CLASS 11 MATHS NCERT SOLUTIONS

NCERT Solutions for Class 11 Maths Chapter 6: Permutations and Combinations – Free PDF Download

Chapter 6, Permutations and Combinations, teaches you how to count arrangements and selections without listing them out one by one. You will learn the Fundamental Principle of Counting, factorial notation, the two core formulas nPr and nCr, and how to apply them to real counting problems involving digits, letters of...

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Exercise 6.1

Q1. How many 3-digit numbers can be formed from the digits 1, 2, 3, 4 and 5 assuming that

(i) repetition of the digits is allowed?
(ii) repetition of the digits is not allowed?

Each of the 3 places (hundreds, tens, units) can be filled by any of the 5 digits, since repetition is allowed. Number of ways = 5 × 5 × 5 = **125**.

The hundreds place can be filled in 5 ways, the tens place (since one digit is used) in 4 ways, and the units place in 3 ways. Number of ways = 5 × 4 × 3 = **60**.

Q2. How many 3-digit even numbers can be formed from the digits 1, 2, 3, 4, 5, 6 if the digits can be repeated?

For the number to be even, the units digit must be 2, 4 or 6, giving 3 choices. Since repetition is allowed, the tens place can be filled in 6 ways and the hundreds place in 6 ways. Required number of even numbers = 6 × 6 × 3 = **108**.

Q3. How many 4-letter code can be formed using the first 10 letters of the English alphabet, if no letter can be repeated?

The first letter can be chosen in 10 ways, the second in 9 ways (as repetition is not allowed), the third in 8 ways, and the fourth in 7 ways. Required number of codes = 10 × 9 × 8 × 7 = **5040**.

Q4. How many 5-digit telephone numbers can be constructed using the digits 0 to 9 if each number starts with 67 and no digit appears more than once?

The first two digits are fixed as 6 and 7. The remaining 3 digits must be chosen (without repetition) from the remaining 8 digits {0,1,2,3,4,5,8,9}. Number of ways = 8 × 7 × 6 = **336**.

Q5. A coin is tossed 3 times, and the outcomes are recorded. How many possible outcomes are there?

Each toss has 2 possible outcomes (Head or Tail). By the multiplication principle, total outcomes = 2 × 2 × 2 = **8**.

Q6. Given 5 flags of different colours, how many different signals can be generated if each signal requires the use of 2 flags, one below the other?

The upper position can be filled by any of the 5 flags, and the lower position by any of the remaining 4 flags. Required number of signals = $5 \times 4 =$ **20**.

Exercise 6.2

Q1. Evaluate

(i) 8! (ii) 4! – 3!

$8! = 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 =$ **40320**.

$4! = 24$, $3! = 6$. So $4! - 3! = 24 - 6 =$ **18**.

Q2. Is 3! + 4! = 7! ?

$3! + 4! = 6 + 24 = 30$. But $7! = 5040$. Since $30 \neq 5040$, **$3! + 4! \neq 7!$** (the statement is false).

Q3. Compute 8!/(6! × 2!)

$8! = 40320$, $6! = 720$, $2! = 2$, so $6! \times 2! = 1440$. Therefore $8!/(6! \times 2!) = 40320/1440 =$ **28**.

Q4. If 1/6! + 1/7! = x/8!, find x.

Since $8! = 8 \times 7 \times 6!$, we get $1/6! = 8 \times 7/8! = 56/8!$. Also $7! = 8!/8$, so $1/7! = 8/8!$.
Therefore, $1/6! + 1/7! = 56/8! + 8/8! = 64/8!$. Comparing with $x/8!$, we get **$x = 64$**.

Q5. Evaluate n!/(n – r)!, when

(i) $n = 6, r = 2$ (ii) $n = 9, r = 5$

$6!/4! = (6 \times 5 \times 4!)/4! = 6 \times 5 =$ **30**.

$9!/4! = 9 \times 8 \times 7 \times 6 \times 5 =$ **15120**.

Exercise 6.3

Q1. How many 3-digit numbers can be formed by using the digits 1 to 9 if no digit is repeated?

Required number $= {}^9P_3 = 9 \times 8 \times 7 =$ **504**.

Q2. How many 4-digit numbers are there with no digit repeated?

The first (thousands) digit cannot be 0, so it can be chosen in 9 ways (1–9). The remaining 3 places are filled from the remaining 9 digits (including 0) without repetition: $9 \times 8 \times 7$ ways. Required number $= 9 \times 9 \times$

$8 \times 7 =$ **4536**.

