THE Duodecimal Bulletin

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Dozenal Home Primes
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The Dozenal Society of America

is a voluntary nonprofit educational corporation, organized for the conduct of research and education of the public in the use of base twelve in calculations, mathematics, weights and measures, and other branches of pure and applied science

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5106 Hampton Avenue, Suite 205
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Official Website:
www.Dozenal.org

Email us at:
Contact@Dozenal.org

The Dozenal Society of Great Britain:
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The *Duodecimal Bulletin* Volume Four Dozen Eleven, Number Two

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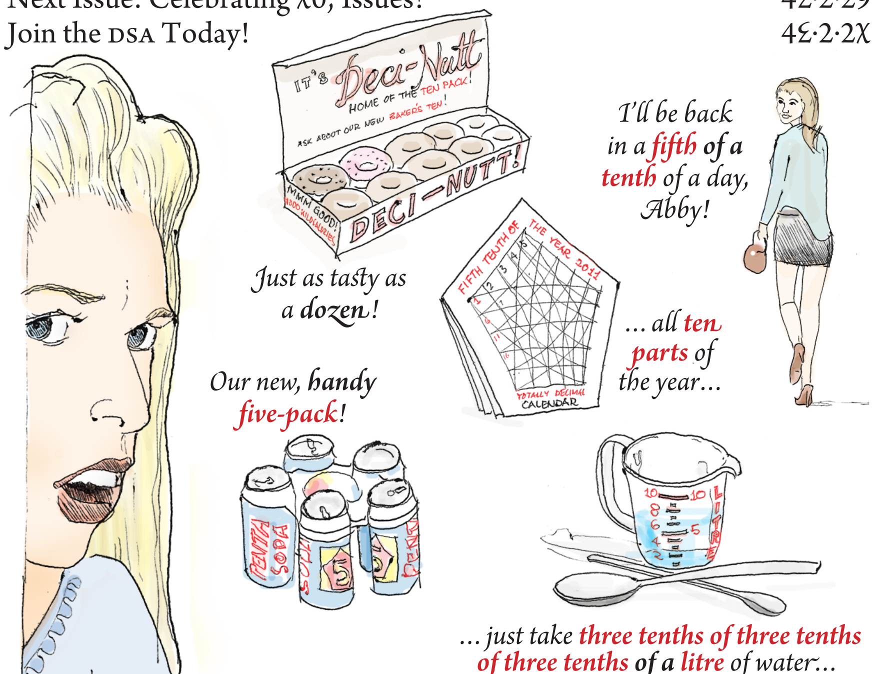
The Duodecimal Bulletin

Contents

The page numbers appear in the format Volume·Number·Page



Abby awakens from a very bad, thoroughly decimal dream...

president's message

Valentine's Day is around the corner, a day we Americans reserve to honor the ones we love. My wife and children know my affections are reserved especially for them; we will exchange gifts, perhaps a dozen roses or chocolates.

Our civilization, at least the commercial side of it, is in love with the dozen. You'll say, skeptically, "then why are we saddled with decimal, with a French metric system?" The answer to that question appears to be simple and complex at the same time—and best reserved for academics and historians to settle for us. Let's look past the decimal number base at the way we actually group things. Right now, I have a catalog we received in the mail, fraught with colorful pictures and exclamatory proclamations about the quality and popularity of the products. My eyes turn to the quantities—*dozens, multiples and powers of the dozen,* explicitly written. I can understand stuffing twelve plush toys in a box, 3 rows of 4, that makes sense. What about mardi gras beads? Can't we just stuff ten or twenty or a hundred into a box? Why dozens? I don't think I can really answer the question just using logic. I think everyone is simply aware that twelve items can be divided in so many ways, that they can be packed in a variety of ways. It's such a useful grouping that, civilizationally, we have come to see the dozen and its multiples and powers as "round numbers" despite our decimal base. We've come to love the dozen.

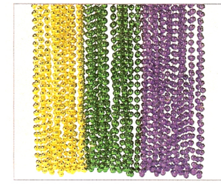
This issue offers the lover of the dozen works of love and intellect celebrating or studying this magnificent number. We have Mr. Dan Simon's report on Simon Stevin, a mathematician young Mr. Simon is so passionate about, he dressed up as Mr. Stevin for Halloween. Prof. Jay Schiffman offers an examination of home primes in dozenal, along with the data he's generated. We invite you to join us in our passion! Send in your thoughts, better yet, come see us in New York this summer! Let's celebrate our favorite number!

Michael Thomas De Vlieger, President and Editor.

M. De Vlieger

The Dozen,
Commerce's Favorite Number

These examples of the pervasiveness of the dozen in our "decimal" civilization illustrates the power of a such a compact, highly divisible number. These examples from an Oriental Trading catalog. Sample the ubiquity of the dozen for yourself at orientaltrading.com.



Mardi Gras Beads Remember the beads! These 33" strands are covered with gold, green and purple metallic plastic beads. (4 dozen per unit)
HL-12/15200 $9.99 Unit Asst.

Mardi Gras Star Beads These awesome necklaces have purple, gold and green metallic plastic star beads on 33" strands. (4 dozen per unit)
HL-12/11910 $7.99 Unit Asst.

The examples displayed here serve merely to illustrate the societal use of the dozen in daily life. The suggestion to visit the website above is not intended to be an advertisement, but an invitation to the reader to examine evidence on their own. Neither should be construed as an endorsement of the Dozenal Society of America of Oriental Trading Co.'s products, nor an endorsement by the Oriental Trading Co. of the Dozenal Society of America or its views.

NEW! St. Patrick's Party Poppers Foil. 4 1/4" *Popper is spring activated, no gunpowder or firework materials in this product.* © OTC *Small Parts*
HL-33/260 $7.99 Dozen

NEW! Personalized Stein Mug Award Trophies Personalize each sticker with 2 lines of 22 characters/spaces per line. Plastic. 4 3/4" *Simple assembly required.* © OTC
HL-47/6920 $14.99 Dz.

Symbology & Nomenclature

The DSA does NOT endorse any particular symbols for the digits ten and eleven. For uniformity in publications we use Dwiggins dek (↊) for ten and his el (↋) for eleven. Whatever symbols are used, the numbers commonly called "ten", "eleven" and "twelve" are pronounced "dek", "el" and "dough" in the duodecimal system.

When it is not clear from the context whether a numeral is decimal or dozenal, we use a period as a unit point for base ten and a semicolon, or Humphrey point, as a unit point for base twelve. Thus $\frac{1}{2}$ = 0;6 = 0.5, $2\frac{2}{3}$ = 2;8 = 2.66666..., $6\frac{3}{8}$ = 6;46 = 6.375

minutes BOARD & MEMBERSHIP 22; JUNE 11Ɛ6;

22; (26.) June 11Ɛ6; (2010.)
Nassau Community College
Garden City, NY 11530

In attendance: Board Chair Jay Schiffman, Board Members: Secretary Alice Berridge, Gene Zirkel, and President and Editor Michael De Vlieger; Member Dan Simon, Ms. Jen Seron, Graham Steele of Framingham, MA.

Board Meeting Minutes

The meeting was called to order at 2:00 PM by Board Chair Jay Schiffman in Room D-3097 at the College. (Thanks to Gene for supplying refreshments, and to Ellen Tufano who brought a delicious array of cookies.)

Minutes of the 23; June 11Ɛ5; Board Meeting were accepted as printed in *The Bulletin*. Members introduced themselves.

Treasurer Ellen Tufano's half-year financial report was accepted and approved by Members. Her report shows that there is a slight increase in net worth, that the largest expenditure was for meeting expenses and that the cost for the printing of *The Bulletin* has markedly decreased, partly due to electronic production and publishing.

Discussion ensued about the filing of IRS forms associated with the Society's 501(c)(3) tax-exempt nonprofit status, which Mike has been investigating. This issue involves theNew York State Certificate of Incorporation. Mike provided us with the latest copy of the DSA Constitution and the Certificate of Incorporation. He is close to settling the issue. Jen Seron suggested that her husband might be able to help with finally rectifying our status.

Members expressed appreciation for Ellen's work (she served as Treasurer for 5 years and on the Board of Directors for 4 years) and she was presented with a DSA Honorary Membership.

Readers are reminded to send dues (student $3; regular Member $16; Supporting Member $30) to Jay's address which is listed in our *Bulletin*.

The Nominating Committee consisting of Alice Berridge, Gene Zirkel and Pat Zirkel proposed the following slate of Officers: Board Chair Jay Schiffman:, President Michael DeVlieger, Vice President John Earnest, Secretary Alice Berridge and Treasurer Jay Schiffman. As there were no other nominations, this slate was approved.

Board Chair Schiffman presented the Ralph Beard Memorial Award for a second time to the same person (this is only the second time that this has occurred in our history)—Mike De Vlieger. (See page 6 for the text of the award).

The next meeting is scheduled for 2 PM 21; June 11Ɛ7; (25. June 2011.) at Nassau Community College. This meeting was adjourned at 3 PM. It is hoped that next time we will be able to link with Dr. Impagliazzo, Qatar via Skype.

Membership Meeting Minutes

The meeting was called to order by President De Vlieger at 3:05 PM. Minutes of the last meeting were accepted as printed in the *Bulletin*. Gene noted that long time dozenal advocate & Board Member Rob Roy McPherson of Gainesville, FL recently passed away. (Notice appears in Vol. 4Ɛ; №. 1 page 4.)

Mike is still working on updating the website, but has managed to eliminate error messages associated with PHP files. Late in 2009 the site had been hacked. Passwords were changed and no further problems have been reported since they were rectified in December 2009. Graham indicated interest in working with the website. It was noted that the membership form needs to be updated. In general, the web pages are generated through PHP, and have not been updated since 2005. Jen agreed to see if she can help update the pages. Jen reiterated her hope that dozens materials suitable for classroom teaching might be developed and posted on the site.

Mike discussed ideas for upcoming issues of the *Duodecimal Bulletin*. The next dozen issues would feature a temporary department looking into dozenal systems of measurement. Takashi Suga has written an interesting two dozen eleven page Universal Unit System, and has discussed a more concise article for the Bulletin. A prominent system is Tom Pendlebury's TGM (time-gravity-mass) system. Mike thinks Member Don Goodman III might lend a hand in examining that system. Mike is also interested in a special issue on music—supplemented, perhaps in part by reprinting prior articles. Jen drew our attention to an interesting song: "Little Dec-Head" written by Dr. Doug Shaw, UNI. It's an amusing spoof on Little Twelve Toes. Dan Simon has written a research report on Simon Stevin and Chinese twelve-tone music and we all encouraged him to submit the article to Mike. (Mr. Simon's Stevin report appears on page 8 of this issue.) Members agreed that the latest *Bulletin* (Vol. 4X; №. 2) is enjoyable and informative.

Mike was reappointed Editor of our *Bulletin*, and Gene was appointed Parliamentarian to the Chair by Jay and also to the President by Mike. Dan noted that the according to the Constitution, another member was needed in the Class of 11Ɛ6; (2010.) due to the passing of Mr. McPherson; Graham Steele agreed to take his place. The Class of 11Ɛ9; (2013.)was elected: Dr. John Impagliazzo, Gene Zirkel, John Earnest and Graham Steele. The Nominating Committee of Gene Zirkel, Pat Zirkel and Alice Berridge was re-elected. The meeting adjourned at 4:05 PM.

Board Chair Jay Schiffman presented "Dozenal Home Primes," a demonstration of duodecimal home primes, to Members. There was avid participation in the discussion of composite numbers whereby successive concatenations are carried out until a prime is reached. Jay showed that the number of steps needed to reach a prime is different for different bases. His first example, decimal 10., needed four steps to reach the home prime (HP) of 773. He pointed out that 49. takes at least 103. steps to reach its HP. (Jay wrote an article on the topic of Home Primes which appears on page 11; of this issue.)

Submitted by Alice Berridge, Secretary

The Ralph Beard Memorial Award
of the
Dozenal Society of America
is hereby presented to

Michael De Vlieger

President & Editor
for his inspiring leadership, for his devotion to the duties of the offices he holds,
for his efforts and generosity on behalf of our Society,
& in particular for his accomplishments as Editor which include
full color Bulletins, creating our eBulletin & especially
for the unmeasurable time & effort he put into
producing the outstanding 'symbology' themed issue.

The members of our Society and the Board of Directors are pleased to present him with this token of our gratitude and our appreciation.

11Ɛ6; 2010.

x^n featured figures

Presenting a simple listing of the positive and negative powers of two and three in dozenal, between -30; (-36.) and 30; (-36.) These facts were calculated using Wolfram Mathematica 7.0. Challenge: Can you write an algorithm that would generate similar output?

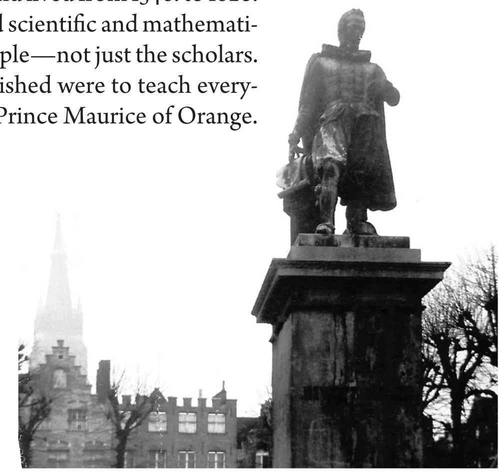
See the bottom of page 23; for an answer!

