Factorial Notation

A factorial notation looks like this $n! = n \times (n-1) \times (n-2)$ ......

Example 1. $8! = 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$

To find the number of ways of choosing r items from a group of n items is written as

$${}^{n}C_{r} \text{ or } \begin{pmatrix} n \\ r \end{pmatrix}$$

This is calculated by $\dfrac{n!}{r!(n-r)!}$

Example 2. Find ${}^{5}C_{3}$

$$= \frac{5!}{2! \times 3!}$$

$$= \frac{5 \times 4 \times 3 \times 2 \times 1}{2 \times 1 \times 3 \times 2 \times 4}$$

$$= \frac{120}{2 \times 6}$$

$$= 10$$

Example 3. Find $\begin{pmatrix} 7 \\ 4 \end{pmatrix}$

$$= \frac{7!}{3! \times 4!}$$

$$= \frac{7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}{3 \times 2 \times 1 \times 4 \times 3 \times 2 \times 1}$$

$$= 35$$

Example 4. 4 People need to sit down but 2 want to sit together. How many different combinations are there?

Using ${}^{n}C_{r} = {}^{4}C_{2}$

$$= \frac{4!}{2!2!}$$

$$= \frac{4 \times 3 \times 2 \times 1}{2 \times 1 \times 2 \times 1}$$

$$= 6$$

The Connection between Combination Notation and Pascal's Triangle

Look at this:-

$^4C_0 = 1 \quad ^4C_1 = 4 \quad ^4C_2 = 6 \quad ^4C_3 = 4 \quad ^4C_4 = 1$

These values are the same as the Index 4 line

$\therefore$ 6th line would be $\binom{6}{0} \binom{6}{1} \binom{6}{2} \binom{6}{3} \binom{6}{4} \binom{6}{5} \binom{6}{6}$