



When to 'Add' and 'Multiply' in Permutation & Combination



By e-gmat.com

Objective of this Article

Why should you read this article?

- Are you someone who is confused whether to add or multiply the cases while solving permutation and combination questions?
- Do you often get questions incorrect simply because you added entities instead of multiplying them?

If the answer to any of the above questions is yes, then in this [e-GMAT](#) article you will learn how to get rid of the confusion by using “AND” & “OR” on these questions.

What will you learn from this article ?

In this e-GMAT article, we will,

- Dive into the details of the application of “AND” & “OR” in permutation and combination.
- Discuss the attributes that AND – OR present through a few GMAT like questions
- Help you to solidify the understanding of the above two keywords and at the end of the article, we will also provide you some practice questions to test your understanding.

When to Add – Usage of keyword “OR”

While solving any P and C question, the most frequent confusion that students have is: “Do I need to add up all the cases or do I need to multiply all the cases?”

Let's understand what I am trying to say with the help of two questions!

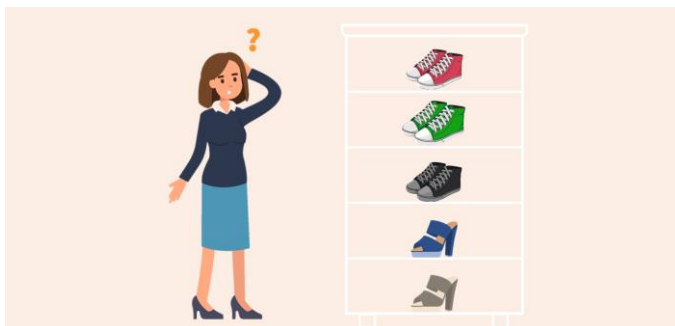
② Amy has 3 different types of shoes and 2 different types of sandals. Whenever she goes out, she likes to wear either a shoe or a sandal. In how many ways can she decide what to wear?

② Joe has 3 different types of shirts and 2 different types of trousers. Whenever he goes out, he likes to wear a shirt and a trouser. In how many ways can he decide what to wear?

Look at these two situations. In both these cases, the numbers are the same. The only difference is that Amy will choose either shoes **OR** sandals to wear and in the second case Joe is going to choose both a shirt **AND** a trouser.

Let us focus on Amy's situation first, and then we will come to Joe.

- ❓ **Amy has 3 different types of shoes and 2 different types of sandals. Whenever she goes out, she likes to wear either a shoe or a sandal. In how many ways can she decide what to wear?**



⚙️ Solution:

Assuming that she has red, green, and black shoes, and she has brown and blue sandals, let us list down all the possible options that she has.

1. She can wear Red Shoes OR
2. She can wear Green shoes OR
3. She can wear Black Shoes OR
4. She can wear Brown Sandals OR
5. She can wear Blue Sandals

Notice how we have used the word OR after each and every case. The OR here emphasizes on the fact that Amy does not have the option to wear two different kind of things at the same time! She needs to choose only 1 of these.

Thus, the answer in this case will be 5.

Now let use the keyword approach (OR) to solve this question easily! 😊

Keyword Approach by e-GMAT

Look at the question once again:

- Amy has 3 different types of shoes and 2 different types of sandals. Whenever she goes out, she likes to wear either a shoe OR a sandal. In how many ways can she decide what to wear?
 - Notice the OR that I have highlighted in this question.
- Whenever you read a question, look for the keyword OR or AND. While looking for the keyword, focus on what we need to find out.
 - In this case we need to find the number of ways in which she can wear a shoe OR a sandal.
 - Since the word OR is used here, we can conclude that both the events cannot happen together.
 - By event I mean, Amy cannot wear Shoe, and Sandal together.