POWERS OF TWO			POWERS OF THREE		
POSITIVE	*n*	NEGATIVE	POSITIVE	*n*	NEGATIVE
1	0		1	0	
2	1	;6	3	1	;4
4	2	;3	9	2	;14
8	3	;16	23	3	;054
14	4	;09	69	4	;019 4
28	5	;046	183	5	;007 14
54	6	;023	509	6	;002 454
X8	7	;011 6	1 323	7	;000 959 4
194	8	;006 9	3 969	8	;000 31Ɛ 14
368	9	;003 46	Ɛ 483	9	;000 107 854
714	X	;001 83	2X 209	X	;000 042 699 4
1 228	Ɛ	;000 X16	86 623	Ɛ	1;4X3 314 E -5
2 454	10	;000 509	217 669	10	5;751 054 E -6
4 8X8	11	;000 264 6	64X 783	11	1;X58 419 4 E -6
9 594	12	;000 132 3	1 727 Ɛ09	12	7;5X9 471 4 E -7
16 Ɛ68	13	;000 077 16	4 97Ɛ 923	13	2;5Ɛ7 164 54 E -7
31 Ɛ14	14	;000 039 69	12 4ƐƐ 369	14	9;ƐX4 615 94 E -8
63 X28	15	;000 01X 946	37 2Ɛ9 X83	15	3;3Ɛ5 605 Ɛ14 E -8
107 854	16	;000 00Ɛ 483	X9 8Ɛ5 809	16	1;139 X01 Ɛ85 4 E -8
213 4X8	17	;000 005 841 6	285 2X5 023	17	4;533 407 X99 4 E -9
426 994	18	;000 002 X20 9	813 873 069	18	1;591 142 773 14 E -9
851 768	19	1;510 46 E -6	2 03Ɛ 199 183	19	5;Ɛ04 54X 650 54 E -X
1 4X3 314	1X	8;662 3 E -7	6 0Ɛ9 553 509	1X	1;Ɛ81 597 618 194 E -X
2 986 628	1Ɛ	4;331 16 E -7	16 2Ɛ4 43X 323	1Ɛ	7;X85 Ɛ26 068 714 E -Ɛ
5 751 054	20	2;176 69 E -7	46 8X1 0Ɛ6 969	20	2;769 Ɛ8X 022 X45 4 E -Ɛ
Ɛ 2X2 0X8	21	1;099 346 E -7	118 263 2X8 483	21	X;633 XƐ4 08Ɛ 559 4 E -10
1X 584 194	22	6;4X7 83 E -8	350 769 881 209	22	3;611 379 42Ɛ 99Ɛ 14 E -10
38 Ɛ48 368	23	3;253 X16 E -8	X31 X85 203 623	23	1;204 527 14Ɛ Ɛ33 854 E -10
75 X94 714	24	1;727 Ɛ09 E -8	2 695 813 60X 669	24	4;815 8X4 57Ɛ 912 994 E -11
12Ɛ 969 228	25	9;73Ɛ 646 E -9	7 845 03X 627 783	25	1;685 XƐ5 5X7 Ɛ04 Ɛ31 4 E -11
25Ɛ 716 454	26	4;97Ɛ 923 E -9	1Ɛ 113 0Ɛ7 67X Ɛ09	26	6;29Ɛ 799 Ɛ67 817 905 4 E -12
4ƐƐ 230 8X8	27	2;49Ɛ X71 6 E -9	59 339 2XX 7Ɛ8 923	27	2;0Ɛ3 X73 3X2 686 701 94 E -12
9ƐX 461 594	28	1;24Ɛ Ɛ36 9 E -9	153 9Ɛ3 887 ƐƐ2 369	28	8;393 651 34X 2X2 407 14 E -13
1 7Ɛ8 902 Ɛ68	29	7;25Ɛ 794 6 E -X	43Ɛ 59Ɛ 21Ɛ Ɛ96 X83	29	2;931 218 517 4Ɛ4 942 454 E -13
3 3Ɛ5 605 Ɛ14	2X	3;72Ɛ 9X8 3 E -X	1 0ƐX 559 65Ɛ Ɛ48 809	2X	Ɛ;104 869 865 797 149 594 E -14
6 7XƐ 00Ɛ X28	2Ɛ	1;975 XƐ4 16 E -X	3 2Ɛ7 454 75Ɛ X22 023	2Ɛ	3;841 6X3 2X1 X72 457 1Ɛ1 4 E -14
11 39X 01Ɛ 854	30	X;98Ɛ 580 9 E -Ɛ	9 8XX 141 X5Ɛ 666 069	30	1;294 635 0Ɛ4 764 95X 478 54 E -14

Simon Stevin

by Dan Simon, DSA Member №. 395;

Simon Stevin was born in Flanders and lived from 1548. to 1620. Stevin was special in that he wanted scientific and mathematical discoveries to be shared with all people—not just the scholars. Many of the books and papers he published were to teach everyone even though he was employed by Prince Maurice of Orange.



A statue honoring Simon Stevin, 1548–1620, at Simonstevinplein in Brugge (Bruges, Belgium), erected in 1846. The Church of Our Lady (Onze-Lieve-Vrouwekerk) in the background. (DSA archive photo).

Major Accomplishments

Stevin is best known for popularizing use of the decimal system—for he published a paper which in less than forty pages explained why everyday people should use decimals vs. fractions. Scholars had been using decimals for hundreds of years but the normal people had no idea.

Stevin "discovered" gravity. Years before Galileo or Isaac Newton's famous experiments with gravity, Stevin published an experiment in which he determined that a heavy object fell to earth at the same rate as a light object.

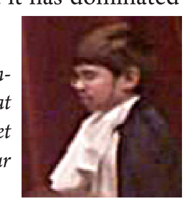
Stevin wrote in Dutch because he wanted the normal people to understand what scholars were doing and he thought Dutch was much more useful than Latin or Greek. He wanted to teach the everyday people as well as the princes.

Stevin was the first European to use a base twelve system to mathematically create a new type of music which was "Equally Tempered".

Equal Temperament

What was this new approach to music? Wu Zaiyu, a Chinese scholar-prince actually discovered it before Simon Stevin, who did a great job of spreading the idea in Europe. Both Wu Zaiyu and Stevin used mathematics to create equal distances in an octave. This equal distance between notes is called "Equal Temperament". In the beginning there was a big fight over whether the old way "Natural Tuning" would win or whether the new "Equal Temperament" way would win.

J. S. Bach wrote an entire piece of music called "The Well-Tempered Clavier" in order to show off how useful this new base-twelve system of tuning would be for musicians. The base-twelve system of Equally Tempered notes won and it has dominated western music even until today.



Editor's Note: Mr. Simon was 8 years old when he dictated this report to his mother Jen Seron, based on readings they found together. Dan presented an oral report at the 2008 NYCHEA History Fair 17 November 2008. in NYC at the Jefferson Market Branch of the New York Public Library in Manhattan. He read it aloud to about four dozen people in attendance. See page nine for some of Mr. Simon's resources.

problem from last issue:

Find the base, b, used in each of the following. Hints: Each equation is written in its base, b. For example $47 = 4b + 7$ and $b > 7$. The base of a logarithm is an integer > 1.

1.) $\text{Log}_b\, 24 - \text{Log}_b\, 3 = \text{Log}_b\, 8$

2.) $2\,\text{Log}_b\, 5 = \text{Log}_b\, 31$

3.) $\text{Log}_b\, 4 + \text{Log}_b\, 30 = \text{Log}_b\, 100$

4.) $\text{Log}_b\, 100{,}000 = 101$

5.) $-\text{Log}_b\, 100 = -2$

6.) $\text{Log}_b\, 5 = -2$

Solution on page 23;

Continued from page 8;

Bibliography and Web Links as of 16. November 2008.

The Discovery of Musical Equal Temperament in China and Europe in the Sixteenth Century by Gene Jinsiong Cho. Studies in the History and Interpretation of Music Volume 93, Edwin Mellen Press. Lewiston, NY. 2003. Abstract retrievable at http://www.mellenpress.com/mellenpress.cfm?bookid=5442&pc=9.

Stevin, Simon: *On the theory of the art of singing (Vande Spiegheling der Singconst)*, 1585, annotated English translation by A.D. Fokker (ed.) with introduction, 1966. http://www.huygens-fokker.org/docs/stevinsp.html.

"Simon Stevin", retrieved in 2008 from http://www.answers.com/topic/simon-stevin via search. Biography and summary of Stevin's work with links to other resources.

http://www.wikipedia.org/wiki/Simon_Stevin *Editor's Note: Mr. Simon used this site to provide a freely licensed image of Simon Stevin, which is not used in this article. Instead, the DSA provides its own archive photograph of the statue of Simon Stevin.*

Genius of China: 3,000 Years of Science, Discovery and Invention by Robert Temple. Paperback Ed., 1993. Carlton Publishing Group. 2005 Reprint. pp. 208-213.

How Do You Pronounce Dozenals?

by Gene Zirkel

Introduction

This article was inspired by a question from a high school senior, Steven Keyes: "How would one pronounce the names of dozenal numbers, such as 11; (a baker's dozen) or X5; (the cube of five)?"

We begin by reprinting the unsigned "Mo for Megro" item in our *Bulletin*, WN 0, Vol. 1; №. 1; p. 10;.

The item followed a report on committees including the Committee on Weights and Measures of which Editor Ralph Beard was the chair. It does not seem to be a part of that report, for it has a separate entry in the table of contents. It was most likely written by Editor Beard.

Shortly after Andrews' 1934 article appeared in the *Atlantic Monthly,* our founders began to write to one another in what Beard called "a round robin" of letters. This first issue of our *Bulletin* appeared dek years later. From the report it is clear that they had been discussing nomenclature among themselves during that time.

The following is the original article reprinted in its entirety:

Mo For Megro

For several years we have used the term "megro" to represent 1,000;, this being a shortened name for meg-gross, or great gross. As it becomes clear that the names for the first three powers of the "do" will also be used as prefixes for similar relationships among the weights and measures, (as in doyard, and groyard), it seems advisable that the two-syllabled "megro" be further shortened to "mo". The ascending progression will then be: do, gro, and mo.

While there has been no special practice as to the descending succession, there has been some use of "doth" to represent one-twelfth, and "groth" as one part of a gross. In place of this awkward construction, the use of the prefix "e" has been accepted as meaning "of, or out of". Thus, one "edo" means one out of a dozen, or one-twelfth. And in place of "percent" we have "egro". The ascending and descending progressions are:

Table 1

1;	One		
10;	Do	0;1	Edo
100;	Gro	0;01	Egro
1,000;	Mo	0;001	Emo
10,000;	Do-mo	0;000,1	Edo-mo
100,000;	Gro-mo	0;000,01	Egro-mo
1,000,000;	Bi-mo	0;000,001	Ebi-mo
1,000,000,000;	Tri-mo	and so on.	

End of Original Article

Pronouncing Whole Numbers using the above system:

Just as a base dek number such as 345,670,000 is pronounced "3 hundred forty 5 million, 6 hundred seventy thousand", so too the dozenal number Ɛ8,65X,300 is pronounced "el do 8 bi-mo, 6 gro 5 do X mo, 3 gro".

Some examples:

40,101,000,000	4 do TRI-MO, 1 gro 1 BI-MO
3↊,030,504	3 do ↊ BI-MO, 3 do MO, 5 gro 4
5,011,000	5 BI-MO, do 1 MO
346,722	3 gro 4 do 6 MO, 7 gro 2 do 2

Of course just as a base dek 456,000 quickly changes from '4 hundred fifty 6 thousand', to simply '456 thousand', so too with a little practice the above examples quickly become:

40 TRI-MO, 101 BI-MO
3↊ BI-MO, 30 GRO, 504
5 BI-MO, 11 MO
346 MO, 722

Fractionals

The table in the original article, which we've labeled "Table 1", given to us by our founders, is very easy to use when dealing with fractionals. Just as in base dek, one merely refers to the position of the rightmost digit when reading fractionals, thus:

0.34	is 34 hundredths
0.056	is 56 thousandths
0.70008	is 70,008 hundred thousandths

So too in dozenals we refer to the position of the last digit, thus:

0;34	is 3 do 4 egro (or 34; egro.)
0;056	is 56; emo
0;70008	is 70,008; egro-mo

An Alternate Proposal for Whole Numbers

Table 1 partially answers the question Steven asked. However in a world of trillion dollar and larger budgets, what about extremely large numbers, words much larger than a tri-mo such as are used in astronomy?

Americans call a '1' followed by 6 zeros a million, by 9 zeros a billion, and by a dozen zeros a trillion. The initial m, b, t of these words is copied in the second column of Table 1 in mo, bi-mo and tri-mo. However, this association of initial letters limps.

I suggest the following as a simpler and regular method of naming duodecimal integers similar in simplicity to that of duodecimal fractionals.

TABLE 2

10	do	$10^{↊}$	do mo mo mo
100	gro	$10^{↋}$	gro mo mo mo
1 000	mo	10^{10}	mo mo mo mo
10 000	do mo	10^{11}	do mo mo mo mo
100 000	gro mo	10^{12}	gro mo mo mo mo
1 000 000	mo mo	10^{13}	mo mo mo mo mo
10 000 000	do mo mo	10^{14}	do mo mo mo mo mo
100 000 000	gro mo mo	10^{15}	gro mo mo mo mo mo
1 000 000 000	mo mo mo	10^{16}	mo mo mo mo mo mo
		⋮	*etc.*

Of course, this notation can easily be simplified to something such as using a subscript to indicate the number of 'mo's in the way that we abbreviate "cubic inches" as "in³".

