SCVJ
Volume 5, Issue 1, 2024
DOI: https://doi.org/10.55989/WAFD6823

Science View Journal
ISSN (Online): 2734-2638

Rules for Divisibility of Number 7: A New Approach

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Abstract:
Rules for divisibility of number 7 were conspicuously ignored in New General Mathematics Book II because the authors as at then had no clue. However, in an attempt to simplify some of these unaddressed issues while delivering lectures, one is compelled to make further discoveries as to expose our students to some of these simple but difficult areas of study. This paper presents rules for the divisibility of number 7 as well as associated mathematical problems. Previous scholars reported a number of approaches to the rule for divisibility of number 7. However, the present study have provided the approach that can solve the divisibility by 7 which is the approach of keeping the last digit and multiplying the remaining digit number by 3 and summing up to check for possibility of division by 7; the process is continued until it becomes easy to see that 7 can divide the new number, otherwise, the original number is not divisible by 7. This approach has the potential to expose our students to other areas of study.

Keywords: Rules, Divisibility, Number, Approach.

I. INTRODUCTION

The rule for divisibility of numbers suggests divisibility tests or rather division rules in Mathematics as a help to check whether a number is divisible by another number without performing the actual method of division (Attwood and Yih, 1982). In fact, if a number is divisible by another number, then the quotient will be a whole number or rather an integer number such that there is no remainder. Of course, a number is said to be divisible by the denominator and there is no remainder, otherwise the process is said to be indivisible implying there is a remainder (Berenson, 1970). At times, the need for tricks and shortcuts but fast approaches is employed to ease some lengthy calculations in mathematics (Cote, 2009). Students are thrilled when such improvise is available for use, especially in examination.

The rules for divisibility of numbers 2,3,4,5,6,8,9 and 10 were extensively discussed in New General Mathematics Book II for JSS II Students in our Secondary Schools. Nonetheless, number 7 was not discussed as they were unable to do that as at the time of print of the text book.

Fortunately, in recent years, a young Nigerian by name Chika Ofili, a twelve (12) year old boy living in America discovered a rule for the divisibility of number 7 (Ofili, 2024). Subsequently other Mathematicians followed suit and discovered other rules for the divisibility of number 7. As we were going through these rules for the divisibility of number 7, we equally discovered another different rule for the divisibility of number 7. These rules for the divisibility of number 7 as well as associated mathematical problems brought about this work.

II. CHIKA OFILI'S APPROACH

This young Nigerian who was given a National honor and recognition in America for this fantastic discovery proposed a situation where the last digit of the number to be tested for division by 7 is multiplied by 5 and the result is added to the remaining digit number and what is obtained is tested if it is divisible by 7, otherwise the process is repeated until it becomes easy to check whether 7 can divide it or not. If what is obtained is divisible by 7, the original number is also divisible by 7 (Ofili, 2024).

Illustrative Examples:
1. 161.
According to Chika:
161= 16 + (1 x 5) = 21 (divisible by 7)
Hence 161 is divisible by 7.

2. 52346
52346 = 5234 + (6 x 5)
= 5264
5264 = 526 + (4 x 5) = 546
546= 54 + (6 x 5) = 84 (Divisible by 7)
Hence 52346 is divisible by 7.

3. 383.
383= 38 + 3 x 5= 53 (Not divisible by 7)
Hence 383 is not divisible by 7.

III. ANOTHER APPROACH

This scholar proposed where the last digit of the number is multiplied by 2 and the result is subtracted from the remaining digit number (JU'S, 2024).

Illustrative Examples:

1. 161

161= 16-(1 x 2) = 14 (divisible by 7)

Thus 161 is divisible by 7.

2. 52346

52346 = 5234 - (6 x 2) = 5222

Now 5222 = 522 –(2 x 2) = 518

518 = 51 – (8 x 2) = 35 (divisible by 7)

Therefore 52346 is divisible by 7.

3. 383

383 = 38 - (3 x 2) = 32 (Not divisible by 7)

Therefore 383 is not divisible by 7.

IV. ANOTHER APPROACH

This scholar proposed where the last two digits are kept and the other digits are multiplied by 2 and the result is added to the last two digits and checked for possibility of division by 7. If the result is still large, the process is continued until it becomes obvious that 7 can divide the number, otherwise the original number is not divisible by 7(Cuemath, 2024).

Illustrative Examples:

1. 161.

161 = (1 x 2) + 61 = 63 (divisible by 7)

2. 52346

52346 = (523 x 2) + 46 = 1092

1092 = (10 x 2) + 92 = 112

112 = (1 x 2) + 12 = 14 (divisible by 7)

Hence 52346 is divisible by 7.

3. 383

383 = (3 x 2) + 83 = 89 (Not divisible by 7)

Hence 383 is not divisible by 7.

V. OUR APPROACH

We proposed a situation where the last digit is kept and the remaining digits are multiplied by 3 and the result is added to the last digit and checked if 7 can divide what is obtained. The process is repeated if the new number obtained is large until it becomes obvious that 7 can divide what is obtained, otherwise the original number is not divisible by 7.

