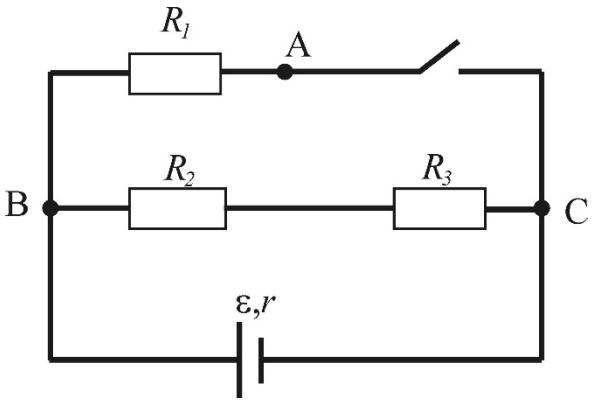
Problema 1 (Задача 1) (10,0 p)

1) **2,5 p**=10x0,25

K deschis

$R_{AB} = R_1 = 1,0\,\text{k}\Omega$; $R_{BC} = R_2 + R_3 = 5,0\,\text{k}\Omega$



K închis

$$R_{AB} = R_{BC} = \frac{(R_2 + R_3)R_1}{R_1 + R_2 + R_3} = 0,83\,\text{k}\Omega$$

2.1) **4,5 p**=18x0,25

Pentru K deschis

Din legea lui Ohm pentru un circuit închis avem:

$I_3 = \dfrac{\varepsilon}{R_2 + R_3 + r}$, de unde rezultă $P_3 = I_3^2 R_3 = \dfrac{\varepsilon^2 R_3}{(R_2 + R_3 + r)^2}$

Pentru K închis

$$\begin{cases} I = I_1 + I_2 \\ I_1 R_1 = I_3(R_2 + R_3) \\ I = \dfrac{\varepsilon}{R_{AB} + r} = \dfrac{\varepsilon(R_1 + R_2 + R_3)}{R_1(R_2 + R_3) + r} \end{cases} \quad I_1 = \frac{R_2 + R_3}{R_1} I_3$$

$$\Rightarrow I = I_3\left(1 + \frac{R_2 + R_3}{R_1}\right) = I_3 \frac{R_1 + R_2 + R_3}{R_1}$$

$$I_3 = \frac{R_1}{R_1 + R_2 + R_3} I = \frac{R_1 \varepsilon}{R_1(R_2 + R_3) + r(R_1 + R_2 + R_3)}$$

De aici puterea disipată pe R_3 va fi

$$P_3 = \frac{\varepsilon^2 R_1^2 R_3}{\left[R_1(R_2 + R_3) + r(R_1 + R_2 + R_3)\right]^2}$$

Dacă considerăm $r = 0$, atunci

Pentru K deschis

$$P_3 = \frac{\varepsilon^2 R_3}{(R_2 + R_3)^2}$$

Pentru K închis

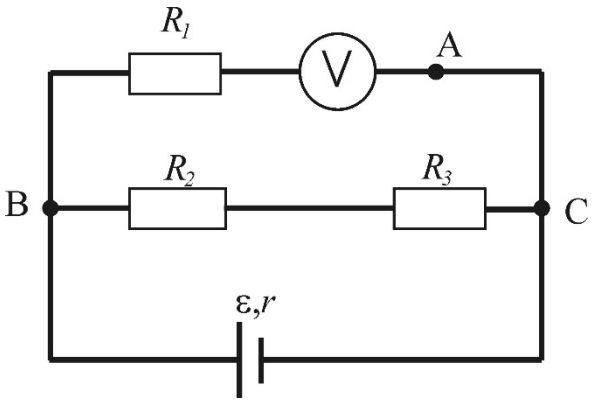
$$P_3 = \frac{\varepsilon^2 R_3}{(R_2 + R_3)^2}$$

sau dacă utilizăm aproximația pentru $r \ll R_{BC}$

$$P_3 \approx \frac{\varepsilon^2 R_3}{(R_2 + R_3)^2}$$

2.3) **1,0 p**=4x0,25

K închis- prin voltmetru trece curent, deci acesta va indica tensiune



2.4) **1,25 p**=5x0,25

$r \approx 0$

$$\begin{cases} U + I_1 R_1 = \varepsilon \\ U = I_1 R_v \end{cases} \Rightarrow R_v = R_1 \frac{U}{\varepsilon - U} = 2,0\,\text{k}\Omega$$

Problema 2 (Задача 2) (10,0 p)