Q3. How many 3-digit even numbers can be made using the digits 1, 2, 3, 4, 6, 7, if no digit is repeated?

The units digit must be even, chosen from {2, 4, 6}: 3 ways. The remaining two places are filled from the remaining 5 digits without repetition: 5×4 ways. Required number $= 3 \times 5 \times 4 =$ **60**.

Q4. Find the number of 4-digit numbers that can be formed using the digits 1, 2, 3, 4, 5 if no digit is repeated. How many of these will be even?

Total 4-digit numbers $= {}^5P_4 = 5 \times 4 \times 3 \times 2 =$ **120**.
For even numbers, the units digit must be 2 or 4 (2 ways). The remaining 3 places are filled from the remaining 4 digits: $4 \times 3 \times 2 = 24$ ways. Even numbers $= 2 \times 24 =$ **48**.

Q5. From a committee of 8 persons, in how many ways can we choose a chairman and a vice chairman assuming one person can not hold more than one position?

Required number $= {}^8P_2 = 8 \times 7 =$ **56**.

Q6. Find n if ${}^{n-1}P_3 : {}^nP_4 = 1 : 9$.

${}^{n-1}P_3 = (n-1)(n-2)(n-3)$ and ${}^nP_4 = n(n-1)(n-2)(n-3)$.
So the ratio $= (n-1)(n-2)(n-3) / [n(n-1)(n-2)(n-3)] = 1/n$.
Given $1/n = 1/9$, therefore $\mathbf{n = 9}$.

Q7. Find r if (i) ${}^5P_r = 2\ {}^6P_{r-1}$ (ii) ${}^5P_r = {}^6P_{r-1}$

${}^5P_r = 5!/(5-r)!$ and ${}^6P_{r-1} = 6!/(7-r)!$.
$5!/(5-r)! = 2 \times 6!/(7-r)! \Rightarrow 5!(7-r)(6-r) = 2 \times 6! \Rightarrow (7-r)(6-r) = 2 \times 6!/5! = 12$.
Let $x = 6-r$: $x(x+1) = 12 \Rightarrow x^2 + x - 12 = 0 \Rightarrow x = 3$ or $x = -4$.
Since $r \le 5$, $x = 3$ gives $r = 6 - 3 =$ **3** ($x = -4$ gives $r = 10$, rejected).

$5!/(5-r)! = 6!/(7-r)! \Rightarrow 5!(7-r)(6-r) = 6! \Rightarrow (7-r)(6-r) = 6!/5! = 6$.
Let $x = 6-r$: $x(x+1) = 6 \Rightarrow x^2 + x - 6 = 0 \Rightarrow x = 2$ or $x = -3$.
Since $r \le 5$, $x = 2$ gives $r = 6 - 2 =$ **4** ($x = -3$ gives $r = 9$, rejected).

Q8. How many words, with or without meaning, can be formed using all the letters of the word EQUATION, using each letter exactly once?

EQUATION has 8 distinct letters. Number of words $= 8! =$ **40320**.

Q9. How many words, with or without meaning can be made from the letters of the word MONDAY, assuming that no letter is repeated, if

(i) 4 letters are used at a time,
(ii) all letters are used at a time,

(iii) all letters are used but first letter is a vowel?

MONDAY has 6 distinct letters. Words using 4 letters at a time = $^6P_4 = 6 \times 5 \times 4 \times 3 =$ **360**.

Words using all 6 letters = 6! = **720**.

MONDAY has 2 vowels: O and A. The first letter can be chosen from these 2 vowels in 2 ways. The remaining 5 letters can be arranged in the remaining 5 places in 5! = 120 ways. Required number = 2 × 120 = **240**.

Q10. In how many of the distinct permutations of the letters in MISSISSIPPI do the four I's not come together?

MISSISSIPPI has 11 letters: M(1), I(4), S(4), P(2).
Total distinct permutations = 11!/(4! 4! 2!) = 39916800/1152 = 34650.
Treating all 4 I's as one block, we have 8 units (the I-block plus M, S, S, S, S, P, P), with S repeated 4 times and P repeated 2 times.
Permutations with all I's together = 8!/(4! 2!) = 40320/48 = 840.
Required number (I's not together) = 34650 − 840 = **33810**.