TABLE 3

10	do	$10^{↊}$	do mo$_3$
100	gro	$10^{↋}$	gro mo$_3$
1 000	mo	10^{10}	mo$_4$
10 000	do mo	10^{11}	do mo$_4$
100 000	gro mo	10^{12}	gro mo$_4$
1 000 000	mo$_2$	10^{13}	mo$_5$
10 000 000	do mo$_2$	10^{14}	do mo$_5$
100 000 000	gro mo$_2$	10^{15}	gro mo$_5$
1 000 000 000	mo$_3$	10^{16}	mo$_6$
		⋮	*etc.*

How to Pronounce Large Numbers

1.) In the examples below, separate the number into what is left of the leftmost comma and what is to the right.

2.) Determine the number of triples (T) to the right.

3.) Utter the left side concatenated with "mo sub T".

4.) Repeat this process with the right side until the right side is empty.

Thus to pronounce a given string of digits such as 12,345,678;:

Separate "12" from "345,678" which has 2 triples. This yields "12 mo$_2$" with 345,678 remaining.

Repeat with "345,678" separating "345" and "678" obtaining "345 mo" with 678 remaining.

Repeat with "678" separating "678" from nothing obtaining "678" with nothing remaining.

Concatenate your results saying "12 mo$_2$, 345 mo, 678" or "do 2-mo-mo, 3-gro 4-do 5-mo, 6-gro 7-do 8".

Conversely, How to Expand Verbal Expressions

Example: Expand "3-gro 4-mo$_3$, 5-do 6-mo".

First we recognize that the first 3 digits preceding the largest subscript are "304" and the remaining digits must come in groups of three.

Next we notice that the largest subscript (3) indicates that the number has more than 3 × 3 and at most 3 × (3 + 1) digits. That is dek, el, or do digits. We have already accounted for three digits, so that leaves 7, 8, or 9 more, and only nine has exactly 3 groups of digits. Thus so far we have "304,*abc*,*def*,*ghi*;".

Repeating this reasoning, "5-do 6-mo" starts with "56" and mo has 1 for a subscript. Thus we have more than 3 × 1 and at most 3 × 2 digits that is 4, 5, or 6. Since we have already accounted for two digits that leaves 2, 3, or 4 more and only 3 has exactly 1 group.

Thus we have the rest of the number—"56,000". Concatenating our results we obtain "304,*abc*,*d*56,000" and thus 304,000,056,000.

Dozenal Home Primes

Jay L. Schiffman ☙ Rowan University

Introduction

The Home Prime Conjecture represents a very neat problem encompassing the interface of mathematics and technology. This problem first sparked a great deal of interest in 11X5; (**1997.**) with a feature article in *The Journal of Recreational Mathematics* by Jeffrey Heleen entitled "Family Numbers: Constructing Primes by Prime Factor Splitting." The iterative process is quite simple. Consider any composite integer and resolve this integer into its prime factorization. Concatenate the factors in order of increasing magnitude and factor the new integer that is formed. Repeat the process. The Home Prime Conjecture asserts that eventually a prime number will be obtained which is the *Home Prime* (HP) of the original composite integer. To cite an example, consider the decimal integer **10**. The repeated factorizations and concatenations result in the eventual prime **773**, which is the Home Prime of **10**. The steps are furnished below:

$$\begin{aligned} \mathbf{10} &= (\mathbf{2})(\mathbf{5}) \rightarrow \mathbf{25} \\ &= (\mathbf{5})(\mathbf{5}) \rightarrow \mathbf{55} \\ &= (\mathbf{5})(\mathbf{11}) \rightarrow \mathbf{511} \\ &= (\mathbf{7})(\mathbf{73}) \rightarrow \mathbf{773}, \text{ a prime} \\ \text{and so } \mathrm{HP}[\mathbf{10}] &= \mathbf{773} \text{ in } \mathbf{4} \text{ steps.} \end{aligned}$$

More compactly, one may write

$$\mathrm{HP}[\mathbf{10}] \rightarrow (\mathbf{2})(\mathbf{5}) \rightarrow (\mathbf{5})(\mathbf{5}) \rightarrow (\mathbf{5})(\mathbf{11}) \rightarrow (\mathbf{7})(\mathbf{73}) \rightarrow \text{Prime } \mathbf{773}\ (\mathbf{4})$$

in base dek where the last (**4**) indicates the number of steps needed for **10** to reach its Home Prime. Note that Home Primes are base-dependent in the sense that families of integers in the repeated factoring and concatenation process in one number base are generally not in the same family in a different number base. For example, in base ten, HP(**10**) = **773** while in dozenal, HP(X;) = 25;. Similarly decimally, HP(**12**) = **223** while in dozenal, HP(10;) = 3357;. Here decimal numerals are in **bold face** to distinguish them from their duodecimal counterparts.

While many composite integers have their Home Primes generated in a few steps, the Home Prime for the decimal integer **49** (and subsequently the integers **77** and **711** which belong to the same family in the repeated concatenation process) remains unresolved after more than one hundred steps. This is due to the inability for even the most sophisticated technology to factor very large integers which is an NP hard problem. (For information on the complexity of algorithms which encompasses algorithmic procedures that can be performed in polynomial time versus those that are intractable, the reader is referred to the on-line mathematics encyclopedia Mathworld as reference 2 in the appended bibliography. Proceed in the alphabetical index to NP Problems.) The factoring algorithm is contingent upon the second largest prime factor when factoring a composite integer. If this second largest prime factor has many digits, the search may become stalled

at that stage of the process. In my paper, I extend this classic Home Prime problem to the duodecimal base using the Mathematica Program to generate the Home Primes for every one of the 91; composite integers save 26; and 6X; among the first gross of integers. Unfortunately the Home Primes for 26; and 6X; are stalled in trying to respectively factor an 85; digit duodecimal and **109** digit decimal composite integer after 55; iterations. I am currently using Mathematica to potentially secure the common Home Prime for these two composite integers and this is a work in progress. In addition, a rechecking of my work for 54; and 68; indicates that the Home Primes have yet to be found for these composite integers as well. After 49; iterations for the integer 54; we are led to a 83; digit composite duodecimal integer (**107** Digits decimally) such that factoring is extremely difficult. Similarly, after 57; iterations for the integer 68;, we encounter a 79; digit composite duodecimal integer (**100** digits decimally) for which factoring is seemingly intractable. These "forbidden four" represent the only integers for which I have yet to secure the Home Prime. This is in contrast to the decimal base where the integers **49** and **77** in the range **1–100** are such that the Home Prime Conjecture remains unresolved.

Our initial goal is to secure the Home Prime for a duodecimal integer. Let us consider the integer 20;. Our repeated factorings and concatenations are as follows:

$$\begin{aligned} \mathrm{HP}[20] &\rightarrow (2)(2)(2)(3) \rightarrow (3)(3)(2\text{XƐ}) \rightarrow (17)(37)(6\text{Ɛ}) \rightarrow (61)(320\text{Ɛ}) \rightarrow (107)(59\text{X}5) \\ &\rightarrow \text{Prime } 1\,075\,9\text{X}5\ (5) \end{aligned}$$

Hence 10759X5 is the Home Prime of 20 achieved in five steps.

Let us contrast this with the Home Prime for the integer **24** in base ten. The iterations are displayed below:

$$\mathrm{HP}[\mathbf{24}] \rightarrow (\mathbf{2})(\mathbf{2})(\mathbf{2})(\mathbf{3}) \rightarrow (\mathbf{3})(\mathbf{3})(\mathbf{13})(\mathbf{19}) \rightarrow \text{Prime } \mathbf{331319}\ (\mathbf{2})$$

Note decimally that **331319** (i.e. 13Ɛ89Ɛ;) is the Home Prime of **24** obtained in two steps.

It should similarly be noted that the numeral 6X; in base duo has a seemingly intractable composite integer to factor with regards to securing its Home Prime during step 59; in base twelve. In contrast, the Home Prime is reached in one step when taken as a decimal numeral:

$$\mathrm{HP}[\mathbf{82}] \rightarrow (\mathbf{2})(\mathbf{41}) \rightarrow \text{Prime } \mathbf{241}\ (\mathbf{1})$$

In a like manner, when 49 in base ten is taken as the duodecimal numeral 41; the repeated concatenation in securing the Home Prime is delightfully easy. We illustrate the steps below:

$$\mathrm{HP}[41] \rightarrow (7)(7) \rightarrow (7)(11) \rightarrow \text{Prime } 711\ (2)$$

Thus 711; is the Home Prime of 41; achieved in just two steps.

We next demonstrate all the Home Primes for the composite integers no greater than one gross with the exceptions of 54;, 68; and 26; and 6X; which belong to the same family. For the latter integers, the iterations including the step where the process is stalled is duly noted. All integers are duodecimal unless otherwise indicated. At times, a large factor continues to a second line. In such a case, we read the entire integer in parentheses as a factor. For example, in the concatenations related to the integer 26; the last factor in iteration 51; which is

→ (5)(2165360400Ɛ)(7Ɛ80290X182750Ɛ223Ɛ532X41X7Ɛ1Ɛ30X276712946XX738X7414036-
17605606189242970640Ɛ180324775)

reads:

7Ɛ80290X182750Ɛ223Ɛ532X41X7Ɛ1Ɛ30X276712946XX738X741403617605606189242970640Ɛ180324775.

Continued on page 15;

Dozenal Home Primes for Integers up to One Gross

Int	Ct	Home Prime
1	—	—
2	0	2
3	0	3
4	3	737
5	0	5
6	Ɛ	18Ɛ194713227Ɛ
7	0	7
8	2	2111
9	3	575
X	1	25
Ɛ	0	Ɛ
10	2	3357
11	0	11
12	1	27
13	1	35
14	14	—See Extended Table Below—
15	0	15
16	2	391
17	0	17
18	1	225
19	1	37
1X	2	57
1Ɛ	0	1Ɛ
20	5	10759X5
21	2	511
22	2	737
23	X	18Ɛ194713227Ɛ
24	2	Ɛ25
25	0	25
26	*	—*In Progress*—
27	0	27
28	4	7655143Ɛ
29	1	3Ɛ
2X	4	5237
2Ɛ	1	57
30	3	251345

Int	Ct	Home Prime
31	0	31
32	1	217
33	2	575
34	9	8Ɛ57733X7Ɛ;
35	0	35
36	1	237
37	0	37
38	2	1517
39	2	Ɛ37
3X	1	21Ɛ
3Ɛ	0	3Ɛ
40	2	33Ɛ321
41	2	711
42	1	255
43	1	315
44	4	22177Ɛ
45	0	45
46	24	—See Extended Table Below—
47	1	5Ɛ
48	6	313Ɛ8XƐ5
49	4	XƐ5ƐƐ
4X	1	225
4Ɛ	0	4Ɛ
50	2	5531
51	0	51
52	2	Ɛ25
53	4	517X7
54	*	—*In Progress*—
55	1	511
56	1	557
57	0	57
58	1	2215
59	2	5711
5X	7	1775591
5Ɛ	0	5Ɛ
60	2	3572ƐƐ

Extended Table

Int	Ct	Home Prime
14	14	1Ɛ59X677360757339047535Ɛ15081Ɛ
46	24	3Ɛ175313542X54749131918477Ɛ0893050181

Dozenal Home Primes for Integers up to One Gross

Int	Ct	Home Prime
61	0	61
62	6	553533
63	Ɛ	1254571591
64	2	455Ɛ
65	2	517
66	8	181Ɛ681591
67	0	67
68	*	—*In Progress*—
69	3	435971
6X	*	—*In Progress*—
6Ɛ	0	6Ɛ
70	2	7391
71	3	11X7
72	1	237
73	1	325
74	1	222Ɛ
75	0	75
76	1	2335
77	1	711
78	1	221Ɛ
79	1	327
7X	2	557
7Ɛ	1	517
80	10	118135891408816007
81	0	81
82	1	277
83	1	33Ɛ
84	3	71X6Ɛ
85	0	85
86	3	5255Ɛ
87	0	87
88	3	77797
89	1	357
8X	17	11Ɛ422925562X983X5027
8Ɛ	0	8Ɛ
90	4	57X1097

Int	Ct	Home Prime
91	0	91
92	1	25Ɛ
93	3	5537
94	1	22227
95	0	95
96	1	2317
97	1	51Ɛ
98	9	8Ɛ57733X7Ɛ
99	7	916928Ɛ
9X	1	24Ɛ
9Ɛ	10	51Ɛ5Ɛ312349295
X0	11	229714587Ɛ0X584Ɛ
X1	2	Ɛ11
X2	1	251
X3	2	Ɛ37
X4	6	313Ɛ8XƐ5
X5	4	53X2Ɛ
X6	1	2337
X7	0	X7
X8	2	246Ɛ2X3Ɛ
X9	4	517X7
XX	5	672ƐƐ
XƐ	0	XƐ
Ɛ0	2	15167
Ɛ1	2	1167
Ɛ2	7	1775591
Ɛ3	1	3335
Ɛ4	1	22215
Ɛ5	0	Ɛ5
Ɛ6	1	231Ɛ
Ɛ7	0	Ɛ7
Ɛ8	2	3187
Ɛ9	1	33Ɛ
ƐX	1	25Ɛ
ƐƐ	1	Ɛ11
100	8	1712221596815

This table lists each duodecimal integer "Int" in red, up to one gross, the Count ("Ct", number of steps) in the second column needed to achieve its corresponding Home Prime in the third column. Note that any prime requires zero steps to reach the Home Prime, namely itself. Visit http://www.Dozenal.org/adjunct/db4b211.pdf to review any new iterations in the process for each of these integers. This document will be updated with regards to 26;, 54;, 68;, and 6X; if and when we obtain more fruitful results, allowing interested readers to peruse them at leisure.

