

PHYSICS 140A : STATISTICAL PHYSICS
HW ASSIGNMENT #8

(1) A grocer starts his day with 4 boxes of pears, 5 boxes of oranges, and 6 boxes of apples. Each box contains 24 fruit and is initially completely filled.

- (a) At some time, the grocer notes that exactly half the pears, a third of the oranges, and a quarter of the apples have been sold. Assuming that customers take fruit from random positions in each of the boxes, find the dimensionless entropy $\ln W$ of the fruit distribution.
- (b) A clumsy customer then topples the table on which the fruit boxes rest, and all the fruit fall to the ground. The customer cleans up the mess, putting all the fruit back into the boxes, but into random locations. What is the entropy of the final state?

(2) The *triple point* of a single component thermodynamic system is an isolated point (T_t, p_t) in the (T, p) plane where there is three phase coexistence between solid, liquid, and vapor. Consider three phase coexistence between a pure solid, a pure vapor, and a solution where the solute fraction is x . Find the shift $(\Delta T_t, \Delta p_t)$ as a function of x, T_t , and the quantities $s_{S,L,V}$ and $v_{S,L,V}$, *i.e.* the molar entropies and volumes of the three respective phases.

(3) A solution of 4.00 g of hemoglobin in 100 mL of water was prepared and its osmotic pressure was measured to be $\pi = 0.0130$ atm at $T = 280$ K. Estimate the molecular mass of hemoglobin.