

**Working With Permutations:**

A. Permutations are often confused with combinations.

1. A permutation can be thought of as changing the alignment of a group.
2. In other words, if we had 3 people A, B, and C, one possible permutation can be ABC, while another can be CAB.
3. Permutations come in many forms.

a. Some forms are obvious permutations:

$${}_6P_3 \text{ or } P(6,3)$$

b. Other forms are not so obvious and are written as word problems which is somewhat difficult to recognize.

Ex [1] How many ways can 3 people be seated 3 at a time in 4 chairs?

Ex [2] How many ways can 2 people sit in 5 chairs in a row?

- 1) One way to know if we are dealing with permutations or combinations, is to answer one question: Does the order matter?
- 2) If the answer is no, then we will be using permutations, not combinations.

Ex [1] How many ways can 3 people be seated 3 at a time in 4 chairs?

- a. We have 3 people: A, B, and C.
- b. Does the order matter? Can I have ABC, CBA, ACB, CAB, BAC, and BCA and count them as 6 or do they all count as 1. In this example it would count as 6, so the order does not matter.

In Ex [2] we can use the same reasoning to see that order will not matter in that case either.

B. How to calculate a permutation:

1. This method uses factorials.

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

Ex [1]  ${}_5P_2 = \underline{\hspace{2cm}}$ .

- a.  $\frac{5!}{(5-2)!} = \frac{5*4*3*2*1}{3*2*1}$
- b.  $\frac{5*4*3*2*1}{3*2*1} = 5*4 = 20$ .
- c. The answer is 20.

Ex [2] How many ways can 4 people sit in 6 chairs in a row?  $\underline{\hspace{2cm}}$ .

- a. Using the same reasoning from above, we can see that order does not matter, so it is indeed a permutation problem.
- b. Notice, we will be using  $P(6,4)$ .
- c.  $\frac{6!}{(6-4)!} = \frac{6*5*4*3*2*1}{2*1}$
- d.  $\frac{6*5*4*3*2*1}{2*1} = \frac{720}{2} = 360$ .
- e. The answer is 360.

\*Note: Sometimes it is easier to cancel some numbers out before multiplying as in Ex [1] step b. Other times it might be easier to compute the numerator first, then the denominator, then divide as in Ex [2] step d.