It is of interest to note that the mapping of a duodecimal integer into its Home Prime is not one-to-one in the sense that different duodecimal integers can possess identical Home Primes and hence belong to the same family. The following is a list of duodecimal integers less than one gross that have the same Home Prime:

4 and 22	→	HP = 737	21 and 55	→	HP = 511
6 and 23	→	HP = 18Ɛ194713227Ɛ	41 and 77	→	HP = 711
9 and 33	→	HP = 575	5X and Ɛ2	→	HP = 1775591
1X and 2Ɛ	→	HP = 57	65 and 7Ɛ	→	HP = 517

X1 and ƐƐ → HP = Ɛ11

Pseudocode

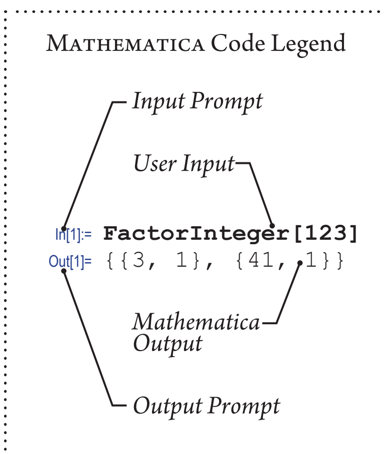
We next furnish an illustration of pseudocode to furnish the Home Prime of a composite integer as well as discuss the role a CAS (Computer Algebra System) program such as MATHEMATICA handles the task. The CAS program MATHEMATICA, a copyright of Wolfram Research, Inc. enabled me to conduct my searches. In the program, the commands **`IntegerDigits[]`** (to convert a decimal numeral to another base) and **`FromDigits[]`** (to covert a numeral in a different base to base ten) are utilized as well as **`FactorInteger[]`** to resolve an integer into its standard prime factored form. A sample problem follows below in which we secure the Home Prime in Base Twelve for the duodecimal integer X3 (**123**). We note that since the computer does not perform duodecimal arithmetic, it necessitates one to keep moving back and forth between duodecimals and decimals. The following is an example of pseudocode to secure the Home Prime of X3:

STEP 1: Express X3 in decimal	→	**123**
STEP 2: Factor **123**	→	**(3)(41)**
STEP 3: Express the factors in duodecimal	→	(3)(35)
STEP 4: Express 335 in decimal	→	**473**
STEP 5: Factor **473**	→	**(11)(43)**
STEP 6: Express the factors in duodecimal	→	(Ɛ)(37)
STEP 7: Express Ɛ37 in decimal	→	**1627**
STEP 8: Factor **1627**	→	**1627** is PRIME

Therefore, HP(X3) = Ɛ37

In MATHEMATICA, the code is as follows:

```
In[1]:= FactorInteger[123]
Out[1]= {{3, 1}, {41, 1}}
In[2]:= IntegerDigits[{3, 41}, 12]
Out[2]= {{3}, {3, 5}}
In[3]:= FromDigits[{3, 3, 5}, 12]
Out[3]= 473
In[4]:= FactorInteger[473]
Out[4]= {{11, 1}, {43, 1}}
In[5]:= IntegerDigits[{11, 43}, 12]
Out[5]= {{11}, {3, 7}}
In[6]:= FromDigits[{11, 3, 7}, 12]
Out[6]= 1627
In[7]:= FactorInteger[1627]
Out[7]= {{1627, 1}}
```



Mathworld, a Wolfram Resource managed by Dr. Eric Weisstein of Wolfram Research, Inc. is an excellent source for everything mathematical and scientific, including a paragraph on our society found under the letter "D" obtainable in the alphabetical index on their website, www.mathworld.wolfram.com. Under the letter "H" is Home Prime which accesses a neat article devoted to this mathematical recreation. Contributors to Mathworld are Dr. Eric Weisstein as well as numerous mathematicians throughout the world. While Home Primes in bases up to ten have been investigated, there is nothing dealing with bases higher than ten which led me to initiate my research. I would be grateful if anyone can eventually factor the large composite integer that has stalled my search in securing the common duodecimal Home Prime for the duodecimal integers 26; and 6X; as they both belong to the same family.

REFERENCES:

1. Heleen, Jeffrey, "Family Numbers: Constructing Primes by Prime Factor Splitting", *The Journal of Recreational Mathematics*, 24; (**28.**), P. 98;-9Ɛ; (P. **116.–119.**), 11X4–X5; (**1996–97.**)
2. Mathworld—A Wolfram Resource, Wolfram Research, Inc., Champaign, IL. 11Ɛ6; (**2010.**)
3. "Home Prime", retrievable in November 11Ɛ6; (**2010.**) at http://mathworld.wolfram.com/HomePrime.html
4. "Duodecimal", retrievable in November 11Ɛ6; (**2010.**) at http://mathworld.wolfram.com/Duodecimal.html

Iterations of The Home Primes for all composite integers through 100; (144.):

4 → (2)(2) → (2)(11) → (7)(37) → PRIME 737 (3).

6 → (2)(3) → (3)(3)(3) → (3)(111) → (7)(7)(91) → (61)(131) → (5)(5)(27)(117) → (1Ɛ)(91)(38Ɛ5) → (431)(56Ɛ85) → (7)(7)(7)(15)(3Ɛ)(3X5) → (3Ɛ)(1Ɛ4762657) → (18Ɛ)(1947)(13227Ɛ) → PRIME 18Ɛ194713227Ɛ (Ɛ).

8 → (2)(2)(2) → (2)(111) → PRIME 2111 (2).

9 → (3)(3) → (3)(11) → (5)(75) → PRIME 575 (3).

X → (2)(5) → PRIME 25 (1).

10 → (2)(2)(3) → (3)(3)(5)(7) → PRIME 3357 (2).

12 → (2)(7) → PRIME 27 (1).

13 → (3)(5) → PRIME 35 (1).

14 → (2)(2)(2)(2) → (2)(5)(11)(25) → (5)(15)(3Ɛ)(107) → (Ɛ)(37)(241)(7ƐƐ) → (5)(231532897) → (1Ɛ)(111)(2596375) → (117)(225)(437)(21X51) → (5)(2877833152935) → (7)(8Ɛ62990542 13Ɛ) → (5)(11)(17)(41XƐ)(2733379Ɛ) → (2047X41)(2608X04XX1Ɛ) → (7)(7)(7)(25)(1521)(9775)(382Ɛ345) → (7)(51)(251)(108Ɛ49586ƐX3718Ɛ) → (11)(12Ɛ)(4085)(14377578Ɛ4729275) → (5)(5)(1Ɛ)(27)(2897)(166Ɛ2ƐX85)(37290391Ɛ) → (1Ɛ5)(9X677)(360757)(3390475)(35Ɛ15081Ɛ) → PRIME 1Ɛ59X67736075733904753 5Ɛ15081Ɛ (14).

16 → (2)(3)(3) → (3)(91) → PRIME 391 (2).

18 → (2)(2)(5) → PRIME 225 (1).

19 → (3)(7) → PRIME 37 (1).

1χ → (2)(Ɛ) → (5)(7) → PRIME 57 (2).

20 → (2)(2)(2)(3) → (3)(3)(2χƐ) → (17)(37)(6Ɛ) → (61)(320Ɛ) → (107)(59χ5)
→ PRIME 10759χ5 (5).

21 → (5)(5) → (5)(11) → PRIME 511 (2).

22 → (2)(11) → (7)(37) → PRIME 737 (2).

23 → (3)(3)(3) → (3)(111) → (7)(7)(91) → (61)(131) → (5)(5)(27)(117)
→ (1Ɛ)(91)(38Ɛ5) → (431)(56Ɛ85) → (7)(7)(7)(15)(3Ɛ)(3χ5)
→ (3Ɛ)(1Ɛ4762657) → (18Ɛ)(1947)(13227Ɛ) → PRIME 18Ɛ194713227Ɛ (χ).

24 → (2)(2)(7) → (Ɛ)(25) → PRIME Ɛ25 (2).

26 → (2)(3)(5) → (7)(3Ɛ) → (5)(157) → (45)(11Ɛ) → (Ɛ)(17)(307) → (61)(19Ɛ67)
→ (457)(14471) → (5)(Ɛ)(Ɛ83957) → (195)(343Ɛ2Ɛ) → (7)(15)(21Ɛ3Ɛ71)
→ (7)(15)(905)(Ɛ5387) → (215Ɛ)(342χ0995) → (1Ɛ)(4Ɛ)(4401)(75χ85)
→ (35)(67)(105χ745897) → (Ɛ)(393Ɛ006504χ75) → (1χ7)(60192638χ35Ɛ)
→ (6995)(33χ05453Ɛ07) → (4Ɛ427)(146524Ɛ6Ɛχ1)
→ (5)(χ9Ɛ5)(11925)(Ɛ570355) → (23147Ɛ)(27418χ0Ɛ6927)
→ (739Ɛ5)(Ɛχ07Ɛ)(390962χ1) → (5)(11)(4Ɛ)(2337)(228045)(79Ɛ225)
→ (125)(32765)(139790691386085) → (7)(11)(11)(255)(7477)(11Ɛ8χ774Ɛ16281)
→ (1796Ɛ)(χ11χ1)(513747Ɛ72687Ɛ266Ɛ) → (8Ɛ64071)(2261ƐƐ791Ɛ036970651Ɛ)
→ (4Ɛ)(95)(12497963Ɛ7)(1Ɛ28383648Ɛ957Ɛ)
→ (7)(85)(1021591656862χ5551452779831)
→ (5)(4071)(146Ɛ5)(5Ɛ4ƐƐ)(67Ɛ4650626343390Ɛ)
→ (17)(33Ɛ)(12χ1)(173297)(78χ2171)(95Ɛ782χ311481)
→ (5)(13Ɛ)(35Ɛ)(6Ɛ354327)(153219311χ31030156934Ɛ)
→ (5)(5)(15)(Ɛ5)(ƐƐ4894137Ɛ27671Ɛ)(19Ɛ250Ɛ3589518551)
→ (6Ɛ)(65977)(3271Ɛ2Ɛ01)(550258Ɛ87χ930150432427χ5)
→ (5)(141)(735)(18650χ4χ509106Ɛ88848722856913839χ15)
→ (17)(9Ɛ3Ɛ)(31Ɛ251)(2χƐ06791)(50Ɛχ9423148χ9989Ɛ6714151)
→ (325)(511)(3χχ659967176Ɛχ21)(38χ2898308495χƐ509652χ5)
→ (27)(617)(3χ2Ɛ)(14893Ɛ)(20317Ɛχ3557Ɛ6Ɛ)(282162687554Ɛ900387)
→ (7)(81)(6823χ250572080644χ05597χ8881482χ3071988χ2Ɛ501)
→ (3479Ɛ2Ɛ09052Ɛ)(232417Ɛ39330033χ177396664χ97Ɛ309Ɛ48Ɛ)
→ (5)(5)(51)(202869Ɛ)(1χ99764Ɛ51256Ɛ1299χ35χ8201854527489Ɛχ761)
→ (507)(214Ɛ5)(1590282717)(417812Ɛ0χ02Ɛ0852χ229186χ49960588χ25)
→ (66Ɛ18854910554525)(92682694839χ31490082873Ɛχ8306Ɛ72χ101)
→ (81)(13Ɛ)(7Ɛ711)(3039114χƐ54Ɛ063514χ55Ɛ)(37Ɛ86Ɛ274χ2χ0χ44493ƐƐ11)
→ (45389Ɛ)(19χ383ƐƐ603Ɛ13247χ001767Ɛ8997343951χ805374χ7Ɛχ120Ɛ)
→ (5)(45)(1245)(1947)(18265094877)(808Ɛ0Ɛ1425407153464489Ɛ2Ɛ864331259957)
→ (3Ɛ)(228Ɛ45)(29Ɛ8χ15ƐƐƐ5)(χχχ764557447)(858Ɛ5416224χ5)(4085088241χχƐ1χ17)
→ (11)(31)(4Ɛ)(557)(721)(1χ23Ɛ)(351χ8ƐƐ90623Ɛ188741)
(17Ɛ6814844226χ09χ1χƐ502397071)
→ (15)(29684643Ɛ)(1934956871)(18545357χ74130χ018Ɛ7)
(113588Ɛ809Ɛ53χ1778389956591)
→ (11)(2Ɛ67)(9616840617697)(2049214414373850χ1485χ035)
(33Ɛχ5ƐƐχƐ69χ743571χχ6χ75χ5)
→ (427)(1921)(Ɛ78877)(308Ɛ3241)(1χƐ95156Ɛ1371677)
(390χ2454χ93525593χ19Ɛ2671χ0χ5509Ɛ6Ɛ)
→ (113512051)
(3984χ1Ɛχ014518Ɛ8Ɛ25873741186395203Ɛ50χ791534980χ112180553801ƐƐƐƐ)
→ (5)(177χ9χ9χ28070901)(242Ɛ6513459202439Ɛχ037)
(83280598χ6χ95245Ɛ57603742341785χ461)
→ (7)(1Ɛ)(771)(χ45)(4χ91)
(1872899089Ɛ11χ95χƐƐƐ72390189580Ɛ8522530723ƐƐ14χ0384Ɛ1Ɛ55802Ɛ0Ɛ1)
→ (1χ617427)(19χ0477Ɛ5χ050541791)
(21226Ɛ12χ739941χχ9701976χ210599534976702Ɛ27194χ6387)
→ (51)(1Ɛ7)(531)(617)(59Ɛ6Ɛ)(Ɛ18Ɛ85545)
(1χ38030114811184463601244446873χ04056Ɛ328χ24265078χ6621)
→ (5Ɛ)(8Ɛ)(12Ɛ)(1Ɛ0Ɛ1)(Ɛ4061360χ4Ɛ18162Ɛ67)
(61Ɛ0χ95718Ɛ4436Ɛ885375029Ɛ48025576χ95χ09Ɛ2709001365)
→ (7)(1011)(8235)(734887)(709781χ7)(46Ɛ13053650ƐƐƐχ61)
(913Ɛ153407χ260129393Ɛ78277132102740119887367)
→ (497)(68Ɛ5χχχ34555333676768χχ4Ɛ9χ515817)
(276152Ɛχχ03275211χ1χχ60690130Ɛχ922023543622χƐ5947)
→ (17)(111)(16Ɛ)(3Ɛ7)(5Ɛ91)(7841)(1328590Ɛ)(χ4χ733727560χ593420765)
(13233138213Ɛ97571Ɛ20χ479ƐƐ37868χ08268284Ɛ)
→ (45)(603601756χ5)(42ƐƐ216Ɛ347Ɛ136765997)
(203918584793Ɛ4890504877Ɛ4116423Ɛ92180337610χ63471794422Ɛ5)
→ (1Ɛ)(131)(χ35)(8χƐ19χ41028χ38Ɛ5Ɛ)
(2χχ8χ47234Ɛ85Ɛ615χ94Ɛ45791625787554χ1781072531Ɛ1χχ412176Ɛ8781χ986χ91)
→ (709Ɛ347)(21196575)(1χ9ƐƐ085000050Ɛ8Ɛ6191)
(9χ040χ763675Ɛ871048576005964634155Ɛχ15χ55284732Ɛ441Ɛ2172ƐƐ)
→ (5)(216536040Ɛ)(7Ɛ80290χ182750Ɛ223Ɛ532χ41χ7Ɛ1Ɛ30χ276712946χχ738χ7414036-
1760560618924297064Ɛ180324775)
→ (7)(277)(4χƐ45Ɛ7)(14240χχ1)(χƐ1χχ9208Ɛ127)(2415806Ɛ001275ƐƐ)
(2χ393611123χ992597910ƐχƐ32χ14Ɛ748368675χ5276274127)
→ (17)(255)(Ɛ7χ7)(122χ1ƐƐƐχƐ)(909Ɛ95994494Ɛ)(6Ɛ910Ɛ31Ɛ51051706Ɛ)
(3808141ƐƐ4074627557χ761295χ494049Ɛ041053161598399χ1)
→ COMPOSITE 17255Ɛ7χ7122χ1ƐƐƐχƐ909Ɛ95994494Ɛ6Ɛ910Ɛ31Ɛ51051706Ɛ3808141ƐƐ4-
074627557χ761295χ494049Ɛ041053161598399χ1 (54).

