

AMA4004 Statistical mechanics: Thermodynamics potentials

This assignment contains no hard parts and as such if this report is handed in for the portfolio the maximum mark you can get for it is 8/12.

In order to do this exercise you will need to watch the following videos:

- Thermodynamic potentials: <http://gtribello.github.io/mathNET/reservoirs-and-thermodynamic-potentials-video.html>
- Maxwell Relations: <http://gtribello.github.io/mathNET/maxwell-relations-video.html>

It will probably be useful for you to also look at:

<http://gtribello.github.io/mathNET/maxwell-relations-exercise.html>

You will be asked to prepare a short (1-page max) report on one of the following thermodynamic potentials:

- The internal energy
- The Enthalpy
- The Helmholtz free energy
- The Gibbs free energy
- The grand potential
- A thermodynamic potential that is suitable for studying nucleation

Please typeset your report using \LaTeX . Define all mathematical symbols that you used and provide written justification for the steps you take in the derivations. For example when you use results that only hold for exact differentials you should explain that the quantity under study is an exact differential. I do not want a report that consists of equations only with no explanations. In your report you will be expected to:

- Explain how the thermodynamic potential is defined and make reference to the nature of the reservoir that is in contact with the system.
- Derive an expression for the differential i.e. some expression similar to $dE = TdS - PdV$
- Show which thermodynamic variables can be calculated from partial derivatives of the thermodynamic potential and how.
- Derive a Gibbs relation from the definition of the thermodynamic potential.

You should consult multiple sources (not just the material on the mathNET website). Please ensure you properly reference all the derivations you have included.