# Thermal Physics - Test 1 Spring 2003 

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Answer 5 questions - if you turn in more than 5 , I will grade the first 5 .

1. Calculate the entropy change when $n$ moles of an ideal gas undergoes a free expansion within a rigid, impermeable, completely insulated container to three times its original volume.
2. $n$ moles of an ideal gas of specific heat $c_{v}$ are heated quasistatically from $T_{1}$ to $T_{2}$ along the path $V=a \mathrm{e}^{b T}$ calculate the work done and the heat transfered.
3. Consider a horizontal slab of air whose thickness (height) is $\mathrm{d} z$. If this slab is at rest, the pressure holding it up from below must balance both the pressure and the weight of the slab. Use this fact to find an expression for $\mathrm{d} P / \mathrm{d} z$, the variation of pressure with altitude, in terms of the density of the air.
4. Suppose you flip three fair coins. List all possible outcomes. What is the probability of getting HTH in that order? What is the probability of getting two heads and one tail in any order?
5. What partial derivative relations can you derive from the thermodynamic identity $\mathrm{d} U=T \mathrm{~d} S-p \mathrm{~d} V+\mu \mathrm{d} N$ by considering processes that take place at constant entropy. (You will have to hold other things constant.) Do the results agree with what you already knew.? Explain. What is a quasistatic process? What is the microcanonical ensemble? What is a macrostate? What is a microstate?
6. Given $U=k \frac{S^{3}}{N V}$, ( $k$ is constant), use the thermodynamic identity and the the definition of enthalpy to calculate $H$ as a function of $S, V$, and $N$.
