## Permutations and Combinations | Past Trends

| Attempt | Easy | Moderate | Advance Level | Total |
|---------|------|----------|---------------|-------|
| May 2018 | 2 | 0 | 0 | 2 |
| Nov 2018 | 2 | 2 | 0 | 4 |
| Jun 2019 | 2 | 1 | 1 | 4 |
| Nov 2019 | 3 | 2 | 0 | 5 |
| Nov 2020 | 2 | 2 | 0 | 4 |
| Jan 2021 | 3 | 2 | 2 | 7 |
| Jul 2021 | 2 | 2 | 0 | 4 |
| Dec 2021 | 4 | 1 | 0 | 5 |
| Jun 2022 | 6 | 2 | 0 | 8 |
| Dec 2022 | 4 | 0 | 0 | 4 |

## Permutations – Basics

| Rules of Counting | Multiplication Rule / AND Rule | Ways of doing things together = m×n ways |
|---|---|---|
| | Addition Rule/ OR Rule | Ways of either one or other thing = m+n ways |

| PYQ Jan 21 PYQ Jun 22 | There are then flights operating between City A and City B. The number of ways in which a person can travel from A to B and return by different flight? |
|---|---|
| | a. 90     b. 95     c. 80     d. 78 |

**Ans: a**

| PYQ Jul 21 | A person can go from A to B by 11 different modes of transport but is allowed to return to A by mode other than earlier. The number of different ways in which the entire journey can be completed is |
|---|---|
| | a. 110     b. $10^{10}$     c. $9^5$     d. $10^9$ |

**Ans: a**

| Factorial | | Symbol | $n!$ or $\lfloor n$ |
|---|---|---|---|
| | | Calculation | $n!=n(n-1)(n-2)...3×2×1$ or $n!=1×2×3...(n-2)×(n-1)×n$ |
| | | Special Trick | $n!=n(n-1)!$ $n!=n(n-1)(n-2)!$ |

| Permutations | Meaning | • The ways of **arranging** or **selecting + arranging** • **smaller or equal** number of persons or objects • from a **group** of persons or **collection** of objects • with due regard being paid to the **order of arrangement** or selection are called **PERMUTATIONS** |
|---|---|---|
| | Theorem | Number of Permutations when r objects are chosen out of n different objects $^nP_r = \dfrac{n!}{(n-r)!}$ **Condition:** $n \geq r$ |

| | Shortcut of Theorem | To find $^nP_r$ do reverse multiplication of n for r times. No. of Factors in $^nP_r = r$ |
|---|---|---|
| | Special Formula | $(n+1)!-n!=n.n!$ |

| **PYQ Nov 18** | The value of N in $\dfrac{1}{7!}+\dfrac{1}{8!}=\dfrac{N}{9!}$ is |
|---|---|
| **Ans: a** | a. 81      b. 78      c. 89      d. 64 |

| **PYQ Jun 19** | Which of the following statement is correct: <br> a. $^nP_n = {^nP_{n-1}}$ <br> b. $^nP_n = {^{2n}P_{n-2}}$ <br> c. $^nP_n = {^{3n}P_{n-3}}$ <br> d. $^nP_n = {^{n(n-1)}P_{n-1}}$ |
|---|---|
| **Ans: a** | |

| **PYQ Nov 19** | $^nP_3 : {^nP_2} = 2:1$ . Find n |
|---|---|
| **Ans: a** | a. 5      b. 7/2      c. 4      d. 2/7 |

| **PYQ Nov 20 PYQ Jul 21** | If $^nP_4 = 20{^nP_2}$ where p denotes the number of permutations, then n is |
|---|---|
| **Ans: d** | a. 4      b. 2      c. 5      d. 7 |

| **PYQ Dec 21** | If $^nP_2 = 12$, then the value of n is |
|---|---|
| **Ans: c** | a. 2      b. 3      c. 4      d. 6 |

| **PYQ Jun 22** | If $\dfrac{n!}{10}=\dfrac{(n-1)!}{(n-1-n+3)!}$ then find n |
|---|---|
| **Ans: b** | a. 4      b. 5      c. 6      d. 7 |

## Number Formations

| **Why Permutations** | • Any number is formed by arranging the given digits <br> • So for the purpose of calculating number of possible numbers formed, we use permutations. |
|---|---|
| **Assumption** | • When question is silent, we assume that digits will not be repeated in forming number |
| **Condition 1** | • If there is a zero, it cannot come to first place of the number |
| **Condition 2** | • If there is a restriction that the numbers formed should be larger than a particular value, then we will use counting rules to find solution |
| **Problem on Summation of** | Use below Steps: <br> 1. Find the number of numbers that can be formed |

| all possible numbers | 2. Find repetition value of each digit |
|---|---|
| | 3. Repetition of each digit = $\dfrac{\text{Value of Step 1}}{\text{no. of different digits}}$ |
| | 4. Find sum of digits |
| | 5. Sum of digits x Repetition |
| | 6. Multiply value of step 4 by 1111, 111, etc. in case of four-digit numbers and three-digit numbers respectively |

