1. Consider a poker hand: a set of five cards drawn at random from a standard deck. What is the probability space for this random experiment? Determine the probabilities of the following events:

(a) flush: all 5 cards have the same suit.

(b) full house: 3 card of the same value, which is different from the value of the other two cards, which are the same. e.g. J, J, J, 7, 7.

(c) 4 of a kind: 4 cards of the same value. e.g. 9, 9, 9, 9, J.

2. Suppose 6n fair dice are rolled. Define a probability space that describes this experiment. Let $p_n$ be the probability that every number (i.e. the numbers 1 through 6) appears exactly n times in one roll of the collection of dice. Give an exact expression for $p_n$. Find a simpler function $f_n$ such that $p_n \sim f_n$.

3. A woman walks randomly on the $n \times n$ grid \{(x, y) : x, y \in \{1, \ldots, n\}\} starting at the point (1, 1) (i.e. the lower left corner). Each minute the woman moves either to the right or up (i.e. a move of the form $(a, b) \rightarrow (a+1, b)$ or a move of the form $(a, b) \rightarrow (a, b+1)$). Her walk ends when she reaches the upper right corner, the point $(n, n)$. At each stage in which the woman has a choice of 2 moves she flips a fair coin to determine her next move. (If the woman is on the right edge (i.e. $(x, y)$ such that $x = n$) she automatically moves up and if she is on the top edge (i.e. $(x, y)$ such that $y = n$) she automatically moves right.) Define a probability space that describes this random walk. What is the probability that the woman reaches the top row of the grid before reaching $(n, n)$? Explain your answer.