28 → (2)(2)(2)(2)(2) → (2)(11111) → (5)(15)(3661) → (7)(655)(143Ɛ) → PRIME 7655143Ɛ (4).

29 → (3)(Ɛ) → PRIME 3Ɛ (1).

2χ → (2)(15) → (5)(51) → (Ɛ)(5Ɛ) → (5)(237) → PRIME 5237 (4).

2Ɛ → (5)(7) → PRIME 57 (1).

30 → (2)(2)(3)(3) → (3)(11)(81) → (25)(1345) → PRIME 251345 (3).

32 → (2)(17) → PRIME 217 (1).

33 → (3)(11) → (5)(75) → PRIME 575 (2).

34 → (2)(2)(2)(5) → (7)(7)(7)(Ɛ) → (57)(145) → (Ɛ)(11)(577) → (χ87)(1051)
→ (186Ɛ)(62ƐƐ) → (17)(841)(1685) → (11χƐ)(14Ɛχ87) → (8Ɛ)(577)(33χ7Ɛ)
→ PRIME 8Ɛ57733χ7Ɛ (9).

36 → (2)(3)(7) → PRIME 237 (1).

38 → (2)(2)(Ɛ) → (15)(17) → PRIME 1517 (2).

39 → (3)(3)(5) → (Ɛ)(37) → PRIME Ɛ37 (2).

3χ → (2)(1Ɛ) → PRIME 21Ɛ (1).

40 → (2)(2)(2)(2)(3) → (3)(3)(Ɛ)(321) → PRIME 33Ɛ321 (2).

41 → (7)(7) → (7)(11) → PRIME 711 (2).

42 → (2)(5)(5) → PRIME 255 (1).

43 → (3)(15) → PRIME 315 (1).

44 → (2)(2)(11) → (11)(15)(15) → (147)(95Ɛ) → (221)(77Ɛ) → PRIME 22177Ɛ (4).

46 → (2)(3)(3)(3) → (3)(7)(Ɛ)(15) → (5)(15)(17)(3Ɛ) → (5)(Ɛ)(17)(856Ɛ)
→ (5)(5)(2X18Ɛ8Ɛ) → (31)(191X8ƐƐƐ) → (5)(37)(117)(1X417) → (5)(5)(26635104Ɛ7)
→ (7)(Ɛ)(1Ɛ)(61)(X562021) → (63997)(1308Ɛ4617)
→ (7)(7)(7)(37)(7X1)(11719047) → (5)(95)(1Ɛ4214945067Ɛ7)
→ (175)(129725)(2X95ƐX1467) → (6Ɛ597)(2960Ɛ360965631)
→ (5)(7)(X4Ɛ)(5835)(113X1)(5282945) → (619075)(Ɛ387XƐƐ)(Ɛ870X22Ɛ)
→ (11)(11)(52X1639510862Ɛ66654Ɛ) → (7)(145)(21X85)(4588425)(1846Ɛ37X1)
→ (5)(47XX671)(37Ɛ892X3X65X055X55) → (7)(57)(785)(927042Ɛ57)(343445334097)
→ (5)(15Ɛ165Ɛ53980711557X5830801Ɛ) → (14Ɛ5)(2395)(169743X1341466X6017X7Ɛ)
→ (8966964Ɛ315)(1Ɛ16694943803478227)
→ (545)(5XƐ47)(27X9X5)(13017343292450X3X1)
→ (1338Ɛ)(18Ɛ5891)(24Ɛ143800X255X9727241Ɛ)
→ (25)(87)(111)(8762Ɛ141)(Ɛ3752230380458X27321)
→ (25)(35)(61)(Ɛ527)(7549ƐX2813197219X47X9Ɛ3257)
→ (3Ɛ)(175313542X5)(4749131918477Ɛ0893050181)
→ PRIME 3Ɛ175313542X54749131918477Ɛ0893050181 (24).

47 → (5)(Ɛ) → PRIME 5Ɛ (1).

48 → (2)(2)(2)(7) → (5)(5)(107) → (3Ɛ)(1475) → (5)(31)(3081) → (8Ɛ7)(7057)
→ (31)(3Ɛ)(8XƐ5) → PRIME 313Ɛ8XƐ5 (6).

49 → (3)(17) → (Ɛ)(35) → (5)(5)(5)(11) → (XƐ)(5ƐƐ) → PRIME XƐ5ƐƐ (4).

4X → (2)(25) → PRIME 225 (1).

50 → (2)(2)(3)(5) → (5)(531) → PRIME 5531 (2).

52 → (2)(27) → (Ɛ)(25) → PRIME Ɛ25 (2).

53 → (3)(3)(7) → (5)(5)(17) → (6Ɛ)(95) → (5)(17)(X7) → PRIME 517X7 (4).

54 → (2)(2)(2)(2)(2)(2) → (2)(7)(11)(17)(111) → (11)(29Ɛ0189Ɛ) → (3Ɛ)(2X510361)
→ (82Ɛ)(X77)(6575) → (7)(15)(17)(637X371) → (27)(87)(347)(1180637)
→ (5)(61)(Ɛ31)(11409Ɛ04Ɛ) → (7)(11)(X27)(28607)(394X35)
→ (11)(17Ɛ)(3Ɛ4396X0172Ɛ97) → (85)(17073Ɛ)(Ɛ97106838X1)
→ (3X67)(64ƐX1)(40922607627) → (15)(95)(2X865)(XƐ455Ɛ)(13X5051)
→ (7)(131)(511)(57X55)(X13Ɛ891658Ɛ) → (4XX2225)(7ƐX46Ɛ1)(22146Ɛ9237)
→ (5)(Ɛ)(37)(61241)(1666ƐƐ)(46887X633Ɛ5) → (577)(14ƐX3Ɛ5)(8Ɛ39183X481XƐ5717)
→ (15)(5Ɛ)(19X71)(2897Ɛ)(174Ɛ35Ɛ7ƐƐ74097Ɛ)
→ (75)(13Ɛ)(34Ɛ9325)(62Ɛ9989013630X5ƐƐ91)
→ (669225)(116XƐ6951096371623Ɛ6527395)
→ (7)(Ɛ)(61)(705)(42Ɛ467)(76211842Ɛ)(13651741XX91)
→ (7)(8Ɛ)(164426X1Ɛ30539106219Ɛ69Ɛ5Ɛ1Ɛ1795)
→ (35)(5ƐƐ095)(3103481)(Ɛ187931)(1700Ɛ8229168Ɛ45)
→ (11)(81)(293435)(1129X7014X31)(16712629Ɛ133XXƐ051)
→ (5)(5)(51)(1Ɛ97267)(123227028668Ɛ)(66X4854482357X3Ɛ85)
→ (11)(6738790715)(91799827800646185X52441821Ɛ27X1)
→ (15)(90Ɛ)(4384047)(X725320104Ɛ0Ɛ)(33X6711654XƐ766025Ɛ)
→ (6X7)(2010Ɛ)(76027Ɛ92687ƐX527)(208099011950Ɛ671X2931)
→ (Ɛ)(15)(105)(1727)(377945706302Ɛ)(X67902Ɛ3Ɛ9X4842X974411567)
→ (8Ɛ)(X3018X928X0699689Ɛ98661)(1562448985151Ɛ81Ɛ0617785)
→ (5)(84809Ɛ)(26X3080ƐXƐ6134Ɛ31X612Ɛ2Ɛ848Ɛ809XƐX58955689Ɛ)
→ (75)(XƐ)(655)(16Ɛ25)(93772491)(134Ɛ77615X4984X2XX379961445990X5)
→ (25)(4Ɛ)(94965655Ɛ)(3X13Ɛ10139717543Ɛ)(2620547X06Ɛ6Ɛ14Ɛ70Ɛ8834Ɛ)
→ (11)(91)(6827)(10Ɛ639X75)(4Ɛ75733649263Ɛ50649905862Ɛ5139301X68ƐƐ1)
→ (95)(665)(8X5137)(80X3Ɛ9Ɛ)(Ɛ01X197)(5X6Ɛ9X4706805Ɛ446Ɛ80Ɛ8Ɛ774Ɛ58ƐƐ)
→ (5)(22Ɛ4423468203ƐX7)(X142X9267Ɛ356465533297X13386704869X22351)
→ (17)(35)(420455)(23Ɛ211035)(59X298X29X187305)(253Ɛ80XX31Ɛ294Ɛ335X8Ɛ7617)
→ (5)(16Ɛ5)(270X58697470X17)(Ɛ39Ɛ974XX6Ɛ50264X739408200101554415Ɛ58631)
→ (27)(31)(Ɛ0XƐ)(2875Ɛ971)(408658Ɛ91287707)(230ƐX66745618787)
(40513771312927315)
→ (5)(Ɛ)(11)(4Ɛ1)(75071)(13571Ɛ75Ɛ)(13680574ƐX912387)
(12X292Ɛ8704351828105262XƐƐ069Ɛ7)
→ (31)(1174Ɛ)(6Ɛ1Ɛ0643Ɛ)(3Ɛ29139337227876249XƐ)
(8Ɛ331432106Ɛ1756898243634Ɛ863XƐ15)
→ (Ɛ)(35)(285)(3ƐƐ89Ɛ)(5213699Ɛ)(86472X6Ɛ54X36X4XƐ288797)
(36XƐ358871519X5578862162X8Ɛ71)
→ (214007962X012475)(3Ɛ243X0Ɛ42787814X7X2627)
(14389813Ɛ659789840566943937X82X012Ɛ)
→ (11)(1Ɛ47526Ɛ3657699782Ɛ4XƐ1967Ɛ8X9409X023X84Ɛ4452X5605435440051540359X077293Ɛ)
→ (21746855710095743367)(4X885Ɛ74512912X98Ɛ915076X35)
(131537819292ƐƐ907650X8392Ɛ221)
→ (347)(287678Ɛ81)(3641419Ɛ68Ɛ)(601X79X3Ɛ91)
(16XX2Ɛ78604Ɛ790Ɛ2722Ɛ61280985068511Ɛ14ƐƐ1815)
→ (673Ɛ)(253951XX43ƐƐ)
(26206200ƐX3825485984X2217Ɛ494Ɛ946055XXX07673710197Ɛ446945XXX495)
→ (6Ɛ1)(1447Ɛ)(137557)(42826941211633123X361574235)
(16387Ɛ20241672X05937792636791736XƐ51668Ɛ5)
→ (5)(5)(8Ɛ)(45X7)(2678223901437)
(482216583753939Ɛ80382742964354Ɛ47882Ɛ1013060XƐ1654989ƐX1Ɛ4X3587)
→ (1Ɛ5)(82X197)(101147ƐƐ)(12032X2X1)(1Ɛ45150985)
(194X04ƐX5059167X41548168X5X9XƐ63Ɛ4568XXƐ8275ƐX89785Ɛ)
→ (Ɛ2Ɛ)(2299420417)(3053X710157)(18011442X1855Ɛ8Ɛ04578991Ɛ3X405Ɛ61)
(226X2Ɛ927861335784963X29518759251)
→ (28X1)(5954Ɛ)(166Ɛ8Ɛ095XƐ67)
(5602X32710181Ɛ47063025782X556823X3Ɛ5535573088419885Ɛ28179Ɛ6414Ɛ7895295)
→ (31)(150Ɛ)(657076638107072947)
(11X86629X48Ɛ80914584452921Ɛ59808791546Ɛ93246ƐX95Ɛ73585X36X0134X939X681)
→ (17)(57)(433913487)(182836937764Ɛ215)(2Ɛ3X6131327756XƐ44704Ɛ325)
(2460310Ɛ5X870135717X97222Ɛ11089750469744ƐƐ7)
→ (5)(5)(996Ɛ)(2056035)(Ɛ6X522057317454XƐ)(165171X474112X862X8888447)
(395Ɛ952826X511149754593Ɛ539937X905684Ɛ2X2505)
→ 55996Ɛ2056035Ɛ6X522057317454XƐ165171X474112X862X8888447395Ɛ952826X-
511149754593Ɛ539937X905684Ɛ2X2505 which is COMPOSITE after 48; (**56.**) steps.