Q11. In how many ways can the letters of the word PERMUTATIONS be arranged if

(i) the words start with P and end with S,
(ii) vowels are all together,
(iii) there are always 4 letters between P and S?

PERMUTATIONS has 12 letters: P, E, R, M, U, T, A, T, I, O, N, S — with T repeated twice and all other letters distinct.

Fix P at the first position and S at the last position. The remaining 10 letters (including T twice) are arranged in the middle 10 places: 10!/2! = 3628800/2 = **1814400**.

The 5 vowels (E, U, A, I, O — all distinct) are treated as one block. This gives 8 units to arrange: the vowel-block plus the 7 consonants P, R, M, T, T, N, S (T repeated twice). Arrangements of units = 8!/2! = 20160. Arrangements within the vowel block = 5! = 120. Required number = 20160 × 120 = **2419200**.

We need pairs of positions (out of 1 to 12) that are exactly 5 apart (so that exactly 4 letters lie between P and S): (1,6), (2,7), (3,8), (4,9), (5,10), (6,11), (7,12) — 7 such pairs. For each pair, P and S can be placed in 2 orders, giving 7 × 2 = 14 ways to place P and S. The remaining 10 letters (T repeated twice) fill the remaining 10 positions in 10!/2! = 1814400 ways. Required number = 14 × 1814400 = **25401600**.

Exercise 6.4

Q1. If $^nC_8 = {}^nC_2$, find $^nC_2$.

Using $^nC_r = {}^nC_{n-r}$, since $^nC_8 = {}^nC_2$, we get n = 8 + 2 = 10.

So ${}^{n}C_2 = {}^{10}C_2 = (10 \times 9)/2 =$ **45**.

Q2. Determine n if

(i) ${}^{2n}C_3 : {}^{n}C_3 = 12 : 1$ (ii) ${}^{2n}C_3 : {}^{n}C_3 = 11 : 1$

${}^{2n}C_3/{}^{n}C_3 = [2n(2n-1)(2n-2)/6] / [n(n-1)(n-2)/6] = 4(2n-1)/(n-2)$.

$4(2n-1)/(n-2) = 12 \Rightarrow 8n - 4 = 12n - 24 \Rightarrow 20 = 4n \Rightarrow$ **n = 5**.

$4(2n-1)/(n-2) = 11 \Rightarrow 8n - 4 = 11n - 22 \Rightarrow 18 = 3n \Rightarrow$ **n = 6**.

Q3. How many chords can be drawn through 21 points on a circle?

Each chord requires 2 points, and order doesn't matter. Required number $= {}^{21}C_2 = (21 \times 20)/2 =$ **210**.

Q4. In how many ways can a team of 3 boys and 3 girls be selected from 5 boys and 4 girls?

Boys can be selected in ${}^{5}C_3 = 10$ ways, and girls in ${}^{4}C_3 = 4$ ways. Required number $= 10 \times 4 =$ **40**.

Q5. Find the number of ways of selecting 9 balls from 6 red balls, 5 white balls and 5 blue balls if each selection consists of 3 balls of each colour.

Required number $= {}^{6}C_3 \times {}^{5}C_3 \times {}^{5}C_3 = 20 \times 10 \times 10 =$ **2000**.

Q6. Determine the number of 5 card combinations out of a deck of 52 cards if there is exactly one ace in each combination.

One ace can be chosen from the 4 aces in ${}^{4}C_1 = 4$ ways. The remaining 4 cards are chosen from the 48 non-ace cards in ${}^{48}C_4 = 194580$ ways. Required number $= 4 \times 194580 =$ **778320**.

Q7. In how many ways can one select a cricket team of eleven from 17 players in which only 5 players can bowl if each cricket team of 11 must include exactly 4 bowlers?

Choose 4 bowlers from the 5 available bowlers: ${}^{5}C_4 = 5$ ways. Choose the remaining 7 players from the remaining 12 non-bowlers: ${}^{12}C_7 = 792$ ways. Required number $= 5 \times 792 =$ **3960**.

Q8. A bag contains 5 black and 6 red balls. Determine the number of ways in which 2 black and 3 red balls can be selected.

Required number $= {}^{5}C_2 \times {}^{6}C_3 = 10 \times 20 =$ **200**.

Q9. In how many ways can a student choose a programme of 5 courses if 9 courses are available and 2 specific courses are compulsory for every student?

Since 2 courses are compulsory, the student must choose the remaining 3 courses from the remaining 7 courses: $^7C_3$ = **35**.

