

- A2.S.9** Differentiate between situations requiring permutations and those requiring combinations
A2.S.10 Calculate the number of possible permutations (${}_nP_r$) of n items taken r at a time
A2.S.11 Calculate the number of possible combinations (${}_nC_r$) of n items taken r at a time
A2.S.12 Use permutations, combinations, and the Fundamental Principle of Counting to determine the number of elements in a sample space and a specific subset (event)

Permutations

A **permutation** is an arrangement of items in a specific order (that is permutations are used when the order of selection is important).

The notation for a permutation of n items taken r at a time is ${}_nP_r$.

$${}_nP_r = n \cdot (n-1) \cdot (n-2) \cdot (n-3) \cdots (n-r+1)$$

Ex: In how many different orders can the 8 students competing in the 200-meter race cross the finish line?

Solution: Obviously, with a race, order matters.

We want to find the order of all 8 students finishes, so in our permutation, $n = 8$, $r = 8$.

$${}_8P_8 = 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 40,320$$

You can also use $8!$ for this.

Ex: How many different ways can first, second, and third place be decided among the twelve horses running in the Kentucky Derby?

Solution: First place can be won by 12 horses, second by 11, and third by 10.

$${}_{12}P_3 = 12 \cdot 11 \cdot 10 = 1,320$$

1. A restaurant critic decides to sample 6 of the 9 desserts on the menu. In how many different orders can this be accomplished?

(1) 720

(3) 241,920

(2) 60,480

(4) 362,880

Ex: How many different arrangements of the letters in the word TOMORROW can be made?

Solution: The word has 8 letters, but there are multiple O's and R's. We must eliminate the extra arrangements of O's and

R's. To do this, we use the formula $\frac{n!}{r!}$ where n is the number of things taken n at a time where r are identical. In this

example there are 3 O's and 2 R's that are repeated, therefore we must divide by both $3!$ and $2!$.

$$\frac{8!}{2!3!} = \frac{8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}{3 \cdot 2 \cdot 1 \cdot 2 \cdot 1} = 3,360$$

2. How many different 5-letter arrangements can be made from the letters of the word TOOTH?

(1) 12

(3) 30

(2) 24

(4) 60

Ex: Given the set of numbers {1, 4, 5, 7, 8}, if each digit can be used only once, how many different

a. four-digit numbers can be formed

{120}

b. four-digit odd numbers can be formed

_____._____._____._____

{72}

c. three-digit numbers larger than 700 can be formed

_____._____._____

{24}

Lesson 11 1 Permutations Worksheet

Jin-Ying Zhang



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