

Section 12.9 Combinations

With permutations the order of the objects did make difference. For example **a, b, c** and **b, c, a** are different arrangements/permutation.

With combinations **a, b, c** and **b, c, a** are the same arrangement because they are the same letters.

a b c d e

A **combination** is a distinct group (or set) of objects without regard to their arrangement.

abc cda
bca adc

Example 1 page 803 Permutation or Combination

a) A group of five friends, Arline, Inez, Judy, Dan, and Eunice, are forming a club. The group will elect a president and a treasurer. In how many different ways can the president and treasurer be selected?

Permutation

b) Of the five individuals named, two will be attending a meeting together. In how many different ways can they do so?

Combo

Consider the elements a, b, c, d. Find the number of permutation of the 4 letter if you choose 2 at a time.

$4P_2$

Permutations

ab, ba, ac, ca, ad, da,
bc, cb, bd, db, cd, dc

Combination

ab, ac, ad, bc, bd, cd

$4C_2$

4 math PRB nCr
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The number of combinations is the number of permutations divides by 2!. If we were selecting 3 items at a time the number of combinations is the number of permutation divided by 3!

$$nC_r = \frac{n!}{(n-r)! \cdot r!}$$

$$\frac{4!}{(4-2)! \cdot 2!} = \frac{24}{2 \cdot 2} = \frac{24}{4} = 6$$

Example 2

An exam consists of six questions. Any four may be selected for answering. In how many ways can this selection be made?

$$6C_4 \quad \text{15}$$

Example 3

Jan Funkhauser has 10 different cut flowers from which she will choose 6 to use in a floral arrangement. How many different ways can she do so?

$$10C_6 = 210$$

Example 4

At the Royal Dynasty Chinese restaurant, dinner for eight people consists of 3 items from column A, 4 items from column B, and 3 items from column C. If columns A, B, and C have 5, 7, and 6 items, respectively, how many different dinner combinations are possible?

$$\begin{array}{c} A \\ 5C_3 \end{array} \cdot \begin{array}{c} B \\ 7C_4 \end{array} \cdot \begin{array}{c} C \\ 6C_3 \end{array} = 7000$$

Warm up

Mrs. Perkin has decided to give away gift cards to the first 2 fastest student to complete their times table chart in math class. The first place student will get a \$20 gift card to Subway and the second place student will receive a \$10 gift card to Subway. If there are 20 students in the class in how many ways can she award a first and second place winner?

$${}_{20}P_2 = 380$$

John has 4 shirts, 3 sweaters and 5 pairs of pant. In how many ways can John create an outfit?

$$4 \cdot 3 \cdot 5 = 60$$

**Determining the Number of Ways of Selecting r Items from n Items
Repetition not permitted.****Permutations**

Permutations are used when order is important.

For example, a, b, c and b, c, a are two different permutations of the same three letters.

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

Problems solved with the permutation formula may also be solved by using the counting principle.

Combinations

Combinations are used when order is not important.

For example, a, b, c and b, c, a are the same combination of three letters. But a, b, c , and a, b, d are two different combinations of three letters.

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

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31. *Posters* Matthew Abbott has eight posters he would like to hang on the wall of his bedroom, but his wall is only wide enough to hang four posters. In how many ways can Matthew select the four posters to hang on his bedroom wall?

32. *Washers and Dryers* Sears has nine different washing machines in stock and six different clothes dryers in stock. The manager wants to place three of the nine washing machines and two of the six clothes dryers on sale. In how many ways can the manager select the items to be listed as sale items?

33. *Quinella Bet* A quinella bet consists of selecting the first- and second-place winners, in any order, in a particular event. For example, suppose you select a 2–5 quinella. If 2 wins and 5 finishes second, or if 5 wins and 2 finishes second, you win. Mr. Smith goes to a jai alai match. In the match, 8 jai alai teams compete. How many quinella tickets must Mr. Smith purchase to guarantee a win?



▲ Jai alai game

46. *Granola Bars* Mrs. Williams and her four children go shopping at a local grocery store. Each of the children will be allowed to select one box of granola bars. On the store's shelf there are 12 boxes of granola bars, and each box contains a different type of bar. In how many ways can the selections be made?
38. *Forming a Committee* The Webster Town Board is forming a committee to explore ways to improve public safety in the town. The committee will consist of 4 representatives from the town board and 3 representatives from a citizens advisory board. If there are 7 town board members and 5 citizens advisory board members from which to choose, how many different ways can the committee be formed?

22. *Banana Split* An ice-cream parlor has 20 different flavors. Cynthia orders a banana split and has to select 3 different flavors. How many different selections are possible?
23. *Test Essays* A student must select and answer four of five essay questions on a test. In how many ways can she do so?
24. *Software Packages* During a special promotion at CompUSA, a customer purchasing a computer and a printer is given the choice of 2 free software packages. If there are 9 different software packages from which to select, how many different ways can the 2 packages be selected?
25. *Scholarships* A scholarship committee has received 8 applications for a \$500 scholarship. The committee has decided to select 3 of the 8 candidates for further consideration. In how ways can the committee do so?
26. *Attending Plays* While visiting New York City, the Nygens want to attend 3 plays out of 10 plays they would like to see. In how many ways can they do so?

27. *Taxi Ride* A group of 7 people wants to use taxis to go to a local restaurant. When the first taxi arrives, the group decides that 4 people should get into the taxi. In how many ways can that be done?
28. *Plants* Mary Robinson purchased a package of 24 different plants, but she only needed 20 plants for planting. In how many ways can she select the 20 plants from the package to be planted?
29. *Entertainers* Ruth Eckerd Hall must select 8 of 12 possible entertainers for its summer schedule. In how many ways can that be done?
30. *CD Purchase* Neo Anderson wants to purchase six different CDs but only has enough money to purchase four. In how many ways can he select four of six CDs for purchase?

34. *Test Question* On an English test, Tito Ramirez must write an essay for three of the five questions in Part 1 and four of the six questions in Part 2. How many different combinations of questions can he answer?
35. *Plasma and LCD TVs* A television/stereo store has 12 different plasma televisions and 8 different LCD televisions in stock. The store's manager wishes to place 3 plasma televisions and 2 LCD televisions on sale. In how many ways can that be done?
36. *Medical Research* At a medical research center, an experimental drug is to be given to 16 people, 8 men and 8 women. If 14 men and 11 women have volunteered to be given the drug, in how many ways can the researcher choose the 16 people to be given the drug?
37. *Dinner Party* Sue Less is having a dinner party. She has 10 different bottles of red wine and 8 different bottles of white wine on her wine rack. She wants to select 4 bottles of red wine and 2 bottles of white wine to serve at her party. In how many ways can she do so?