**PYQ Nov 19**
**PYQ Jul 21**

**Ans: a**

How many numbers can be formed with the help of 2, 3, 4, 5, 6, 1 which are not divisible by 5, given that it is a five-digit number and digits are not repeating?
  a. 600          b. 400          c. 1200          d. 1400

**PYQ Jan 21**

**Ans: b**

How many four-digit odd numbers can be formed with digits 0, 1, 2, 3, 4, 7 and 8?
  a. 150          b. 300          c. 120          d. 210

**Exercise 5A Que 19**

**Ans: d**

The sum of all 4-digit number containing the digits 2, 4, 6, 8 without repetitions is
  a. 133330          b. 122220          c. 213330          d. 133320

**Exercise 5B Que 10**

**Ans: c**

The number of numbers lying between 10 and 1000 can be formed with the digits 2, 3, 4, 0, 8, 9 is
  a. 124          b. 120          c. 125          d. None

**PYQ Dec 22**

**Ans: b**

How many 3 digit odd numbers can be formed using the digits 5, 6, 7, 8, 9 if the digits can be repeated?
  a. 55          b. 75          c. 65          d. 85

## Word Formations

| Why Permutations | • Any arrangement of letters as a word, <br> • Meaning or Pronunciation is irrelevant | |
|---|---|---|
| **Words always Together/ Not Together** | Total ways when some letters are together | • Group of things which are together should be counted as one thing only <br> • Things within group can change their place within themselves, their arrangements also need to be considered. <br> • If based on information in questions, things in the group cannot change their places, ignore their arrangement |
| | Total ways when some letters are not together | Total ways – Ways of always together = Ways of Never Together |

| Permutations when letters are alike | $$p = \dfrac{n!}{n_1!\,n_2!\,n_3!}$$ |
|---|---|

| PYQ Jan 21 PYQ Dec 21 | In how many ways can the letters of the word "DETAIL" be arranged so that vowels occupy only the odd positions? <br> a. 32    b. 36    c. 48    d. 60 |
|---|---|
| **Ans: b** | |
| PYQ Dec 21 | The number of words that can be formed using the letters of the word "PETROL" such that the words do not have P in the first position is <br> a. 720    b. 120    c. 600    d. 540 |
| **Ans: c** | |
| PYQ Jun 22 | If four letters are taken with or without meaning from the word "LOGARITHAM" without repetition, how many words will be formed? <br> a. 5040    b. 2520    c. 120    d. 40320 |
| **Ans: b** | |

## Circular Permutations

| Meaning | if we arrange the objects along a **closed curve** viz., a circle, the permutations are known as circular permutations |
|---|---|
| Theorem | The number of circular permutations of n different things **chosen all** at a time is <br> $$(n-1)!$$ <br> (This theorem applies only when we choose all of n things) |
| Circular Permutations Type II | number of ways of arranging n persons along a closed curve **so that no person has the same two neighbours** is <br> $$\frac{1}{2}(n-1)!$$ <br> Examples: Garlands, Necklaces |

| PYQ Jul 21 | The number of ways 5 boys and 5 girls can be seated at a round table, so no two boys are adjacent is <br> a. 2550    b. 2880    c. 625    d. 2476 |
|---|---|
| **Ans: b** | |
| Exercise 5B Que 3 | If 50 different jewels can be set to form a necklace, then the number of ways is <br> a. 50! / 2    b. 49! / 2    c. 49!    d. None |

## Miscellaneous Problems

| PYQ Dec 22 | The number of ways 4 boys and 3 girls can be seated in a row so that they are alternate is: <br> a. 12    b. 288    c. 144    d. 256 |
|---|---|

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**Ans: c**

| | |
|---|---|
| **PYQ Nov 19** | Three girls and five boys are to be seated in a row so that no girls sit together. Total number of ways of this arrangement are |

    e.  120       f.  14400       g.  $^5P_3$       h.  $3! \times 5!$

**Ans: b**

| | |
|---|---|
| **PYQ Dec 21** | Six boys and five girls are to be seated for a photograph in a row such that no two girls sit together, and no two boys sit together. Find the number of ways in which this can be done. |

    a.  74200       b.  96900       c.  45990       d.  86400

**Ans: d**

| | |
|---|---|
| **PYQ Jun 22** | 8 people are seated in a row in a meeting among them the president and vice president are to be seated always in the centre. What is the arrangement? |

    a.  7! 2!       b.  6! 2!       c.  6!       d.  1!

**Ans: b**

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