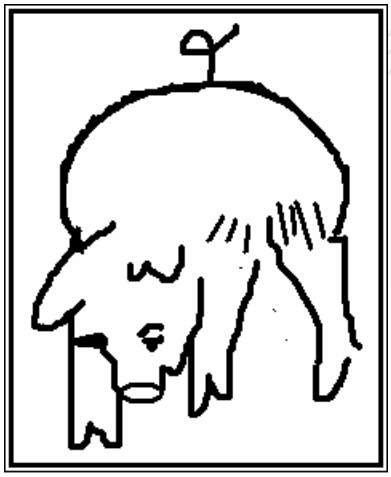
Mathematrix

- Sreenivasa Rao Ainapurapu.

We received calls from California asking whether there is any Srinivasa Ramanujan Math Club event in California. "May be in the near future" is the answer for this. We concluded "Srinivasa Ramanujan Math club" for 2006 summer. It went on well with 9 kids and about 8 adults. They all enjoyed the program and kids received their completion certificates. Thanks for those who asked about the solution to find 18 decimal places of 1/19. You will see the solution it in this issue. Many formulae were given thousands of years ago in Vedic scriptures in encrypted format. Only some saints after researching a lot figured out some formulae. Those are what we tried to bring up in the previous issues.

This time we will discuss about : some tips to do some complex calculations in easy way, problem solving techniques and many more. Have fun.

Note : You should teach these techniques to kids only after they learn ordinary methods. Then only they can appreciate these tips and the concepts behind. It is always better to use normal methods to verify till you are comfortable.



Let us start with a picture shown on left. What do you see there? A pig or an old man? On the first instinct, some people see pig and others see an old man. Depending on what part of our brain we are using, the result varies. Depending on a person's interest in literature, logical thinking, grammar, sports, arts etc., the dominant part of the brain (Left or Right) can be understood.

How to divide a number by 9 quickly? Simple! See the examples in next page.

Division by 9 :

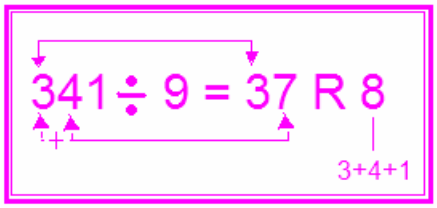


Figure A

For example, 341/9 is 37R8. 3 (3+4) = 37 is the coefficient. (3+4+1) = 8 is the reminder. In 341, 3 is in hundreds' place, 4 in tens' place and 1 in units' place. Keeping hundreds' place as tens' place in coefficient, add hundreds' and tens' place to calculate units' place in coefficient. Reminder is some of hundreds', tens' and units' place. See Figure A for description.

785624 ÷ 9 = 7(7+8)(7+8+5)(7+8+5+6)(7+8+5+6+2)R(7+8+5+6+2+4)
= 7(15)(20)(26)(28)R(32)
= 7(15)(20)(28)8+3R5 [32>9. So 32 = 3R5]
= 7(15)(22)88+3R5
= 7(17)288+3R5
= 87288+3R5
= 87291R5

Figure B

Take 785624/9, the coefficient is [7(7+8)(7+8+5)(7+8+5+6)(7+8+5+6+2)] = [7(15)(20)(26)(28)] = [7(15)(20)(28)8] = [7(15)(22)88] = [7(17)288] = 87288. Reminder is 7+8+5+6+2+4 = 32, which is more than 9. So dividing it by 9, we get 3R5 (coefficient 3 and reminder 5). Now the coefficient is 87288 + 3 = 87291 and reminder 5. See Figure B and Figure C for description.

Coefficient	Reminder
7 8 5 6 2	4
7 8 5 6	2
7 8 5	6
7 8	5
7	8
	7
8 7 2 8 8	3

Figure C

135 X 11 = 1(1+3)(3+5)5
= 1485
784352 X 11 =
= 7(7+8)(8+4)(4+3)(3+5)(5+2)2
= 7(15)(12)7872
= 85(12)7872
= 8627872

Figure D

Multiplication by 11 :

For example, 135 x 11 = 1(1+3)(3+5)5 = 1485.
Let us take 784352 x 11 = 7(7+8)(8+4)(4+3)(3+5)(5+2)2 = 7(15)(12)7872 = 7(16)27872 = 8627872. Verify these answers by calculating them in regular methods. Very easy! Isn't it? The addition should go from Right to left. See Figure D for more details.

Complex division :

