Physical Chemistry Cume
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Try to answer as many questions as possible – qualitative answers are welcome!

1. Explain the concept of pure and mixed quantum states. How would you describe systems in mixed states? Can you show some example of a system in a mixed state and explain how did it get there?

2. a) Explain the concept of microstates for classical and quantum particles.

   b) Show different equilibrium ensemble distributions of such systems (a) in terms of microstates. How would you apply this concept (distributions) to (interacting) electrons in thermalized atoms?

   c) Let's assume now that the classical and quantum particles do not interact. What kind of equation of state do you expect that these particles obey? Explain.

3. How would you describe a highly diluted gas of O_2 molecules at room temperature using the language of statistical mechanics? Consider all the degrees of freedom. How might U, G, S look like (just try to make a good guess - formulas)?

4. a) Can you write formulas describing electric field in different regions (vacuum inside and outside, metallic sphere) of the following system (right):

   b) Do the same when you replace vacuum by water.

   c) What do you expect to get if you replace the hollow metallic sphere by a hollow metallic cube?

   d) What is an electromagnetic radiation, how can it be generated, and how would you describe it? Show examples of coherent and incoherent sources. How would you describe it quantum mechanically?