Thermodynamics: Princeton Prelims Edition (IN PROGRESS)

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1 What Is This?

I am writing this document to solidify my understanding of Thermodynamics in preparation for the Princeton Prelims for physics Ph.D. study. Many of the conceptual explanations here are paraphrased from my textbooks [1][2][3][4]. Others are paraphrased from Professor Lyman Page's Fall 2018 *Thermal Physics* class lectures (PHY 301). When solving some of the problems I referred to the Princeton Prelims Wiki to compare my answers [5]. I do not guarantee that my solutions are correct, nor do I guarantee that the Wiki solutions are correct. If you are reading this document and have a question or a correction, feel free to email me at sarafs@princeton.edu.

2 Thermodynamics Concepts

2.1 Useful Constants

- $k_B \approx 1.4 \times 10^{-23}$ J K^{-1}. Recall units because

$$\frac{1}{k_B T} \equiv \frac{d}{dE} \ln \Omega$$

  Also β, the "coldness" of the system, is $1/(k_B T)$.

- 1 atm $\approx 10^5$ Pa
- Standard temperature and pressure (STP) = 0°C and 1 atm
- 1 calorie = the energy required to raise 1 g of water by 1°C. 1 calorie $\approx$ 4 J.
- The mass of a molecule in atomic mass units (amu) is equal to molar mass of that molecule in grams (g/mole).

2.2 Definitions

2.2.1 Heat and Temperature

- **Heat** is thermal energy in transit. You cannot say "an object contains a certain quantity of heat", you can only measure how much heat an object