Physics 301: Problems #3
September 2, 2020

1. The heat capacity of water is 4179.6 $J/(K \cdot kg)$. The ideal gas constant $R = 8.3$ $J/(K \cdot mole)$. What is the molar heat capacity of water expressed as a multiple of R? Compare this to the molar heat capcity of a solid, and to the heat capcity of an ideal gas. Count the degrees of freedom of a water molecule, including vibrational modes of stretching the hydrogen bonds. From the equipartion of energy, what would you expect for the molar heat capcity of water? Discuss.

2. What is the bulk modulus of an isothermally compressed ideal gas? Adiabatically compressed ideal gas? Compare to water, 2×10^9 Pa.

3. Suppose you flip 50 coins (or 1 coin 50 times)

   (a) How many possible outcomes (microstates) are there?

   (b) How many ways are there of getting exactly 25 heads?

   (c) What is the probability of getting exactly 25 heads?