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Pick a 4 digits number $1000a + 100b + 10c + d$

Create a second number $1000b + 100c + 10d + a$

Add them together $1000a + 100b + 10c + d + 1000b + 100c + 10d + a$
 $= 1001a + 1100b + 110c + 11d$

Divisible by 11 because:-

$$1001a + 1100b + 110c + 11d = 11(91a + 100b + 10c + d)$$

This only works with an even number because if it is odd number:-

$$100a + 10b + c + 100b + 10c + a = 101a + 110b + 11c$$

$$10000a + \dots + e + 10000b + \dots + a = 10001a + \dots + 11e$$

a will not be divisible by 11.

However, an even number:-

$$10a + b + 10b + a = 11a + 11b$$

$$100000a + \dots + f + 100000b + \dots + a = 100001a + \dots + 11f$$

$$10000000a + \dots + h + 10000000b + \dots + a = 10000001a + \dots + 11h$$

a will always be divisible by 11.

An odd number is not divisible by 11 because

Multiple of 11 :-

$$1001 = 1 - 0 + 0 - 1 = 0$$

$$4757 = 4 - 7 + 5 - 7 = 0$$

But an odd number of zeros in 101 result in the ones not cancel up to 0

$$101 = 1 - 0 + 1 = 2$$

$$10001 = 1 - 0 + 0 - 0 + 1 = 2$$

Tiffany



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Four digit number

$$\begin{array}{r} 1000a \quad 100b \quad 10c \quad 1d \\ + 1000b \quad 100c \quad 10d \quad 1a \\ \hline 1001a \quad 1100b \quad 110c \quad 11d \end{array}$$

$$11(91a \quad 100b \quad 10c \quad d)$$

↑ always divisible by 11

Three digit number

$$\begin{array}{r} 100a \quad 10b \quad c \\ + 100b \quad 10c \quad a \\ \hline 101a \quad 110b \quad 11c \end{array}$$

$$11(9.1\bar{8}a \quad 10b \quad c)$$

↑ doesn't work

Five digit number

$$\begin{array}{r} 10000a \quad 1000b \quad 100c \quad 10d \quad 1e \\ + 10000b \quad 1000c \quad 100d \quad 10e \quad 1a \\ \hline 10001a \quad 11000b \quad 1100c \quad 110d \quad 11e \end{array}$$

$$11(909.1\bar{8}a \quad 1000b \quad 100c \quad 10d \quad e)$$

↑ doesn't work

Prediction: Every even digit number will work

→ A will always get something with 1 number of 0 and then 1. So if odd number $10001 \quad 10-0+0-1 = 9$. Odd numbers always get 9 but even ^{numbers} $1001 \quad 10-0+1 = 11$.



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If we do $a b c d + b c d a$ it will equal to:

$$1000a + 100b + 10c + d \\ + 1000b + 100c + 10d + a$$

$$= 1001a + 1100b + 110c + 11d$$

We can write it as $11(91a + 100b + 10c + 1d)$
this will be equal to $abcd + dcba$.

The no. will only work ~~with~~ when the no. of a is divisible by 11.

◁ So if you have odd digits number it will not work as a ~~is~~
won't be divisible by 11.

To conclude all even digits number add by its no. move the first digit to the back it will be divisible by 11.

Even digits

$$+ 1000a + 100b + 10c + d \\ + 1000b + 100c + 10d + a \\ = 1001a + 1100b + 110c + 11d$$

$$11(91a + 100b + 10c + d)$$



Odd digits

$$+ 10000a + 1000b + 100c + 10d + e \\ + 10000b + 1000c + 100d + 10e + a \\ = 10001a + 11000b + 1100c + 110d + 11e$$

$$11(\overbrace{909}^{11}a + 1000b + 100c + 10d + e)$$

