# Number Rules - OK

## nRICH problems

1. Two consecutive numbers add to give an odd number
2. The product of two consecutive numbers is even
3. The sum of four consecutive numbers is never a multiple of $4$
4. Two odd numbers add to give an even number
5. The pattern below continues forever:

$$7^2 = 6^2 + 6 + 7$$
$$8^2 = 7^2 + 7 + 8$$
$$9^2 = 8^2 + 8 + 9$$

6. Squaring an odd number always gives an odd number
7. If a square number is multiplied by a square number the product is a square number

1. Let us have the integer '$n$'

$$n + n+1$$

unknown

next consecutive integer

This can be simplified to make $2n+1$

You can check whether this is uneven by dividing by 2.

$$\frac{2n+1}{2} = n + \frac{1}{2}$$

This is therefore not an integer and this is proof that the sum of 2 consecutive integers is odd.

Examples

$6 + 7 = 13$

$24 + 25 = 49$

$138 + 139 = 277$

all are ODD

2. Again, like the above problem, let us have 2 consecutive integers.

$n$ and $n+1$

One of these integers is even, the other is odd. Therefore, in any multiplication sum, when one number is always even, the product is always even.

Example $n(n+1)$

let $n = 4$ and $n+1 = 5$

$5 \times 4 = \underline{20}$ (EVEN)

let $n = 39$ and $n+1 = 40$

$39(40) = \underline{1560}$ (EVEN)

3. Let us have 4 consecutive numbers

$(n) + (n+1) + (n+2) + (n+3)$

→ this simplifies to $4n+6$

E.g. let $n = 2$

$4(2) + 6 = 14$ (not a multiple of 4)

$n = 6 \rightarrow 4(6) + 6 = 30$ (not a multiple of 4)

$$\frac{4n+6}{4} = n + \frac{6}{4}$$ (not a multiple of 4)

4. $2n$ = even

$2n+1$ = odd

let us have 2 integers

$\underline{2n+1}$ and $\underline{2m+1}$

$$2n+1 + 2m+1 = 2n + 2m + 2$$

factorising $2(n+m+1)$

* Note: I knew I was onto something that would have been a mathematical proof, but reached a dead-end.

5. $n^2 = (n-1)^2 + (n-1) + n$

$n^2 = (n-1)(n-1) +$ " "

$= n^2 - 2n + 1 + n - 1 + n$

Simplifies to $\underline{n^2 = n^2}$

Touché!

6. An odd number would either be $2n+1$ or $2n-1$

Squaring $(2n+1)^2 = \underline{4n^2 + 4n} + 1$

With a factor of 2 : $2(2n^2+2n) + 1$

first 2 terms only

$2n^2 + 2n = x$

which is $\underline{2x + 1}$

$\therefore$ square of any odd number always $\underline{\text{ODD}}$