

Nrich Solution for Two and Two (Thursday Batch)

This task of Two and Two was taken for 2 sessions with a group of 17 students in Ganit Kreedā, Vicharvatika, India by **Shubhangee(facilitator)**.

The names of the students are:

Kanaa, Ruhi, Kimaya, Ananya, Aarav, Shravani, Pushan, Ishan, Adithya, Avyukth, Mrunmayee, Shivashree, Shreehari, Aniket, Anirudh and Vikrant.

Kids together found out that:

ONE + TWO = THREE

Not possible, as two 3-digit numbers' sum cannot be 5-digit.

ONE + THREE = FOUR

Not possible as one 3-digit number and one 5-digit number cannot be added to get 4-digit sum.

Kids shared different observations for:

ONE + ONE = TWO.

O has to be even and O can't be 0, as $O = E + E$.

O has to be smaller than 5 as $O + O = T$ and there can't be any carry over.

This means O can only be 2 or 4.

Kids then systematically worked by changing the values for O and found out 16 solutions as shown.

O	2	4
E	1 or 6	2 or 7

$\begin{array}{r} 407 \\ + 231 \\ \hline 462 \end{array}$	$\begin{array}{r} \textcircled{1} \\ 271 \\ + 271 \\ \hline 542 \end{array}$	$\begin{array}{r} \textcircled{1} \\ 281 \\ + 281 \\ \hline 562 \end{array}$	$\begin{array}{r} 291 \\ + 291 \\ \hline 582 \end{array}$	}	$\begin{array}{r} 407 \\ 407 \\ \hline 814 \end{array}$	$\begin{array}{r} 417 \\ 417 \\ \hline 834 \end{array}$
$\begin{array}{r} 206 \\ 206 \\ \hline 432 \end{array}$	$\begin{array}{r} 216 \\ 216 \\ \hline 432 \end{array}$	$\begin{array}{r} 236 \\ 236 \\ \hline 472 \end{array}$	$\begin{array}{r} 286 \\ 286 \\ \hline 572 \end{array}$	}	$\begin{array}{r} 427 \\ 427 \\ \hline 854 \end{array}$	$\begin{array}{r} 457 \\ 457 \\ \hline 914 \end{array}$
$\begin{array}{r} 432 \\ 432 \\ \hline 864 \end{array}$	$\begin{array}{r} 452 \\ 452 \\ \hline 904 \end{array}$	$\begin{array}{r} 482 \\ 482 \\ \hline 964 \end{array}$	$\begin{array}{r} 467 \\ 467 \\ \hline 934 \end{array}$	}	$\begin{array}{r} 467 \\ 467 \\ \hline 934 \end{array}$	$\begin{array}{r} 467 \\ 467 \\ \hline 934 \end{array}$

Total solutions = 16

Kanaa's Solution ↴

$$\begin{array}{r} \text{One} \\ + \text{One} \\ \hline \text{Two} \end{array}$$

Conditions

different letters have to be different numbers

- Ones Place
- E can be in 0-9
- Tens Place
- O has to be double of E, Hence it's an even number
 - N can be in 0-9
 - W has to be double of E, Hence it's an even number but it's odd when there is a carryover (C.O.)
- Hundred Place
- O has to be an even number except for carry over
 - Hence O is sometimes even, T can be 1-9

Observations

E has to be in 1-9 because E can't be the same as O,
E can't be 0.

O can be 8, 6, 4, 2, 0

If there is a carryover N can be 0, if there isn't,
N can't be 0. Otherwise N can be 1-9.

W has to be 0-9 (Including C.O.)

O can't be 8, 6 because it will become a 2 digit number. Now O can be 4, 2, 0

If O is 4 T can be 8, 9, When O is 2 T can be 4, 5, If O is 0 then T can be 1. H.

Hence T can be 8, 9, 4, 5, 1.

Kanaa's Solⁿ ↴

$\begin{array}{r} 231 \\ 231 \\ \hline 462 \\ \hline \end{array}$	$\begin{array}{r} 286 \\ 286 \\ \hline 572 \\ \hline \end{array}$	$\begin{array}{r} 437 \\ 437 \\ \hline 874 \\ \hline \end{array}$
$\begin{array}{r} 271 \\ 271 \\ \hline 542 \\ \hline \end{array}$	$\begin{array}{r} 432 \\ 432 \\ \hline 864 \\ \hline \end{array}$	$\begin{array}{r} 457 \\ 457 \\ \hline 914 \\ \hline \end{array}$
$\begin{array}{r} 281 \\ 281 \\ \hline 562 \\ \hline \end{array}$	$\begin{array}{r} 452 \\ 452 \\ \hline 904 \\ \hline \end{array}$	$\begin{array}{r} 467 \\ 467 \\ \hline 934 \\ \hline \end{array}$
$\begin{array}{r} 291 \\ 291 \\ \hline 582 \\ \hline \end{array}$	$\begin{array}{r} 462 \\ 462 \\ \hline 924 \\ \hline \end{array}$	$\begin{array}{r} 487 \\ 487 \\ \hline 974 \\ \hline \end{array}$
$\begin{array}{r} 206 \\ 206 \\ \hline 412 \\ \hline \end{array}$	$\begin{array}{r} 472 \\ 472 \\ \hline 944 \\ \hline \end{array}$	
$\begin{array}{r} 216 \\ 216 \\ \hline 432 \\ \hline \end{array}$	$\begin{array}{r} 482 \\ 482 \\ \hline 964 \\ \hline \end{array}$	
$\begin{array}{r} 236 \\ 236 \\ \hline 472 \\ \hline \end{array}$	$\begin{array}{r} 417 \\ 417 \\ \hline 834 \\ \hline \end{array}$	

