

Permutations: The arrangement of objects in a specific order.

The choice of r things from a set of n things, in which order matters

Notation: ${}_n P_r$ or $P(n,r)$

titles, office, prizes, etc

n -the total number of objects

r -the number of objects to be chosen

Formula:

$${}_n P_r = \frac{n!}{(n-r)!}$$

Examples: Compute each of the following

1. ${}_5 P_3$

$$\frac{5!}{(5-3)!} = \frac{120}{2}$$

$$60$$

2. ${}_7 P_7$

$$\frac{7!}{(7-7)!} = \frac{7!}{0!}$$

$$\frac{7!}{1}$$

3. Find the number of ways to arrange 5 paintings chosen from a set of 7 different paintings.

$${}_7 P_5 = \frac{2520}{2520}$$

Combinations: A set of objects in which position (order) is not important.

The choice of r things from a set of n things, in which order does not matter

Committees
group

Notation: ${}_n C_r$ or $C(n,r)$

n -the total number of objects

r -the number of objects to be chosen

Formula:

$${}_n C_r = \frac{n!}{r!(n-r)!}$$

Examples: Compute each of the following

1. ${}_7 C_2$

$$\frac{7!}{2!(7-2)!} = 21$$

2. ${}_5 C_5$

$$\frac{5!}{5!(5-5)!}$$

$$\frac{1}{0!} = \frac{1}{1} = 1$$

3. There are 25 students in Mr. Gaston's math class. Find the number of ways Mr. Gaston can create a 6 person team for next week's math competition.

$${}_{25} C_6 = 177100$$

Advanced Functions and Modeling
Permutations and Combinations

Name: _____
Date: _____ Period: _____

In ex. 1 - 7, tell whether permutations (ordered) or combinations (unordered) are being described.

- 1. A president, vice-president, and secretary are chosen from a 25-member garden club. P
- 2. A cook chooses 5 potatoes from a bag of 12 potatoes to make a potato salad. C
- 3. A teacher makes a seating chart for 22 students in a classroom with 30 desks. P
- 4. 13 cards are selected from a deck of 52 to form a bridge hand. C
- 5. 7 digits are selected (without repetition) to form a telephone number. P
- 6. 4 students are selected from the senior class to form a committee to advise the cafeteria director about food. C
- 7. 4 actors are chosen to play the Beatles in a film biography. P

In ex. 8 - 11, count the number of ways that each procedure can be done.

- 8. Line up three people for a photograph.
- 9. Prioritize four pending jobs from most to least important.
- 10. Arrange five books from left to right on a bookshelf.
- 11. Award ribbons for 1st place to 5th place to the top five dogs in a dog show.

Answer the following.

- 12. How many 9-letter "words" (not necessarily in any dictionary) can be formed from the letters of the word LOGARITHM? (Curiously, one such arrangement spells another work related to mathematics. Can you name it?) 9! P
- 13. The 13 members of the East Brainerd Garden Club are electing a president, vice-president, and secretary from among their members. How many different ways can this be done? 13! P
- 14. From among 12 projects under consideration, the mayor must put together a prioritized (that is, ordered) list of 6 projects to submit to the city council for funding. How many such lists can be formed?

12! P

1. The school board has seven members
 - a. The board must have three officers: a chairperson, an assistant chairperson, and a secretary. How many different sets of these officers can be formed from this board?
 - b. How many three-person committees can be formed from this board?
 - c. Is part (a) asking for a number of permutations or a number of combinations? What about part (b)?

2. Kandi Barr has room for three plants on a windowsill.
 - a. In how many different ways can three plants be arranged on her windowsill? $3P_3$
 - b. Was (part a) a permutation or a combination?
 - c. Suppose Kandi has six plants. How many groups of three plants can be put on her windowsill? $6C_3$
 - d. Was (part c) a permutation or a combination?
 - e. Suppose Kandi has nine plants. How many ways can three of these plants be arranged on her windowsill? $9P_3$
 - f. Was (part e) a permutation or a combination?

3. To open your locker, you must dial a sequence of three numbers called the lock's *combination*. Given that there are 40 numbers on a lock, how many different locker combinations are there?

4. Suppose fifteen people qualify for a college cheerleading squad, six women and nine men.
 - a. How many six-member squads can be selected?
 - b. Suppose that exactly two members of the six-member squad must be male. How many six-member squads can be selected?
 - c. Find the probability of the event in part (b) if you were to pick the squads randomly.

5. Ten band directors at a summer band camp are planning to give a performance. One of the pieces they want to play calls for a flute, an oboe, a bassoon, and a clarinet. Each of the band directors can play all four instruments. How many different quartets can they have?
6. A pizza parlor offers a selection of 3 different cheeses and 9 different meats. In how many ways can a pizza be made with the following ingredients?

	cheese	meat	
a) 1 cheese and 3 meats	$(3C_1)$	$(9C_3)$	$= 252$
b) 2 cheese and 5 meats	$(3C_2)$	$(9C_5)$	$= 378$
c) 3 cheese and no meat	$(3C_3)$	$(9C_0)$	$= 1$

7. For each of the following, determine whether each situation involves a permutation or a combination.
- a) Four recipes were selected for publication out of the 302 recipes that were submitted.
 - b) Nine players are selected from a team of 15 to start the softball game.
 - c) Four out of 200 contestants were awarded prizes of \$100, \$75, \$50 and \$25.
 - d) The batting order for the 9 starting players is announced.
 - e) The winner and first, second, and third runners-up in a contest with 10 finalists.
 - f) An arrangement of the letters in the word *HAWAIIAN*.
 - g) Selecting three of fifteen flavors of ice cream at the grocery store.
 - h) Selecting nine books to check out of the media center from a reading list of twelve.
 - i) Selecting three students from our class to go get breakfast at Bojangles.

8. How many different 12-member juries can be chosen from a pool of 32 people?
9. A test consists of 20 questions, and students are told to answer 15 of them. In how many different ways can they choose the 15 questions?
10. How many different ways are there to purchase 2 CDs, 3 DVDs, and 1 VHS tape if there are 7 CD titles, 5 DVD titles, and 3 VHS titles?