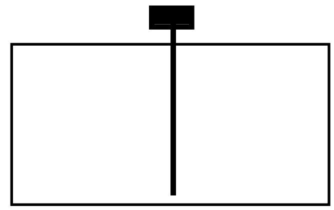
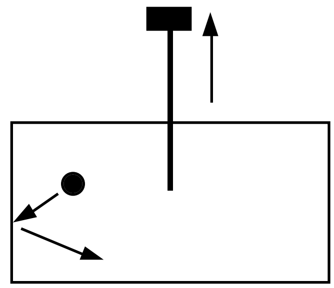
GENERAL CHEMISTRY RECITATION
2nd Semester
Group Exercise #5

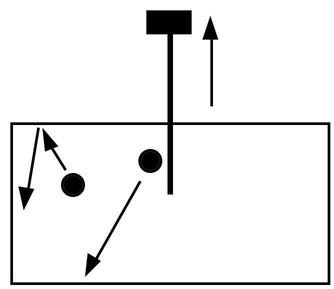
Your group will require three coins for this exercise. They do not need to be of the same denomination.



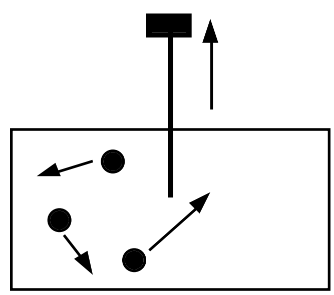
1. Suppose you have a sealed 1.0 L container that is divided into equal halves by a removable partition. Both sides of the container are initially evacuated.



a) A single molecule is placed in the left half of the container, and the partition is removed. One second after the partition is removed, what will be the probability of finding the molecule in the left half of the container? If you return tomorrow, what will be the probability of finding the molecule in the left half of the container?



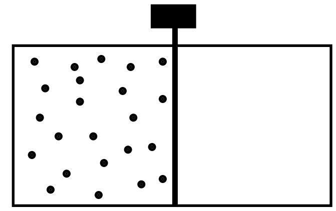
b) Let's repeat the experiment of part (a) with two molecules. Long after the partition is removed, we want to determine the probability of finding both molecules <u>simultaneously</u> in the left half of the container. We can simulate this experiment by flipping coins. How is flipping a single coin similar to your description of the molecule in part (a)? Devise a scheme to flip a pair of coins as a means of simulating the probability that both molecules will be found in the left half of the container. Tabulate your results over many series of coin flips. What do you conclude from your simulation?



c) If three molecules are placed in the container, what is the probability of finding all three molecules <u>simultaneously</u> in the left half of the container? Use a coin-flipping simulation to support your answer.

d) Suppose six molecules were placed in the container. Based on the trend in your answers for parts (a) - (c), what would you predict as the probability for all six molecules to appear simultaneously in the left half of the container?

e) Now let's scale the experiment up to more realistic conditions. 1.0 atm of $He_{(g)}$ at 298 K is placed in the left half of the container, while the right half of the container is completely evacuated. How many He atoms are in the container? What will happen when the partition is removed? What do you estimate as the probability for all the He atoms simultaneously returning to the left half of the container?

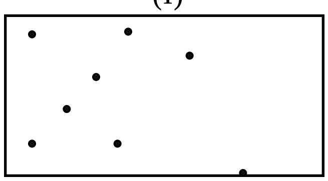


f) Does the internal energy of the system increase, decrease, or remain constant during the process described in part (e)? Explain.

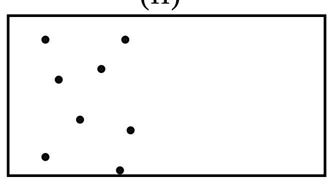
g) Would you characterize the process described in part (e) as reversible or irreversible? In light of your responses to questions (a)-(f), provide a sound argument as to why a gas will spontaneously expand into a vacuum. Do not use the word, "entropy", at this stage in your discussion.

h) Provide a layperson's definition of the term, "entropy." Rank the following diagrams in order of increasing entropy.

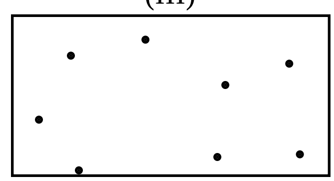
(i)



(ii)



(iii)



Referring back to the process described in part (e), what is happening to the entropy of the system immediately after the partition is removed?

i) Provide a few examples of everyday processes which show a similar change in entropy.

Signature	**Role in Group**
______________________	Leader - keeps the group on the task at hand, and watches the clock.
______________________	Encourager - makes sure each group member participates in the process.
______________________	Prober - asks for rationale and elaboration, and questions the group's assumptions, model, etc.
______________________	Recorder - writes down group's solution to the problems.