Aarav's solution:

Cryptarithm Puzzle	
① one + one = two	② two + two = four
1 231 + 231 = 462	1 632 + 632 = 1264
2 271 + 271 = 542	2 734 + 734 = 1468
3 281 + 281 = 562	3 765 + 765 = 1530
4 291 + 291 = 582	4 867 + 867 = 1734
5 236 + 236 = 472	5 928 + 928 = 1856
6 286 + 286 = 572	
7 482 + 482 = 964	
8 487 + 487 = 974	
9 452 + 452 = 904	
10 251 + 251 = 502	

- **Adithya's explanation for ONE + ONE = TWO:**
- I first wrote down the same digit in all the 'O's. Then, as 'F' can only be 1, I wrote that down. Then I found a number that when taken 2 times is equal to 'FO'. Then depending on whether carryover is needed or not I found out 'W'.



$$\begin{array}{r|l}
 \underline{\quad} & \underline{6} & \underline{2} \\
 \underline{\quad} & \underline{6} & \underline{2} + \\
 \underline{1} & \underline{2} & \underline{4} \\
 \hline
 & \textcircled{1} & \\
 \hline
 \end{array}$$

①
obtians

$$\underline{2} \underline{3} \underline{4}$$

$$\underline{2} \underline{3} \underline{4}$$

$$\underline{2} \underline{3} \underline{4} +$$

$$\underline{2} \underline{3} \underline{4} \checkmark$$

$$\underline{1} \underline{4} \underline{6} \underline{8}$$

$$\begin{array}{r}
 \underline{1} \\
 \underline{4} \quad \underline{6} \quad \underline{8} \\
 \downarrow
 \end{array}$$

$$\begin{array}{r}
 1 \\
 \underline{7} \\
 7 \\
 \underline{5} \\
 0 \\
 \text{①}
 \end{array}
 \quad
 \begin{array}{r}
 1 \\
 \underline{6} \\
 6 \\
 \underline{3} \\
 0 \\
 \text{②}
 \end{array}
 \quad
 \begin{array}{r}
 \underline{5} \checkmark \\
 5 \\
 \underline{0} \\
 0
 \end{array}
 +$$

$$\begin{array}{r}
 8 \\
 \underline{8} \\
 6 \\
 \text{①}
 \end{array}
 \quad
 \begin{array}{r}
 11 \\
 \underline{34} \\
 34 \\
 \underline{79} \\
 2 \\
 \text{②}
 \end{array}
 \quad
 \begin{array}{r}
 \underline{6} \checkmark \\
 6 \\
 \underline{2} \\
 2
 \end{array}$$

$$\begin{array}{r}
 1 \\
 \underline{8} \\
 8 \\
 \underline{7} \\
 \text{①}
 \end{array}
 \quad
 \begin{array}{r}
 1 \\
 \underline{6} \\
 6 \\
 \underline{3} \\
 \text{②}
 \end{array}
 \quad
 \begin{array}{r}
 \underline{7} \checkmark \\
 7 \\
 \underline{4} \\
 4
 \end{array}
 +$$

$$\begin{array}{r}
 9 \\
 \underline{9} \\
 8 \\
 \text{①}
 \end{array}
 \quad
 \begin{array}{r}
 11 \\
 \underline{23} \\
 23 \\
 \underline{57} \\
 \text{②}
 \end{array}
 \quad
 \begin{array}{r}
 \underline{8} \checkmark \\
 8 \\
 \underline{6} \\
 6
 \end{array}$$

$$\begin{array}{r}
 9 \\
 \underline{9} \\
 9 \\
 \text{①}
 \end{array}
 \quad
 \begin{array}{r}
 9 \\
 \underline{9} \\
 9 \\
 \text{②}
 \end{array}
 \quad
 \begin{array}{r}
 \underline{9} \\
 9 \\
 \underline{8} \\
 8
 \end{array}$$

Confirmed assumptions

1. F must always be 1 as the maximum carryover must always 1.
2. If $^6O^2$ is an even number, we should check from 2-4 as 5-7 will give us a carryover in the hundreds place which is not necessary.
3. If $^6O^2$ is an odd number, we should check in the tens place from 5-9 as 4-6 will not give us a carryover.