

## Exercise 2.1-2

### Do the Math for the Formation Entropy

Illustration

*Do the Math* needed for going from the first to the second formula:

● First formula:

$$F = -kT \cdot \ln Z = kT \cdot \sum_i \left( \frac{h\omega_i}{4\pi \cdot kT} + \ln \left( 1 - \exp - \frac{h\omega_i}{2\pi \cdot kT} \right) \right)$$

● Second formula:

$$S = k \cdot \sum_i \left( -\ln \left( 1 - \exp \frac{h\omega_i}{2\pi \cdot kT} \right) + \frac{\frac{h\omega_i}{2\pi \cdot kT}}{\exp \left( \frac{\frac{h\omega_i}{2\pi \cdot kT}}{1} \right)} \right)$$

Now, using the approximations [referred to](#), derive the Final formula

$$S_F = k \cdot \sum_i \ln \frac{\omega_i}{\omega'_i}$$

*Discuss the quality of the approximations*

● (Hint: Use some real numbers or order of magnitudes for e.g. Debye temperatures, vacancy concentrations etc.)

[Link to the Solution](#)