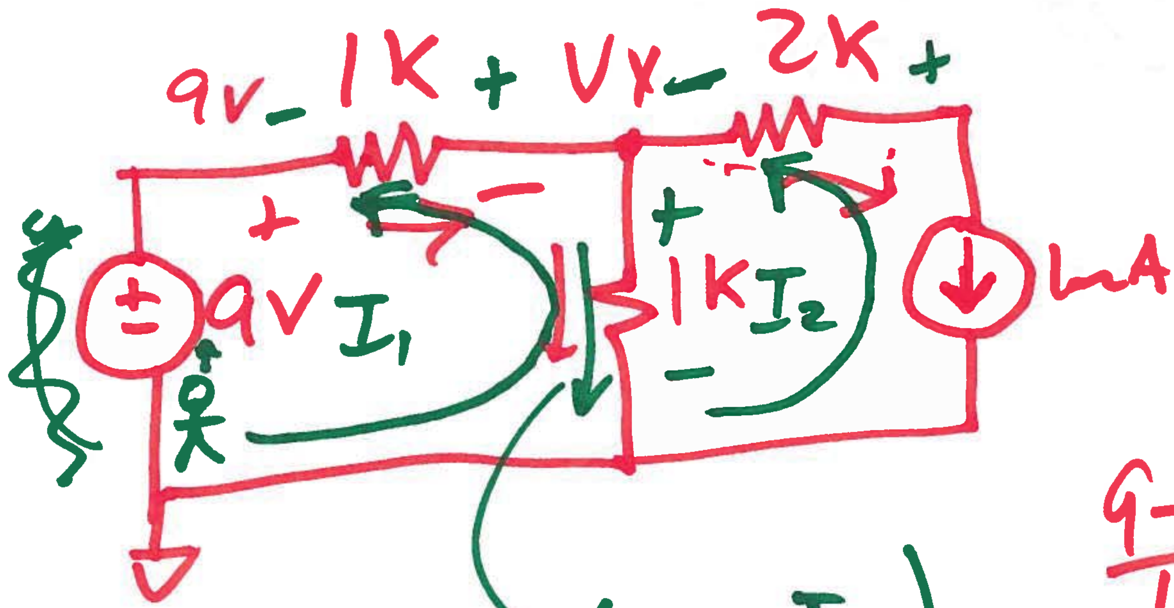


$-\frac{1}{2}V$

$V_x = -\frac{1}{2}V$

$-\frac{1}{2}V = -\frac{1}{2}K \cdot 10^{-3}$

$V_x = 4.5 - \frac{1}{2} = \underline{4V}$



KCL

$$\frac{9-V_x}{1K} = 1mA + \frac{V_x}{1K}$$

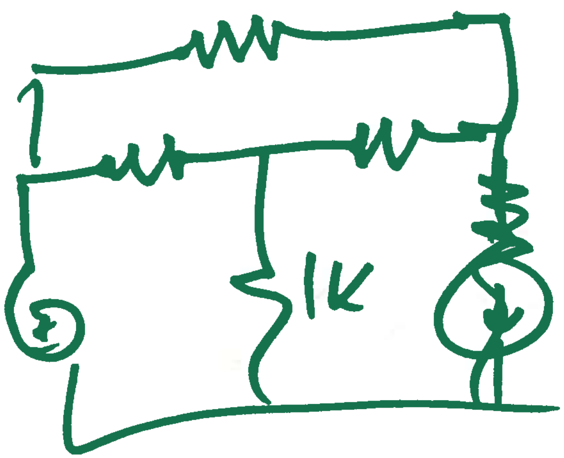
$$\frac{9-V_x}{1K} - 1mA - \frac{V_x}{1K} = 0$$

