Inspiring Greatness

ISD

INDEPENDENCE SCHOOL DISTRICT

Math Virtual Learning

Algebra IIB

May 19, 2020

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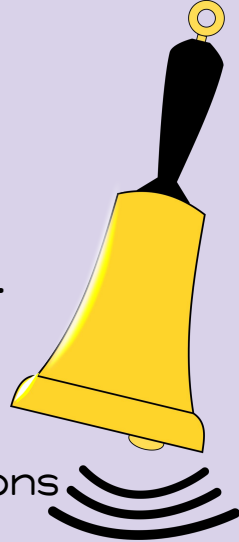
Lesson: May 19, 2020

Objective/Learning Target:
Students will be able to calculate the number of possible outcomes for a Combination or Permutations

Let's Get Started!



Below is one Combination, one Permutation and one Counting Principle situation. Identify which one is which.

1. The school cafeteria offers 3 types of milk and 1 juice, 5 main entrees, and 4 serve yourself sides to choose from. How many different meal combinations can you choose from to make your lunch?
2. Students submitted 8 songs to be played at the next pep assembly, but there is only time to play 4 of them. All 8 songs are liked equally well. How many ways can the student council choose the 4 songs that will be played?
3. A crime has been committed. The police have 9 suspects. How many ways can they create a line-up of 5 suspects at a time?

Let's Get Started! ANSWERS

Below is one Combination, one Permutation and one Counting Principle situation. Identify which one is which.

1. The school cafeteria offers 3 types of milk and 1 juice, 5 main entrees, and 4 serve yourself sides to choose from. How many different meal combinations can you choose from to make your lunch? **This is a COUNTING PRINCIPLE because you are making 3 choices from a list of choices.**
2. Students submitted 8 songs to be played at the next pep assembly, but there is only time to play 4 of them. All 8 songs are liked equally well. How many ways can the student council choose the 4 songs that will be played? **This is a COMBINATION because the order that the songs are played in doesn't matter. 4 songs is 4 songs in any order.**
3. A crime has been committed. The police have 9 suspects. How many ways can they create a line-up of 5 suspects at a time? **This is a PERMUTATION because order matters. A suspect is the 1st position is not the same as that same suspect in the 3rd position. Each position is counted as a different line-up.**

How many ways….

Yesterday we learned how to determine if a situation is classified as a Counting Principle, Combination or Permutation.

Today we are going to learn how to calculate the number of possibilities.

We have already learning how to find the number of possibilities if it is a Counting Principle situation. Just a reminder for those, it is the product of the number of options for each choice.

For Combination and Permutations, we are going to use formulas.

Formulas for Calculating the Number of Possibilities

COMBINATION

$$C(n,r) = \frac{n!}{r!(n-r)!}$$

PERMUTATION

$$P(n,r) = \frac{n!}{(n-r)!}$$

Understanding the Formulas

- n = the number of total options
- r = the number of options you are choosing from the total
- ! stands for factorial.
  Factorial is to multiply the number by all the numbers less than it until you get to 1 (5! = 5*4*3*2*1 8! = 8*7*6*5*4*3*2*1)
  NOTE: 0! = 1

Calculating the Number of Possibilities

COMBINATION

$$C(n,r) = \frac{n!}{r!(n-r)!}$$

Ex 1: There are 9 people in my AP class and my teacher is forming groups of 3. How many ways can the groups be formed.

n = 9 because there are 9 total people in the class

r = 3 because each group is choosing three people

n - r = 6

$$C(9,3) = \frac{9!}{(3!)(6!)} = \frac{9*8*7*6*5*4*3*2*1}{(3*2*1)(6*5*4*3*2*1)}$$

$$\frac{362880}{6*720} = \frac{362880}{4320} = 84$$

There are 84 possible student groups

Calculating the Number of Possibilities

COMBINATION

$$C(n,r) = \frac{n!}{r!(n-r)!}$$

Ex 2: There 8 different types of flowers in the yard and I want to pick four of them for my mother. What are all the different ways can the bouquet be made?

n = 8 because there are 8 total types of flowers

r = 4 because I am picking four of the 8 for the bouquet

n - r = 4

$$C(8,4) = \frac{8!}{4!\,4!} = \frac{8*7*6*5*4*3*2*1}{(4*3*2*1)(4*3*2*1)}$$

$$\frac{40320}{(24)(24)} = \frac{40320}{576} = 70$$

There are 70 different ways the bouquet could be made.

You Try! Find the number of combinations for each

COMBINATION

$$C(n,r) = \frac{n!}{r!(n-r)!}$$

1. A 4 person subcommittee needs to be selected from a group of 11 people. How many ways can the committee be formed?

2. There are 12 standbys hoping to get on a flight to Kansas City. There are currently 5 seats available. How many different ways can the group of 5 be picked?

You Try #1 Answer

COMBINATION

$$C(n,r) = \frac{n!}{r!(n-r)!}$$

1: A 4 person subcommittee needs to be selected from a group of 11 people. How many ways can the committee be formed?

n = 11

r = 4

n - r = 7

$$C(11,4) = \frac{11!}{4!\,7!} = \frac{11*10*9*8*7*6*5*4*3*2*1}{(4*3*2*1)(7*6*5*4*3*2*1)}$$

$$\frac{39916800}{24*5040} = \frac{39916800}{120960} = 330$$

There are 330 ways the subcommittee could be formed.

