8.1 $\vartheta_K = 20^\circ C$ $R_K = 14{,}7\,\Omega$

$\vartheta_W = 55^\circ C$

$\Delta\vartheta = \vartheta_W - \vartheta_K = 55 - 20 = 35^\circ C$

$\Delta R = \Delta\vartheta \cdot \alpha \cdot R_K =$

$= 35 \cdot 0{,}004 \cdot 14{,}7 =$

$= 2{,}058\,\Omega$

$R_W = R_K + \Delta R = 14{,}7 + 2{,}058 =$

$= 16{,}758\,\Omega$

8.2 $\vartheta_K = 20°C$ $\quad R_K = ?$

$\vartheta_W = 65°C$

$\Delta R = 4{,}5\,\Omega$

$$\Delta\vartheta = \vartheta_W - \vartheta_K = 65 - 20 = 45°C$$

$$\Delta R = R_K \cdot \alpha \cdot \Delta\vartheta \quad | : \alpha : \Delta\vartheta$$

$$R_K = \frac{\Delta R}{\alpha \cdot \Delta\vartheta} = \frac{4{,}5}{0{,}004 \cdot 45} =$$

$$= 25\,\Omega$$

8.3 $U = 230\,V$ $I_K = 750\,mA$

$I_W = 650\,mA$

$\vartheta_K = 20°C$

$$R_K = \frac{U}{I_K} = \frac{230}{0,75} = 306,6\,\Omega$$

$$R_W = \frac{U}{I_W} = \frac{230}{0,65} = 353,8\,\Omega$$

$$\Delta R = R_W - R_K = 353,8 - 306,6 = 47,2\,\Omega$$

$$\Delta R = R_K \cdot \alpha \cdot \Delta\vartheta \quad | : R_K : \alpha$$

$$\Delta\vartheta = \frac{\Delta R}{R_K \cdot \alpha} = \frac{47,2}{306,6 \cdot 0,004} = 38,5°$$

$$\vartheta_W = \vartheta_K + \Delta\vartheta = 20 + 38,5 = 58,5°C$$

8.4 $\vartheta_K = 20°C$ $R_K = 120\,\Omega$

$\vartheta_W = 50°C$

$\phi = 0{,}6\,mm$ Kupferlack

$$\Delta\vartheta = \vartheta_W - \vartheta_K = 50 - 20 = 30°C$$

$$\Delta R = R_K \cdot \alpha \cdot \Delta\vartheta = 120 \cdot 0{,}004 \cdot 30 = 14{,}4\,\Omega$$

$$R_W = R_K + \Delta R = 120 + 14{,}4 = 134{,}4\,\Omega$$

$$A = \frac{d^2 \cdot \pi}{4} = \frac{0{,}6^2 \cdot \pi}{4} = 0{,}283\,mm^2$$

$$R = \frac{l}{\gamma \cdot A} \quad | \cdot \gamma \cdot A$$

$$l = R \cdot \gamma \cdot A = 120 \cdot 56 \cdot 0{,}283 = 1901\,m$$

8.5 $\rho_W = 0{,}0210 \frac{\Omega mm^2}{m}$

Annahme: $l = 1\,m$

$A = 1\,mm^2$

20°C

$$R_K = \frac{l \cdot \rho}{A} = \frac{1 \cdot 0{,}0178}{1} =$$

$$= 0{,}0178\,\Omega$$

$$R_W = \frac{l \cdot \rho_W}{A} = \frac{1 \cdot 0{,}021}{1} = 0{,}021\,\Omega$$

$$\Delta R = R_W - R_K = 0{,}021 - 0{,}0178 =$$

$$= 0{,}0032\,\Omega$$

$$\Delta \vartheta = \frac{\Delta R}{R_K \cdot \alpha} = \frac{0{,}0032}{0{,}0178 \cdot 0{,}004} = 44{,}8\,°C$$

$$\vartheta_W = \vartheta_K + \Delta \vartheta = 20 + 44{,}8 = 64{,}8\,°C$$

8.6 $l = 1{,}6\ km$

$A_{Al} = 70\ mm^2$ $A_{Fe} = 12\ mm^2$

$\gamma_{Fe} = 10 \frac{m}{\Omega\, mm^2}$

$$R_{Al} = \frac{l}{\gamma \cdot A} = \frac{1600}{36 \cdot 70} = 0{,}63\ \Omega$$

$$R_{Fe} = \frac{l}{\gamma \cdot A} = \frac{1600}{10 \cdot 12} = 13{,}3\ \Omega$$

$$R = \frac{R_{Al} \cdot R_{Fe}}{R_{Al} + R_{Fe}} = \frac{0{,}63 \cdot 13{,}3}{0{,}63 + 13{,}3} = 0{,}6\ \Omega$$

$R_{W_{20°C}} = R_N (1 + \alpha \cdot \Delta\vartheta) =$ **20°C**

$= 0{,}6 (1 + 0{,}004 \cdot (20 - 20)) = 0{,}6\ \Omega$

$R_{W_{50°C}} = 0{,}6 (1 + 0{,}004 (50 - 20)) = 0{,}672\ \Omega$

$R_{W_{-30°C}} = 0{,}6 (1 + 0{,}004 ((-30) - 20)) = 0{,}48\ \Omega$

8.7 $U = 230\,V$

$I_K = 75\,mA$ $\qquad$ $I_W = 65\,mA$

$\vartheta_K = 20°C$

$$R_K = \frac{U}{I_K} = \frac{230}{75m} = 3066\,\Omega$$

$$R_W = \frac{U}{I_W} = \frac{230}{65m} = 3538\,\Omega$$

$$\Delta R = R_W - R_K = 3538 - 3066 =$$

$$= 472\,\Omega$$

$$\Delta\vartheta = \frac{\Delta R}{R_K \cdot \alpha} = \frac{472}{3066 \cdot 0{,}004} =$$

