1. Consider 2 non-interacting electrons populating two single-particle levels of energy $-\epsilon$ and ϵ.

   (a) What is the average energy for $T = 0$?

   (b) What is the entropy for $T = 0$?

   (c) What is the average energy as $T \to \infty$?

   (d) What is the entropy as $T \to \infty$?

2. Consider a partition function, $Z(T) = 2A \cosh(\beta\epsilon)$.

   (a) Find the average energy $E(T)$

   (b) Find the entropy $S(T)$

   (c) What is the entropy as $T \to 0$?

3. Beginning with:
$$TdS = dE + PdV - \mu dQ,$$

   prove:
$$\left.\frac{\partial E}{\partial Q}\right|_{S,P} = \mu - P\left.\frac{\partial \mu}{\partial P}\right|_{S,Q}$$