Miscellaneous Exercise

Q1. How many words, with or without meaning, each of 2 vowels and 3 consonants can be formed from the letters of the word DAUGHTER?

DAUGHTER has 8 letters: 3 vowels (A, U, E) and 5 consonants (D, G, H, T, R).
Vowels can be chosen in $^3C_2 = 3$ ways, and consonants in $^5C_3 = 10$ ways, giving $3 \times 10 = 30$ groups of 5 letters. Each group of 5 letters can be arranged in $5! = 120$ ways.
Required number of words = 30×120 = **3600**.

Q2. How many words, with or without meaning, can be formed using all the letters of the word EQUATION at a time so that the vowels and consonants occur together?

EQUATION has 8 letters: 5 vowels (E, U, A, I, O) and 3 consonants (Q, T, N), all distinct. Treating the vowel-block and consonant-block as 2 units, they can be arranged in 2! ways. The vowels within their block can be arranged in 5! ways, and the consonants within their block in 3! ways.
Required number of words = $2! \times 5! \times 3! = 2 \times 120 \times 6$ = **1440**.

Q3. A committee of 7 has to be formed from 9 boys and 4 girls. In how many ways can this be done when the committee consists of:

(i) exactly 3 girls? (ii) atleast 3 girls? (iii) atmost 3 girls?

Exactly 3 girls means 4 boys as well: $^4C_3 \times {}^9C_4 = 4 \times 126$ = **504**.

At least 3 girls means exactly 3 girls or exactly 4 girls (there are only 4 girls). Exactly 4 girls (3 boys): $^4C_4 \times {}^9C_3 = 1 \times 84 = 84$. Required number = 504 + 84 = **588**.

At most 3 girls = Total ways of choosing 7 from 13 – ways with all 4 girls. Total ways = $^{13}C_7 = 1716$. Ways with 4 girls = 84 (from above). Required number = 1716 – 84 = **1632**.

Q4. If the different permutations of all the letters of the word EXAMINATION are listed as in a dictionary, how many words are there in this list before the first word starting with E?

EXAMINATION has 11 letters: A(2), I(2), N(2), and E, X, M, T, O (1 each).
Arranged alphabetically, the letters available are A, E, I, M, N, O, T, X. The only letter that comes before E is A.
So we need the number of words starting with A. Fixing one A in the first place, the remaining 10 letters are A(1), I(2), N(2), E, X, M, T, O(1 each).
Number of arrangements = $10!/(2!\ 2!) = 3628800/4$ = **907200**.

Q5. How many 6-digit numbers can be formed from the digits 0, 1, 3, 5, 7 and 9 which are divisible by 10 and no digit is repeated?

A number is divisible by 10 only if its units digit is 0. Fixing 0 in the units place, the remaining 5 digits {1, 3, 5, 7, 9} are arranged in the remaining 5 places in 5! ways.
Required number = 5! = **120**.

Q6. The English alphabet has 5 vowels and 21 consonants. How many words with two different vowels and 2 different consonants can be formed from the alphabet?

Vowels can be chosen in $^{5}C_{2} = 10$ ways, and consonants in $^{21}C_{2} = 210$ ways, giving $10 \times 210 = 2100$ groups of 4 letters. Each group of 4 letters can be arranged in $4! = 24$ ways.
Required number of words = 2100 × 24 = **50400**.

Q7. In an examination, a question paper consists of 12 questions divided into two parts i.e., Part I and Part II, containing 5 and 7 questions, respectively. A student is required to attempt 8 questions in all, selecting at least 3 from each part. In how many ways can a student select the questions?

The possible splits of 8 questions with at least 3 from each part (Part I has only 5 questions, Part II has only 7) are (3,5), (4,4), (5,3):

3 from Part I, 5 from Part II: $^{5}C_{3} \times {}^{7}C_{5} = 10 \times 21 = 210$

4 from Part I, 4 from Part II: $^{5}C_{4} \times {}^{7}C_{4} = 5 \times 35 = 175$

5 from Part I, 3 from Part II: $^{5}C_{5} \times {}^{7}C_{3} = 1 \times 35 = 35$

Required number of ways = 210 + 175 + 35 = **420**.

Q8. Determine the number of 5-card combinations out of a deck of 52 cards if each selection of 5 cards has exactly one king.

One king is chosen from 4 kings in $^{4}C_{1} = 4$ ways. The remaining 4 cards are chosen from the 48 non-king cards in $^{48}C_{4} = 194580$ ways.
Required number = 4 × 194580 = **778320**.

