Assignment 2: Due 22 Aug 2024 before class

(material for Q. 2-3 will be covered in the lecture on 16 Aug)

1. A system contains ten atoms, each of which can exist in one of two states, according to whether it has zero units or one quantum of energy. How many distinct arrangements of quanta are possible for this system if we have (a) ten quanta of energy; (b) four quanta of energy?

2. Derive the critical constants for a gas following the Dieterici equation in terms of the a and b coefficients.

3. (a) Find the total differential of the function $Z = \frac{1}{2}x^2y + c$, where c is a constant.

   (b) Consider a process in the position space with initial state $(0, 0)$ and final state $(1, 1)$. Obtain ΔZ for the process along path I: $y = x$ and along path II: $y = x^2$. Consider another path via an intermediate state $(1, 1)$ such that you move from $(0, 0)$ to $(1, 0)$ keeping y constant and then $(1, 0)$ to $(1, 1)$ keeping x constant.

   (c) Now consider the differential $dZ = xydx + xydy$ and carry out the same process via three different paths.

   (d) Show using the perfect gas and van der Waal's equations of state that differential of pressure is an exact differential.