55 → (5)(11) → PRIME 511 (1).

56 → (2)(25) → PRIME 225 (1).

58 → (2)(2)(15) → PRIME 2215 (1).

59 → (3)(1Ɛ) → (5)(7)(11) → (17)(37) → (7)(291) → (11)(27)(27) → (45)(2ƐXƐ)
→ PRIME 452ƐXƐ (6).

5X → (2)(5)(7) → (5)(5Ɛ) → (7)(95) → (17)(4Ɛ) → (5)(11)(37) → (5)(7)(7)(2ƐƐ)
→ (17)(75)(591) → PRIME 1775591 (7).

60 → (2)(2)(2)(3)(3) → (3)(5)(7)(2ƐƐ) → PRIME 3572ƐƐ (2).

62 → (2)(31) → (5)(5)(11) → (7)(11)(87) → (11Ɛ)(615)→ (7)(1ƐƐ1Ɛ)
→ (5)(5)(3533Ɛ) → PRIME 553533Ɛ (6).

63 → (3)(5)(5) → (7)(5Ɛ) → (11)(6Ɛ) → (5)(15)(1Ɛ) → (85)(737) → (17)(5421)
→ (5)(5)(X7)(X7) → (5)(Ɛ)(12461) → PRIME 5Ɛ12461 (8).

64 → (2)(2)(17) → (45)(5Ɛ) → PRIME 455Ɛ (2).

65 → (7)(Ɛ) → (5)(17) → PRIME 517 (2).

66 → (2)(3)(11) → (33)(6Ɛ) → (11)(15)(27) → (117)(Ɛ71) → (2Ɛ1)(481) → (7)(15)(25)(157)
→ (Ɛ)(27)(31)(Ɛ84Ɛ) → (181Ɛ)(681591) → PRIME 181Ɛ681591 (8).

68 → (2)(2)(2)(2)(5) → (5)(52X1) → (Ɛ7)(577) → (7)(17Ɛ11) → (17)(46127) → (5)(3X602Ɛ)
→ (7)(7)(397)(415) → (31)(37)(8321Ɛ) → (5)(2745)(2X2ƐƐ) → (27)(1Ɛ7Ɛ)(103627)
→ (11)(15)(87)(24480625) → (5)(111)(24X794X7091) → (31)(179919064ƐƐ661)
→ (94X1)(3Ɛ4868619581) → (5)(15)(45)(11020X5)(33XƐ011)
→ (75)(9X4407)(X0Ɛ583X136Ɛ) → (45)(361Ɛ3481)(5956229047)
→ (5)(7)(211690Ɛ)(88849X314487) → (15)(1771047911)(25065X8Ɛ42Ɛ)
→ (111)(30Ɛ)(9380Ɛ)(6707X6032Ɛ71Ɛ) > (287Ɛ)(49944000042Ɛ06XX3161)
→ (25)(87)(16X8Ɛ4952401449ƐƐ7X8Ɛ) → (25)(2121X57)(5X3X3912333545X91)
→ (5)(Ɛ)(61)(3X5)(32Ɛ5506476580XX84XƐƐ)
→ (Ɛ141261)(235545671)(29908166110Ɛ)
→ (15)(45)(95)(105)(8X997575)(2Ɛ4708950Ɛ2077)
→ (X7)(8Ɛ67161Ɛ)(22460X0XX4X869Ɛ94036Ɛ)
→ (25)(27)(3Ɛ)(217)(4XƐ55)(16Ɛ005)(104220Ɛ)(383408457)
→ (15)(2893X86XX1)(357Ɛ9056641)(2211X5499X8X10Ɛ)
→ (485)(8616733663X072411)(52000346383688O137)
→ (31)(105)(45Ɛ)(25657)(1725880Ɛ01ƐXƐX6Ɛ963303702447)
→ (1185)(247Ɛ)(899XƐ)(780090X2281)(24Ɛ6X2173542826Ɛ25Ɛ)
→ (6Ɛ)(13X8031)(15Ɛ5572614X61897691577 64Ɛ9X42217XX1)
→ (157Ɛ1)(33051)(36117)(455747)(928505)(15407Ɛ3154274X671855)
→ (59872004Ɛ7021X6147)(30589890XƐ0X482Ɛ587809917609Ɛ)
→ (5)(5)(7)(11)(1947)(17ƐX1046247)(15X14Ɛ6Ɛ0X5X28546080Ɛ04129128X5)
→ (Ɛ)(45)(145)(34X03506Ɛ1)((3591538X021Ɛ3649Ɛ2814Ɛ5Ɛ68101Ɛ008Ɛ497)
→ (7)(1543629ƐX7)(224Ɛ501726Ɛ)(6155Ɛ07916172828X8367277518 87Ɛ135)
→ (33Ɛ5X5)(4X7X75689468575)(Ɛ40397818XƐ150Ɛ) > (56833Ɛ00Ɛ116X8325467)
→ (5)(5)(277987)(73315944X805845948244740779141663 21XX0ƐX400397781)
→ (3X5889712 5Ɛ270175)(14X0X0267XX8152755566X9Ɛ3089Ɛ351057457XƐ5)
→ (2741)(1Ɛ054527577)(480551Ɛ58X34X343Ɛ705)(1Ɛ9X1X61Ɛ2X47X8Ɛ0565809X7)
→ (37618587)(5921X8932721)(7X88917710Ɛ05)(234252X56177841Ɛ1193XX331X25)
→ (5)(11)(1711)(15ƐƐ930351)(344959X4755X64981Ɛ3Ɛ41X7607Ɛ8142456333430XƐ7031)
→ (28665)(56X433 21Ɛ)(1886604Ɛ8X92X17442217)(2413819X84X80X5X45976Ɛ242X11471)
→ (11)(17)(81)(3755853438525X665)(3XX37665Ɛ3687X1054899Ɛ)
(1ƐX9Ɛ35136746Ɛ25572157X1)
→ (25)(55291943Ɛ071978X52028562016028302945 9Ɛ4374592095430X57357507 2891X25)
→ (2Ɛ0Ɛ)(4975)(113997794025265)(37200838746935456271 46Ɛ)
(6383769547554671 78Ɛ7X0775)
→ (5)(7)(45)(8XƐ)(234Ɛ)(1374Ɛ)(3X332690X0Ɛ6075)(1183831216X7924Ɛ0924Ɛ)
(344677444Ɛ33X3Ɛ00830107)
→ (1Ɛ)(25)(2Ɛ975466XX10495)
(4X60623727665007X5992584ƐX85X077Ɛ560X8188Ɛ8802Ɛ988672Ɛ1805)
→ (Ɛ)(Ɛ)(Ɛ)(11)(252Ɛ7)(167765)
(741XX6234Ɛ51285223098982X80X9735710827961956 46Ɛ13X03596202XƐƐ65)
→ (271)(153308X77Ɛ97)(5ƐX7867805X5Ɛ)
(653Ɛ92X4426457X5Ɛ7981661452Ɛ2Ɛ5X5Ɛ0227552684866161371)
→ (7)(Ɛ)(35)(35)(251)(6807)(355XƐ)
(109Ɛ870790028357 1Ɛ9259X822835896353795496 95X44Ɛ64X49Ɛ7892X714X8621)
→ (5)(2118335)(1Ɛ7X39261)(1174673Ɛ251Ɛ)(713X437973845)
(6X454541Ɛ188X2X49X0982Ɛ9Ɛ4Ɛ3X48Ɛ0X639Ɛ9055X07)
→ (5)(5)(35)(2485)(22523530X1069721125944Ɛ0X5)
(17X530438X65X3039543473X62439X7Ɛ7128Ɛ9553Ɛ942015864Ɛ35Ɛ)
→ 3Ɛ4554523X52XƐ201079Ɛ5X8Ɛ0336112Ɛ87083XXX99256487233 55X3379341X517580
X2408 9842308007782882365 → COMPOSITE (49).

69 → (3)(3)(3)(3) → (3)(5)(11)(25) → (435)(971) → PRIME 435971 (3).

6X → (2)(35) → (7)(3Ɛ) → continues as in HP[26]. We arrive at the integer 17255Ɛ7X7122X1ƐƐ-
ƐXƐ909Ɛ95994494Ɛ6Ɛ910Ɛ31Ɛ51051706Ɛ3808141ƐƐ4074627557X761295X494049Ɛ0410-
53161598399X1 which is COMPOSITE after 54; (**64.**) steps.

70 → (2)(2)(3)(7) → (7)(391) → PRIME 7391 (2).

71 → (5)(15) → (Ɛ)(57) → (11)(X7) → PRIME 11X7 (3).

72 → (2)(37) → PRIME 237 (1).

73 → (3)(25) → PRIME 325 (1).

74 → (2)(2)(2)(Ɛ) → PRIME 222Ɛ (1).

76 → (2)(3)(3)(5) → PRIME 2335 (1).

77 → (7)(11) → PRIME 711 (1).

78 → (2)(2)(1Ɛ) → PRIME 221Ɛ (1).

79 → (3)(27) → PRIME 327 (1).

7X → (2)(3Ɛ) → (5)(57) → PRIME 557 (2).

7Ɛ → (5)(17) → PRIME 517 (1).

80 → (2)(2)(2)(2)(2)(3) → (3)(3)(12Ɛ)(241) → (5)(5)(307)(61X7) → (Ɛ)(5Ɛ22X465)
→ (1Ɛ)(Ɛ7)(1Ɛ1)(3291) → (25)(169Ɛ)(63X307) → (1X3451)(1383317)
→ (7)(25)(35)(47615Ɛ941) → (17)(18Ɛ)(273X262X795) → (7)(4Ɛ)(681309X5Ɛ3871)
→ (X37)(877Ɛ0X3712567) → (11)(81)(35891)(408816007)
→ PRIME 118135891408816007 (10).

82 → (2)(7)(7) → PRIME 277 (1).

83 → (3)(3)(Ɛ) → PRIME 33Ɛ (1).

84 → (2)(2)(5)(5) → (11)(205) → (7)(1X6Ɛ) → PRIME 71X6Ɛ (3).

86 → (2)(3)(15) → (5)(Ɛ)(5Ɛ) → (5)(25)(5Ɛ) → PRIME 5255Ɛ (3).

88 → (2)(2)(2)(11) → (22)(X17) → (7)(7)(797) → PRIME 77797 (3).

89 → (3)(5)(7) → PRIME 357 (1).

8X → (2)(45) → (Ɛ)(27) → (5)(15)(17) → (12Ɛ)(415) → (5)(2ƐX51) → (315)(1825)
→ (871)(4435) → (7)(17)(93785) → (X95)(7Ɛ371) → (11)(61)(177901) → (771)(1943251)
→ (35)(X4Ɛ)(2689X7) → (5)(5)(7)(7)(175)(277)(11X5) → (1635)(370X78866Ɛ1)
→ (3Ɛ)(107)(X4Ɛ07)(51710Ɛ) → (5)(58X527)(178366X101)
→ (37)(3X55)(71Ɛ667)(7Ɛ32X5) → (7)(30665)(158275)(1466X3ƐƐ)
→ (11Ɛ4229255)(62X983X5027) → PRIME 11Ɛ4229255 62X983X5027 (17).

90 → (2)(2)(3)(3)(3) → (3)(31)(2X1) → (255)(13Ɛ5) → (5)(7)(X1097) → PRIME 57X1097 (4).

92 → (2)(5)(Ɛ) → PRIME 25Ɛ (1).

93 → (3)(31) → (7)(57) → (5)(5)(37) → PRIME 5537 (3).

94 → (2)(2)(2)(2)(7) → PRIME 22227 (1).

96 → (2)(3)(17) → PRIME 2317 (1).

97 → (5)(1Ɛ) → PRIME 51Ɛ (1).

98 → (2)(2)(25) → (7)(7)(7)(Ɛ) → (57)(145) → (Ɛ)(11)(577) → (X87)(1051)
→ (186Ɛ)(62ƐƐ) → (17)(841)(1685) → (11XƐ)(14ƐX87) → (8Ɛ)(577)(33X7Ɛ)
→ PRIME 8Ɛ57733X7Ɛ (9).

