Division by zero

Egor Shavanov Alexandrovich

sa.science.account@yandex.ru

English version

I have often found that many people who have explained something related to division have said that division is finding the amount of something in something. For example, dividing 12 by 4 (that is, 12 / 4) is finding out how many fours can fit into 12. The answer in this example is 3, so there are three fours in 12.

12 / 4 = 3. Makes sense.

But this "division" did not work when dividing by zero. More precisely, it worked, but the result was equal to infinity. Why? Because it is logical that if such "division" is finding of quantity of something in something, then zeros in any number can be infinity, they do not occupy inherently any size, so they can fit in something in infinite quantity. Even with such "division" of zero by zero itself, because zero can contain an infinite number of zeroes, since those zeroes that we fit into zero have no size and can fit into it as many as they want.

But this "division" is essentially not division. It is more like finding the capacity, that is, how many objects "B" fit into object "A".

I, on the other hand, have understood division differently since I was a child. Let's say there is a round cake. If you divide it into 8 parts, then we find out what size one part has (its arc length or volume, whatever). After all, it is logical that after dividing the known to us whole by the known to us number of equal parts (because we have given their number) we get the previously unknown size of one part. That is, we divide the whole into equal parts and get the size of one part. That is, we divide the whole so that after division we get a given number of equal pieces and the size of any one of them is the result of division. This is division. This is the real one, and not just called it, because it is division that is being done here. And the operation I mentioned above, which was only called "division", is the finding of capacity.

And everything is logical here. If, for example, for a round cake we find the arc length of its slice (in fact - the arc of a part of a circle, or more exactly - the arc of its sector) (and we could search not necessarily this arc length, but for example the volume of a slice, knowing the volume of the cake), then if the length of the entire circle of the cake is 32 (no matter, meters, millimeters, etc.).), and we want to divide it into 8 (equal, of course) slices (cutting the cake from the center of its circumference to the edge and in a straight line, so that we end up with sectors by these divisions, of course), we end up with a slice whose arc length equals four.

32 / 8 = 4. Makes sense.

By the way, we can do the same with that example of "dividing" (finding the capacity) that I mentioned above.

12 / 4 = 3. Same result.

And after "putting" these pieces together, we will, of course, get back the whole that we were dividing. So, for example, from the cake example, by putting all 8 pieces together (that is, by joining these pieces back together as they were before the cake was divided), each with an arc size equal to four, we get their total arc length equal to 32, like the cake in the beginning.

4 * 8 = 32. Makes sense.

That is, we split the pieces apart and then put them back together. So this division is the DIVISION, the real division. That is, we divide the whole so that after division we get a given number of equal pieces and the size of any of them is the result of division, and by combining them back, we get the whole. And it is this operation of true division that is the inverse of multiplication.

You may be thinking now, "How is it that we have been using the operation of finding the capacity all along and it has not failed logically, and how was this "division" (finding the capacity) similar to the real division and gave the same result?" It's just that at non-zero values these two operations gave the same value, but at zero they give different values. And by the way yes, let me explain what happens if we divide by the real division by zero and how it is different from finding the capacity.

If we divide (true division) any number or object by zero, then we divide that number or object so that it ends up with zero pieces, that is, in fact, we remove (or simply do not take) that number or object, and end up with one piece size equal to zero, that is, no pieces, because we have removed (or not taken) that number or object. Like in multiplication. If we multiply something by a number in multiplication, we are essentially taking that something as many times as we want. It's the same with multiplication by zero, if we take something zero times, then we don't take it (or remove it). So it makes sense that real division by zero and multiplication by zero give the same result.

You might say, "Now how do we apply this real division, or rather division by zero, to the existing formulas? Do we have to redo the formulas now?" No, we don't need to redo any formulas, the real division by zero in them is also logical, and now I will show you this.

