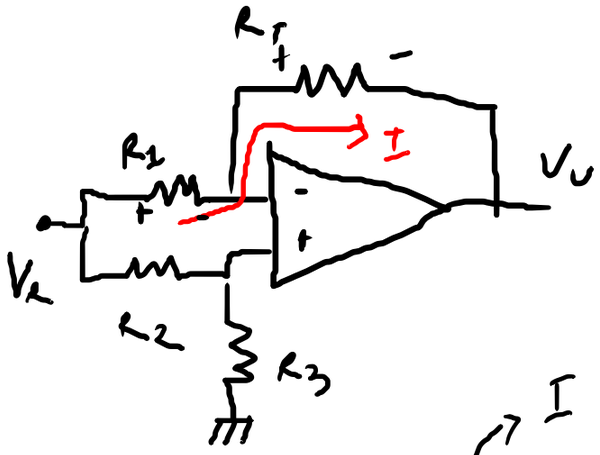


PUNTO 1

$V^+ = V^-$ $\quad I = \dfrac{V_R - V^-}{R_1}$ $\quad V^- = V_R \dfrac{R_3}{R_2+R_3}$

$V_U = V^+ - R_T I$

$I = \dfrac{V_R}{R_1} - \dfrac{V_R}{R_1}\dfrac{R_3}{R_2+R_3}$

$\dfrac{V_R}{R_1}\left(1 - \dfrac{R_2}{R_2+R_3}\right)$ $\quad \dfrac{1}{2}$

I

$V_U = \dfrac{V_R R_3}{R_2+R_3}\dfrac{R_2}{R_2}\dfrac{R_1}{R_1} - R_T I$

$\dfrac{R_2}{R_2}\dfrac{R_1}{R_1}$

$I = \dfrac{V_R}{2R_1}$

$V_U = \dfrac{R_3 R_1}{R_2} I - R_T I = I\left(\dfrac{R_3 R_1}{R_2} - R_T\right)$

$V_U = I\left(\dfrac{R_3 R_1 - R_T R_2}{R_2}\right)$

$\dfrac{R_3}{R_2} = \dfrac{\bar{R}}{R_1}$

SE $\quad R_3 R_1 = \bar{R} R_2$

$V_U = -I \bar{\alpha} \bar{R} \Delta T$

$$V_U = I\left(\frac{R_3 R_1 - R_T R_2}{R_2}\right) = I\,(R_1 - R_T) \qquad I = \frac{V_R}{2R_1}$$

$$R(T) = R(T_0)\, e^{\left[B\left(\frac{1}{T} - \frac{1}{T_0}\right)\right]} \qquad T_C = 37\,^\circ C$$

$$\bar{R} = R(T_0)\, e^{\left[B\left(\frac{1}{273+37} - \frac{1}{273+20}\right)\right]} = 215.37\,\Omega \qquad \bar{\alpha} = TCR(T_C) = -\frac{B}{(37+273)^2} = -0.0068\,^\circ C^{-1}$$

$$R_C(T) = \bar{R}\,(1 + \bar{\alpha}\,(T - T_C)) = \bar{R}\,(1 + \bar{\alpha}\,\Delta T)$$