$(-I_1 + I_2)$

$(-(-5mA) \mp 1mA) = 4mA$, $V_x = 1K \cdot 4mA$

$= 4V$

$I_2 = -1mA$



$$9 + 1K \cdot I_1 - 1K(-I_1 + (-1mA)) = 0$$

$$9mA + 2I_1 + 1mA = 0$$

$$I_1 = -5mA$$

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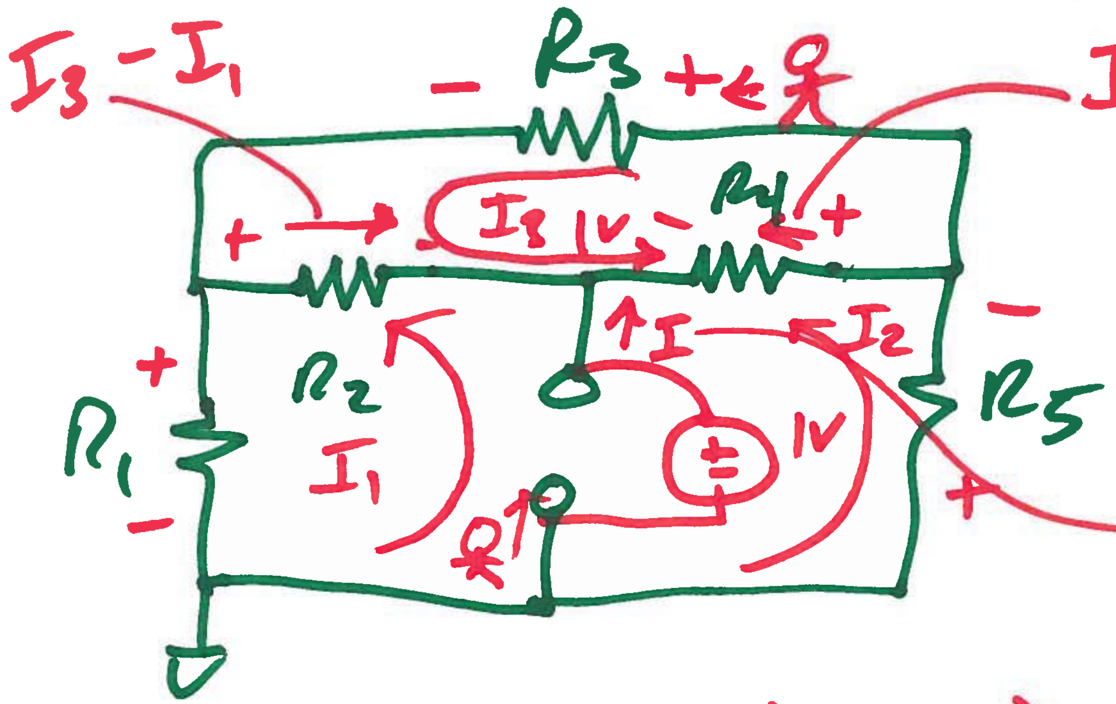
9)



