01.00.00 PHYSICAL AND MATHEMATIC SCIENCE

REPRESENTATION OF THE NUMBER IN THE NUMBER SYSTEM OF 10 AS SUM OF THE LEVELS OF 3.

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Annotation: This article examines the proof that arbitrary numbers in the 10-digit number system can be expressed as powers of 3.

Keyword: powers of 3, remainder, sum, proof, summary.

Theorem: Numbers in any arbitrary 10-digit number system can be expressed as a sum of powers of 3.

Proof: Let's calculate the proof of this theorem using several problems.

Issue 1. Express the number 10283 in the number system of 10 as a sum of powers of 3?

Solution:

$10283 \div 3 = 3427$ (2 *qoldiq*)
$3427 \div 3 = 1142$ (1 *qoldiq*)
$1142 \div 3 = 380$ (2 *qoldiq*)
$380 \div 3 = 126$ (2 *qoldiq*)
$126 \div 3 = 42$ (0 *qoldiq*)
$42 \div 3 = 14$ (0 *qoldiq*)
$14 \div 3 = 4$ (2 *qoldiq*)
$4 \div 3 = 1$ (1 *qoldiq*)
$1 \div 3 = 0$ (1 *qoldiq*)

$$(10283)_{10} = (112002212)_3 = 1*3^8 + 1*3^7 + (3-1)*3^6 + 0 + 0 + (3-1)*3^3 +$$

$$(3-1)*3^2 + 3^1 + (3-1)*3^0 = 3^8 + 3^7 + 3^7 - 3^6 + 3^4 - 3^3 - 3^3 - 3^2 + 3^1 + 3^1 - 3^0 =$$

a)

$$= 3^8 + (3-1)*3^7 - 3^6 + 3^4 - (3-1)*3^3 - 3^2 + (3-1)*3^1 - 3^0 =$$

$$= 3^8 + 3^8 - 3^7 - 3^6 + 3^4 - 3^4 + 3^3 - 3^2 + 3^2 - 3^1 - 3^0 = (3-1)*3^8 -$$

$$-3^7 - 3^6 + 3^3 - 3^1 - 3^0 = 3^9 - 3^8 - 3^7 - 3^6 + 3^3 - 3^1 - 3^0$$

Issue 2. Express the number 283 in the number system of 10 as a sum of powers of 3?

Solution:

$283 \div 3 = 94$ (1 *qoldiq*)
$94 \div 3 = 31$ (1 *qoldiq*)
$31 \div 3 = 10$ (1 *qoldiq*)
$10 \div 3 = 3$ (1 *qoldiq*)
$3 \div 3 = 1$ (0 *qoldiq*)
$1 \div 3 = 0$ (1 *qoldiq*)

a) $(283)_{10} = (101111)_3 = 1*3^5 + 0 + 1*3^3 + 1*3^2 + 1*3^1 + 1*3^0 = 3^5 + 3^3 + 3^2 + 3^1 + 3^0$

Issue 3. Express the number 27139 in the number system of 10 as a sum of powers of 3?

Solution:

$27139 \div 3 = 9046$ (1 *qoldiq*)
$9046 \div 3 = 3015$ (1 *qoldiq*)
$3015 \div 3 = 1005$ (0 *qoldiq*)
$1005 \div 3 = 335$ (0 *qoldiq*)
$335 \div 3 = 111$ (2 *qoldiq*)
$111 \div 3 = 37$ (0 *qoldiq*)
$37 \div 3 = 12$ (1 *qoldiq*)
$12 \div 3 = 4$ (0 *qoldiq*)
$4 \div 3 = 1$ (1 *qoldiq*)
$1 \div 3 = 0$ (1 *qoldiq*)

$$(27139)_{10} = (1101020011)_3 = 1*3^9 + 1*3^8 + 0 + 1*3^6 + 0 + (3-1)*3^4 + 0 + 0 + 1*3^1 + 1*3^0 =$$

a)

$$= 3^9 + 3^8 + 3^6 + 3^5 - 3^4 + 3^1 + 3^0$$

Issue 4. Express the number 45058 in the number system of 10 as a sum of powers of 3?

Solution:

$45058 \div 3 = 15019$ (1 *qoldiq*)
$15019 \div 3 = 5006$ (1 *qoldiq*)
$5006 \div 3 = 1668$ (2 *qoldiq*)
$1668 \div 3 = 556$ (0 *qoldiq*)
$556 \div 3 = 185$ (1 *qoldiq*)
$185 \div 3 = 61$ (2 *qoldiq*)
$61 \div 3 = 20$ (1 *qoldiq*)
$20 \div 3 = 6$ (2 *qoldiq*)
$6 \div 3 = 2$ (0 *qoldiq*)
$2 \div 3 = 0$ (2 *qoldiq*)

a)

$$(45058)_{10} = (2021210211)_3 = (3-1)*3^9 + 0 + (3-1)*3^7 + 1*3^6 + (3-1)*3^5 + 1*3^4 +$$

$$0 + (3-1)*3^2 + 1*3^1 + 1*3^0 = 3^{10} - 3^9 + 3^8 - 3^7 + 3^6 + 3^6 - 3^5 + 3^4 + 3^3 - 3^2 + 3^1 + 3^0 =$$

$$3^{10} - 3^9 + 3^8 - 3^7 + (3-1)*3^6 - 3^5 + 3^4 + 3^3 - 3^2 + 3^1 + 3^0 = 3^{10} - 3^9 + 3^8 - 3^7 + 3^7 - 3^6 -$$

$$-3^5 + 3^4 + 3^3 - 3^2 + 3^1 + 3^0 = 3^{10} - 3^9 + 3^8 - 3^6 - 3^5 + 3^4 + 3^3 - 3^2 + 3^1 + 3^0$$

Issue 5. Express the number 98 in the number system of 10 as a sum of powers of 3?

Solution:

$98 \div 3 = 32$ (2 *qoldiq*)
$32 \div 3 = 10$ (2 *qoldiq*)
$10 \div 3 = 3$ (1 *qoldiq*)
$3 \div 3 = 1$ (0 *qoldiq*)
$1 \div 3 = 0$ (1 *qoldiq*)

$$(98)_{10} = (10122)_3 = 1*3^4 + 0 + 1*3^2 + (3-1)*3^1 + (3-1)*3^0 = 3^4 + 3^2 + 3^2 - 3^1 + 3^1 - 3^0 =$$

a)

$$= 3^4 + (3-1)*3^2 - 3^0 = 3^4 + 3^3 - 3^2 - 3^0$$

The theorem was proved using the above 5 problems.

So, we can come to the following conclusion: any number in the 10-digit number system can be expressed as a sum of powers of 3.

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