



工学系  
公務員試験  
専門試験問題  
演習講座

H.17 国家I種 理工I (現国家総合職 工学) No.41  
(電気回路)

電気

# (1) キルヒホッフの法則

- ① 向きも含め  $I$  を全て文字でおく  
→ 文字数を減らしておく
- ② ループを決め、キルヒホッフ第2

①  $1 = (1-\alpha)R(I+I_1) + 3RI_1$   
 $= (1-\alpha)RI + (4-\alpha)RI_1$

②  $\alpha RI = 3RI_1 \rightarrow I_1 = \frac{\alpha}{3} I$

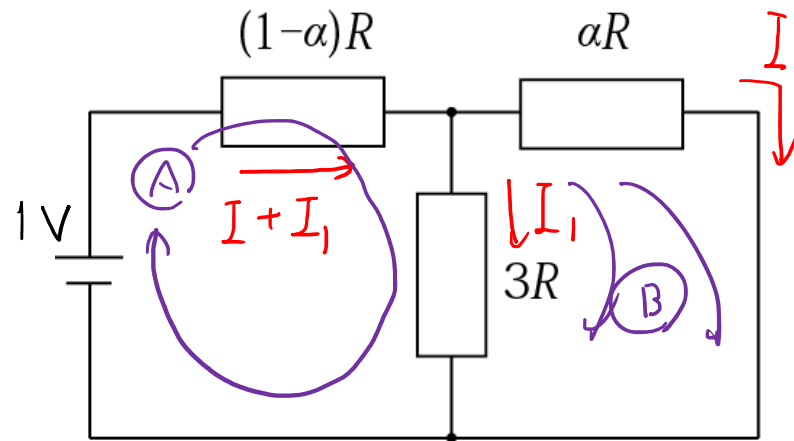
∴ ①より

$$1 = (1-\alpha)RI + \left(\frac{4}{3}\alpha - \frac{\alpha^2}{3}\right)RI$$

$$= \left(-\frac{\alpha^2}{3} + \frac{\alpha}{3} + 1\right)RI \Rightarrow$$

$$\Rightarrow I = \frac{1}{\left\{-\frac{1}{3}\left(\alpha - \frac{1}{2}\right)^2 + \frac{13}{12}\right\}R}$$

$$\alpha = \frac{1}{2} //$$

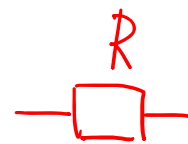


(2) 縱橫行列

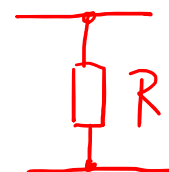
$$\begin{pmatrix} 1 \\ I_1 \end{pmatrix} = \begin{pmatrix} 1 & (1-\alpha)R \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ \frac{1}{3R} & 1 \end{pmatrix} \begin{pmatrix} 1 & \alpha R \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 0 \\ I \end{pmatrix}$$

$$= \begin{pmatrix} \frac{4}{3} - \frac{\alpha}{3} & (1-\alpha)R \\ \frac{1}{3R} & 1 \end{pmatrix} \begin{pmatrix} \alpha R I \\ I \end{pmatrix}$$

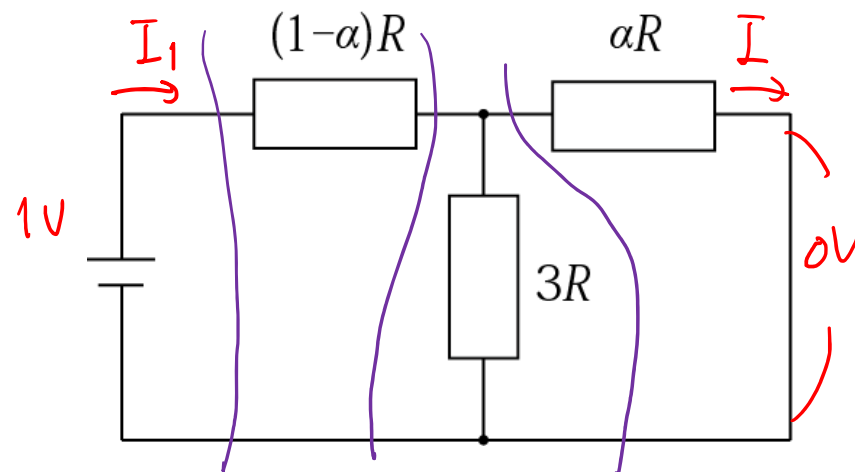
$$= \begin{pmatrix} \left( \frac{4}{3}\alpha - \frac{\alpha^2}{3} + 1 - \alpha \right) RI \\ \left( \frac{\alpha}{3} + 1 \right) I \end{pmatrix}$$



