

Problem 1 It has been proposed to use the thermal gradient of the ocean to drive a heat engine. Suppose that at a certain location the water temperature is 27 degrees Celsius at the ocean surface and 4 degrees at the ocean floor. What is the maximum possible efficiency of an engine operating between these temperatures?

Problem 2 What does Gibbs free energy tell us about volume, entropy, and chemical potential? $dU = TdS - PdV + \mu dN$, $G = U + pV - TS$ are given.

Problem 3 Consider a two state system with energy states 1 and 2. State 1 has energy ϵ and magnetic momentum of $-\mu$. While state 2 has energy of $-\epsilon$ and magnetic momentum of $+\mu$.

- A) What is the partition function?
- B) What is the average energy of this system?
- C) What is the average magnetic momentum of this system?
- D) Average energy at infinite temperature?
- E) Average magnetic momentum at infinite temperature?