

PI WORDS

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The number π ($= 3.14159265358979323846264338327950288\dots$) is fundamental to the very fabric of the universe, so it's not surprising to encounter it in a number of logological contexts. In this article we explore families of words having a connection with the value of π . Unless noted, all words are in Webster's Third Unabridged.

Fractional Pi Words

Integer word values (e.g., obtained by summing letter values) are common, but to make a word's value approximate π a fractional value is useful. Here is one way to define the fractional value of a word. For the denominator of the fraction, take the ordinary sum of the letter values (A=1, B=2, etc.) in the word. For the numerator, take the *product* of the letter values, then factor this number into primes and write as a product of prime powers (say, $p^x q^y r^z \dots$). Now insert a "+" sign between each prime – that is, compute $p^x + q^y + r^z + \text{etc.}$ This is the value of the numerator.

For example, consider the word UNIVERSE. The letter values are (21, 14, 9, 22, 5, 18, 19, 5) with product 497712600 and prime factorization $2^3 \cdot 3^5 \cdot 5^2 \cdot 7^2 \cdot 11 \cdot 19$. The fraction value is therefore

$$(2^3 + 3^5 + 5^2 + 7^2 + 11 + 19) / (21 + 14 + 9 + 22 + 5 + 18 + 19 + 5) \\ = 355/113.$$

Note that $355/113 = 3.1415929\dots$, a remarkably good approximation of the number π . Furthermore, our fairly extensive search makes it appear that UNIVERSE is the *only English word* having a value of 355/113. The fraction 355/113 is significant because no other fraction with a three-digit, or even four-digit, denominator approximates π as well. If UNIVERSE is, in fact, the only 355/113 word, then it is also unique in its closeness to the value of π , since there does not exist another fraction in this range, for which a word might turn up, whose value is closer to π .

It is worth noting a few runners-up. The next best approximation of π using three-digit fractions is 732/233, but this is unlikely to be found due to the size of the denominator. We did not find any words having the value of the third-best fraction (377/120) but there are at least three with the next-best value. GAREFOWLS, GEMMIPARES, and the trade name BUDWEISER are all equal to 333/106 ($= 3.1415\dots$).

Since 355/113 approximates π so well, fractions of the form $355k / 113m$ (with appropriate k and m) will approximate integer multiples of π closely. Here are the $n\pi$ words we found:

	<i>Multiple of π</i>
SHOWERY	2
SYNARCHY	2
TURGENCY	3
STOPGAPS	4
MYRIORAMA	7
REJECTORS	11
TACHEOMETER	45

Although we haven't found it in a dictionary, the word **OVEREXQUISITELY** achieves a, well, overexquisitely large multiple (namely, 194π), and in addition is the only $n\pi$ word we found having a denominator of 226, instead of the usual 113.

Even though **UNIVERSE** appears to be unique, many pairs of words exist having the value $355/113$. Staying with the **UNIVERSE** theme, we find $355/113$ in the **GAMMA GALAXIES**, the **WEIRD SUN** in the **GRUFF SKY**, and the **ZODIAC'S LAVA**. In the following sentence,

Waif's anagram baffles Queen Eve, ruins Malaysia men.

each word pair (**WAIFS ANAGRAM**, **BAFFLES QUEEN**, ...) has value $355/113$. The shortest possible $355/113$ pair is probably seven letters, as in **UP ABUZZ** or **WHIZ NOR**; the longest we found has 17 letters (**AGALMA CABBAGEWOOD**).

Might we be able to approximate π even more closely using a pair of words and a different numerical scheme? The first three digits of π (3 1 4) look like "3 / 4", thus suggesting that we try making a fraction based on 3's and 4's. Aha! – what about using the 4th and 3rd powers of the letter values of the two different words?

Sure enough – if we take the pair of short words **CAR** and **TITTLES** and make them into a fraction, computing the sum of the 4th powers of the letter values in the numerator, and sum of the 3rd powers in the denominators, we get

$$\begin{aligned} &\text{CAR} / \text{TITTLES} \\ &= (3^4 + 1^4 + 18^4) / (20^3 + 9^3 + 20^3 + 20^3 + 12^3 + 5^3 + 19^3) \\ &= 105058 / 33441 \\ &= 3.141592655\dots \end{aligned}$$

which is correct to nine digits (as opposed to seven for $355/113$). **CAR / PRONOUNCEABLE** also has this value. We only found one word pair that approximates π better than this:

$$\text{FIBONACCI} / \text{UNQUEENING} = 103638 / 32989 = 3.141592652\dots$$

which is interesting in that it involves the name of a famous mathematician.

