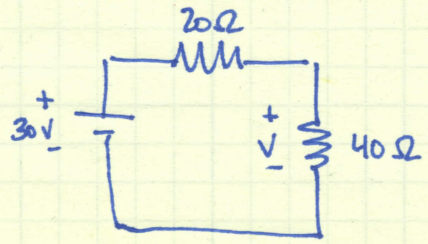
HW #5

5-27

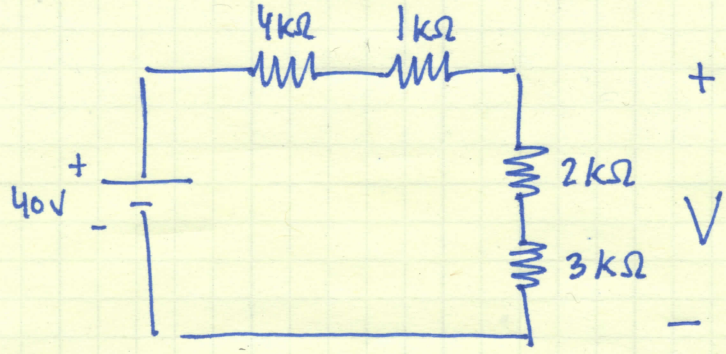
a.



$$V_x = E \cdot \frac{R_x}{R_T}$$

$$V_{40\Omega} = 30\,V \cdot \frac{40\,\Omega}{(20\,\Omega + 40\,\Omega)} = \boxed{20\,V = V_{40\Omega}}$$

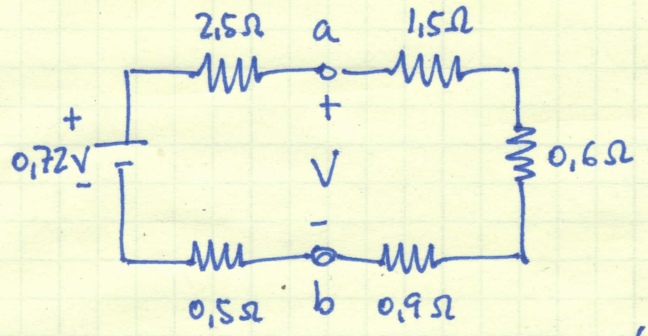
b.



$$V_x = E \cdot \frac{R_x}{R_T}$$

$$V = 40\,V \cdot \frac{(3\,k\Omega + 2\,k\Omega)}{(4\,k\Omega + 1\,k\Omega + 2\,k\Omega + 3\,k\Omega)} = \boxed{20\,V = V}$$

c.

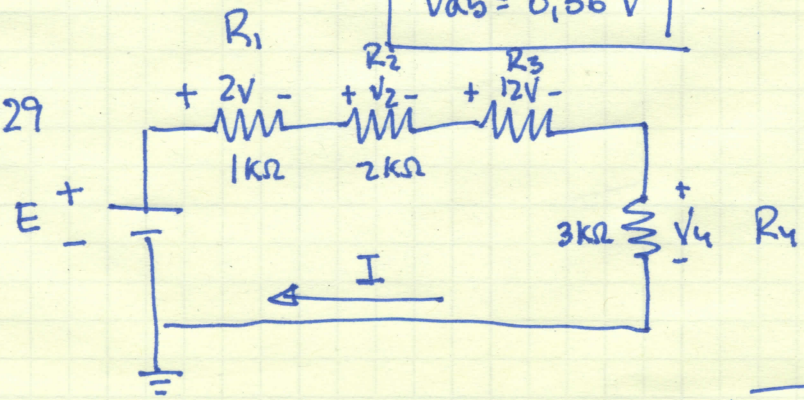


$$V_x = E \cdot \frac{R_x}{R_T}$$

$$V_{ab} = 0{,}72\,V \cdot \frac{(1{,}5\,\Omega + 0{,}6\,\Omega + 0{,}9\,\Omega)}{(2{,}5\,\Omega + 1{,}5\,\Omega + 0{,}6\,\Omega + 0{,}9\,\Omega + 0{,}5\,\Omega)} = 0{,}36\,V$$

$$\boxed{V_{ab} = 0{,}36\,V}$$

5-29



$$V_{R1} = I_T \cdot R_1 \quad \therefore \quad I_T = \frac{V_{R1}}{R_1} = \frac{2\,V}{1\,k\Omega} = \boxed{2\,mA = I_T}$$

$$V_{R2} = I_T \cdot R_2 \quad \therefore \quad V_{R2} = 2\,mA \cdot 2\,k\Omega = \boxed{4\,V = V_{R2}}$$

$V_{R3} = I_T \cdot R_3$ ∴ $R_3 = \frac{V_{R3}}{I_T} = \frac{12\ V}{2\ mA} = \boxed{6\ k\Omega = R_3}$

