Es. 1

$\bar{V} = u_2 - u_1$ $\qquad \bar{\imath} = \dfrac{u_2 - u_1}{R}$

$V_E = u_1$

$V_\alpha = u_2 - u_3$

$V_1 = u_3 - u_2$ $\qquad i_1 = a(u_3 - u_2) + b(-u_2)$

$V_2 = -u_2$ $\qquad i_2 = c(u_3 - u_2)$

KCL(* 3U *2) $\overline{\Pi}_{23} \rightarrow$ $\bar{\imath} + \bar{\imath}_1 - (i_1 + i_2) = \bar{\imath} - i_2 =$

$= \dfrac{u_2 - u_1}{R} - c(u_3 - u_2) = 0 \rightarrow u_2 - u_1 = Rc(u_3 - u_2)$

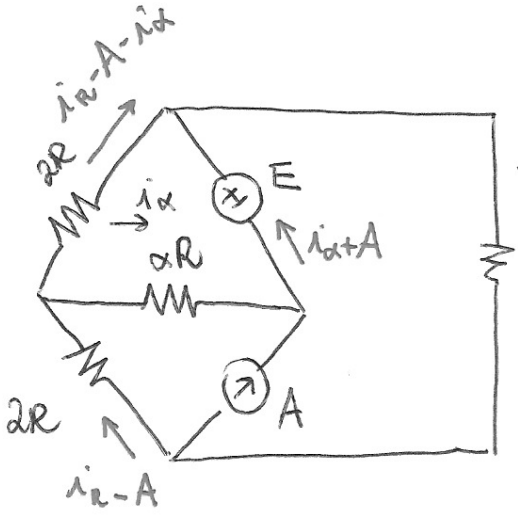
$u_1 = E$ $\qquad u_1 = E$

$u_2 - u_3 = \alpha(u_2 - u_1)$ $\qquad -\dfrac{1}{\alpha}(u_3 - u_2) = u_2 - u_1$

$u_3 - u_2 \equiv 0 \rightarrow u_3 = u_2 \rightarrow u_2 = u_1$

$\bar{\imath} = \emptyset \rightarrow P_e^E = E(-\bar{\imath}) = \emptyset$

Es. 2



$\downarrow i_R$ eq1 $2R(i_R - A - i_\alpha) + 2R(i_R - A) + Ri_R = 0$

eq2 $2R(i_R - A - i_\alpha) - \alpha R i_\alpha + E = 0$

eq1 − eq2 → (*)

(*) $2R(i_R - A) + Ri_R + \alpha R i_\alpha + E = 0$

(*) $3Ri_R + \alpha R i_\alpha = 2RA + E$

eq.2 $2Ri_R - R(2+\alpha) i_\alpha = 2RA - E$

(*)−eq.2 → $3Ri_R + \alpha R i_\alpha - 2Ri_R + R(2+\alpha) i_\alpha = 2E$

$Ri_R + 2i_\alpha(\alpha+1)R = 2E$

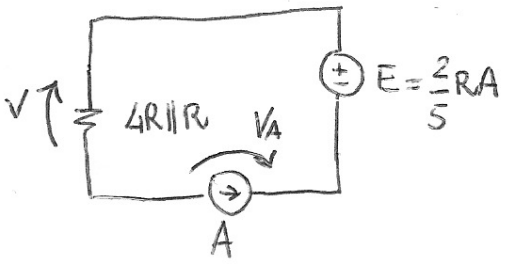
$i_R = -2(\alpha+1) i_\alpha + \frac{2E}{R}$ in eq.2 →

$(2R(-2(\alpha+1)) - (2+\alpha)R) i_\alpha = 2RA - E - 4E$

$R(-4\alpha - 4 - 2 - \alpha) i_\alpha = -(5\alpha+6) R i_\alpha = 2RA - 5E$

$i_\alpha = \frac{5E - 2RA}{(5\alpha+6)R}$

$i_\alpha = 0 \iff E = \frac{2}{5}RA$



$P_e^E = AE = \frac{2}{5}RA^2$

$R_{eq} = \frac{4R^2}{5R}$

$V = \frac{4}{5}RA$

$V_A + E - V = 0$

$V_A = \frac{4}{5}RA - \frac{2}{5}RA = \frac{3}{5}RA$

$P_E^A = \frac{2}{5}RA^2$

Es. 3

$$R(t) = \begin{cases} R_S & t \in [0, T/2] \\ -\frac{R_S 4}{T}\left(t - \frac{3}{4}T\right) & t \in [\frac{T}{2}, \frac{3}{4}T] \\ 0 & t \in [3/4T, T] \end{cases}$$

$$i = \frac{V}{R_S + R(t)} \qquad P_e^V(t) = \frac{V^2}{R_S + R(t)} = \begin{cases} \frac{V^2}{2R_S} \\ \frac{V^2}{R_S\left(1 - \frac{4}{T}\left(t - \frac{3}{4}\right)T\right)} \\ \frac{V^2}{R_S} \end{cases}$$

$$W_E^V = \frac{V^2}{2R_S} \cdot \frac{T}{2} + \frac{V^2}{R_S}\frac{T}{4} + \int_{T/2}^{3/4T} \frac{TV^2}{R_S 4} \frac{1}{(T - t)}\, dt$$

$$= \frac{2V^2T}{2 4 R_S} + \frac{TV^2}{R_S 4} \log(2) = \frac{V^2T}{2R_S}\left(1 + \frac{\log(2)}{2}\right) =$$

$$= \frac{V^2T}{2R_S}\,\frac{2 + \log(2)}{2} = \frac{V^2T}{R_S}\,\frac{2 + \log(2)}{4}$$

$$R_S = \frac{2 + \log(2)}{4} \rightarrow W_E^V = T[J] \; 24 \cdot 3600 \text{ sec}$$

$$\frac{864\,KJ}{24 \cdot 3600} \qquad \frac{864 \cdot 10^3 \text{ W} \cdot \text{sec}}{24 \cdot 3600 \text{ W} \cdot \text{sec}} = 10$$

$$\frac{V^2}{R_S\left(1 - \frac{4}{T}t + \frac{3T}{T}\right)} = \frac{TV^2}{R_S(T - 4t + 3T)} = \frac{TV^2}{4R_S(T - t)}$$

$$\int_{T/2}^{\frac{3}{4}T} \frac{1}{T - t}\, dt \qquad T - t = \tau \quad d\tau = -dt$$

$$-\int_{T/2}^{T/4} \frac{1}{\tau}\, dt = \int_{T/4}^{T/2} \frac{1}{\tau}\, d\tau = \log\frac{T}{2} - \log\frac{T}{4} =$$

$$= \log\frac{T}{2} \cdot \frac{4}{T} = \log 2$$