$$R = \frac{1V}{I} = \frac{1V}{I_1 - I_2}$$

$$I = I_1 - I_2$$

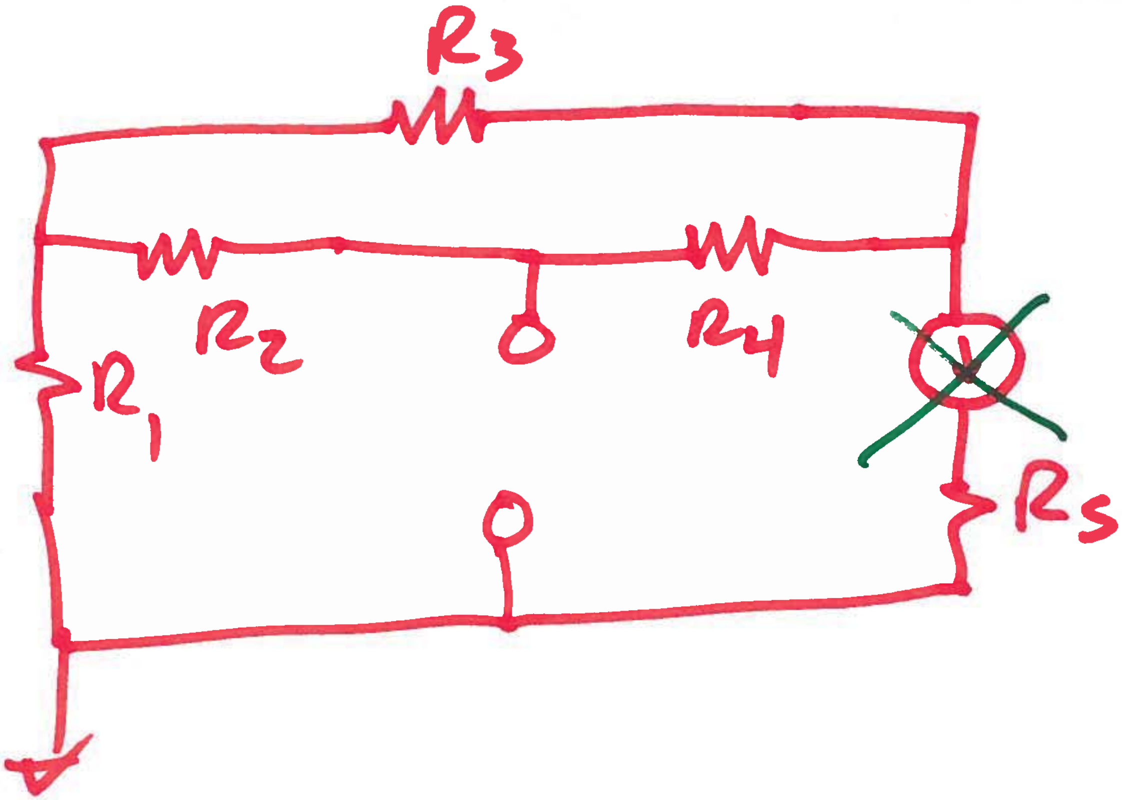
$$1 + R_2(I_3 - I_1) - R_1 \cdot I_1 = 0$$