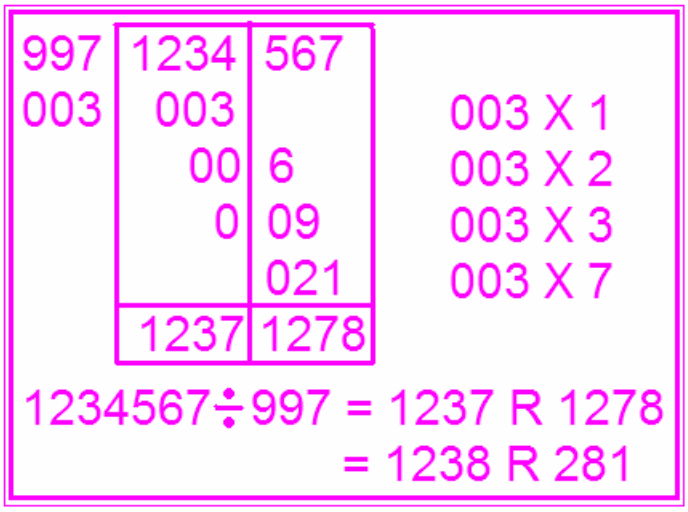


Figure E

Say for example 1234567/997 can be done as shown in figure E. When we divide a number by 997, the reminder is always less than that. So let us keep the last 3 digits for reminder. So we separate1234 (Coefficient part) and 567 (Reminder part). Now 997 is 3 short of 1000 (10^3). So we write 003 below 997. Now multiplying 003 by 1 (1st digit from left In coefficient part), we wrote it in second line. After that 003 is multiplied by the sum of 2 (2nd digit from left in coefficient part) and 0 (the digit below 2 in 2nd row) and wrote it in 3rd line. Now again multiply 003 by 3 (sum of 3rd digit from left in coefficient part, the value in 2nd line below 3 and the value in 3rd line below 3.), and wrote in 4th line. Then 003 is multiplied by 7 (Sum of 4th digit from left in coefficient, the value below 4 in 2nd line, the value below 4 in 3rd line and the value below 4 in 4th line) and wrote in 5th line. Now adding up the coefficient parts and reminder parts, we got 1237 and 1278 respectively. Reminder can not be more than 997. So subtracting 997 from 1278, the reminder is 281. The coefficient is 1237 + 1, that is 1238. So the solution to 1234567/997 is 1238 R 281.

Now coming to the problem of your interest, let us find 18 decimal places of 1/19. It can be done in two different ways namely multiplication method and division method.

Multiplication method :

In 1/19, 19 is the denominator. This formula can be applied to fractions having denominator ending with 9. For example this formula can be used for 1/29, 2/39, 5/9 etc. Here we should remember the key number, which is (denominator – 9)/10 + 1. In otherwords, the denominator without units place. So the key number for 1/19 is 2, 1/29 is 3, 5/9 is 1. The maximum number of decimal places we might get for a recurring number are (denominator – numerator), that is 19-1=18.Here we write the 18 digits starting from right, the right most being the numerator. Multiply the numerator with the key number and put it on left side and proceed as shown in below figure F. From right to left it starts with 1 (numerator), 2 (1 multiplied by key number), 4 (2 multiplied by key number), 8 (4 multiplied by key number), 16 (8 multiplied by key number and tens place is written below units place as shown in picture) and so on till the pattern repeats or reach 18 (denominator – numerator) digits.

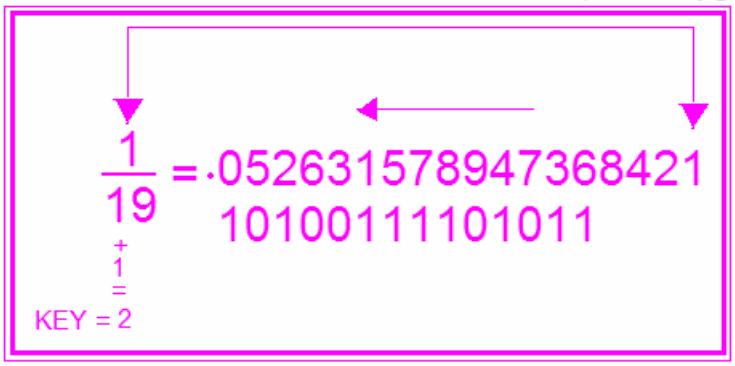


Figure F

For finding the value of 1/7, we can multiply both numerator and denominator with 7 to get 7/49. Now we can find the value starting with 7 and key 5.

So 1/7 = 0.142857
21423

For finding 5/9 value, we have key 1 and starting number 5. By multiplying 5 by key, we get 5 again. So the value of 5/9 = 0.555… = $0.\overline{5}$ (recurring).

Only one time summer holidays per year!!

Student : When is next Srinivasa Ramanujan math club?
Math club volunteer : Every year summer holidays.
Student : Oh! Unfortunately we get only one time summer holidays per year. If we get more than one time summer holidays, we could have had more fun filled math club sessions.
Math Club volunteer : ?#@!?

Division method : This is exactly opposite to the previous method. Here also Key is 2. If we divide numerator (1) by key (2), the coefficient is 0 and reminder is 1. So our answer starts with 0.0 and the reminder is placed below coefficient as shown in figure G. Now dividing 10 by key (2), the coefficient is 5 and reminder is 0. Dividing 5 (05) by key (2), gives coefficient 2 and reminder 1 and so on as shown in Figure.

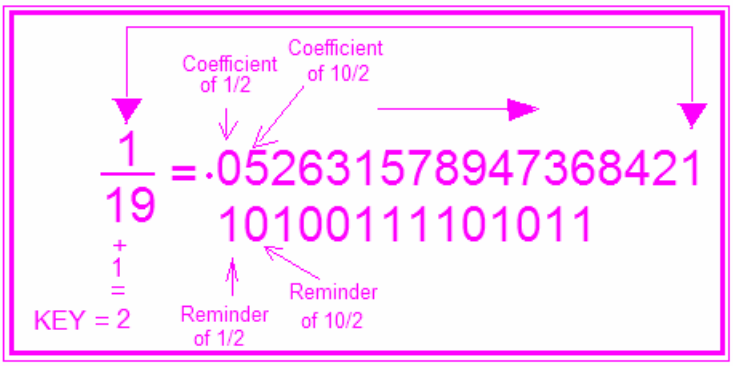


Figure G

Srinivasa Ramanujan Math club 2006 participants

Giving a pause for Mathematrix. Expressing my sincere thanks to all my childhood to present teachers for their encouragement and timely suggestions. – Sreenivasa Rao Ainapurapu.