You Try #2 Answer

COMBINATION

$$C(n,r) = \frac{n!}{r!(n-r)!}$$

2: There are 12 standbys hoping to get on a flight to Kansas City. There are currently 5 seats available. How many different ways can the group of 5 be picked?

n = 12

r = 5

n - r = 7

$$C(11,4) = \frac{12!}{5!\,7!} = \frac{12*11*10*9*8*7*6*5*4*3*2*1}{(5*4*3*2*1)(7*6*5*4*3*2*1)}$$

$$= \frac{479001600}{120*5040} = \frac{479001600}{604800} = 792$$

There are 792 possible groups of 5 people.

Calculating the Number of Possibilities

PERMUTATION

$$P(n,r) = \frac{n!}{(n-r)!}$$

Ex 1: I am in a drawing with three other people. First place gets a TV, Second place gets a BluRay player, Third place gets a $50 gift card and Fourth Place gets a $10 gift card. How many ways can we all win?

n = 4 because there are 4 total people in the class

r = 4 because all four are going to be chosen

n - r = 0

$$P(4,4) = \frac{4!}{0!} = \frac{4*3*2*1}{1} = \frac{24}{1} = 24$$

There are 24 different ways we could all win prizes.

Calculating the Number of Possibilities

PERMUTATION

$$P(n,r) = \frac{n!}{(n-r)!}$$

Ex 2: There are 10 people in the race. There is a metal for the top four racers. What are the possible ways that they could finish 1st to 4th place?

n = 10 because there are 10 total racers

r = 4 because we are only choosing the top 4 racers

n - r = 6

$$P(10,4) = \frac{10!}{6!} = \frac{10*9*8*7*6*5*4*3*2*1}{6*5*4*3*2*1}$$

$$\frac{3628800}{720} = 5040$$

There are 5040 different ways the racers could place 1st-4th place

You Try! Find the number of permutations for each

PERMUTATION

$$P(n,r) = \frac{n!}{(n-r)!}$$

3. A segment of the radio will play 4 songs (out of 8 options). How many ways can the playlist be arranged?

4. In a production of Grease, seven actors are considered for the male roles of Danny, Kenickie and Marty. How many ways can the roles be cast?

You Try #3 Answer

PERMUTATION

$$P(n,r) = \frac{n!}{(n-r)!}$$

3: A segment of the radio will play 4 songs (out of 8 options). How many ways can the playlist be arranged?

n = 8

r = 4

n - r = 4

$$P(8,4) = \frac{8!}{4!} = \frac{8*7*6*5*4*3*2*1}{4*3*2*1} = \frac{40320}{24} = 1680$$

There are 1680 different orders for the playlist.

You Try #4 Answer

PERMUTATION

$$P(n,r) = \frac{n!}{(n-r)!}$$

4: In a production of Grease, seven actors are considered for the male roles of Danny, Kenickie and Marty. How many ways can the roles be cast?

n = 7

r = 3

n - r = 4

$$P(7,4) = \frac{7!}{4!} = \frac{7*6*5*4*3*2*1}{4*3*2*1} = \frac{5040}{24} = 210$$

There are 210 different ways the roles could be cast.

Using Technology

Using the formulas for the sample problems we had was doable - annoying maybe - but doable. However, if you start to get larger numbers in your problems, it becomes unreasonable. What if we were talking about your high school and we had to calculate 1000! ? That would be a nightmare.

Therefore, a helpful tool is this **PERMUTATION & COMBINATION CALCULATOR.**

This tool will let you input N and R and it will calculate the P(N,R) or C(N,R) for you.

You Try: Mixed Practice

COMBINATION

$$C(n,r) = \frac{n!}{r!(n-r)!}$$

PERMUTATION

$$P(n,r) = \frac{n!}{(n-r)!}$$

Identify if the problem is a Combination or Permutation and then find the total number of possibilities

5. In the Long Beach Air Race, there are 6 planes entered, assuming there are no ties, how many ways can the top three finishers place?

6. There are 30 songs in your graduation playlist, but there is only time to play 4. How many ways can the playlist of 4 songs be arranged?

7. There are 100 actors trying out for a musical chorus of 12 people. How many different ways can the group of 12 singers be selected?

You Try #5 Answer

PERMUTATION

$$P(n,r) = \frac{n!}{(n-r)!}$$

5: In the Long Beach Air Race, there are 6 planes entered, assuming there are no ties, how many ways can the top three finishers place?

n = 6

r = 3

n - r = 3

$$P(6,3) = \frac{6!}{3!} = \frac{6*5*4*3*2*1}{3*2*1} = \frac{720}{6} = 120$$

There are 120 ways the top 3 finishers could place.

You Try #6 Answer

PERMUTATION

$$P(n,r) = \frac{n!}{(n-r)!}$$

6: There are 30 songs in your graduation playlist, but there is only time to play 4. How many ways can the playlist of 4 songs be arranged?

n = 30

r = 4

n - r = 26

Because the number 30 is so large, I used the calculator linked earlier and found there are 657,720 ways the playlist could be arranged.

You Try #7 Answer

COMBINATION

$$C(n,r) = \frac{n!}{r!(n-r)!}$$

7: There are 100 actors trying out for a musical chorus of 12 people. How many different ways can the group of 12 singers be selected?

n = 100

r = 12

n - r = 88

**Because the number 100 is so large, I used the calculator linked earlier. There are 1,050,421,051,106,700 ways the chorus of 12 singers could be formed.