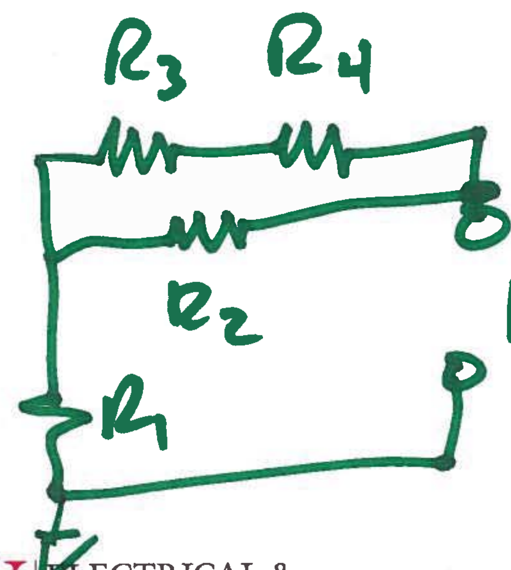
$$-I_2 R_5 - R_4(I_2 - I_3) - 1 = 0$$

$$-R_3 I_3 - R_2(I_3 - I_1) + R_4(I_2 - I_3) = 0$$

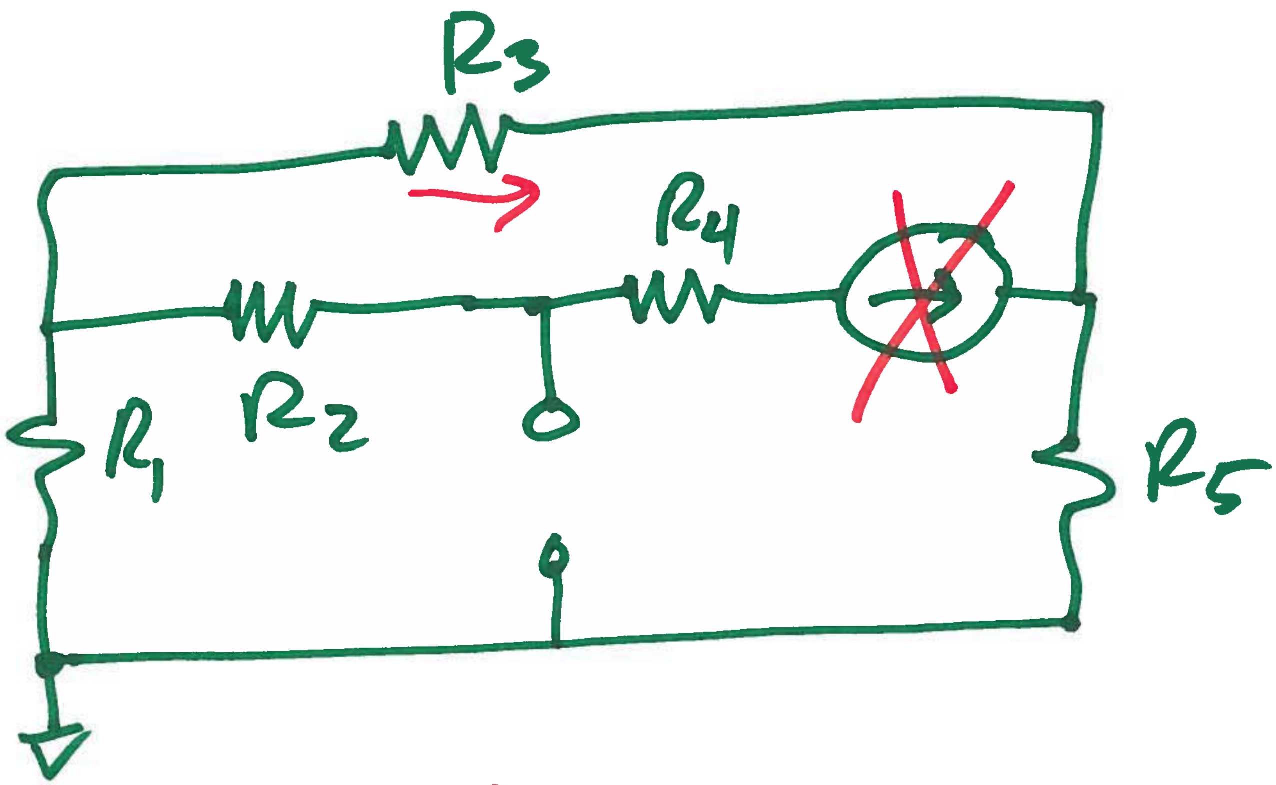
$$1 + R_2 I_3 - I_1 \cdot (R_1 + R_2) = 0$$

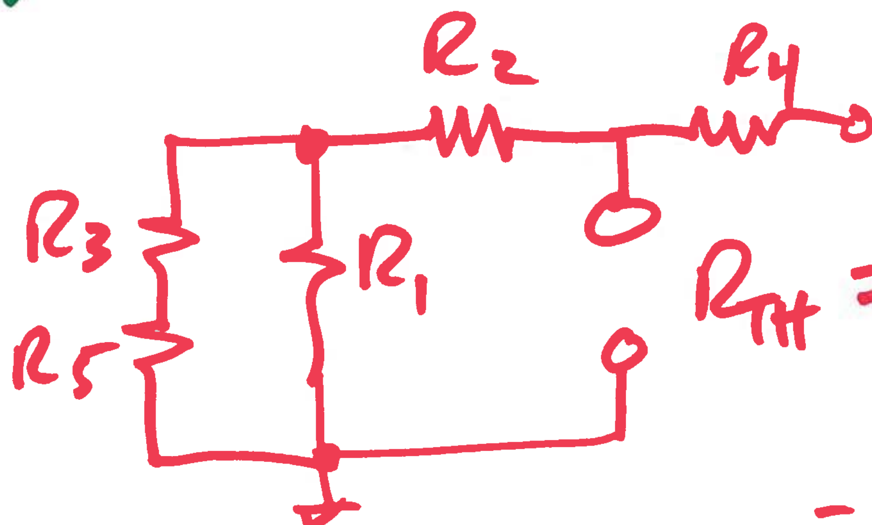
$$I_3 = I_1 \cdot \frac{R_1 + R_2}{R_2} + \frac{1}{R_2}$$





$$R_{TH} = R_1 + (R_3 + R_4) \parallel R_2$$





$$R_{TH} = R_2 + R_1 \| (R_3 + R_5)$$

$$= R_2 + \frac{R_1 \cdot (R_3 + R_5)}{R_1 + R_3 + R_5}$$