$V_{R4} = I_T \cdot R_4 = 2\ mA \cdot 3k\Omega = \boxed{6\ V = V_{R4}}$

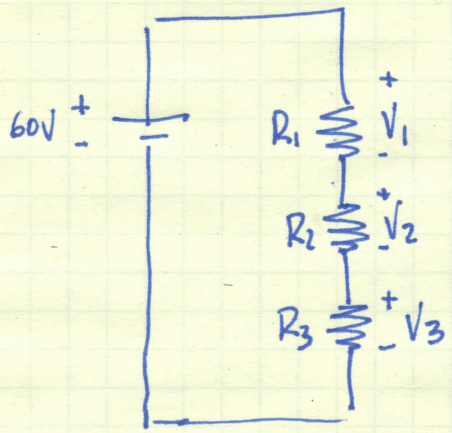
<u>KVL</u> $\quad -E + V_{R1} + V_{R2} + V_{R3} + V_{R4} = \emptyset$

$E = V_{R1} + V_{R2} + V_{R3} + V_{R4} = 2V + 4V + 12V + 6V = \boxed{24V = E}$

5-33

$R_1 = 2R_3$

$R_2 = 7R_3$



$R_T = R_1 + R_2 + R_3 = 2R_3 + 7R_3 + R_3 = 10R_3$

$V_x = E \cdot \frac{R_x}{R_T}$ $\quad V_{R3} = 60\ V \cdot \frac{\cancel{R_3}}{10\cancel{R_3}} = \boxed{6\ V = V_{R3}}$

$V_{R3} = I_T \cdot R_3$ ∴ $R_3 = \frac{V_{R3}}{I_T}$

$V_{R1} = I_T \cdot R_1$ ∴ $R_1 = \frac{V_{R1}}{I_T}$

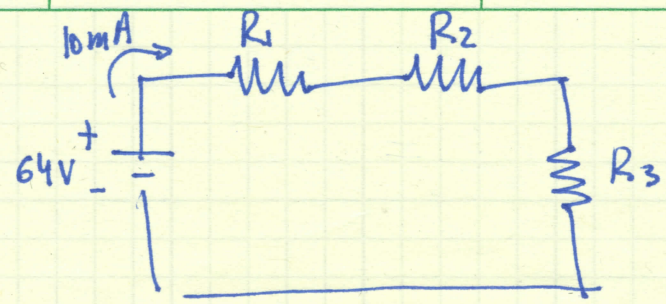
$R_1 = 2R_3$

$\frac{V_{R1}}{\cancel{I_T}} = 2 \cdot \frac{V_{R3}}{\cancel{I_T}}$ ∴ $V_{R1} = 2V_{R3} = 2 \cdot 6 = \boxed{12\ V = V_{R1}}$

$R_2 = 7R_3$

$\frac{V_{R2}}{\cancel{I_T}} = 7 \cdot \frac{V_{R3}}{\cancel{I_T}}$ ∴ $V_{R2} = 7V_{R3} = 7 \cdot 6V = \boxed{42\ V = V_{R2}}$

5-34



$V_{R2} = 3V_{R1}$

$V_{R3} = 4V_{R2}$

$I_T = 10\,mA$

$E_T = 64\,V$

a. $V_{R3} = 4V_{R2} = 4\cdot(3V_{R1}) = 12V_{R1}$

$E = V_{R1} + V_{R2} + V_{R3} = V_{R1} + 3V_{R1} + 12V_{R1} = 16V_{R1}$

$E_T = I_T R_T$ " $R_T = \frac{E_T}{I_T} = 16R_1 = \frac{64\,V}{10\,mA} \Rightarrow R_1 = \frac{64\,V}{10\,mA\cdot 16}$

$$\boxed{\begin{aligned} R_1 &= 400\,\Omega \\ R_2 &= 3R_1 = 1{,}2\,k\Omega \\ R_3 &= 12R_1 = 4{,}8\,k\Omega \end{aligned}}$$

b. $I = 10\,\mu A$

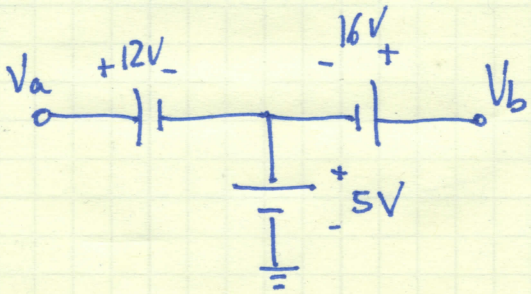
$R_T = \frac{E_T}{I_T} = \frac{64\,V}{10\cdot 10^{-6}\,A} = 6{,}4\,M\Omega$

$$\boxed{\begin{aligned} R_1 &= \frac{6{,}4\,M\Omega}{16} = 400\,k\Omega \\ R_2 &= 3R_1 = 1{,}2\,M\Omega \\ R_3 &= 12R_1 = 4{,}8\,M\Omega \end{aligned}}$$

If $\frac{I_1}{I_2} = \frac{10\,mA}{10\,\mu A} = \underline{\underline{10^3}}$ then $\frac{R_1}{R_1'} = \frac{400\,k\Omega}{400\,M\Omega} = \underline{\underline{10^3}}$

5-35

a.



