Universität Stuttgart **Prof. Dr. Rudolf Hilfer**
Fakultät 8, Fachbereich Physik **Tillmann Kleiner**

Advanced Statistical Physics, SS 2017
Sheet 7

Problem 1: **(6 points)**

Water has its triple point at $T_3 = 273.2°$ K, $p_3 = 600$ Pa. The density of ice is 0.9 g/cm^3 and its heat of fusion is 80 cal/g. Recall that one mole of water weighs about 18 g.

a) Calculate Δs, the change in specific entropy associated with the liquid-solid phase transition near the triple point.

b) Calculate Δv, the change of the specific volume associated with the same phase transition.

c) Estimate the melting temperature of water under a pressure of 100 atmospheres (1 atmosphere $\approx 10^5$ Pa). Assume that Δv and Δs remain approximately constant.

d) Does the Clausius-Clapeyron equation explain why ice-skating works?

Problem 2: **(4 points)**

Consider spheres in n dimensions, where $n \gg 1$. Let $V_n(R)$ be the volume of an n dimensional sphere of radius R and $S_n(R)$ its surface area.

a) Explain why $S_n = \frac{\partial V_n}{\partial R}$. *(Hint: Think about doing a volume integral in radial coordinates.)*

b) Calculate the dimensionless number $RS_n(R)/V_n(R)$. What happens to this number for large n? Why could this be important?

c) Calculate the volume and surface area of a hypersphere. (That is, assume $V_n(R) = \alpha_n R^n$, and find α_n.) *(Hint: One possible method: calculate $\int \mathrm{e}^{-x^2}\, \mathrm{d}^n r$ in two different ways and equate the answer. You can use a different method if you know one.)*

Deliver your hand-written solutions at the beginning of the lecture on Friday, June 2nd.