$$= 38{,}4°C$$

$$\vartheta_W = \vartheta_K + \Delta\vartheta = 20 + 38{,}4 = 58{,}4°C$$

$58{,}4°C < 80°C \Longrightarrow$ Nein

8.8 $\vartheta_K = 20\,^\circ C$ $R_K = 1{,}4\,\Omega$

$\vartheta_W = 75\,^\circ C$

$\Delta\vartheta = \vartheta_W - \vartheta_K = 75 - 20 = 55\,^\circ C$

$R_W = R_K(1 + \alpha\,\Delta\vartheta) =$

$= 1{,}4(1 + 0{,}004 \cdot 55) = 1{,}468\,\Omega$

8. P $U = 16\,V$ $N = 2200$

$\varnothing = 0{,}6\,mm$ $I_U = 0{,}8\,A$

$d_i = 25\,mm$ $d_a = 55\,mm$

$$d_m = \frac{d_i + d_a}{2} = \frac{25 + 55}{2} = 40\,mm$$

$$U = d_m \cdot \pi = 40 \cdot \pi = 125{,}66\,mm$$

$$l = N \cdot U = 2200 \cdot 125{,}66 = 276{,}4\,m$$

$$R = \frac{l}{\gamma \cdot A} = \frac{276{,}4}{56 \cdot 0{,}28} = 17{,}63\,\Omega$$

$$A = \frac{d^2 \cdot \pi}{4} = \frac{0{,}6^2 \cdot \pi}{4} = 0{,}28\,mm^2$$

$$R_W = \frac{U}{I} = \frac{16}{0{,}8} = 20\,\Omega$$

$$\Delta R = R_W - R_K = 20 - 17{,}63 = 2{,}37\,\Omega$$

$$\Delta\vartheta = \frac{\Delta R}{R_K \cdot \alpha} = \frac{2{,}73}{17{,}63 \cdot 0{,}004} = 38{,}7\,°C$$

$$\vartheta_W = \vartheta_K + \Delta\vartheta = 20 + 38{,}7 = 58{,}7\,°C$$

8.10 $\vartheta_K = 20°C$ $R_K = 2\,k\Omega$

$\alpha = 0{,}000\,01\ \frac{1}{K}$

$\Delta R = 0{,}5\,‰$

$$\Delta R = \frac{R_K \cdot 0{,}5\,‰}{1000} = \frac{2\,k \cdot 0{,}5}{1000} = 1\,\Omega$$

$$\Delta\vartheta = \frac{\Delta R}{\alpha \cdot R_K} = \frac{1}{0{,}000\,01 \cdot 2000} = 50°C$$

$$\vartheta_W = \vartheta_K + \Delta\vartheta = 20 + 50 = 70°C$$

8.11 $\vartheta_K = 25\,°C$ $R_K = 47\,k\Omega$

$\vartheta_W = 45\,°C$ $R_W = 18\,k\Omega$

$$\Delta\vartheta = \vartheta_W - \vartheta_K = 45 - 25 = 20\,°C$$

$$\Delta R = R_W - R_K = 18k - 47k = -29k\Omega$$

$$\Delta R = R_K \cdot \alpha \cdot \Delta\vartheta \quad | : R_K : \Delta\vartheta$$

$$\alpha = \frac{\Delta R}{R_K \cdot \Delta\vartheta} = \frac{-29k}{47k \cdot 20} =$$

$$= -0{,}03\,\frac{1}{K} \quad \text{oder} \quad -0{,}03\,\frac{1}{°C}$$

8.12 PTC

$\vartheta_K = 20°C$ $\quad R_K = 200\,\Omega$

$\vartheta_W = 50°C$ $\quad R_W = 900\,\Omega$

$$\Delta R = R_W - R_K = 900 - 200 = 700\,\Omega$$

$$\Delta\vartheta = \vartheta_W - \vartheta_K = 50 - 20 = 30°C$$

$$\alpha = \frac{\Delta R}{\Delta\vartheta \cdot R_K} = \frac{700}{30 \cdot 200} = 0{,}116\,\frac{1}{K}$$

8.13 $\alpha = 0{,}00385 \frac{1}{K}$

$\vartheta_K = 0°C$ $\quad R_K = 100\,\Omega$

$U = 2\,V$ $\quad I_W = 9{,}2\,mA$

$$R_W = \frac{U}{I_W} = \frac{2}{9{,}2\,m} = 217{,}3\,\Omega$$

$$\Delta R = R_W - R_K = 217{,}3 - 100 = 117{,}3\,\Omega$$

$$\Delta\vartheta = \frac{\Delta R}{R_K \cdot \alpha} = \frac{117{,}3}{100 \cdot 0{,}00385} = 305°C$$

$$\vartheta_W = \vartheta_K + \Delta\vartheta = 0 + 305°C = 305°C$$

8.14 $\vartheta_K = 20°C$ $I_K = 2,1\,A$

$I_U = 900\,mA$

$U = 230\,V$ $\alpha = 0,004\,\frac{1}{K}$

$$R_K = \frac{U}{I_K} = \frac{230}{2,1} = 109,5\,\Omega$$

$$R_U = \frac{U}{I_U} = \frac{230}{0,9} = 255,5\,\Omega$$

$$\Delta R = R_U - R_K = 255,5 - 109,5 = 146\,\Omega$$

$$\Delta\vartheta = \frac{\Delta R}{R_K \cdot \alpha} = \frac{146}{109,5 \cdot 0,004} = 333°C$$

$$\vartheta_U = \vartheta_K + \Delta\vartheta = 20 + 333 = 353°C$$