Whenever we have a situation in which two events cannot occur simultaneously, we simply add all the cases. Thus, in this case, we will say:

Total possible cases for Amy = She will wear shoes OR she will wear Sandals

Number of ways she can wear shoes = 3

Number of ways she can wear Sandals = 2

Therefore, total possible cases = 3 OR 2 = $3 + 2 = 5$

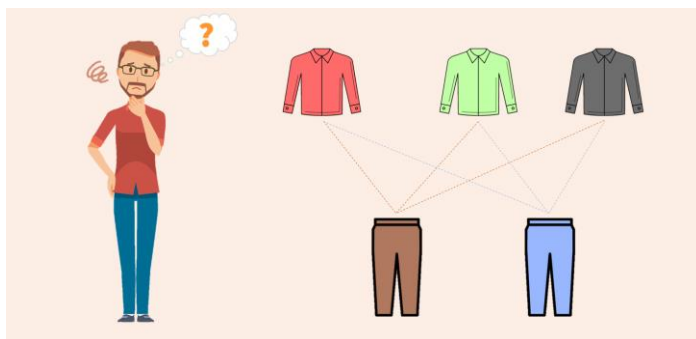
Takeaway by e-GMAT experts

- Whenever we come across a situation involving 2 or more events, and occurrence of one event does not affect the occurrence of the other event, i.e., both of the events cannot occur simultaneously, then in that case we will simply add up all the events!
- Look for the word OR in the question while figuring out what you need to find out and if OR is present then that means you need to add up the events.

When to Multiply – Usage of Keyword “AND”

Now let us look at Joe's case.

- ❓ **Joe has 3 different types of shirts and 2 different types of trousers. Whenever he goes out, he likes to wear a shirt and a trouser. In how many ways can he decide what to wear?**



Solution:

Assuming that he has red, green, and a black shirt, and he has brown and blue trousers, let us list down all the possible options that he has.

1. He can wear Red Shirt AND Brown Trousers
2. He can wear Red Shirt AND Blue Trousers
3. She can wear Green shirt AND Brown Trousers
4. She can wear Green shirt AND Blue Trousers
5. She can wear Black shirt AND Brown Trousers
6. She can wear Black shirt AND Blue Trousers

Notice how I have used the word AND after each and every case. The AND here emphasizes on the fact that Joe has to wear both shirt AND trousers at the same time!

We cannot imagine a scenario, where he wears just a shirt OR just a trouser.

From the above cases, we can see that he has 6 different options of wearing a shirt and a trouser.

Now let use the keyword approach (AND) to solve this question easily! 😊

Let's use the Keyword "AND"

Look at the question once again:

- Joe has 3 different types of shirts and 2 different types of trousers. Whenever he goes out, he likes to wear a shirt AND a trouser. In how many ways can he decide what to wear?
 - Notice the AND that I have highlighted in this question.
- In this case also focus on what we need to find out.
 - In this case we need to find the number of ways he can wear a shirt AND a trouser.
 - Since the word AND is used here, we can conclude that both the events need to happen together.
 - Which means he needs to wear the shirt and trouser together.

Whenever we have a situation in which two events can happen simultaneously, we simply "multiply" all the cases. Thus, in this case, we can say

Total possible cases for Joe = He will wear a Shirt AND he will wear Trousers

Number of ways he can wear a shirt = 3 (Red OR Green OR Black) [Keyword OR: hence addition]

Number of ways he can wear trousers = 2 (Blue OR Brown)

Therefore, total possible cases = 3 AND 2 = $3 \times 2 = 6$

Takeaway by e-GMAT experts

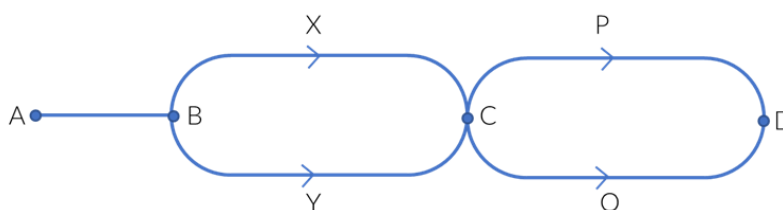
- Please remember that whenever we come across a situation involving 2 or more events and **each event can happen simultaneously**, i.e., event 1, event 2, event 3 and so on, all can happen simultaneously.
- Then in that case we will simply MULTIPLY up all the events!
- Look for the word AND in the question while figuring out what you need to find out, and if AND is present, then that means you need to add up the events.

What to do when AND or OR keyword is not present?

Now, there could be a situation when the word AND or OR is not explicitly mentioned in the question. What should we do then? Let us understand this with the help of 3 examples:

e-GMAT Example 1

? In how many ways can you go from Point A to point D?



