Answer on Question #50640, Physics, Molecular Physics | Thermodynamics

For a thermocouple, the values of C1 and C2 are 40.0 x 10^-6 V°C^-1 and -0.01 x 10 ^-6 V°C^-2 respectively. If the thermo emf between the junctions is 2.3 x 10^-2 V and the cold junction is kept at the ice point, calculate the temperature of the hot junction.

Answer:

All the voltage-temperature relationships of the letter designated thermocouples are monotonic, but not linear. For instance the type N thermocouple voltage output is defined by the following polynomials, where t is the temperature in degree Celsius:

$$Emf = \sum_{i=1}^{n} C_i t^i$$

Confine polynomial to the second degree:

$$Emf = C_1 t + C_2 t^2$$

Where $Emf = 2.3 \cdot 10^{-2}\ V$, $C_1 = 40 \cdot 10^{-6}\ V\ ℃^{-1}$, $C_2 = -0.01 \cdot 10^{-6}\ V\ ℃^{-2}$

Finally the obtained equation looks as:

$2.3 \cdot 10^{-2}\ V = 40 \cdot 10^{-6}\ V\ ℃^{-1} \cdot t - 0.01 \cdot 10^{-6}\ V\ ℃^{-2} \cdot t^2$

According to the wolfram alpha
http://www.wolframalpha.com/input/?i=2.3*0.01%3D40*%2810%5E%28-6%29%29*t-0.01*%2810%5E%28-6%29%29*t*t

There is two solutions :

$$t_1 = 696.16\ ℃$$
$$t_2 = 3303.84\ ℃$$

If the $C_2 = 0.01 \cdot 10^{-6}\ V\ ℃^{-2}$ (minus changed to plus)

http://www.wolframalpha.com/input/?i=2.3*0.01%3D40*%2810%5E%28-6%29%29*t%2B0.01*%2810%5E%28-6%29%29*t*t

Solution becomes more certain :

$$t_1 = -4509.98\ ℃ < 0\ is\ not\ hot\ junction, does\ not\ fit$$
$$t_2 = 509.98\ ℃$$