Q9. It is required to seat 5 men and 4 women in a row so that the women occupy the even places. How many such arrangements are possible?

A row of 9 seats has 4 even positions (2, 4, 6, 8) and 5 odd positions (1, 3, 5, 7, 9). The 4 women can occupy the 4 even places in 4! ways, and the 5 men can occupy the 5 odd places in 5! ways.
Required number = 4! × 5! = 24 × 120 = **2880**.

Q10. From a class of 25 students, 10 are to be chosen for an excursion party. There are 3 students who decide that either all of them will join or none of them will join. In how many ways can the excursion party be chosen?

Case 1: All 3 join. Choose the remaining 7 from the remaining 22 students: $^{22}C_{7} = 170544$.

Case 2: None of the 3 join. Choose all 10 from the remaining 22 students: ${}^{22}C_{10}$ = 646646.
Required number = 170544 + 646646 = **817190**.

Q11. In how many ways can the letters of the word ASSASSINATION be arranged so that all the S's are together?

ASSASSINATION has 13 letters: A(3), S(4), I(2), N(2), T(1), O(1).
Treating all 4 S's as a single block, we have 10 units to arrange: the S-block, A(3), I(2), N(2), T(1), O(1).
Required number = 10!/(3! 2! 2!) = 3628800/24 = **151200**.

Class 11 Maths Chapter 6 – Notes and Extra Questions

Fundamental Principle of Counting: If an event can occur in m different ways, and following it, a second event can occur in n different ways, then the two events together can occur in m × n ways.

Factorial notation: n! = n × (n−1) × (n−2) × … × 2 × 1, the product of the first n natural numbers. By convention, 0! = 1.

Permutations formula: The number of permutations of n distinct objects taken r at a time (without repetition) is ${}^nP_r = n!/(n-r)!$, where $0 \le r \le n$.

Permutations with repetition allowed: The number of permutations of n distinct objects taken r at a time, when repetition is allowed, is n^r.

Permutations with repeated objects: The number of permutations of n objects, where p_1 objects are of one kind, p_2 of a second kind, …, p_k of a kth kind (and the rest, if any, are distinct), is $n!/(p_1!\ p_2!\ \ldots\ p_k!)$.

Combinations formula: The number of combinations (selections) of n distinct objects taken r at a time is ${}^nC_r = n!/[r!(n-r)!]$, where $0 \le r \le n$.

Relation between permutations and combinations: ${}^nP_r = {}^nC_r \times r!$.

Key properties of ${}^nC_r$: ${}^nC_r = {}^nC_{n-r}$; ${}^nC_0 = {}^nC_n = 1$; and ${}^nC_r + {}^nC_{r-1} = {}^{n+1}C_r$ (Pascal's rule).

Permutation vs Combination: Use a permutation when the order of arrangement matters (e.g., arranging letters, forming numbers); use a combination when only the selection matters and order is irrelevant (e.g., choosing a committee, selecting cards).

What is the difference between a permutation and a combination?

A permutation is an arrangement of objects where the order matters, such as arranging letters to form a word or digits to form a number. A combination is a selection of objects where order does not matter, such as choosing members for a committee. Since every combination of r objects can be arranged in r! ways, the two are related by ${}^nP_r = {}^nC_r \times r!$.

How many exercises are there in Class 11 Maths Chapter 6 in the current NCERT textbook?

The current (2026-27 rationalised) NCERT Class 11 Maths textbook has four exercises in this chapter — Exercise 6.1 (Fundamental Principle of Counting), Exercise 6.2 (factorial notation), Exercise 6.3 (Permutations), and Exercise 6.4 (Combinations) — followed by a Miscellaneous Exercise that combines concepts from the whole chapter.

Why is 0! defined as 1?

0! is defined as 1 by convention so that formulas like $^nP_r = n!/(n-r)!$ and $^nC_r = n!/[r!(n-r)!]$ remain valid even when $r = n$. For example, $^nP_n = n!/0! = n!/1 = n!$, which correctly gives the number of ways to arrange all n objects.

What are some real-life applications of permutations and combinations?

Permutations and combinations are used in forming passwords and PIN codes, arranging seating plans, selecting sports teams or committees, dealing cards in games, planning timetables, and in probability calculations. They form the foundation for the Binomial Theorem and Probability chapters that follow later in the syllabus.