

ALGEBRA 2H
Section 12.2: Permutations
NOTES

I. Permutations

1. Definition: A **permutation** is an arrangement of objects in a specific order.

Examples: How many different ways (orders) can the letters A, B, C be arranged?
List them.

How many different ways (orders) can the letters A, B, C, D be arranged?
List them.

2. In some situations involving choices, the _____ in which choices are made is important. These are permutations. You only need to know how many objects you have to figure out how many ways they can be arranged.

Examples: How many ways can 3 objects be arranged if the order matters?

How many ways can 4 objects be arranged if the order matters?

3. Large Numbers of Objects: As we use larger and larger numbers of objects we can use a **factorial** to do the multiplying for us. The symbol for a factorial is the exclamation point.

Examples: $4! =$ _____ $7! =$ _____

4. **Formula:** The number of permutations of n objects is _____.

Examples: How many ways can 10 objects be arranged if the order matters? _____

How many ways can 25 objects be arranged if the order matters? _____

Examples: How many ways can you arrange the letters in the word MATH? _____

How many ways can you arrange 9 books on a shelf? _____

II. Permutations of n Objects Taken r at a Time

1. If you have n objects but you are only using r of them in your arrangement, the permutation changes.

Examples: If you have 7 books, but only have room for 4 of them on a bookshelf, how many different arrangements can you make?

2. If the number of objects and/or the number of objects you are using gets large, it is helpful to have a formula to find the permutation.

Formula: The permutation of n objects taken r at a time, denoted _____,

is found by _____

Note: You can find these permutation with a calculator (the calculator knows the formula).

Examples: If you have 20 books and can place 7 of them on shelf, how many different arrangements can you make?

If you have 10 CD's, how many ways can you listen to 3 of them?

III. Permutations with Repetitions

1. Fewer permutations result when some of the objects being rearranged are the same.

Example: List all the possible arrangements of the letters in the word MOM.

How many different arrangements are possible? _____

2. **Formula:** The number of permutations of n objects with r_1 identical objects, r_2 identical objects of another kind, r_3 identical objects of another kind, . . . , and r_k identical objects of another kind is given by

3. **Example:** Find the number of permutations of the letters of the given word.

(a) CALCULUS

(b) OWOSSO

(c) MASSACHUSETTS

4. **Example:** Steve is planting 11 colored flowers in a line. In how many ways can he plant 4 red flowers, 5 yellow flowers, and 2 purple flowers?

IV. Circular Permutations

1. Thus far we have considered only linear permutations, but permutations may also be circular.

Example: List all the linear permutations of the letters ABC.

Draw all the circular permutations of ABC.

2. **Formula:** If you have n different object to be arranged in a circle, it can be done in

_____ or _____ ways.

3. **Example:** In how many ways can 8 people be seated around a round dinner table?