$$V_U(T) = I\,\left(R_1 - \bar{R} - \bar{R}\,\bar{\alpha}\,\Delta T\right)$$

$$V_U(37\,^\circ C) = I\,(R_1 - \bar{R}) = 0 \qquad (\Delta T = 0)$$

$$\Rightarrow \boxed{R_1 = \bar{R} = 215.37\,\Omega}$$

$$S = -I\alpha\bar{R} = -0.1\ V/^{\circ}C$$

$$I = -\frac{S}{\alpha\bar{R}} = -9.9\ mA$$

$$I = \frac{V_R}{2R_1} \Rightarrow V_R = I \cdot 2R_1$$

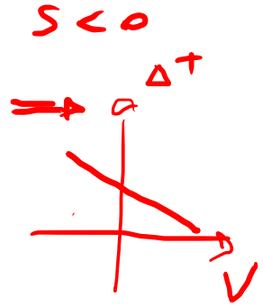
$$\boxed{V_R = -4.31\ V}$$

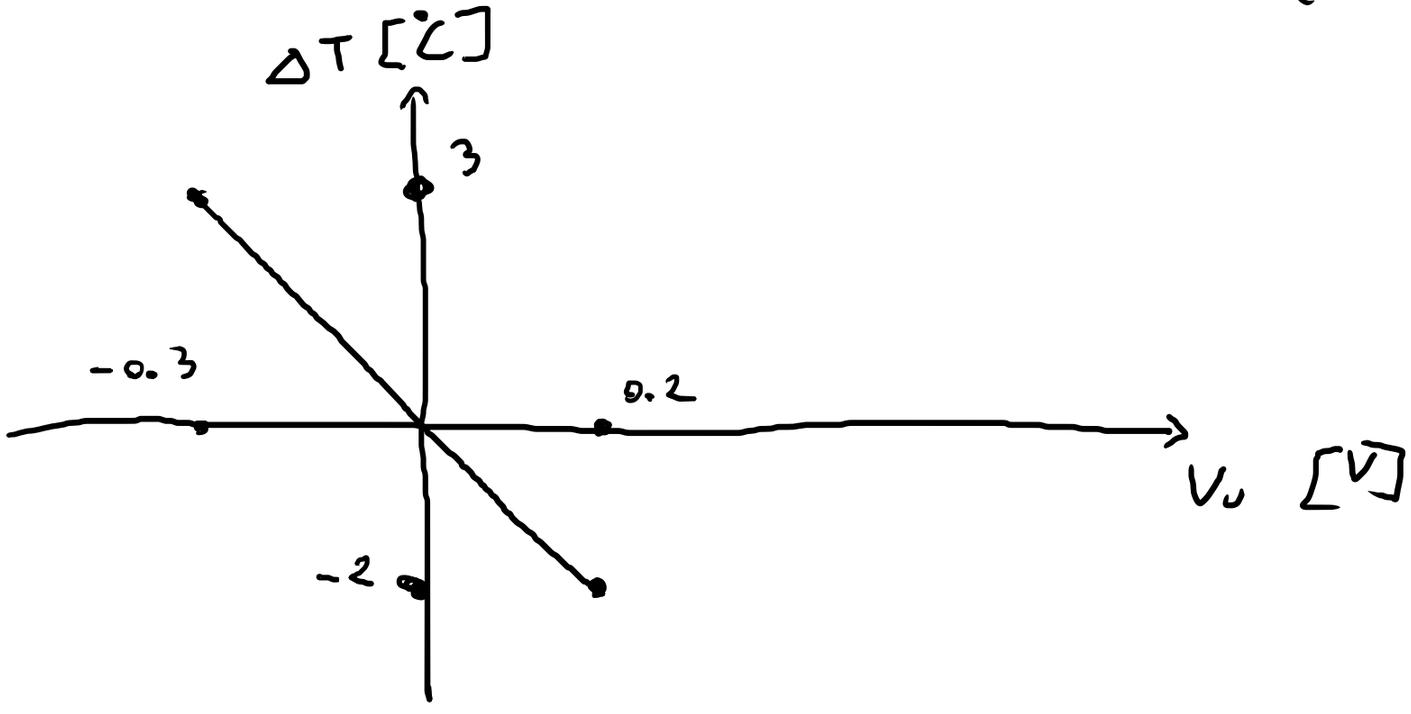
PUNTO 2

$$V_u = S\,\Delta T \qquad \Delta T = V_u / S$$

$V_u(35^{\circ}C) = S \cdot (-2^{\circ}C) = 0.2\ V$

$V_u(40^{\circ}C) = S\,(3^{\circ}C) = -0.3\ V$





$$|\varepsilon_e| = \left| \frac{\Delta V}{S} \right| = \left| \frac{\Delta R}{S_R} \right| = \left| \frac{\Delta R}{\bar{R}\bar{\alpha}} \right|$$

$$|\Delta R| = |R_L - R_T|$$

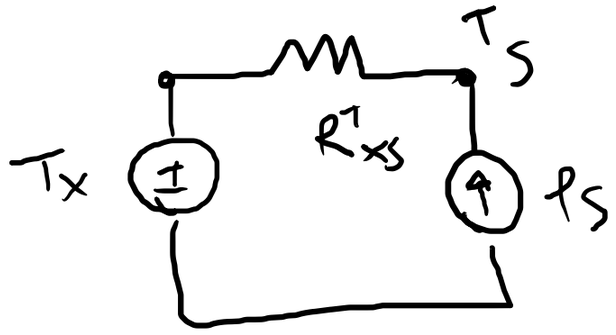
→ 35°C →
- $R_T = 236.66\,\Omega$
- $R_L = 235.53\,\Omega$
- $\Delta R = 1.13\,\Omega$

→ 40°C →
- $R_T = 187.4\,\Omega$
- $R_L = 185.13\,\Omega$
- $\Delta R = 2.27\,\Omega$ → MAX ERROR!

$$|\varepsilon_e| = \left| \frac{2.27\,\Omega}{\bar{R}\bar{\alpha}} \right|$$

$$\boxed{|\varepsilon_e| = 0.23\,^\circ C}$$

PUNTO 3



$$T_S = T_x + R^T_{xs} P_S$$

$$0 < T_S - T_x = \Delta T = R^T_{xs} P_S$$

AUTORISCALDAMENTO

$$P_S = R_T(T_S) I^2$$

$$R_{\angle 2} = \bar{R}_2 (1 + \bar{\alpha}_2 \Delta T$$

$$\Delta T = T_S - T_x$$

LINEARIZZAZIONE $\longrightarrow$ T_x

$$\bar{R}_2 = R_T(36 + 273) = 225.73$$

$$\bar{\alpha}_2 = \frac{-P}{(36+273)^2} = -0.0471\ ^\circ C^{-1}$$

$$\Delta T = \frac{R^T_{xs} \bar{R}_2 I^2}{1 - \bar{\alpha}_2 R^T_{xs} \bar{R}_2 I^2} = 1.07\ ^\circ C$$

$$\Delta T = 1.05\ ^\circ C$$

$$T_S = T_x + \Delta T = 37.05\ ^\circ C$$

$$\Delta T_M = \frac{V_U}{S} = \frac{I(R_1 - R(T_S))}{S} = \frac{R_1 - R(T_S)}{-2R} = 0.05\,^\circ C$$

$$\Rightarrow \boxed{T_M = T_C + \Delta T_M = 37.05\,^\circ C}$$

In alternativa usare il metodo introdotto nell'esercitazione presa dal compito del 24/7/19