**Permutations and Arrangements Exercises and Solutions**

**Question 1**

In how many ways can 5 students be arranged in a line such that

1. two particular students are always together
2. two particular students are never together.

**Solutions**

1. We consider the arrangements by taking 2 particular students together as one and hence the remaining 4 can be arranged in 4! = 24 ways. Again two particular students taken together can be arranged in two ways. Therefore, there are 24 × 2 = 48 total ways of arrangement.
2. Among the 5! = 120 permutations of 5 students, there are 48 in which two students are together. In the remaining 120 – 48 = 72 permutations, two particular students are never together.

**Question 2**

If all permutations of the letters of the word AGAIN are arranged in the order as in a dictionary. What is the 49th word?

**Solution**

(Dictionary – in alphabetical order) Arrange words alphabetically using permutations/arrangement method to find out the number of each.

Starting with letter A, and arranging the other four letters, there are 4! = 24 words. These are the first 24 words. Then starting with G, and arranging A, A, I and N in different ways, there are 12 = words. Next the 37th word starts with I. There are again 12 words starting with I. This accounts up to the 48th word. The 49th word is NAAGI.

**Question 3**

In how many ways 3 mathematics books, 4 history books, 3 chemistry books and 2 biology books can be arranged on a shelf so that all books of the same subjects are together

**Solution**

First we take books of a particular subject as one unit. Thus there are 4 units which can be arranged in 4! = 24 ways. Now in each of arrangements, mathematics books can be arranged in 3! ways, history books in 4! ways, chemistry books in 3! ways and biology books in 2! ways. Thus the total number of ways = 4! × 3! × 4! × 3! × 2! = 41472.

**Question 4**

Three married couples are to be seated in a row having six seats in a cinema hall. If spouses are to be seated next to each other, in how many ways can they be seated? Find also the number of ways of their seating if all the ladies sit together.

**Solution**

Let us denote married couples by S1, S2, S3, where each couple is considered to be a single unit as shown in the following figure:



Then the number of ways in which spouses can be seated next to each other is 3! = 6 ways. Again each couple can be seated in 2! ways. Thus the total number of seating arrangement so that spouses sit next to each other = 3! × 2! × 2! × 2! = 48.

Now we want three ladies to sit together so we will tie them together(eg in one block or group). Thus we have 4 units now that is 3 men + ladies tied together.

Also, there will be 3! possible arrangements of ladies among themselves.

The number of possible ways in which ladies sit together.

= 4! x 3!

= 24 x 6

= 144