Solution:

In the question and diagram, you can see that there is no mention of the word AND or OR, so what should we do?

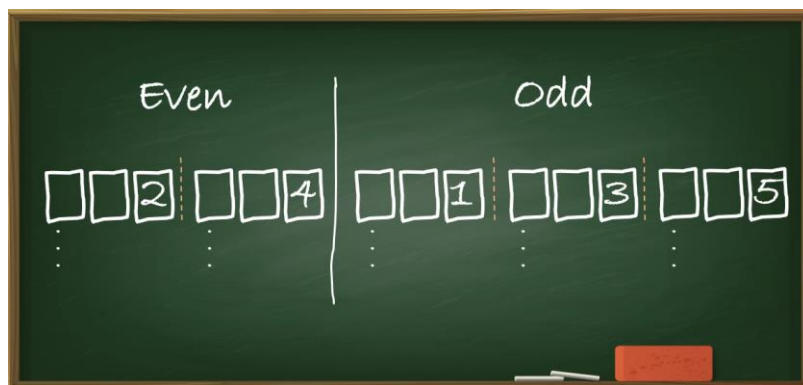
- Well, we will simply look at each and every end point and figure out what we are exactly doing.
- So, think, in how many ways can we go from point A to B?
 - We can go in one way, right?
 - So, let us just write $A \rightarrow B : 1 \text{ way}$
- Now, when we want to go from B to C, we can go via X OR Y.
 - Notice how we are using the word OR here.
 - We know that we cannot simultaneously go via both the routes. And thus, we need to use the word OR here.
 - Thus, total number of ways to go from B to C = 2
 - $B \rightarrow X \rightarrow C \text{ OR } B \rightarrow Y \rightarrow C = 2 \text{ ways}$
- Lastly, we want to go to our final destination D, we can go via P OR Q
 - In this case also, we are using the word OR.
 - Hence, we will simply ADD all the cases and get $C \rightarrow D = 2 \text{ ways}$.
- So, now we know that we can go from A to B in 1 way, then from B to C in 2 ways and from C to D in 2 ways.
 - Now, ask yourself, should we add these cases or multiply?
 - Can we reach from A to D by going through A to B or B to C or C to D?
 - No, we cannot, right?
 - We need to go from A to B AND then from B to C AND finally from C to D to reach our destination.

Thus, total cases possible are $= 1 \times 2 \times 2 = 4 \text{ ways}$

e-GMAT Example 2

Let us increase the difficulty a bit and figure out how to solve the following question.

- ❓ **How many 3 digits even numbers can be created using the digits 1,2,3, 4 and 5 without repetition of digits?**

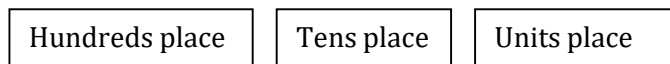


Solution:

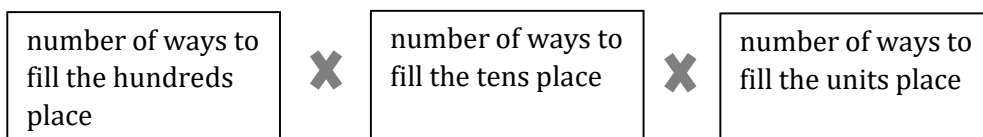
This question does not mention the keywords, AND or OR.

Hence, we will try to figure out what the question is asking.

Any 3-digit number can be represented as:



- We have to make a 3-digit number.
 - Now think, can we make a three-digit number by just filling the Units place OR the tens place OR the hundreds place?
 - No, we cannot, Right?
 - Thus, we have to fill the units place AND the tens place AND the hundreds place to get the three-digit number.
 - Notice, we used the keyword AND here. Hence, we will multiply all the cases
 - Thus, total ways =



- We have to form a 3 digit even number.
 - Hence, the units digit of the number must be even.
 - Among the given digits: 1, 2, 3, 4, and 5, the units can be filled with 2 digits.
 - Either 2 OR 4.
 - Can you see the usage of the keyword OR here?
 - Hence, the number of ways to fill the units place = 2