99 → (3)(3)(11) → (11)(301) → (7)(1X87) → (Ɛ)(87)(XƐ) → (75)(16Ɛ7)
→ (5)(159XƐƐ) → (91)(6928Ɛ) → PRIME 916928Ɛ (9).

9X → (2)(4Ɛ) → PRIME 24Ɛ (1).

9Ɛ → (7)(15) → (5)(5)(35) → (7)(15)(67) → (7)(15)(15)(61) → (7)(37)(34X51) → (1Ɛ)(301)(1324Ɛ) → (11)(195666 85Ɛ) → (7)(37)(67)(Ɛ571X5) → (3Ɛ)(XXƐ)(2073915) → (7)(82Ɛ)(1245)(83X35) → (91)(X1X4394Ɛ065) → (5)(1Ɛ5)(Ɛ312349295) → PRIME 51Ɛ5Ɛ312349295 (10).

X0 → (2)(2)(2)(3)(5) → (11Ɛ)(1X7) → (11)(15)(90Ɛ) → (75)(19297) → (15)(52Ɛ16Ɛ) → (5)(7)(1Ɛ)(3151Ɛ) → (37)(2X95)(6571) → (5)(5)(Ɛ)(3Ɛ)(5945X1) → (7)(665)(871)(201ƐƐ) → (5)(9X17)(1X0X6481) → (5)(91)(107Ɛ)(155XƐ2X7) → (17)(41097)(X80910087) → (2297145)(87Ɛ0X584Ɛ) → PRIME 229714587Ɛ0X584Ɛ (11).

X1 → (Ɛ)(Ɛ) → (Ɛ)(11) → PRIME Ɛ11 (2).

X2 → (2)(51) → PRIME 251 (1).

X3 → (3)(35) → (Ɛ)(37) → PRIME Ɛ37 (2).

X4 → (2)(2)(27) → (5)(5)(107) → (3Ɛ)(1475) → (5)(31)(3081) → (8Ɛ7)(7057) → (31)(3Ɛ)(8XƐ5) → PRIME 313Ɛ8XƐ5 (6).

X5 → (5)(5)(5) → (5)(111) → (17)(327) → (5)(3X2Ɛ) → PRIME 53X2Ɛ (4).

X6 → (2)(3)(3)(7) → PRIME 2337 (1).

X8 → (2)(2)(2)(2)(2)(2)(2) → (2)(46Ɛ)(2X3Ɛ) → PRIME 246Ɛ2X3Ɛ (2).

X9 → (3)(37) → (5)(5)(17) → (6Ɛ)(95) → (5)(17)(X7) → PRIME 517X7 (4).

XX → (2)(5)(11) → (4Ɛ)(5Ɛ) → (11)(46Ɛ) → (17)(855) → (67)(2ƐƐ) → PRIME 672ƐƐ (5).

Ɛ0 → (2)(2)(3)(Ɛ) → (15)(167) → PRIME 15167 (2).

Ɛ1 → (7)(17) → (11)(67) → PRIME 1167 (2).

Ɛ2 → (2)(57) → (5)(5Ɛ) → (7)(95) → (17)(4Ɛ) → (5)(11)(37) → (5)(7)(7)(2ƐƐ) → (17)(75)(591) → PRIME 1775591 (7).

Ɛ3 → (3)(3)(3)(5) → PRIME 3335 (1).

Ɛ4 → (2)(2)(2)(15) → PRIME 22215 (1).

Ɛ6 → (2)(3)(1Ɛ) → PRIME 231Ɛ (1).

Ɛ8 → (2)(2)(5)(7) → (31)(87) → PRIME 3187 (2).

Ɛ9 → (3)(3Ɛ) → PRIME 33Ɛ (1).

ƐX → (2)(5Ɛ) → PRIME 25Ɛ (1).

ƐƐ → (Ɛ)(11) → PRIME Ɛ11 (1).

100 → (2)(2)(2)(2)(3)(3) → (3)(11)(8081) → (Ɛ)(27)(35)(471) → (1Ɛ)(5Ɛ)(ƐX531) → (1Ɛ)(205)(60387) → (5)(37)(21Ɛ1)(7225) → (181)(3200119X5) → (171)(2221)(596815) → PRIME 1712221596815 (8).

Editor's Note: This data is current as of 27 November 2010.

We Depend on You

Annual dues are due as of 1 January 2011. If you forgot, please forward your check for only one dozen six dollars ($18.) to our Treasurer, Prof. Jay Schiffman, 604-36 S. Washington Sq. Apt. 815, Philadelphia, PA 19106-4115, USA. Student dues are $3.

Take it up a notch, to three dozen dollars and receive a one-year paper-copy subscription of the *Duodecimal Bulletin* as a Supporting Member. As you know, our continued work depends very much upon the tax deductible dues and gifts from our Members.

problem corner

solution from page 9

by Gene Zirkel

1.) $\mathrm{Log}_b\, 24 - \mathrm{Log}_b\, 3 = \mathrm{Log}_b\, 8$
$(2b+4)\,/\,3 = 8$
$b = X$

2.) $2\,\mathrm{Log}_b\, 5 = \mathrm{Log}_b\, 31$
$5^2 = 3b + 1$
$b = 8$

3.) $\mathrm{Log}_b\, 4 + \mathrm{Log}_b\, 30 = \mathrm{Log}_b\, 100$
$4(3b) = 100$
$10b = b^2$
$b = 10$

4.) $\mathrm{Log}_b\, 100{,}000 = 101$
$5 = b^2 + 1$
$b = 2$

5.) $-\mathrm{Log}_b\, 100 = -2$
$b^2 = b^2$
Which is true for all bases > 2.

6.) $\mathrm{Log}_b\, 5 = -2$
$b^{-2} = 5$
$b = 1\,/\sqrt{5}$
Which is not an integer, hence there is no solution.

Find the base, b, used in each of the following.

Hints: Each equation is written in its base, b.

For example $47 = 4b + 7$ and $b > 7$. The base of a logarithm is an integer > 1.

problem solution in next issue

by Gene Zirkel

In a cryptogram, each letter has been replaced by a different letter. To solve the puzzle, one must recover the original lettering.

FTQ NQEF MDSGYQZF RAD NMEQ FIQX-HQ AHQD NMEQ FQZ UE M XAAW MF FTQ RDMOFUAZMX QJBDQEEUAZ RAD 1/3 UZ NAFT NMEQE.

Editor's Note: Hint on page 24;!

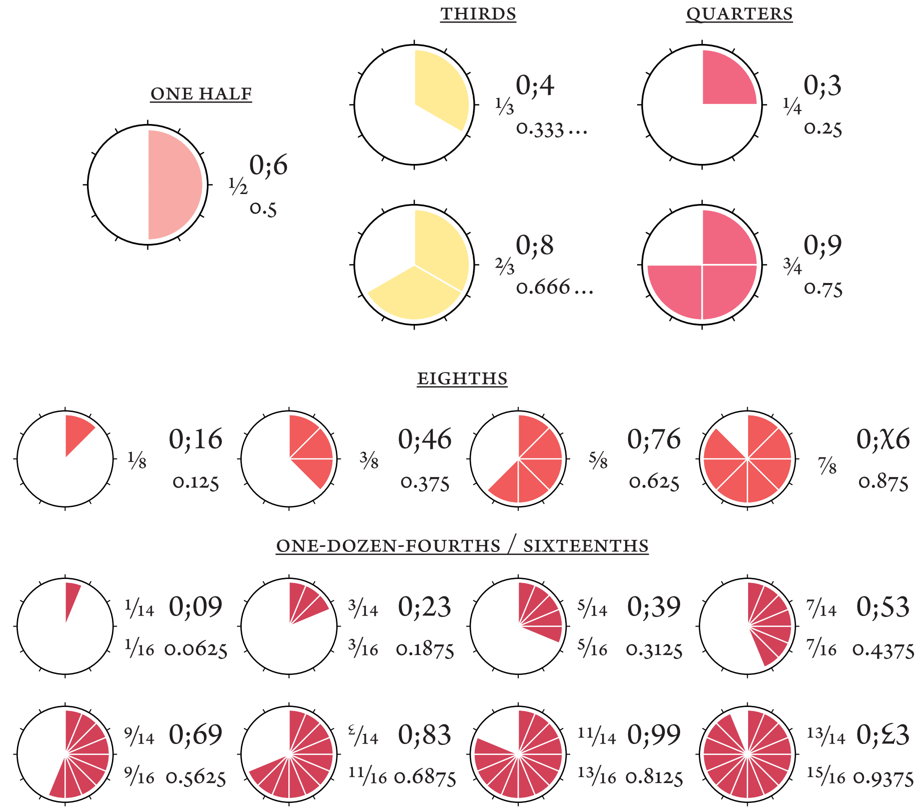
A possible algorithm written in pseudocode for the Featured Figures challenge from page 7:

```
Set x = to the desired exponent
Loop as r goes from 1 to 30
    Set Base 10; numeral a = to x^n
    Set Base 10; numeral b = to x^(-n)
    Set Base 10; numeral c = to r
    Print line a, c, b
End Loop
```

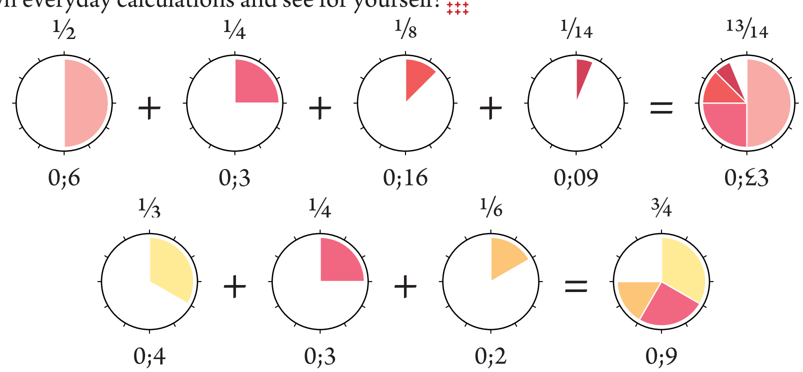
Visit www.Dozenal.org/adjunct/db4b207.pdf to download the Society's Mathematica output with similar data on the first 5 primes!

Key Dozenal Fractions

One of the benefits of dozenal is its succinct, regular (non-repeating) representation of the commonest fractions. The decimal equivalents of such fractions, apart from the half, are either longer, or are repeating fractions. Dozenal expansions appear above, on the right of each figure, with their decimal-expansion equivalents shown below.



The briefer, regular digital representations of these common fractions simplifies calculations such as addition shown in the dozenal examples below. Dozenal simplifies the everyday calculations we might use in the kitchen or the worksite. Use dozenal in your own everyday calculations and see for yourself!



the mailbag

Mr. Gene Zirkel, DSA Life Member №. 67; and Fellow, writes on behalf of Mr. Bryan Ditter:

»Dear Mike,

I received a call from Bryan Ditter. His daughter Sharon Ditter joined the DSA in 1994. as Member №. 343; but along the way she moved and we lost contact with her.

He … asked about the possibility of getting copies of all the *Bulletins* she missed. He wanted to give them to her as a gift.

Are the *Bulletins* on the web as of now? Is it possible that we could tell him how to access the old *Bulletins* and then in turn he could present her with that info as a gift?

Stay cool!

Fond regards,
Gene ::::

»Dear Gene,

Mr. Ditter can visit www.Dozenal.org/archive/archive.html, the *Duodecimal Bulletin* Archive Index, to reach all the posted digital copies of the *Bulletin*. If she's missed anything in the last dozen issues, these either haven't been optimized nor posted [yet].

Cordially,
Mike De Vlieger, [DSA Life Member №. 37Ɛ;]
Editor, *The Duodecimal Bulletin* :::

: : : : : :

Mr. Timothy F. Travis, DSA Member №. 342; wrote in a July 2010. email conversation:

»Gene,

I have created a font [conveying] my seven-stroke dozenal numbers using www.fontstruct.fontshop.com. [Editor's note: Travis' numerals are: 0 123456789dn, the digit-ten is called "dek", the digit-eleven is called "brad"; see Vol. 4Ɛ; №. 1 WN 9Χ;, page 8.]

Timothy ::::

»Gene,

Attached is an article in PDF that may be of interest for the *Bulletin* [Ed.: the article appeared in Vol. 4Ɛ; №. 1 WN 9Χ;, entitled "Dozenal Counting on Your Fingers"]. If you think an article giving detailed instructions on how to use fontstruct.fontshop.com to create the Digital Dozenal numbers as a font members can use, let me know and I will submit it.

Timothy ::::

»Michael, [in reply to a technical response by M. De Vlieger]

I used [AutoDesk] AutoCad to produce the article because [the article included] a drawing and because, even though I can use fontstruct to put the digital font numbers in an article and print it out, I do not know how to send it in an e-mail.

Another subject: The cover of the *Duodecimal Bulletin*. Would there be a lot of resistance to considering updating the cover? [Ed.: the cover was updated in 2008.]

"Dozenal" has replaced "Duodecimal" as the word for base[-twelve] numbering. I would drop "Duodecimal" and call the *Bulletin* something like "The Dozenal Bulletin" or "The Bulletin of the Dozenal Society of America".

What is the circle on the cover [See Figure 2.] supposed to actually represent? It is not a [twelve-]hour clock face. What is it? I suggest something of a more graphic design. Please see the attached drawing. [See Figure 3.] If the clock and day part is too much, how about just the [twelve-]point star, with or without the numbers?