For example, take the formula for finding the path by speed and traveled time. The motion is without acceleration, that is, the speed is constant, just for convenience. We just need only division.

$$\Delta S = \frac{\upsilon}{\Delta t}.$$

Here is this formula, where ΔS – is the distance traveled, υ – is velocity, Δt – is the elapsed time during which, for example, some object traveled the distance ΔS. If time is equal to zero, then it is logical that no path will be passed, i.e. the passed path will be equal to zero, because in frozen time (at the beginning of the path) the passed path cannot be calculated, the object has not passed any path yet. Therefore, it is logical that at the present division of velocity (whatever it may be) by time equal to zero, we will get zero. That is, the real division and logic converge here.

From now on, I'll just say "division" instead of "real division." It's easier that way.

Or let's take another formula, like this one:

$E = mc^2$. Intriguing?

Yes, it's a formula for the dependence of mass on energy and vice versa. Where E – is energy, m – is mass, c – is the speed of light in a vacuum (i.e. the supposed maximum speed of light).

We do this mathematical operation, dividing both parts of the equation by the mass m (that is, we transfer the mass m to the left part of the equation):

$$\frac{E}{m} = c^2.$$

If the mass of any object is zero, then it is logical that this means that the object in question also has no energy, that is, dividing the energy E by zero mass will give zero. But then we get the following situation:

$0 = c^2$.

That is, the constant is equated to zero. Is it a mistake? No. And here's why. Since the object does not exist (since it does not have energy and mass), no constant, whatever it may be, even if it is the maximum speed of light, does not exist for it, because if it does not exist, the laws of physics have no effect on, there is nothing to act on it. And that's why the constant for this object RATES to zero, i.e. STANDS equal to zero. Makes sense.

You will probably say, "How so? A constant equals zero? The result must be wrong, and division by zero probably doesn't work here. No, it does. And it gives the same result as if we multiplied the whole thing without moving the mass to the left side of the equation:

$E = mc^2$.

If the mass here is zero then the constant "c" will be multiplied by zero, i.e. we take it zero times, i.e. we don't take the speed of light at all (and since we didn't take it, it is zero here). This multiplication will give zero, and we end up with:

$E = 0$.

That is, the energy of the object is zero with a mass equal to zero. Makes sense. So we got the same result here as in division, i.e. everything is zeroed out. Since in division we divided the energy so that we were left with zero pieces (that is, that for there was no energy at all, that is, we zeroed it out, did not take it), that is, so that the energy became equal to zero, and in multiplication we got the same thing, that the energy became equal to zero, it turns out that everything is logical.

You might say, "How is it possible to equate a constant to zero? That must be a mistake." No, it's not. Let me show you another example from thermodynamics of how a constant becomes zero without division.

Here is the Mendeleev-Clapeyron equation:

$PV = \nu RT$.

Where P – is gas pressure, V – is gas volume, v – is gas quantity, R – is the universal gas constant, and T is gas temperature.

For example, in an isothermal process, with the same amount of gas, when the volume of gas changes, its pressure changes in the opposite direction, that is, if the volume increases, then the pressure in the same ratio decreases, logically. That is, in this case the temperature T and the amount of gas v do not change, i.e. they become constants.

What do we end up with if, for example, the volume of gas is zero? If we think logically, it turns out that there is no gas, it does not exist (at least in our 3-dimensional dimension), since its volume is zero. So there is no pressure, or its quantity, or its temperature. We get the same thing mathematically:

$P * 0 = \nu RT$;

$0 = \nu RT$.

And from here we get that the amount of gas and its temperature are equal to zero, well or one of them (but if we think logically then without the amount of gas its temperature cannot exist, and in fact multiplying the temperature by zero amount of gas, that is taking the temperature zero times, we will get zero, that is that there is no temperature, since we did not take it. Makes sense). Makes sense. And yet we had temperature and amount of gas as constants. Even though in fact the pressure in such a case should tend to infinity, whatever it is we multiply it by zero, i.e. we take zero times, i.e. we do not take it at all, i.e. it is absent. So we get zero on the left side of the equation. And it turns out that we equate the constant amount of gas and temperature to zero.

Here, even without division, you can still get an equation of the constant to zero. In mathematics, you have to apply logic, too.

It possible to divide by zero. Because it is necessary to DIVIDE, not to find the capacitance.