ENTROPY OF ALUMINUM AT LOW TEMPERATURES

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Reference: Daniel V. Schroeder, *An Introduction to Thermal Physics*, (Addison-Wesley, 2000) - Problem 3.14.

A curve fit to experimental measurements of the heat capacity of one mole of alumin(i)um at low temperatures is

$$C_V = aT + bT^3 \tag{0.1}$$

where $a = 0.00135$ J K^{-2} and $b = 2.48 \times 10^{-5}$ J K^{-3}.

We can use this to work out the entropy from the formula

$$S_f - S(0) = \int_0^{T_f} \frac{C_V(T)}{T} dT \tag{0.2}$$

$$= aT_f + \frac{b}{3} T_f^3 \tag{0.3}$$

If we take $S(0) = 0$, we can evaluate the formula at a few temperatures.

At $T = 1$ K, we have

$$S(1) = 1.358 \times 10^{-3} \text{ J K}^{-1} \tag{0.4}$$

In dimensionless form, we have

$$\frac{S(1)}{k} = 9.84 \times 10^{19} \tag{0.5}$$

At $T = 10$ K

$$S(10) = 0.0218 \text{ J K}^{-1} \tag{0.6}$$

$$\frac{S(10)}{k} = 1.58 \times 10^{21} \tag{0.7}$$