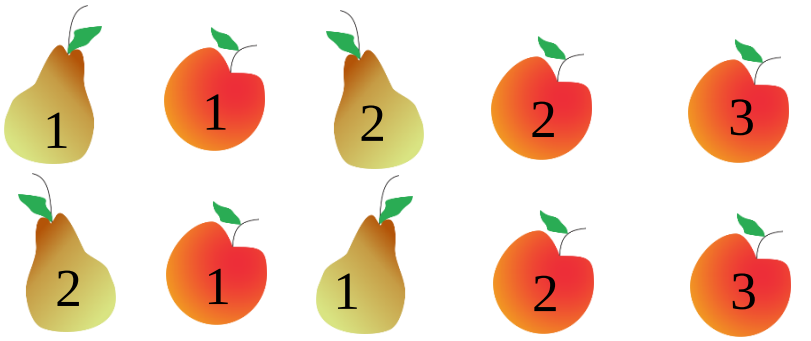
Math 4c. Class work 25.

$$\frac{1\frac{5}{9} : 7 + 1\frac{5}{6}}{6\frac{1}{6} \cdot 3}$$

1. 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).




one way

second way

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*.

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

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

4. Write the following expressions in a shorter way:

*Example*: $7 \cdot 7 \cdot 7 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 9 \cdot 9 \cdot 9 \cdot 9 \cdot 9 = 7^3 \cdot 8^4 \cdot 9^5$

$2 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 7 \cdot 7;$

$\underbrace{3 \cdot 3 \cdot \ldots \cdot 3}_{n\ times} \cdot \underbrace{5 \cdot 5 \cdot \ldots \cdot 5}_{m\ times}$

$\underbrace{(-4) \cdot (-4) \cdot \ldots \cdot (-4)}_{k\ times} \cdot \underbrace{6 \cdot 6 \cdot \ldots \cdot 6}_{l\ times}$

5. Compare the numbers:

$a.\ 5^3 \quad 5 \cdot 3$ $\qquad$ $b.\ 12^2 \quad 12 \cdot 2$

$c.\ 2^5 \quad 5^2$ $\qquad$ $d.\ 3^4 \quad 4^3$

$e.\ 5^3 \quad 5 \cdot 3$ $\qquad$ $f.\ 2^4 \quad 4^2$

6. Simplify the following expressions:

a. $3 \cdot 3^4(-3)^2;$

b. $2^5 \cdot 2(-2^2)c^{4-1}c^3;$

c. $5^3 \cdot 5(-5^5)5^3 \cdot 5;$

d. $2 \cdot 3^2 \cdot 5^3 \cdot (-4 \cdot 3 \cdot 5^2);$

e. $0.5a(-b)^6 \cdot 10a^2b^2;$

f. $\frac{1}{6}(-5)^3 5 \cdot 3 \cdot (-6 \cdot 5 \cdot 3^3);$

g. $2^4 + 2^4;$

h. $2^m + 2^m;$

i. $2^m \cdot 2^m;$

j. $3^2 + 3^2 + 3^2;$

k. $3^k + 3^k + 3^k;$

l. $3^k \cdot 3^k \cdot 3^k;$

7. 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?

8. Evaluate:

$2^3 \cdot 2^2 =$ $\qquad$ $5^2 \cdot 5 =$

$2^5 \cdot 2^3 \cdot 2 =$ $\qquad$ $(2^3)^2 =$

$(3^7)^2 =$ $\qquad$ $(n^5)^3 =$

9. Write the following expressions as a product or power:

   a. $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$;
   b. $2 + 2 + 2 + 2 + 2$;
   c. $a \cdot a \cdot a$;
   d. $a + a + a$;
   e. $\underbrace{x \cdot x \cdot \ldots \cdot x}_{20\ times}$;
   f. $\underbrace{x + x + \cdots + x}_{20\ times}$;