MATHEMATICS · GRADES 10-12

Combinations

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you count the groups you can make when order does not matter. Picking a three-person team from your class or choosing toppings for a pizza are combinations, because the same team in a different order is still the same team. Knowing how to count them stops you from listing every possibility by hand when the numbers get big.



Rule

A combination counts groups where order does not matter.

Choosing the same group in a different order still counts as one group. The number of ways to choose r things from n is $C(n, r) = \frac{n!}{r! \times (n - r)!}$.

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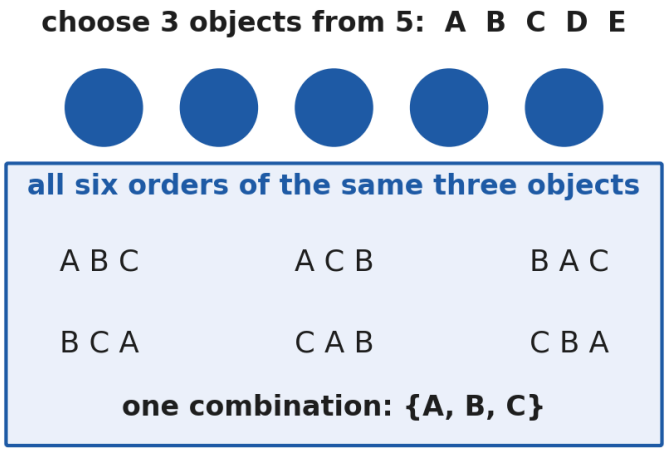
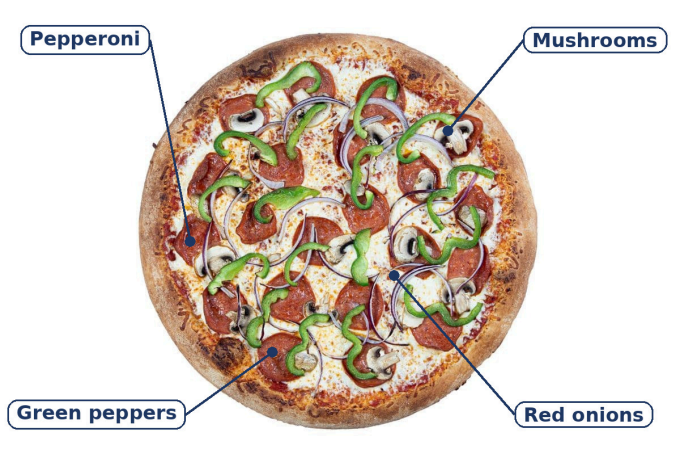


Worked examples

EXAMPLE 1

Q How many ways can you choose 2 toppings from 4?



SOLUTION

Toppings: pepperoni, mushrooms, green peppers, onions

Pairs: (pepperoni, mushrooms), (pepperoni, green peppers), (pepperoni, onions), (mushrooms, green peppers), (mushrooms, onions), (green peppers, onions).

Order inside a pair does not matter, so each pair is counted once.

So the answer is 6 ways.

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EXAMPLE 2

Q Find C(5, 2), the number of ways to choose 2 out of 5.

SOLUTION

Put n = 5 and r = 2 into the formula. The 3! on the top and the bottom cancel, leaving $C(5, 2) = \frac{(5 \times 4)}{(2 \times 1)}$.

The top works out to 5 × 4 = 20, and the bottom works out to 2 × 1 = 2, so this is 20 divided by 2.

C(5, 2) = 10

Practice questions

1 A coach must pick 2 captains from 4 players. How many ways can she choose them?

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2 A pizza shop offers 6 toppings. How many ways can you choose 2?

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3 A salad bar has 5 toppings. How many ways can you choose 3?

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4 A committee of 3 is chosen from 8 volunteers. How many ways can it be chosen?

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5 When do you use a combination instead of a permutation?

- A When order matters
- B When you choose all the items
- C When order does not matter
- D When repetition is allowed

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6 A teacher picks 2 monitors from 7 students. How many ways can she pick them?

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7 From a 5-card set, how many different 2-card hands can you deal if order does not matter?

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8 A DJ picks 1 song from 8 to open the show. How many ways can she pick it?

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9 **A coach picks a team of 2 from 10 players. How many different teams can she pick?**

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10 **A lottery ticket picks 3 numbers from 10. How many different tickets are possible?**

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ANSWER KEY

1. 6

2. 15

3. 10

4. 56

5. When order does not matter

6. 21

7. 10

8. 8

9. 45

10. 120

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