A. Combinations

1. Combination: An arrangement of $r$ objects chosen from $n$ objects \textit{without regard to order}.
   
   (a) The symbol for combination of $r$ objects chosen from $n$ objects is $C(n, r)$ where $r \leq n$
   
   (b) Combination of $n$ objects taken $r$ at a time $= C(n, r) = \frac{n!}{(n-r)!r!}$ \textbf{REMEMBER: ORDER IS NOT IMPORTANT}
   
   (c) The above formula is also equivalent to $C(n, r) = \frac{P(n,r)}{r!}$

2. Permutation involving $n$ objects that are not all different: The number of permutations of $n$ objects, of which $n_1$ are of one kind, $n_2$ are of a second kind, \ldots, and $n_k$ are of a $k$th kind is given by

   \[
   \frac{n!}{n_1!n_2!n_3! \ldots n_k!}
   \]

   where $n_1 + n_2 + \cdots + n_k = n$

B. Examples:

1. Evaluate: $C(6, 2) = \frac{6!}{(6-2)!2!} = \frac{6!}{4!2!} = \frac{6 \cdot 5 \cdot 4!}{4! \cdot 2!} = 15$

2. In how many ways can you deal a hand of 13 cards from a deck of 52 cards? $C(52, 13) = \frac{52!}{(52-13)!13!} = \frac{52!}{39!13!} = 635,013,559,600$

3. In how many ways can 3 people be chosen from 12 applicants? $C(12, 3) = \frac{12!}{(12-3)!3!} = \frac{12!}{9!3!} = \frac{12 \cdot 11 \cdot 10 \cdot 9!}{3 \cdot 2 \cdot 1 \cdot 9!} = 220$

4. How many distinct “words” can be made using all the letters in the eight letter word BASEBALL? $\frac{8!}{2!2!2!} = 5040$