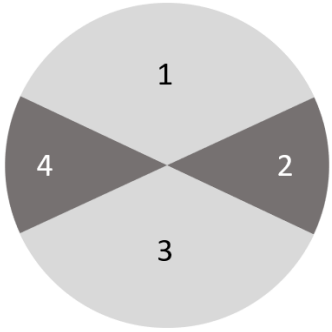
HOMEWORK 1_Makeup

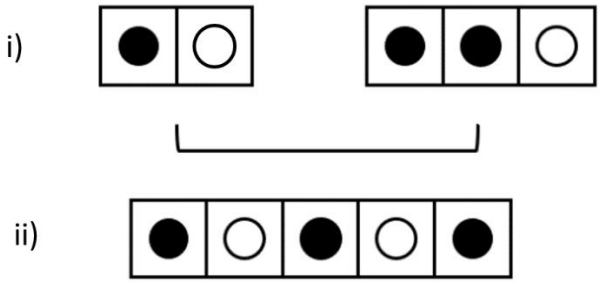
- Show all the work/derivation with neat writing (this counts for the score). Engineering paper should be used. Each student should finish the homework independently.

1. Consider a dart board below. This board is divided into four regions numbered from 1 to 4, corresponding to the score if the dart lands in this region. Note that region 1, 3 have an angle of $2\pi/3$ and 2, 4 has an angle of $\pi/6$. Blindfolded, you throw two darts to the board. Assuming the darts always hit the board:

   (a) What is the probability of you scoring 5 points in total?
   (b) Considering the game as a thermodynamic system and assume each of the **total score** is a micro-state, from a statistical mechanics viewpoint, what is the entropy of this system?



2. Consider 5 particles. At state i), they are separated into two boxes, as shown below. At state ii), these two boxes are combined. At each state, the position of boxes are fixed (i.e., the two boxes at state i cannot be swapped), but the distribution of particles within each box is random. Assume the interaction energy between black particles is $\epsilon_{WW} = 1$
   a) Compute the entropy S, the internal energy U and the Helmholtz free energy F of both state i and state ii. Verify whether your result satisfies $\mathrm{U} - \mathrm{TS} = \mathrm{F}$.
   b) Comment on how do U, S and F change from state i to iii and explain the trends.



-