Illustrative Examples:

1. 161

161 = (16 x 3) + 1 = 49 (divisible by 7)

Hence 161 is divisible by 7.

2. 52346

52346 = (5234 x 3) + 6 = 15708

15708 = (1570 x 3) + 8 = 4718

4718 = (471 x 3) + 8 = 1421

1421 = (142 x 3) + 1 = 427

427 = (42 x 3) + 7 = 133

133 = (13 x 3) + 3 = 42 (divisible by 7).

Therefore 52346 is divisible by 7.

3. 385

385 = (38 x 3) + 5 = 119

119 = (11 x 3) + 9 = 42 (divisible by 7)

Therefore 385 is divisible by 7.

4. 5236

5236 = (523 x 3) + 6 = 1575

1575 = (157 x 3) + 5 = 476

476 = (47 x 3) + 6 = 147 (divisible by 7)

Therefore 5236 is divisible by 7.

PROBLEMS THAT ARE SOLVABLE BY OUR APPROACH

Let t, x, m, y, k, etc $\in \mathbb{Z}^+$, that is, t, x, m, y and k belong to the set of positive integers, then following problem can be solved using our approach.

1. Find the value of t if 5234t is divisible by 7 where $0 \leq t \leq 9$ and 5234t is a five (5) digit number.

   Solution: 5234t = (5234 x 3) + t = 15702 + t

   But 15702 + t = (2243 x 7) + 1 + t

   Need 1 + t = 7 ∴ t= 6 Ans. Therefore 52346 is divisible by 7.

2. Find the value of X if 299X is divisible by 7 where $0 \leq X \leq 9$ and 299X is a four digit number.

   Solution: 299X = (299 x 3) + X= 897 + X.

   But 897 + X = (128 x 7) + 1 + X

   Need 1 + X = 7 ∴ X = 6 Ans. Therefore 2996 is divisible by 7.

3. Find the value of M if 38M is divisible by 7 where $0 \leq M \leq 9$ and 38M is a three digit number.

   Solution: 38M = (38 x 3) + M = 114 + M

   But 114 + M = (16 x 7) + 2 + M

   Need 2 + M = 7 ∴ M = 5 Ans. Therefore 385 is divisible by 7.

4. Find the value of Y if 532Y is divisible by 7 where $0 \leq Y \leq 9$ and 532Y is a four digit number.

   Solution 532Y = (532 x 3) + Y = 1596 + Y

   But 1596 + Y = (228 x 7) + Y

   Need Y = 0 or 7. Therefore 5320 or 5327 is divisible by 7.

5. Find the smallest positive integer K if 65K is divisible by 7.

   Solution: 65K = (65 x 3) + K = 195 + K

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But 195 + K = 7 ∴ K = 1 Ans. Therefore 651 is divisible by 7.

Note: The method applied in solving the above problem arose from the rule for the division of number 7 using our approach.

6. Find the value of y in 2y96 if 2y96 is divisible by 7 where $0 \leq y < 10$.

   Solution: 2y96 implies that $20 \leq 2y \leq 29$

   Since $y \neq 10$

   Again what are the multiples of 7 between 20 and 29? It is only 28.

   Hence 2y96

   $\frac{-28}{=(y-8)96}$. y must be positive, hence y can only be 9 since $y \neq 10$.

   Therefore 2996 is divisible by 7.

7. Find the value of k if 29k6 is divisible by 7 where $0 \leq k < 10$, ie, k is one digit number.

   Solution: 29k6

   $\frac{-28}{=1k6}$.

   Now, k should be a number such that if we subtract any multiple of 7 between 10 and 19 we should obtain a digit number that should be divisible by 7

   That is, 1 k 6

   $$= \frac{-14}{(K-4)6}$$

   But we need (k – 4) = 5 ∴ k = 9.

   The implication is that it is only 56 that can be divided by 7 in the range ($50 \leq k \leq 59$). Clearly k = 9 Ans.

VI. Discussion

The rules for divisibility of number 7 has been investigated by a number of scholars. In Ofili, (2024) approach, the last digit was multiplied by 5 and the result added to the remaining digits for possibility of division by 7. The process continues until it becomes easy to check for division by 7. JU'S (2024) approach is to keep the last two digits, multiply the other digits and add the rest of the digits check for division by 7. Also, the process is continued until it becomes easy that 7 can divide the new number, otherwise, the original number is not divisible by 7. Cuemath (2024) used the approach of multiplying the last two digits and subtracting from the remaining digit number. Likewise, the process continues until it becomes obvious that 7 can divide the obtained result, otherwise the original number is not divisible by 7. However, the approach of this study is keeping the last digit and multiplying the remaining digit number by 3 and summing up to check for possibility of division by 7. The process is continued until it becomes easy to see that 7 can divide the new number, otherwise, the original number is not divisible by 7. The present study have provided the approach that can solve the divisibility by 7. For instance, what value of t will make 16t to be divisible by 7 given that $0 \leq t \leq 9$? This can be solved by doing the following; (16 x3) + t = 48 + t; but 48t = (6x7) + 6+ t, clearly, 6 + t need to be a factor of 7, thus, 6 + t = 7, therefore, t = 1.therefore, 161 and 168 are all divisible by 7..

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