

Toets stf2 Fall/Winter 2011

State clearly your name and - if available - collegekaartnummer. Tip: Read first all questions, and then start with the ones that are easiest for you.

1 Canonical partition function (3 points)

Show that the average energy of a canonical ensemble follows from the partition function via differentiation as follows:

$$\langle E \rangle = -\frac{\partial}{\partial \beta} \ln Z$$

with $\beta = 1/(k_B T)$.

2 Virial expansion (5 points)

- (a) Write the first two terms of the virial expansion of βp (p : pressure).
- (b) Calculate the second virial coefficient

$$B_2 = -2\pi \int_0^{\infty} r^2 \left(e^{-\beta w(r)} - 1 \right) dr$$

for a gas with hardcore repulsion and an attractive box-like potential: $w(r) = \infty$ for $0 \leq r \leq d$, $w(r) = -\varepsilon < 0$ for $d < r \leq 2d$ and $w(r) = 0$ for $r > 2d$.

3 Partition (2 points)

Write down all the partitions of the set $\{1, 2, 3, 4\}$.