Va → from a to the ground

$V_a = +12V + 5V = \boxed{+17V = V_a}$

Vb → from b to the ground

$V_b = +16V + 5V = \boxed{+21V = V_b}$

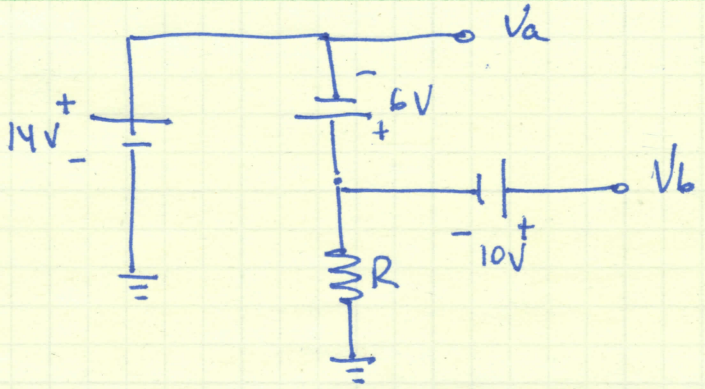
Vab → from a to b

$V_{ab} = +12 - 16 = \boxed{-4V = V_{ab}}$

or

$V_a - V_b = 17V - 21V = \boxed{-4V = V_{ab}}$

b.



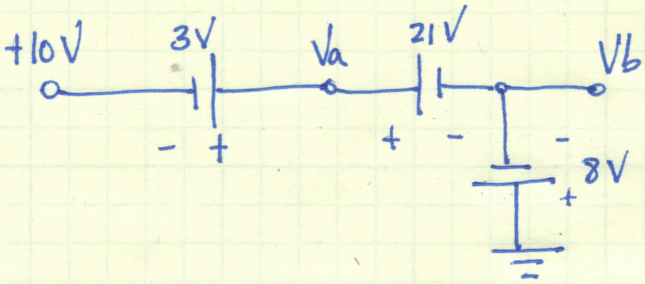
$\boxed{V_a = +14\,V}$

$\boxed{V_b = +10\,V + 6\,V + 14\,V = +30\,V}$

$V_{ab} = V_a - V_b = 14 - (+30\,V) =$

$\boxed{V_{ab} = -16\,V}$

c.



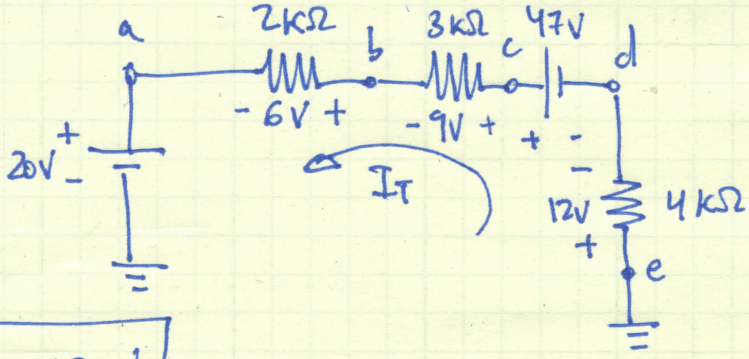
$V_a = +21 - 8 = \boxed{+13\,V = V_a}$

$\boxed{V_b = -8\,V}$

$V_{ab} = V_a - V_b = +13 - (-8) = 21\,V$

$\boxed{V_{ab} = +21\,V}$

5-37



$I_T = \frac{E_T}{R_T} = \frac{47V - 20V}{9k\Omega} = 3\,mA$

$V_{2k\Omega} = I_T \cdot 2k\Omega = 6\,V$

$V_{3k\Omega} = I_T \cdot 3k\Omega = 9\,V$

$V_{4k\Omega} = I_T \cdot 4k\Omega = 12\,V$

a) $\boxed{V_a = +20\,V}$

$V_b = +6\,V + 20\,V = \boxed{+26\,V = V_b}$

$V_c = +9\,V + 6\,V + 20\,V = \boxed{+35\,V = V_c}$

$\boxed{V_d = -12\,V}$

$\boxed{V_e = 0\,V}$

b) $V_{ab} = V_a - V_b = 20\,V - 26\,V = \boxed{-6\,V = V_{ab}}$

$V_{dc} = V_d - V_c = -12\,V - 35\,V = \boxed{-47\,V = V_{dc}}$

$V_{cb} = V_c - V_b = +35 - 26\,V = \boxed{+9\,V = V_{cb}}$

c) $V_{ac} = V_a - V_c = 20 - 35 = \boxed{-15\,V = V_{ac}}$

$V_{db} = V_d - V_b = -12 - 26 = \boxed{-38\,V = V_{db}}$

TOPS 35500