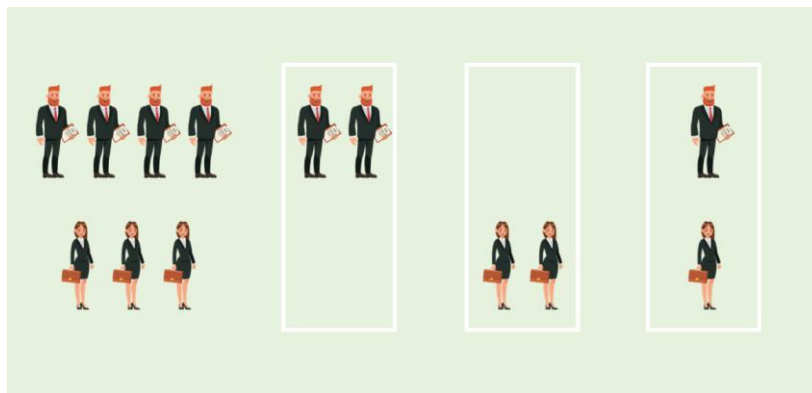
- Now, we have filled the units digit to take care of the even nature of the number
 - We have 4 digits remaining – 1 even and 3 odd.
 - The tens place can be filled with either 1 OR 3 OR 5 OR the remaining number between (2/4).
 - Thus, total ways to fill tens place= 4 ways.
- Now, we only have to fill the last digit and we have 3 digits remaining.
 - Are you now able to visualise that we will use OR to select 1 among the 3 digits?
 - We can select either the 1st remaining digit OR the 2nd remaining digit OR the 3rd remaining digit.
 - We used the keyword OR here. Hence, we will add the cases.
 - Thus, total ways to fill tens place= 3 ways.
- As discussed, we need to multiply all these 3 individual cases to get the total number of ways in which the number can be formed.

◦ Hence total ways= $3 \times 4 \times 2 = 24$ ways

Let us come to the last question of this [e-GMAT](#) article.

e-GMAT Example 3

- ❓ **A committee of 2 members is to be formed from a panel of 4 male and 3 female members of a club. In how many ways can the committee be formed?**



Solution:

You should now start thinking a step ahead to find the use of AND/OR in such problems. Let us find out how we can form the committee of 2 members in the above question.

- We can select either 2 males OR 2 females OR 1 male AND 1 female to form the committee.
 - Look for the keywords- AND and OR in the above statement.
 - Now it is easy, we know that we add the number of cases when we have an OR, and, we multiply the cases when we have an AND.

- Total ways = ways to select 2 males + ways to select 2 females + ways to select 1 male × ways to select 1 female

Let us find in how many we can select 2 males, 2 females and 1 male and 1 female.

We have 4 males:

- We can select 2 males from 4 males in $4C2$ ways and,
- We can select 1 male from 4 males in $4C1$ ways.

We have 3 females:

- We can select 2 females in $3C2$ ways and,
- We can select 1 females in $3C1$ ways.

Thus, total ways = $4C2 + 3C2 + 4C1 \times 3C1 = 6 + 3 + 4 \times 3 = 21$

Thus, the committee can be formed in 21 ways.

Takeaways from this article

1. Specific keywords can be the X factor in solving PNC questions. You can trust them, but at the same time apply common sense just to be sure you are on the right path.
2. Always try to figure out after reading the question whether the events are dependent or independent. Making this inference will help you solve the question more efficiently.
3. Whenever we have a situation where OR is involved, please ADD up all the events.
4. Whenever we have a situation where AND is involved, please MULTIPLY all the events,
5. Whenever the keyword is not available, always try to jot down all the events first and then decide whether you need them together or independently.

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Upcoming e-GMAT articles on Permutation & Combination

This article is one of a series of [e-GMAT](#) articles that we are going to write on Permutation and Combination.

- We have two more articles coming up in the next 10 days, in which we are going to discuss the following aspects:



You will learn a sure shot way to identify when to apply selection and when to apply both, selection, and arrangement.



You will learn how to avoid double counting: A common mistake made by a majority of student!

Stay tuned....

Practice Questions by e-GMAT

Now, let's apply the above takeaways on some GMAT styled questions. Click on the following links to access the questions.

 [Question 1](#)

 [Question 2](#)

 [Question 3](#)

 [Question 4](#)

 [Question 5](#)





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