Physics 831 Quiz #1 - Friday, Sep. 5

1. Consider 2 identical spin-0 bosons 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:
$$\mu - T\frac{\partial\mu}{\partial T}\bigg|_{Q,V} = \frac{\partial E}{\partial Q}\bigg|_{T,V}$$