



The Dozenal Society of America

EGGSACTLY A DOZEN

A SIMPLE APPROACH TO DUODECIMAL COUNTING
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With the advent of the computer, numeration systems with bases other than ten have become more than just a “fill-in” topic. Rather they are a matter to be examined with care, not only by those entering the computer field but also by those of us who have just a passing interest in the computer because of its influence on so many facets of our lives.

To introduce the fundamental ideas of numeration systems I have come across a presentation using the duodecimal system that students seem to find interesting and easy to grasp. I’d like to share it with you, making no claims to originality. Here is the “story” I tell:

Many years ago, I was traffic manager for one of the largest wholesale egg dealers in the Northeast United States. My job consisted mainly in seeing to it that each delivery truck that left our depot was directed correctly and was loaded with sufficient eggs. Each deliverer carried with him the order forms which had been picked up the previous afternoon by our salesmen. Since our deliveries were made between 12 midnight and 6 AM, these orders had to be most exact; the store managers had little chance to see the driver and even if they did there were no extra eggs on the truck to increase an order.

After some months of observation, I decided that order forms need not be picked up ahead of time but could be left taped on the doors of those places receiving deliveries. The drivers and I were able to estimate, quite accurately, the number of eggs each delivery would need and hence the total number of eggs each driver would need to carry. Our order form had the following configuration:

| CRATES | GROSSES | DOZENS | EGGS |
|--------|---------|--------|------|
| | | | |

wherein twelve eggs equals one dozen, twelve dozen equal one gross and twelve gross equal one crate or great gross. So a supermarket might leave an order blank which would look like:

| CRATES | GROSSES | DOZENS | EGGS |
|--------|---------|--------|------|
| 3 | 4 | 0 | 0 |

which calls for a delivery of 5760 eggs. Because the business was owned by the same family for three generations, there were a few customers who were accorded, the privilege of home delivery. Many of these were elderly and their orders were small. One of these might be:

| CRATES | GROSSES | DOZENS | EGGS |
|--------|---------|--------|------|
| | | 1 | 4 |

which calls for a delivery of sixteen eggs.

Wanting to simplify our systems, I decided to eliminate the order form completely and have each customer simply tape a slip of paper on his door and on the paper write a four digit number. The digit furthest right would tell the driver how many loose eggs he should leave, the digit to the left indicated the numbers of dozens and so on; our first order would appear as: 3400 and our second as 0014. This worked well until at one of our private home customers the driver left three hundred eggs! The customer was irate, the driver defensive and I was confused.

Looking at the order made everything clear. Here is what was taped to the door:

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00210.

The customer wanted two dozen and ten loose eggs. The driver, very correctly, interpreted the order as no loose eggs, one dozen and two gross. Something had to be done!

The problem was created by the occasional need to use ten and eleven. So we, the management and I, invented symbols to represent these numbers when they were needed. We chose χ to represent ten and $\#$ to represent eleven. Our “problem” order would now be:

002 χ .

A supermarket order would now appear as: 12 χ 0. The store manager and my driver both understood this to mean an order of one crate, two gross, ten dozen and no loose eggs.

We had invented, so we thought, a new numeration system. Our “digits”, with the corresponding decimal equivalents were:

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|--------|------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | χ | $\#$ |

To convert a “base twelve” numeral to the “base ten” numeral naming the same number we simply took each “base twelve” digit and multiplied it by its “base ten” value. The number represented by 2 $\#$ χ would be represented by 430_{ten}. This was arrived at by multiplying 2 by 144, and the $\#$ (11) by 12, and the χ (10) by 1 and then adding the products.

To convert a “base ten” numeral to the “base twelve” numeral naming the same number was, for us, somewhat more complicated. We had to decide how many crates (1728 eggs) we could make up from our “base ten” representation of the number, then subtract this from the total number of eggs. From the eggs left, we would make up as many gross (144) as possible, from the remaining eggs as many dozens as possible and the number of eggs left gave us the rightmost digit. For instance, the number of eggs represented by 3300_{ten} is also represented by 1 χ $\#$ 0_{twelve}. This is arrived at by noting that one crate, (1728), can be formed from 3300 leaving 1572, ten (χ) gross can be formed leaving 132 to be accounted for. Next 132 make up eleven ($\#$) dozens leaving (0) to be accounted for.

I was chagrined, some time later, to learn of a simple method for converting a base ten numeral to its equivalent in any other base. (See “An Introduction to Dozenal Counting”).

This “story” having been told, I introduce the name duodecimal, do some examples of conversion from one base to the other and finish up with some problems in addition and multiplication. Introducing the students to number bases other than ten or twelve is now readily accomplished. They seem to now be able to “let go of” base ten and begin to “think” in any base that may be suggested. I have used this approach for many years and seldom have found a student not able to reach an understanding of number bases. $\# \# \#$

Originally published in *Duodecimal Bulletin* VOL. 26; N^o. 1, WN 42;; 1191; (1981.)

This document was remastered 18 January 2011 by Michael Thomas D^e Vlieger. The dozenal numerals dek and el were changed to the DSA-Dwiggins numerals (χ = digit-ten, $\#$ = digit-eleven) from the “Bell” numerals (χ = digit-ten, $\#$ = digit-eleven). All tables and figures were updated.

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