1) **1,75 p**=7x0,25

$W_2 = q_2\rho_2 V_2 = 221,4\,\text{MJ} = 61,5\,\text{kWh}$

$W_3 = q_3 m_3 = 360\,\text{MJ} = 100\,\text{kWh}$

2) **1,0 p**=4x0,25

$\eta_2 = \frac{W_1}{W_2} = \frac{50}{61,5} \approx 0,81$; $\eta_3 = \frac{W_1}{W_3} = \frac{50}{100} = 0,5$

3) **1,0 p**=4x0,25

$C_1 = W_1 P_1 = 100\,lei$; $C_2 = V_2 P_2 = 37,5\,lei$; $C_3 = m_3 P_3 = 36\,lei$

4.1) **1,25 p**=5x0,25

$[K] = \frac{[Q]}{[S\Delta T\tau]} = \frac{\text{J}}{\text{m}^2\text{Ks}} = \frac{\text{W}}{\text{m}^2\text{K}}$; $[R] = \frac{\text{m}^2\text{K}}{\text{W}}$ $[\alpha_{i,e}] = [K] = \frac{\text{W}}{\text{m}^2\text{K}}$; $[\lambda] = [Kd] = \frac{\text{W}}{\text{mK}}$

4.2) **0,5 p**=2x0,25

$Q = W_1 = 50\ \text{kWh}$

4.3) **0,5 p**=2x0,25

$K = \frac{Q}{S\Delta T\tau} = 1,0\frac{\text{W}}{\text{m}^2\text{K}}$

4.4) **1,0 p**=4x0,25

$\frac{1}{K} = \frac{1}{\alpha_i} + \frac{1}{\alpha_e} + \frac{d_1}{\lambda_1} \Rightarrow \lambda_1 = \frac{d_1}{\frac{1}{K} - \frac{1}{\alpha_i} - \frac{1}{\alpha_e}} \approx 0.49\frac{\text{W}}{\text{mK}}$

4.5) **3,0 p**=12x0,25

$\frac{1}{K'} = \frac{1}{\alpha_i} + \frac{1}{\alpha_e} + \frac{d_1}{\lambda_1} + \frac{d_2}{\lambda_2} \Rightarrow K' = \frac{1}{\frac{1}{\alpha_i} + \frac{1}{\alpha_e} + \frac{d_1}{\lambda_1} + \frac{d_2}{\lambda_2}} = \frac{1}{0.1 + 0.05 + 0.816 + 1.25}\frac{W}{m^2K} \approx 0.45\frac{W}{m^2K}$

$Q' = K'S\Delta T\tau = \frac{K'}{K}Q$

$C_2' = C_2\frac{K'}{K} = 16.22\,lei$

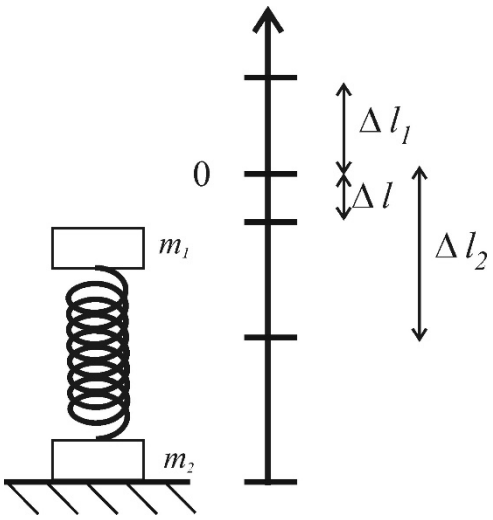
$\Delta C = 21.28\,lei$

Problema 3 (Задача 3) (10,0 p)

1) **2,0 p**=5x0,4

$m_1 g = k\Delta l$

$\Delta l = \frac{m_1 g}{k} = 1{,}5 \text{ cm}$



2) **4,0 p**=10x0,4

$F_1 = (m_1 + m_2)g = 4\,\text{N}$

$k(\Delta l + \Delta l_1) = (m_1 + m_2)g$ sau $k\Delta l_1 = m_2 g$

$\Delta l_1 = \frac{m_2 g}{k} = 2{,}5\,\text{cm}$

3) **4,0 p**=10x0,4

$F_2 = k(\Delta l_2 - \Delta l)$

$\frac{k\Delta l_2^2}{2} = m_1 g(\Delta l_2 + \Delta l_1) + \frac{k\Delta l_1^2}{2} \Rightarrow \Delta l_2 = 2\Delta l + \Delta l_1 = \frac{2m_1 g}{k} + \frac{m_2 g}{k} = (2m_1 + m_2)\frac{g}{k} = 5{,}5\,\text{cm}$

$F_2 = (m_1 + m_2)g = 4\,\text{N}$