If we are going to indicate Dozenal dates, where are we going to start? Remember that our regular calendar does not have a year zero. It starts at 1. Do you have a copy of my book? [*4000, The Fifth Milenium, Six Revolooshunairy Iedeeas*, 1994.] I would be glad to send one if you wish and if you give me your mailing address. I have a section on Dozenal dates and years.

Timothy ::::

»Mr. Travis,

No, I don't have your book but would very much enjoy reading it. I've read about it in the *Bulletin* and had visited your website when it was up. I've discovered parts of it preserved at www.archive.org.

There never should be "resistance to considering" any idea. (There may be resistance in adopting it!) I've thought it through and wrote a long response. Here's an execsum [i.e. executive summary] in place of a longwinded reply:

The *Bulletin* is set up the way it is today, (even after my own digitalization, redesign, and modernization of it) to communicate content to our readers in a neutral, unbiased way.

The conventions (Dwiggins numerals [Χ = digit-ten, Ɛ = digit eleven], the classic logo, and the publication title) act to edify the authors featured within the covers by being a "safe", neutral vehicle. Articles like your own or those of others are where the reader ought to find the brilliance, flair, and interest. As Editor, my job is to communicate your thought as clearly to the reader as possible; my job is to stimulate their thought through articles like yours and related content.

I reserve a deep respect for Ralph Beard, our first Editor, though I never met him. He aimed to ensure that "there will be unbiased presentation of all such proposals" and that's what I aim to uphold and defend.

Have a happy Friday!,
Michael Thomas De Vlieger :::

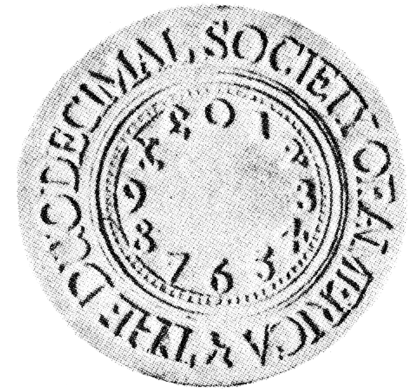


Figure 1. The DSA Seal from a Classic Bulletin.

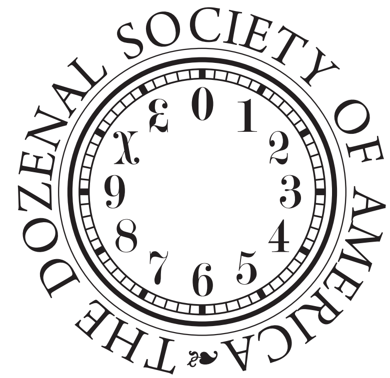


Figure 2. The DSA logo derived from the seal.

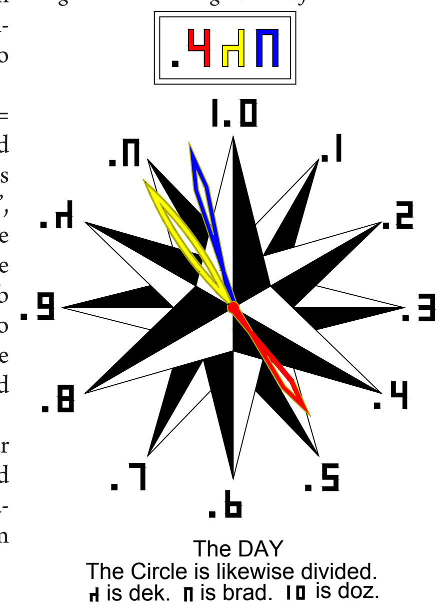


Figure 3. Timothy Travis' suggestion.

»Dear Timothy,

Mike forwarded his response to your letter to me. The circle [Figure 2] is our official seal. We once had a metal device to emboss it on a document but it broke and we did not think the expense of replacing it was worthwhile [See Figure 1 Page26; for the embossed facsimile that graced the covers of the "classic" *Duodecimal Bulletin* (Vols. 1–25;)]. In a similar vein, we decided to retain our *Duodecimal Bulletin* title for emotional reasons; it was a good part of our history. Both of these date back to our Founders. Either or both could be changed if we decided it was a good idea. I personally favor keeping them, but I am open to ideas and reasons. As to the year, why start anew? Is there any problem with writing the current year as 11Ɛ6;? I feel the fewer changes we ask people to make, the more converts we can attract.

Regards,
Gene ⁞⁞

⁝ ⁝ ⁝ ⁝ ⁝ ⁝

Ms. Doris Demarest, dsa Supporting Member №. 303; sent in:

»Dear Mr. [De]Vlieger,
I do not have the *Duodecimal Bulletin* (Vol. 4Χ; №. 2 wn 99;). I will send my dues tomorrow in the amount of $36 to the address at the bottom of the subscription form. I really enjoy the *Bulletins*, so I'm sure I will appreciate receiving them in the mail rather than on the computer. I am not very computer-literate as you might guess. I hope you will send wn 99; with the ones that come out in the future. If I owe you more money let me know.

Doris Demarest ⁞⁞

»Dear Ms. Demarest,

Thank you for your Membership! I think I owe you an explanation.

I do apologize that the *Bulletins* are not as timely as they ought to be. All our work is volunteer and has to occur when folks are available to produce them. We are trying to get back on schedule.

The 3 dozen 4 page wn 9Χ; has gone to press, and the press master was sick (an operation). There are 4 small high quality presses like this one in St. Louis, this one is the closest (across the street!) which makes press checking convenient. The electronic copy comes out quickly, as soon as the final review clears. Normally there's a week between the electronic and the hardcopy but this was complicated by the holidays and the press master's absence. wn 9Ɛ; [this issue] is mostly composited. One of the authors wrote a data-intensive article. Late in the production process he discovered some errors in his data, and needed to pull the data until he ran a full check. Now the check is done and I have yet to apply changes. On my plate, I run a business; business has been abysmal this year, but right now there's a large project in house and it needs full attention till 15. December. After 15. December, there is time to mail wn 9Χ; and finish wn 9Ɛ;, but a new project is moving in. On top of this it is now Christmas season and that means the post office will be jammed. … So all of this is colluding to make for some late *Bulletins*.

I have a plan to get back on track. The plan was to have both wn 9Χ; and wn 9Ɛ; come out with about a month between them. It now seems that wn 9Ɛ; will come out sometime between January and February. I have some contributors lined up for wn Χ0; and have put together one of their articles. [As of mid January 2011., wn Χ0; is about 90 P/G complete]. There are more articles coming in for that issue. I hope to shift the *Bulletin* emergences from May-December. This is because these are intensive times for both the academics involved in review and my own business. If we could move emergence to January-February and July-August, this seems better all around. wn Χ0; should come out in May. Then we should be back on track.

Ms. Demarest, this organization isn't too large that folks fall through the cracks. Please be assured that I will get you the *Bulletin* copies you desire. You are on my mind, keeping me motivated to get the *Bulletin* out in a timely manner. I do hope you enjoy the coming issues!

Happy holidays to you and yours,
Michael Thomas De Vlieger ⁞⁞

⁝ ⁝ ⁝ ⁝ ⁝ ⁝

Mr. Mike Ruocco, at the npr Science Desk, wrote the following email after chatting on the telephone with Gene Zirkel:

»Hi Gene,
This is Mike from npr (National Public Radio), we just spoke on the phone. I just wanted to say thank you for the help and that below I've included a link to the ongoing series, entitled "Krulwich Wonders", in which we will mention the Dozenal Society of America.

Krulwich Wonders:

[Ed.: Here is a more recent link than the one in the original message: http://www.npr.org/blogs/krulwich/2010/12/12/131936853/12-12-is-coming-how-to-celebrate#more]

Thank you again for your help, it is greatly appreciated.
Mike Ruocco ⁞⁞

⁝ ⁝ ⁝ ⁝ ⁝ ⁝

Mr. Peter B. Andrews, dsa Member №. Χ9; wrote on 14. June 2010.:

»Dear Michael,

I have been a member of the Dozenal Society … for many years, and my father, F. Emerson Andrews, was one of the founders of the Society.

I am sure that a lot of effort was devoted to setting up the current method of distributing the electronic *Duodecimal Bulletin*, and it is a nice advance, but I would like to suggest a further improvement. I would suggest imitating the Association for Automated Reasoning, which has all of its newsletters available for all to see at any time at the web site http://www.aarinc.org/.

The objectives of the Society would be best served by making the *Bulletin* freely available to anyone who would like to look at it. I notice that the Dozenal Society already has a web site, so it might be quite easy to make this change. Of course, it would still be useful to inform members by email when new issues of the *Bulletin* appear.

I hope you will give serious consideration to this proposal.

Best regards,
Peter B. Andrews ⁞⁞

⁝ ⁝ ⁝ ⁝ ⁝ ⁝

Editor's Note: The Dozenal Society has recently taken Mr. Andrews' advice to heart and produced the *Duodecimal Bulletin* Digital Archive, at www.Dozenal.org/archive/archive.html, with a pictorial archive at www.Dozenal.org/archive/dbpict.html. We are building tables of content pages (toc) so that one doesn't need to download issues to see what they're about. Our archive compares well with the aar archive. The Society owes Mr. Peter Andrews a debt of gratitude for his brilliant suggestion. ⁞⁞

Dozenal Jottings

We welcome our latest Members:

Mr. Donald P. Goodman III №. 398; of Martinsville, VA. Mr. Goodman is active on the DozensOnline web forum and is a user of Tom Pendlebury's TGM dozenal measurement system. Mr. Goodman has developed a dozenal LaTeX package he described in an article in Vol. 4X; №. 2 of the *Duodecimal Bulletin* entitled "Dozenal Mathematical Displays Using LaTeX".

Mr. T. J. Gaffney №. 399; STUDENT MEMBER, of Reno, NV. Mr. Gaffney wrote an article in the last issue (Vol. 4Ɛ; №. 1) of the *Duodecimal Bulletin*, concerning maximal repeating digital fraction sequences in dozenal.

Mr. Austin Welsh №. 39X; STUDENT MEMBER, of Sunnyvale, CA.

Ms. Sherry V. Bruning №. 39Ɛ; of San Jose, CA.

Mr. Graham Steele №. 3X0; of Framingham, MA. Mr. Steele drove down to Nassau Community College for the DSA Annual Meeting in June 11Ɛ6;. He is active in local government and runs the website www.hexnet.org, dedicated to the hexagon. In January 11Ɛ7; Mr. Steele volunteered to work on the DSA website.

Ms. Sophia Berridge №. 3X1; of Middletown, NJ.

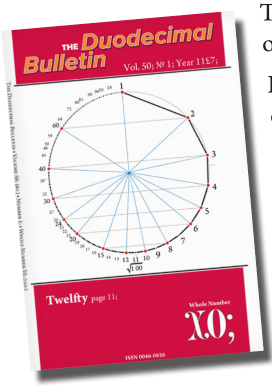
Ms. Jen Seron №. 3X2; SUPPORTING MEMBER, of New York City, NY. Ms. Seron and her son, STUDENT MEMBER Dan Simon №. 395; attended the Annual Meeting in June 11Ɛ6; at Nassau Community College. Dan and Prof. Jay Schiffman discussed home primes on the LIRR train to Penn Station. Members Seron, Simon, LIFE MEMBER Michael De Vlieger №. 37Ɛ; and his wife Laura De Vlieger met in Manhattan for breakfast in December 11Ɛ6;.

Mr. Benjamin Palmere №. 3X3; STUDENT MEMBER of Milton, MA.

Ms. Hilda Gonzalez-Cabrera №. 3X4; STUDENT MEMBER of Weslaco, TX.

Mr. Dan Seymour №. 3X5;.

Next Issue: Celebrating X0; Issues!



The Dozenal Society of America celebrates the ten-dozenth issue of its *Duodecimal Bulletin* in early 11Ɛ7;!

In honor of this milestone, we'll examine the "long hundred" of our Nordic forefathers, and highly divisible numbers in general. Bill Lauritzen shoves prime numbers out of the limelight to make room for what he calls "versatile numbers". Dr. Jens Ulff-Møller, PHD. revisits the Society with a fresh take on the Germanic long hundred of ten dozens. Mike De Vlieger validates the dozenal division of the circle, using geometry, practicality, and drafting tools. The *Bulletin* interviews Australian Wendy Y. Krieger on her use of base-ten-dozen, a number she calls "Twelfty". This issue is packed with color illustrations and plenty of new ideas to consider. It will surely stand as a collector's item among dozenalists! Make sure you receive a hard copy by joining or renewing your Membership at the supporting level for only three dozen dollars (USD $36.) for the year! Your membership dues and donations have helped the Society publish its *Bulletin* for five dozen six years—*and counting!* Join us for this gala, at the intersection of the decade and the dozen, in Whole Number X0;!

JOIN THE DSA TODAY!

You are invited to join the Dozenal Society of America!
The only requirement is a constructive interest in duodecimals!
Dues include a subscription to the *Duodecimal Bulletin*.

We depend on you! Annual dues are due as of 1 January. Make your checks for only one dozen six dollars ($18.) payable to the Dozenal Society of America and receive an electronic copy of the *Duodecimal Bulletin*, or be a Supporting Member at three dozen dollars ($36) and receive a paper copy of the *Duodecimal Bulletin*. Student dues are $3. A limited number of free memberships are available to students. As you know, our continued work depends very much upon the tax deductible dues and gifts from our Members.

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We'd be delighted to see you at our meetings, and are always interested in your thoughts and ideas. Please include your particular duodecimal interests, comments, and suggestions on a separate sheet of paper.

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