Warm-Up

Write the following as a decimal and as a percent

1. 1/2 = 0.5 $\frac{1}{2} = \frac{50}{100}$ 50%
2. 1/5 = 0.2 $\frac{1}{5} = \frac{20}{100}$ 20%
3. 3/20 = 0.15 15%
4. 12/25 = 0.48 48%
5. 7/36 = 0.19 19%
6. 15/32 = 0.47 47%

$36\overline{)7.000}$ .19

$32\overline{)15.000}$

7-1 Permutations and Combinations

Going Deeper

Essential question: *What are permutations and combinations and how can you use them to calculate probabilities?*

COMMON CORE **Standards for Mathematical Content**

CC.9-12.S.CP.9(+) Use permutations and combinations to compute probabilities of compound events and solve problems.*

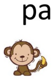
Fundamental Counting Principle

If there are n items and m_1 ways to choose a first item, m_2 ways to choose a second item after the first item has been chosen, and so on, then there are $m_1 \cdot m_2 \cdot \ldots \cdot m_n$ ways to choose n items.

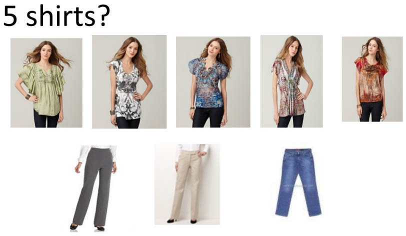
4 types of Bread | 5 types of Meat | 10 types of topping

$4 \cdot 5 \cdot 10 = 200$ ways

How many different outfits can be made out of 3 pairs of pants and 5 shirts?



$5 \cdot 3 = 15$ ways



A multiple choice test has 10 questions with 4 answer choices for each question. In how many different ways can you complete the test?

$4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4$

#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
a	a	a	a	a	a	a	a	a	a
b	b	b	b	b	b	b	b	b	b
c	c	c	c	c	c	c	c	c	c
d	d	d	d	d	d	d	d	d	d

$4.4.4.4.4.4.4.4.4.4 = 4^{10} = 1{,}048{,}576$

A password for a site consists of 4 digits followed by 2 letters. The letters *A* and *Z* are not used, and each digit or letter may be used more than once. How many unique passwords are possible?

10 26

$10 \cdot 10 \cdot 10 \cdot 10 \cdot 24 \cdot 24 = 5{,}760{,}000$

Using the letters in the word SQUARE, how many 6-letter arrangements with no repetitions are possible if vowels and consonants alternate, beginning with a vowel?

$3 \cdot 3 \cdot 2 \cdot 2 \cdot 1 \cdot 1$

36 ways

Use the digits 0, 1, 2, 3, 4 without repetition. Determine the number of ways to form each arrangement.

5 total

3-digit numerals whose values are at least 100

$4 \cdot 4 \cdot 3 = 48$ ways

Use the digits 0, 1, 2, 3, 4 without repetition. Determine the number of ways to form each arrangement.

4-digit numerals whose values are at least 1000 and less than 4000

$3 \cdot 4 \cdot 3 \cdot 2 = 72$ ways

All the examples we discussed involve permutation where order matters.
For example: 312 is different from 231 even though both use the same digits.

FACTORIALS

$\boxed{4}$ $\boxed{2nd}$ $\boxed{x!}$

4! $= 4 \cdot 3 \cdot 2 \cdot 1 = 24$

0! $= 1$

$\boxed{\text{by definition}}$

$\boxed{PRB}$

$\boxed{MATH}$ PRB

A **permutation** is a selection of a group of objects in which order is important. For example, there are 6 permutations of the letters A, B, and C.

ABC
ACB
BAC
BCA
CBA
CAB

$3 \cdot 2 \cdot 1$

$\underline{10} \cdot \underline{9} \cdot \underline{8}$

Permutations

The number of permutations of n objects taken r at a time is given by

$$_nP_r = \frac{n!}{(n-r)!}.$$

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$$_{10}P_3 = \frac{10!}{(10-3)!} = \frac{10!}{7!} = \frac{10 \cdot 9 \cdot 8 \cdot \cancel{7!}}{\cancel{7!}}$$

The members of a club want to choose a president, a vice-president, and a treasurer. Seven members of the club are eligible to fill these positions. In how many different ways can the positions be filled?

$_7P_3$

President	Vice-President	Treasurer	
7 ×	6 ×	5 =	210

Suppose the club members also want to choose a secretary from the group of 7 eligible members. In how many different ways can the four positions (president, vice-president, treasurer, secretary) be filled? Explain.

840; there are $7 \times 6 \times 5 \times 4 = 840$ permutations $_7P_4$

Suppose 8 members of the club are eligible to fill the original three positions (president, vice-president, treasurer). In how many different ways can the positions be filled? Explain.

336; there are $8 \times 7 \times 6 = 336$ permutations $_8P_3$

Every student at your school is assigned a four-digit code, such as 6953, to access the computer system. In each code, no digit is repeated. In how many ways are there to assigned a code with the digits 1, 2, 3, and 4 in any order?

$$_4P_4 = \frac{4!}{(4-4)!} = \frac{4!}{0!} = \frac{4 \cdot 3 \cdot 2 \cdot 1}{1}$$

$$= 24$$

4P4 = 24

How many ways can a student government select a president, vice president, secretary, and treasurer from a group of 6 people?

$_6P_4$

(6P4). There are 360 ways to select the 4 people.

How many ways can a stylist arrange 5 of 8 vases from left to right in a store display?

$_8P_5$

$$_8P_5 = \frac{8!}{(8-5)!} = \frac{8!}{3!}$$

There are 6720 ways that the vases can be arranged.

In the probability world, the order in which items are arranged is important :-)

How many ways can a 2-digit number be formed by using only the digits 5–9 and by each digit being used only once?

$$_5P_2 = \frac{5!}{(5-2)!} = \frac{5!}{3!} = \frac{5\bullet 4\bullet \cancel{3\bullet 2\bullet 1}}{\cancel{3\bullet 2\bullet 1}}$$

There are 20 ways for the numbers to be formed.

Awards are given out at a costume party. How many ways can “most creative,” “silliest,” and “best” costume be awarded to 8 contestants if no one gets more than one award?

$$_8P_3 = \frac{8!}{(8-3)!} = \frac{8!}{5!}$$

$_8P_3$

There are 336 ways to arrange the awards.