$$\begin{pmatrix} 1 & R \\ 0 & 1 \end{pmatrix}$$



$$\begin{pmatrix} 1 & 0 \\ \frac{1}{R} & 1 \end{pmatrix}$$

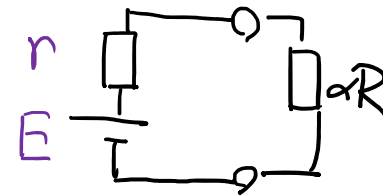
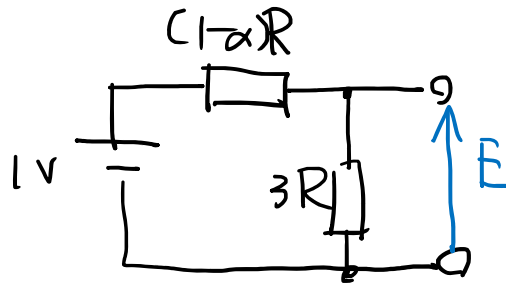




### (3) テータンの定理

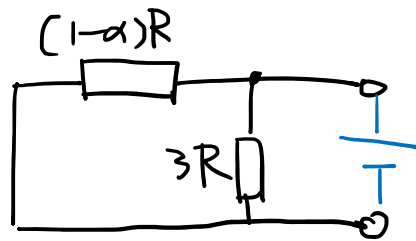
① テータンの E を求める

$$E = I \times \frac{3R}{(1-\alpha)R + 3R} = \frac{3}{4-\alpha}$$



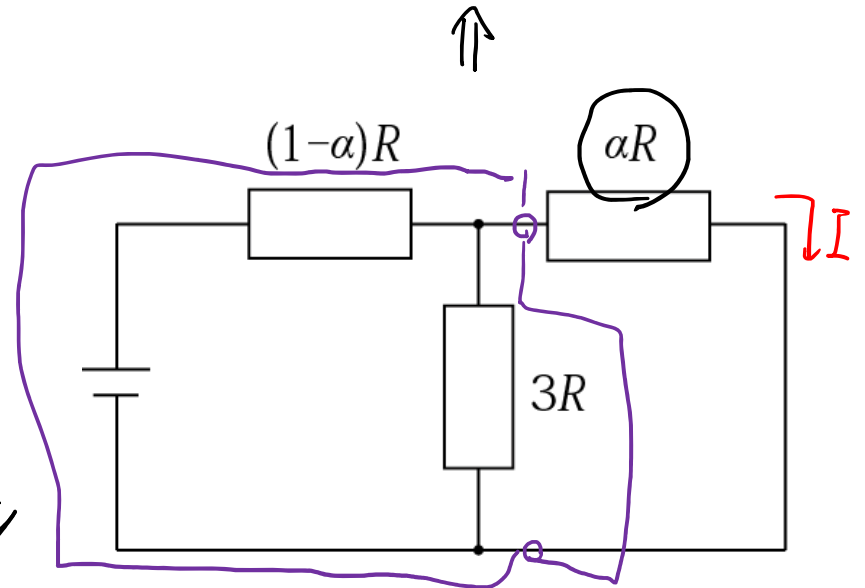
② テータンの r を求める

$$\frac{1}{r} = \frac{1}{(1-\alpha)R} + \frac{1}{3R} = \frac{4-\alpha}{3(1-\alpha)R}$$



$$\therefore r = \frac{3(1-\alpha)}{4-\alpha} R$$

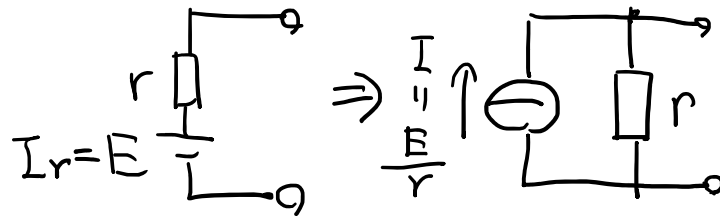
$$\Rightarrow I = \frac{E}{r + \alpha R} = \frac{\frac{3}{4-\alpha}}{\left\{ \frac{3(1-\alpha)}{4-\alpha} + \alpha \right\} R} = \frac{3}{(-\alpha^2 + \alpha + 3)R}$$



# (4) 电压源 → 电流源

$$I : I_1 : I_2 = \frac{1}{\alpha} : \frac{1}{3} : \frac{1}{1-\alpha}$$

$$= 3(1-\alpha) : \alpha(1-\alpha) : 3\alpha$$



$$I = \frac{1}{(1-\alpha)R} \times \frac{3(1-\alpha)}{3 - 3\alpha - \alpha^2 + \alpha + 3\alpha}$$

(Note: A blue arrow points from the circled  $3(1-\alpha)$  in the previous equation to the numerator here.)

$$= \frac{3}{(-\alpha^2 + \alpha + 3)} R //$$

