

Mathematics

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(Chapter – 7) (Permutations and Combinations)

(Class – XI)

Exercise 7.4

Question 1:

If ${}^n C_8 = {}^n C_2$, find ${}^n C_2$

Answer 1:

It is known that, ${}^n C_a = {}^n C_b \Rightarrow a = b$ or $n = a + b$

Therefore,

$${}^n C_8 = {}^n C_2 \Rightarrow n = 8 + 2 = 10$$

$$\therefore {}^n C_2 = {}^{10} C_2 = \frac{10!}{2!(10-2)!} = \frac{10!}{2!8!} = \frac{10 \times 9 \times 8!}{2 \times 1 \times 8!} = 45$$

Question 2:

Determine n if

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

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

Answer 2:

(i)

$$\frac{{}^{2n} C_3}{{}^n C_3} = \frac{12}{1}$$

$$\Rightarrow \frac{(2n)!}{3!(2n-3)!} \times \frac{3!(n-3)!}{n!} = \frac{12}{1}$$

$$\Rightarrow \frac{(2n)(2n-1)(2n-2)(2n-3)!}{(2n-3)!} \times \frac{(n-3)!}{n(n-1)(n-2)(n-3)!} = 12$$

$$\Rightarrow \frac{2(2n-1)(2n-2)}{(n-1)(n-2)} = 12$$

$$\Rightarrow \frac{4(2n-1)(n-1)}{(n-1)(n-2)} = 12$$

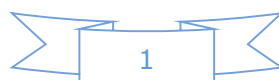
$$\Rightarrow \frac{(2n-1)}{(n-2)} = 3$$

$$\Rightarrow 2n-1 = 3(n-2)$$

$$\Rightarrow 2n-1 = 3n-6$$

$$\Rightarrow 3n-2n = -1+6$$

$$\Rightarrow n = 5$$



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(ii)

$$\begin{aligned}\frac{{}^{2n}C_3}{{}^nC_3} &= \frac{11}{1} \\ \Rightarrow \frac{(2n)!}{3!(2n-3)!} \times \frac{3!(n-3)!}{n!} &= 11 \\ \Rightarrow \frac{(2n)(2n-1)(2n-2)(2n-3)!}{(2n-3)!} \times \frac{(n-3)!}{n(n-1)(n-2)(n-3)!} &= 11 \\ \Rightarrow \frac{2(2n-1)(2n-2)}{(n-1)(n-2)} &= 11 \\ \Rightarrow \frac{4(2n-1)(n-1)}{(n-1)(n-2)} &= 11 \\ \Rightarrow \frac{4(2n-1)}{n-2} &= 11 \\ \Rightarrow 4(2n-1) &= 11(n-2) \\ \Rightarrow 8n-4 &= 11n-22 \\ \Rightarrow 11n-8n &= -4+22 \\ \Rightarrow 3n &= 18 \\ \Rightarrow n &= 6\end{aligned}$$

Question 3:

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

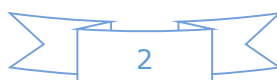
Answer 3:

For drawing one chord on a circle, only 2 points are required.

To know the number of chords that can be drawn through the given 21 points on a circle, the number of combinations have to be counted.

Therefore, there will be as many chords as there are combinations of 21 points taken 2 at a time.

$$\text{Thus, required number of chords} = {}^{21}C_2 = \frac{21!}{2!(21-2)!} = \frac{21!}{2!19!} = \frac{21 \times 20}{2} = 210$$



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Question 4:

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

Answer 4:

A team of 3 boys and 3 girls is to be selected from 5 boys and 4 girls.

3 boys can be selected from 5 boys in 5C_3 ways.

3 girls can be selected from 4 girls in 4C_3 ways.

