

## Practice Exam #1

1. Air at room temperature is compressed adiabatically to  $1/32$  of its original volume. Estimate the temperature of air after the compression.
2. 10 coins are flipped. (a) How many possible outcomes are there? (b) What is the probability of HTHHTTTHTH in exactly that order? (c) what is the probability of getting 6 heads and 4 tails in any order?
3. An Einstein solid with 3 oscillators and 4 units of energy is placed in contact with an Einstein solid with 2 oscillators and no units of energy. After equilibrium is reached how many units of energy will most likely be found in the second solid?
4. A thermally insulated cylinder is divided by a movable and impermeable wall into two compartments, A and B, both with the same amount of an ideal monoatomic gas ( $N_A = N_B = N$ ). Initially, the temperatures in A and B are  $T_0$  and  $3T_0$ , respectively. Assume that the gases are always in mechanical equilibrium; eventually, they also reach thermal equilibrium.
  - (a) Find the ratio of the volumes of the two gases at  $t = 0$  (initially) and at  $t = \text{infinity}$  (i.e. when they reach thermal equilibrium).
  - (b) Find the change in entropy from  $t = 0$  to  $t = \text{infinity}$ .