Permutation Restriction – “Together or Not” – Practice

1. There are 13 books on a shelf, including 4 math texts. If the 4 math texts must be together on the shelf, how many ways can the books be arranged?
   A) (13!) – (4!)   B) (10!)(4!)   C) 9!   D) (13!)(4!)

2. Every week, a used car dealer advertizes the best deals on 5 featured cars and lines them up in a special spot near the main roadway. This week he has a Honda, a Hyundai, a Ford, a Chev and a Dodge. How many ways could he arrange these 5 cars if the Honda and the Hyundai **cannot** be together?
   A) 12   B) 36   C) 72   D) 144

3. A high school football coach has 5 starting offensive linemen (center, 2 tackles and 2 guards) who can all play any of the 3 positions. In certain situations, he would like to have his 3 (out of these 5) best over-all athletes all together. How many ways can the coach arrange his 5 linemen if the 3 best athletes are together?
   A) 9   B) 24   C) 36   D) 72

4. There are 8 children at the Day Care who are walking across a field to a park. How many ways can the 8 children hold hands, if good friends, Sarah and Marnie, want to hold hands (and it has to be Sarah’s right hand holding Marnie’s left hand)?

Answer _______

5. Determine the number of ways to arrange all the letters of the word ROUTINE, if the vowels **cannot** be together. Show all work. Explain.

6. Suppose 3 couples go to the movie theatre. In a particular row, there are 6 available seats. How many ways can the couples be seated if each couple is seated next to their partner? Show all work. Explain.

Permutation Restriction – "Together or Not" – PracticeSolutions

1. There are 13 books on a shelf, including 4 math texts. If the 4 math texts must be together on the shelf, how many ways can the books be arranged?
   A) (13!) – (4!)   B) (10!)(4!)   C) 9!   D) (13!)(4!)

Solution

Place the 4 math texts together in one stage. There are 9 other books, or 9 other stages. There are now a total of 10 stages.

Let M represent a math text.

MMMM __ __ __ __ __ __ __ __ __

The letters in each of these 10 stages can be arranged in 10! ways.

For each of these 10! ways, the 4 math books can be arranged in 4! ways. The final answer is the product of these two values.

The correct answer is B.

2. Every week, a used car dealer advertizes the best deals on 5 featured cars and lines them up in a special spot near the main roadway. This week he has a Honda, a Hyundai, a Ford, a Chev and a Dodge. How many ways could he arrange these 5 cars if the Honda and the Hyundai **cannot** be together?
   A) 12   B) 36   C) 72   D) 144

Solution

The number of ways the cars are together, and the number of ways the cars are not together are complementary; i.e. there are no other options.

Together + Not Together = Total (without restrictions)

In other words:

Not Together = Total - Together

Determine the number of ways the two cars are together first.

HH __ __ __

When the Honda and Hyundai are placed together in one stage, the total of 4 stages can be arranged in 4! ways. We need to now account for the fact that these 2 vehicles can be either [Honda/Hyundai] or [Hyundai/Honda]; in other words, 2! ways. Multiply 4! by 2! and the result is 48.

Without any restrictions, the 5 cars can be arranged in 5! ways, or 120.

Not Together = 120 - 48

Not Together = 72

The correct answer is C.

3. A high school football coach has 5 starting offensive linemen (center, 2 tackles and 2 guards) who can all play any of the 3 positions. In certain situations, he would like to have his 3 (out of these 5) best over-all athletes all together. How many ways can the coach arrange his 5 linemen if the 3 best athletes are together?

   A) 9 B) 24 C) 36 D) 72

Solution

Place the 3 best athletes (call each of the B) together in one stage.

Let B represent "best over-all athlete".

BBB __ __

Ordering these 3 stages, there are 3! ways.

Now we need to account for the fact that these 3 best over-all athletes can be in any one of 3 spots within a specific stage. The number of arrangements here is also 3!.

The final answer is the product of 3! and 3!

The correct answer is C.

4. There are 8 children at the Day Care who are walking across a field to a park. How many ways can the 8 children hold hands, if good friends, Sarah and Marnie, want to hold hands (and it has to be Sarah's right hand holding Marnie's left hand)?

Answer _5040__

Solution

Place Sarah and Marnie together in one stage.

SM __ __ __ __ __ __

There are 7! ways to order the girls given the 7 stages.

We do not have to consider ordering Sarah and Marnie in more than one way in of the 7! Stages, since we are specifically told how they are to hold hands.

The final answer is 5040.

5. Determine the number of ways to arrange all the letters of the word ROUTINE, if the vowels **cannot** be together. Show all work. Explain.

Solution

The number of ways the vowels are together, and the number of ways the vowels are not together are complementary; i.e. there are no other options.

Together + Not Together = Total (without restrictions)

In other words:

Not Together = Total - Together

First find the number of ways the vowels are together.

EIOU __ __ __

4! X 4! = 576

The total number of ways that 7 letters can be arranged with no restrictions is 7! or 5040.

Not Together = 5040 - 576

Not Together = 4464

If the vowels cannot be together, there are 4464 ways to arrange the letters of the word ROUTINE.

6. Suppose 3 couples go to the movie theatre. In a particular row, there are 6 available seats. How many ways can the couples be seated if each couple is seated next to their partner? Show all work. Explain.

Solution

$\underline{A_1A_2}$ $\underline{B_1B_2}$ $\underline{C_1C_2}$

The couples, as a pair, can seat themselves in one of three stages. Here, there are 3! ways to arrange them as a total group.

But we have to account for the fact that the couples can be arranged in 2! ways for each of the three stages above. Each of the three couples must be ordered in 2! ways.

The final answer is 3! X 2! X 2! X 2! which is equal to 48.