Math 4c. Class work 24.

a.	b.	c.	d.
$0.6\cdot\frac{2}{3}$	$\frac{4}{5}\cdot\frac{3}{5}$	$-0.25\cdot\frac{4}{7}$	$(0.6)^2$
$:(-0.08)$	$:(-1.2)$	$-2\frac{6}{7}$	$:0.04$
$+3\frac{12}{17}$	$-\left(-7\frac{1}{5}\right)$	$:0.02$	$-\frac{3}{5}$
$\cdot\left(-3\frac{1}{11}\right)$	-11.8	$+155$	-4.4
?	?	?	?

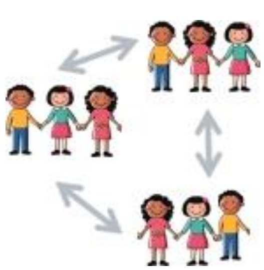
How many different 3-digit numbers can we create using 8 digits, 1, 2, 3, 4, 5, 6, 7, and 8 without repetition of the digits, i.e. such numbers that only contain different digits?

How many different ways are there to choose a team of 3 students out of 8 to participate in the math Olympiad?

What are the similarities in these two problems?

Can you see the difference between them?

In both cases, we have 8 possible ways to choose the first item (digit or student), 7 possible ways to choose the second item, and 6 different ways to choose the third one. So, there are $8\cdot 7\cdot 6$ different 3-digit numbers created from digits 1, 2, 3, 4, 5, 6, 7, and 8 and $8\cdot 7\cdot 6$ different teams of 3 students out of 8. Or not? We can create numbers



123 132
213 231
321 312

and they are all different numbers. If we chose a team of 3 students for the math Olympiad, it doesn't matter in which order we wrote their names.

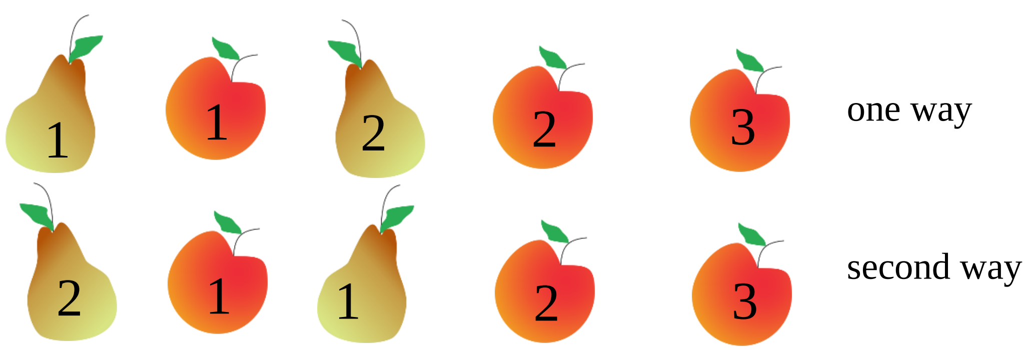
Mike, Maria, Jessika	Mike, Jessika, Maria
Maria, Mike, Jessika	Maria, Jessika, Mike
Jessika, Mike, Maria	Jessika, Maria, Mike

In the first case, we have $8 \cdot 7 \cdot 6$ ways to create a 3-digit number out of 8 digits. In the second case for each group of 3 kids we will count 6 times (3! – number of ways to put 3 kids in line) more possible choices than there really are. So, the total number of the way to choose the teem is

$$\frac{8 \cdot 7 \cdot 6}{3 \cdot 2 \cdot 1}$$

1. Mother has an apple, a pear, a banana, a peach, an apricot. Each day she gives one fruit to her kid for lunch. How many different ways are there to give these fruits?

2. Mother has 3 apples and 2 pears. Each day she gives one fruit to her kid for lunch. How many different orders are there to give these fruits? (both pears are considered to be absolutely identical, as well as all three apples).



Is there any difference for kid between these two ways to eat fruits during the school week?

Exponent.

Exponentiation is a mathematical operation, written as $\boldsymbol{b^n}$, involving two numbers, the **base** *b* and the **exponent** *n*. When *n* is a positive integer, exponentiation corresponds to repeated multiplication of the base: that is, $\boldsymbol{b^n}$ is the product of multiplying *n* bases:

$$b^n = \underbrace{b \times \cdots \times b}_{n}$$

In that case, $\boldsymbol{b^n}$ is called the *n*-th power of *b*, or *b* raised to the power *n*.

Properties of natural exponent:

If the same base raised to the different power and then multiplied:

$$b^3 \cdot b^4 = (b \cdot b \cdot b) \cdot (b \cdot b \cdot b \cdot b) = b \cdot b \cdot b \cdot b \cdot b \cdot b \cdot b = b^7$$

Or in a more general way:

$$b^n \cdot b^m = b^{n+m}$$

If the base raised to the power of n then raised again to the power of m:

$$(b^2)^3 = (b \cdot b)^3 = (b \cdot b) \cdot (b \cdot b) \cdot (b \cdot b) = b^{2 \cdot 3}$$

$$(b^m)^n = b^{mn}$$

If we want to multiply $b^n = \underbrace{b \cdot b \cdot b \ldots \cdot b}_{n\ times}$ by another b we will get the following expression:

$$b^n \cdot b = \underbrace{b \cdot b \cdot b \ldots \cdot b}_{n\ times} \cdot b = \underbrace{b \cdot b \cdot b \cdot b \ldots \cdot b}_{n+1\ times} = b^{n+1} = b^n \cdot b^1$$

In order to have the set of power properties consistent, $b^1 = b$ for any number b.

If we multiply b^n by 1, we won't change anything, so we can write

$$b^n \cdot 1 = b^{n+0} = b^n \cdot b^0$$

In order to have the set of power properties consistent, $b^0 = 1$ for any number $b \neq 0$

If two different bases raised to the same power, then:

$$(a \cdot b)^3 = (a \cdot b) \cdot (a \cdot b) \cdot (a \cdot b) = a \cdot a \cdot a \cdot b \cdot b \cdot b = a^3 b^3$$

$$(a \cdot b)^n = a^n b^n$$

The exponent indicates how many copies of the base are multiplied together. For example, $3^5 = 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 = 243$. The base 3 appears 5 times in the repeated multiplication, because the exponent is 5. Here, 3 is the *base*, 5 is the *exponent*, and 243 is the *power* or, more specifically, *the fifth power of 3*, *3 raised to the fifth power*, or *3 to the power of 5*.

3. How many two-digit numbers can be composed from digits 1, 2, 3 without repetition of digits?

4. How many two-digit numbers can be composed from digits 1, 2, 3, if repetition is allowed?

5. Peter took 5 exams at the end of the year. Grade for exams are A, B, C, D. How many different ways are there to fill his report card?