**Lesson2 Permutations Involving Different Objects**

1. Two letters, A and B, can be written in two different orders, AB and BA. These are permutations of A and B.
	1. List all of the permutations of 3 letters A, B, and C.

How many permutations are there?

* 1. List all of the permutations of 4 letters A, B, C, and D.

How many permutations are there?

* 1. Predict the number of permutations of 5 letters A, B, C, D, and E.
1. Instead of arranging letters in order, we can arrange objects if they are all different.
	1. How many different ways can 5 people be arranged in a line?
	2. How many different ways can 5 different books be arranged on a shelf?
	3. How many permutations are there of the letters of the word PROVE?
2. When you press the “shuffle” button on a CD player it plays a permutation of the songs on the CD. If the CD has 8 songs on it, how many permutations of the songs are possible?
3. How many permutations can be formed using all the letters of the word COMPUTE?
4. A group of 4 boys and 3 girls goes to the movies. How many ways can they sit in a row, if the boys want to sit together, and girls want to sit together, as well?

6. Five mathematics books, 4 chemistry books and 3 history books are to be arranged on a shelf. In how many ways can they be arranged, so that

a) the books on the same subject are together

b) only the math books are together

7.Consider the letters A, B, C, D, and E. Instead of using all the letters to form permutations, we could use fewer letters. For example, DB is a 2-letter permutation of these 5 letters.

1. List all the different 2-letter permutations of the 5 letters A, B, C, D, and E.
2. How many different 3-letter permutations are there?

**Permutations**

* An *ordered* arrangement of distinct objects is called a *permutation*
* The number of permutations of *n* distinct objects is
* The number of permutations of *n* distinct objects taken *r* at a time is
1. How many ways can a president, vice president, and treasurer be selected from a class of 30 students?
2. How many ways can 4 magazines be arranged on a shelf if they are selected from 11 different magazines?

**Permutations Involving identical Objects**

1. The permutations of the 4 different letters A, B, E, and F are :

**ABEF ABFE AEBF AFBE AEFB AFEB BAEF BAFE EABF FABE EAFB FAEB BEAF BFAE EFAB FEAB EBAF FBAE BEFA BFEA EFBA FEBA EBFA FBEA**

How many permutations are there?

1. a) What happens if two of the letters are the same? Investigate this by converting each F to E. Then count the number of permutations of the letters A, B, E, and E.

**ABEF ABFE AEBF AFBE AEFB AFEB BAEF BAFE EABF FABE EAFB FAEB BEAF BFAE EFAB FEAB EBAF FBAE BEFA BFEA EFBA FEBA EBFA FBEA**

There are permutations of the letters A, B, B, and B.

b) How does this number compare with exercise 1?

1. Generalize the pattern from the investigation on the previous page to determine the number of permutations of
2. A, B, C, D, D
3. A, D, D, D, D
4. A, A, A, B, B

**Generalization**

The number of permutations of *n* objects of which there are *a* objects alike of one kind, *b* alike of another kind, *c* alike of another kind, and so on, is

1. Determine the number of permutations of all the letters in each of the following words.
2. OGOPOGO
3. STATISTICIAN
4. PARALLEL
5. A true-false test has 7 questions. How many answer keys are possible if 3 answers are T and 4 answers are F?
6. On the following grid, how many different paths can A take to get to B, assuming one can only travel east and south? Explain.

Method 1 – Using Permutations of Like Method 2 – by counting paths (Pascal’s

Objects **A** Triangle) **A**

 **B B**

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1. a)

**Worksheet Permutations**

1. a) How many different permutations of the word SASKATOON are there?

b) How many different permutations of the word SASKATOON are there if all the consonants are together?

1. In an 8-block school system you can chose from 15 different classes. How many different schedules can you have?
2. How many 5-digit numbers can be made if the number:
3. Has no restrictions
4. Must be odd.
5. Must be divisible by 10
6. Has no repeats
7. Simplify the following;
8. $\frac{n!}{\left(n-2\right)!}$
9. $\frac{n(n!)^{2}}{\left(n-2\right)!\left(n+1\right)!}$
10. In how many ways are there to order 8 students if
11. Lenny, Carl, and Moe must sit together?

(i.e.: s,s,s,L,C,M,s,s OR s,M,L,C,s,s,s,s)

1. Lenny, Carl, and Moe must sit together, and the other students must all sit together?
2. Mr. and Mrs. Knapp want to take a family picture with their children, Anita, Ivana, and Kat. In how many ways can all five line up in a straight line for the picture if:
3. There are no restrictions
4. The parents must be at either end
5. The parents stand together
6. The parents stand together and the children stand together