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| **Topic/Skill**  | **Definition/Tips** | **Example****Topic: Systematic Listing**  |
| 1. Combination | A collection of things, where the **order does not matter**. | How many combinations of two ingredients can you make with apple, banana and cherry?Apple, BananaApple, CherryBanana, Cherry3 combinations |
| 2. Permutation | A collection of things, where the **order does matter**. | You want to visit the homes of three friends, Alex (A), Betty (B) and Chandra (C) but haven’t decided the order. What choices do you have?ABCACBBACBCACABCBA |
| 3. Permutations with Repetition | When something has $n$ different types, there are $n$ **choices each time**.Choosing $r$ of something that has $n$ different types, the permutations are:$$n×n×…\left(r times\right)=n^{r}$$ | How many permutations are there for a three-number combination lock?10 numbers to choose from $\{1, 2, ….10\}$ and we choose 3 of them 🡪$10×10×10=10^{3}=1000$ permutations. |
| 4. Permutations without Repetition | We have to **reduce the number of available choices each time**.One you have chosen something, you cannot choose it again. | How many ways can you order 4 numbered balls?$$4×3×2×1=24$$ |
| 5. Factorial | The factorial symbol ‘!’ means to multiply a series of descending integers to 1.Note: $0!=1$ | $$4!=4×3×2×1=24$$ |
| 6. Product Rule for Counting | If there are $x$ **ways of doing something** and $y$ **ways of doing something else**, then there are $xy$ **ways of performing both**. | To choose one of $\{A,B,C\}$ and one of $\{X,Y\}$ means to choose one of $\{AX, AY, BX, BY, CX, CY\}$The rule says that there are $3×2=6$ choices. |

**Knowledge Organiser**