Physics 332, Spring 2022
Problem Set 3
Due Wednesday April 20th - either bring to class or e-mail to Prof. Driscoll by 1:00 pm.

1. Give an example of a process in which a system is not heated, but its temperature increases. Also give an example of a process in which a system is heated, but its temperature is unchanged.

2. Derive the identities:

$$\left(\frac{\partial C_P}{\partial P}\right)_T = -T\left(\frac{\partial^2 V}{\partial T^2}\right)_P$$

and

$$\left(\frac{\partial C_V}{\partial V}\right)_T = T\left(\frac{\partial^2 P}{\partial T^2}\right)_V$$

3. Three coins are tossed in succession. Assume that they are fair coins, that is, the chance of getting heads or tails is equiprobable. Find the probabilities of the following events:

   (a) the first coin is heads

   (b) exactly two heads have occurred in the three flips

   (c) not more than two heads have occurred in the three flips

4. Two people take turns tossing a fair coin. The first person to obtain heads is the winner, that it is the players pass the coin back and forth until one of them flips a head and wins. Find the probabilities of the following events:

   (a) The game terminates at the fourth toss

   (b) the first player wins the game

   (c) the second player wins the game

5. A bored farmer wants to estimate how many fish are in a pond on their land. The farmer takes out 200 fish and paints a spot on them, and then returns them to the pond. After allowing sufficient time for the tagged fish to mix with the others, the farmer removes 250 fish at random and finds that 25 of them are tagged. Estimate the number of fish in the pond.