Therefore, by multiplication principle, number of ways in which a team of 3 boys and 3

$$\begin{aligned} \text{girls can be selected} &= {}^5C_3 \times {}^4C_3 = \frac{5!}{3!2!} \times \frac{4!}{3!1!} \\ &= \frac{5 \times 4 \times 3!}{3! \times 2} \times \frac{4 \times 3!}{3!} \\ &= 10 \times 4 = 40 \end{aligned}$$

Question 5:

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.

Answer 5:

There are a total of 6 red balls, 5 white balls, and 5 blue balls.

9 balls have to be selected in such a way that each selection consists of 3 balls of each colour.

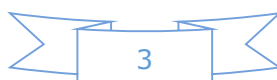
Here,

3 balls can be selected from 6 red balls in 6C_3 ways.

3 balls can be selected from 5 white balls in 5C_3 ways.

3 balls can be selected from 5 blue balls in 5C_3 ways.

Thus, by multiplication principle, required number of ways of selecting 9 balls



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$$\begin{aligned} &= {}^6C_3 \times {}^5C_3 \times {}^5C_3 = \frac{6!}{3!3!} \times \frac{5!}{3!2!} \times \frac{5!}{3!2!} \\ &= \frac{6 \times 5 \times 4 \times 3!}{3! \times 3 \times 2} \times \frac{5 \times 4 \times 3!}{3! \times 2 \times 1} \times \frac{5 \times 4 \times 3!}{3! \times 2 \times 1} \\ &= 20 \times 10 \times 10 = 2000 \end{aligned}$$

Question 6:

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

Answer 6:

In a deck of 52 cards, there are 4 aces. A combination of 5 cards have to be made in which there is exactly one ace.

Then, one ace can be selected in 4C_1 ways and the remaining 4 cards can be selected out of the 48 cards in ${}^{48}C_4$ ways.

Thus, by multiplication principle, required number of 5 card combinations

$$\begin{aligned} &= {}^{48}C_4 \times {}^4C_1 = \frac{48!}{4!44!} \times \frac{4!}{1!3!} \\ &= \frac{48 \times 47 \times 46 \times 45}{4 \times 3 \times 2 \times 1} \times 4 \\ &= 778320 \end{aligned}$$

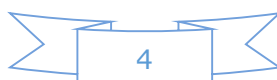
Question 7:

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?

Answer 7:

Out of 17 players, 5 players are bowlers.

A cricket team of 11 players is to be selected in such a way that there are exactly 4 bowlers.



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4 bowlers can be selected in 5C_4 ways and the remaining 7 players can be selected out of the 12 players in ${}^{12}C_7$ ways.

Thus, by multiplication principle, required number of ways of selecting cricket team

$$= {}^5C_4 \times {}^{12}C_7 = \frac{5!}{4!1!} \times \frac{12!}{7!5!} = 5 \times \frac{12 \times 11 \times 10 \times 9 \times 8}{5 \times 4 \times 3 \times 2 \times 1} = 3960$$

Question 8:

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.

Answer 8:

There are 5 black and 6 red balls in the bag.

2 black balls can be selected out of 5 black balls in 5C_2 ways and 3 red balls can be selected out of 6 red balls in 6C_3 ways.

Thus, by multiplication principle, required number of ways of selecting 2 black and 3 red

$$\text{balls} = {}^5C_2 \times {}^6C_3 = \frac{5!}{2!3!} \times \frac{6!}{3!3!} = \frac{5 \times 4}{2} \times \frac{6 \times 5 \times 4}{3 \times 2 \times 1} = 10 \times 20 = 200$$

Question 9:

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?

Answer 9:

There are 9 courses available out of which, 2 specific courses are compulsory for every student.

Therefore, every student has to choose 3 courses out of the remaining 7 courses. This can be chosen in 7C_3 ways.



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Thus, required number of ways of choosing the programme

$$= {}^7C_3 = \frac{7!}{3!4!} = \frac{7 \times 6 \times 5 \times 4!}{3 \times 2 \times 1 \times 4!} = 35$$

