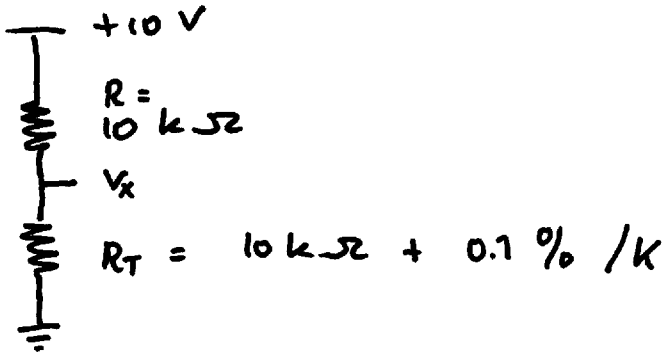
wheatstone

The final resolution of the system in terms of measured parameter (in this case temperature) is given by the resolution of the measuring equipment (multimeter) divided by the sensitivity (volt per °C in this case). $\Delta S = \Delta V / \frac{dV(S)}{dS}$

(S is the measured signal)

a) voltage divider



V_x is around 5 volt, so we have to use the 20 volt scale of the multimeter. At that scale the voltage resolution is 10 mV. (= ΔV). The sensitivity is the derivative of the function $V(T)$.

$$\frac{dV_x}{dT} = \frac{dV_x}{dR_T} \cdot \frac{dR_T}{dT}$$

$$= 10V \cdot \frac{R}{(R_T+R)^2} \cdot \frac{10\,k\Omega}{1000}$$

$$= \frac{10\,V}{1000\,K} \times \frac{(10\,k\Omega)^2}{(20\,k\Omega)^2} = 2.5\ mV/K$$

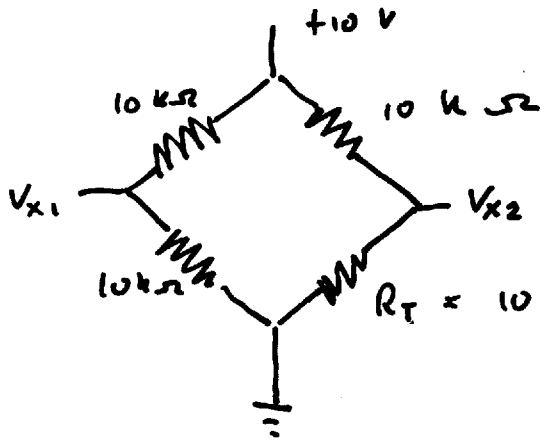
$$V_x = \frac{R_T}{R_T + R} \times 10\ V$$

$$R_T = 10\,k\Omega \cdot \left[1 + \frac{(T-T_0)}{1000\,K}\right]$$

$$\Delta T = \Delta V / \frac{dV_x}{dT} = 10\ mV / 2.5\ mV/K = 4\ K$$

b) Whatstone bridge

(2)/2



V_{x1} is always at 5 Volt. $V_{x2} = \frac{R_T}{R_T + R} \cdot 10\ V \sim 5\ V$

For the multimeter we connect $V = V_{x2} - V_{x1} \sim 0\ V$

We can use the smallest scale available : 20 mV.

Here the resolution is 10 µV ($= \Delta V$).

$$\frac{dV}{dT} = \frac{d\,(V_{x2} - V_{x1})}{dT} = \frac{dV_{x2}}{dT} = 10\ V \cdot \frac{R}{(R_T + R)^2} \cdot \frac{10\ k\Omega}{1000}$$

(same as for voltage divider !)

Resolution : $\Delta T = \frac{\Delta V}{dV/dT} = \frac{10\ \mu V}{2.5\ mV/K} = 4\ mK$

3 orders of magnitude better.