Not only is **CAR** related to the number π , but so, in a different way, is the word **AUTOMOBILE**. Define a *p/i word* (short for *Prime/Integer word*) as one equal to $355/113$ under the following scheme: compute the denominator of a fraction as the sum of the usual letter values, and the numerator with letter values equal to the primes (A=2, B=3, C=5, D=7, E=11, etc.).

Under this rule the word **AUTOMOBILE** has the value 355/113, as do more than a hundred others. Among the many p/i words we note the following special ones:

- **PIERROTIC** is the only one that starts with **PI**. (It also starts with **PIE!**)
- **COPROLITE** and **SUPERFINE** contain **P** and **I** symmetrically placed within the word.
- **AERODROMES** and **ZOOPHILIC** are the alphabetically first and last words of this type.
- If we take the p/i word **ANGELOLOGY**, remove “**AN E**” (where *e* is another important mathematical constant), and add **O**, a circular symbol closely related to π , the result is an anagram of **LOGOLOGY**.
- The p/i word **UNLAURELED** is an anagram of “**Laud N, Euler!**”. Leonhard Euler (1707-1783) made many important contributions to the study of π , and also established the Greek letter as the standard symbol for the number.

Pi-Anagram Words

We now turn our attention to a rather different kind of π word, exemplified by the word **ZODIAC**. Its letter values are 26, 15, 4, 9, 1, 3, and this collection of digits (26154913) is an anagram of 3.1415926, the value of π to eight decimal places. Words that encapsulate fewer digits than this are easy to find; for three to seven digits we have, for example, **CAD** [which does them in order], **MAD**, **MADE**, **MINE**, **SEWN**. But there are few specimens that achieve eight or more digits. Here are the ones we found:

8 digits: **CRAZED FILMED FUCOID PEDICAB ZODIAC**
 9 digits: **CALEFIED MODIFY PEDICLE (or PEDICEL) SPEWED**
 10 digits: **WIFEDOM (OED)**

Though not a single word, there is a bold-face entry in Webster’s Third that achieves 12 digits: **FEED SCREW**. The use of more than one word suggests a different challenge: how many digits can be captured with a series of words (hopefully, one that makes a phrase or sentence)? It’s not too hard to imagine the leader of a mythical tribe of proud but unsuccessful gardeners declaring

I am Chief Big Weed!

which encodes 3.1415926535897932. Similarly, the query

Which giddy chief affected wigwam?

reaches to the 34th decimal place, just past the first zero. Here, the letter **T=20** is employed to capture the zero – a much better choice than the hard-to-use **J=10**. Especially apt are the two sentences

Circle I feed. (13 digits)
 and
 Feed big chic circle. (19 digits)

since these refer to the very shape whose circumference π can be interpreted as “feeding”.

Constructing even longer texts of this type can be viewed as a (rather difficult) form of constrained writing. It turns out that the early digits (up to around 40 or 50) are easier to work with than what we find in the long-term statistics of π (where each digit occurs with roughly equal frequency). We were able to construct longer π texts of this kind of 100 to 200 digits, but none with an acceptable level of aesthetic quality. Perhaps a reader will take up the challenge.

A variation on this theme is to use the mod-10 letter values instead of their normal ones (i.e., A=1, B=2, ... I=9, J=0, K=1, ..., S=9, T=0, U=1, ... Z=6). Since each single digit now corresponds to more than one letter there is more flexibility, this results in more and longer π words of this type. Some long examples include:

11 digits:	CYCLOPAEDIA EMPLEOMANIA PSEUDOCUMYL
12 digits:	SHAMEFACEDLY UNCOMPULSORY
13 digits:	EPIMYOCARDIAL

Since we don't expect to reach the first “0” in π with a single word, we could choose to assign 123456789 (and repeat) to the alphabet, instead of 1234567890 as in the previous scheme. This gives even longer words, such as the 14-digit COUNTERSHADING, INEXHAUSTIVELY, and NONCAPITALIZED and the 15-digit BLEPHAROCERIDAE (not in Web3, but a standard term for the family including net-wing midges). Certain fast-food patrons might find it entertaining to note that QUARTER POUNDERS is also a 15-digit solution.

The longest word of this type that we found is the 17-letter NONARITHMETICALLY, which seems quite appropriate given that these π words are defined nonarithmetically. Finally, we note one more remarkable coincidence: the surname of one of the members of Oulipo, François CARADEC, has values 3191453 in this scheme, which anagrams to 3.141593 – the correct value of π rounded to six decimals.