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1.

a. $R_1 = R_2$

$\frac{1}{R_1} = \frac{1}{R} + \frac{1}{R}$

$\frac{1}{R_1} = 2$

$R_1 = \frac{1}{2}$, $R_2 = \frac{1}{2}$

R_3

$\frac{1}{R_3} = \frac{1}{R} + \frac{1}{R_3}$

$= \frac{1}{1} + \frac{1}{5} = \frac{6}{5}$

$R_3 = \frac{5}{6}$

$R_3 = R + R_3$

$= 1 + \frac{5}{6}$

$= \frac{11}{6}$

$R_{1,2} = \frac{1}{2} + \frac{1}{2}$

$= 1$

$\frac{11}{R_t} = \frac{1}{11} + 1 + 1 + \frac{1}{9}$

$= \frac{6}{11} + 1 + 1 + \frac{1}{9}$

$= \frac{328}{99}$

$R_t = \frac{99}{328}$

b. $\frac{1}{R_2} = \frac{1}{R} + \frac{1}{R_2}$

$= 1 + \frac{1}{9} = \frac{10}{9}$

$R_2 = \frac{9}{10}$

$R_2 = R_2 + R_4$

$= \frac{9}{10} + \frac{1}{5}$

$= \frac{11}{10}$

$\frac{1}{R_t} = \frac{1}{R} + \frac{1}{R_2} + \frac{1}{R}$

$= 1 + \frac{10}{11} + 1$

$= \frac{32}{11}$

$R_t = \frac{11}{32}$

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2. KCL = $I_{in} : I_{out}$

$I_{in} = I_1 + I_2$

$I_{R1} = I_{R2}$, $I_A = I_B$

$L_1 = V_{S1} - V_{S2} - V_{R1} - V_{R2} - V_{R3} - V_{SA} = 0$

$= 12 - 6 - (I_{R1} \cdot 5) - (I_{R2} \cdot 3) - (I_{R3} \cdot 7) - 1 = 0$

$= 12 - 6 - 5I_{R1} - 3I_{R2} - 7I_{R3} - 1 = 0$

$= 5 - 8I_{R1} - 7I_{R2} = 0$

$L_2 = V_{S3} + V_{R1} + V_{S2} - V_{RA} = 0$

$= 2 + 5I_{R1} + 6 - \frac{99}{328} I_{RA} = 0$

$= 5I_{R1} + 8 = \frac{99}{328} I_{RA}$

$L_3 = -V_{S3} + V_{R2} - V_{RB}$

$= -2 + 3I_{R2} - \frac{11}{32} I_{RB} = 0$

$= -2 - \frac{11}{32} I_{RB} = -3I_{R2} \rightarrow 2 + \frac{11}{32} I_{RB} = 3I_{R1}$

L_2 & L_3

$5I_{R1} - \frac{99}{328} I_{RA} = -8 \quad | \times 3 \quad 15I_{R1} - \frac{297}{328} I_{RA} = -24$

$-3I_{R1} + \frac{11}{32} I_{RA} = -2 \quad | \times 5 \quad -15I_{R1} + \frac{55}{32} I_{RA} = -10 \; +$

$\frac{3443}{1312} I_{RA} = -34$

$I_{RA} = -34 \cdot \frac{1312}{3443} = -89,22A$

Bernilai negatif, arus hambatan R_2 dan R_B berlawanan loop.

L_2

$5I_{R1} - \frac{99}{328} \cdot (-89,224) = -8$

$5I_{R1} + 26,93 = -8$

$5I_{R1} = -8 - 26,93$

$= -34,93$

$I_{R1} = -6,986$

Bernilai negatif, arus hambatan R_1 dan R_2 berlawanan loop

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L4

$5 - 8(-6,98) - 7I_{R3} = 0$

$5 - 8(-6,98) = -7I_{R3}$

$5 + 55,84 = 7I_{R3}$

$I_{R3} = \frac{60,84}{7}$

$= 8,69$

Bernilai positif, maka hambatan R_3 searah dengan loop