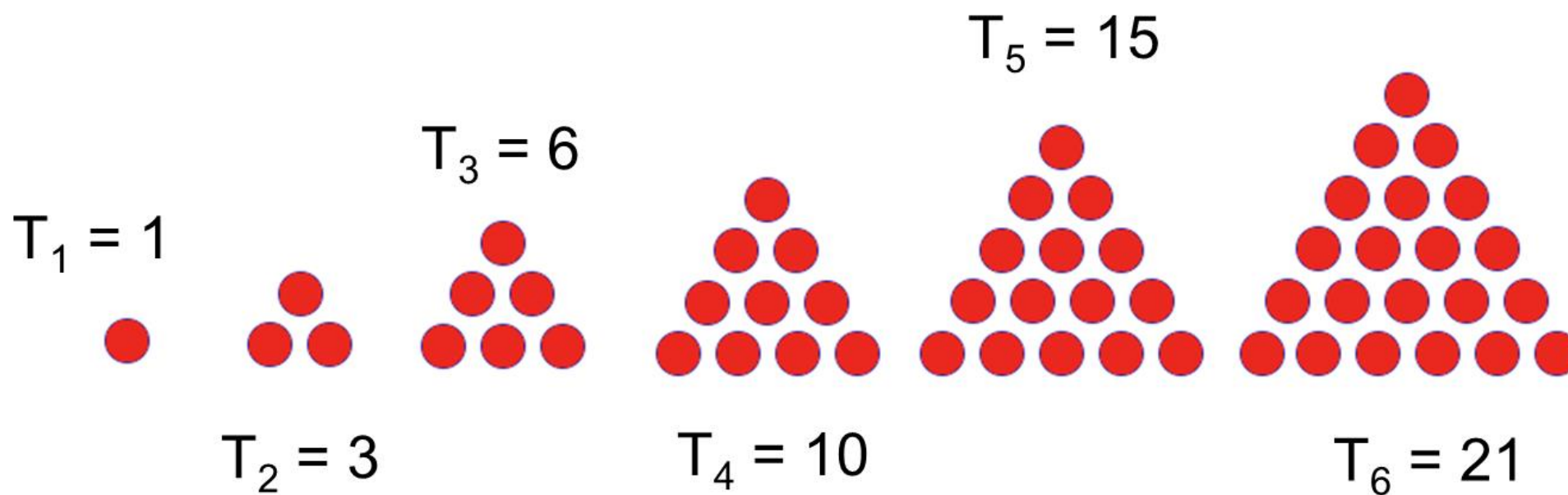


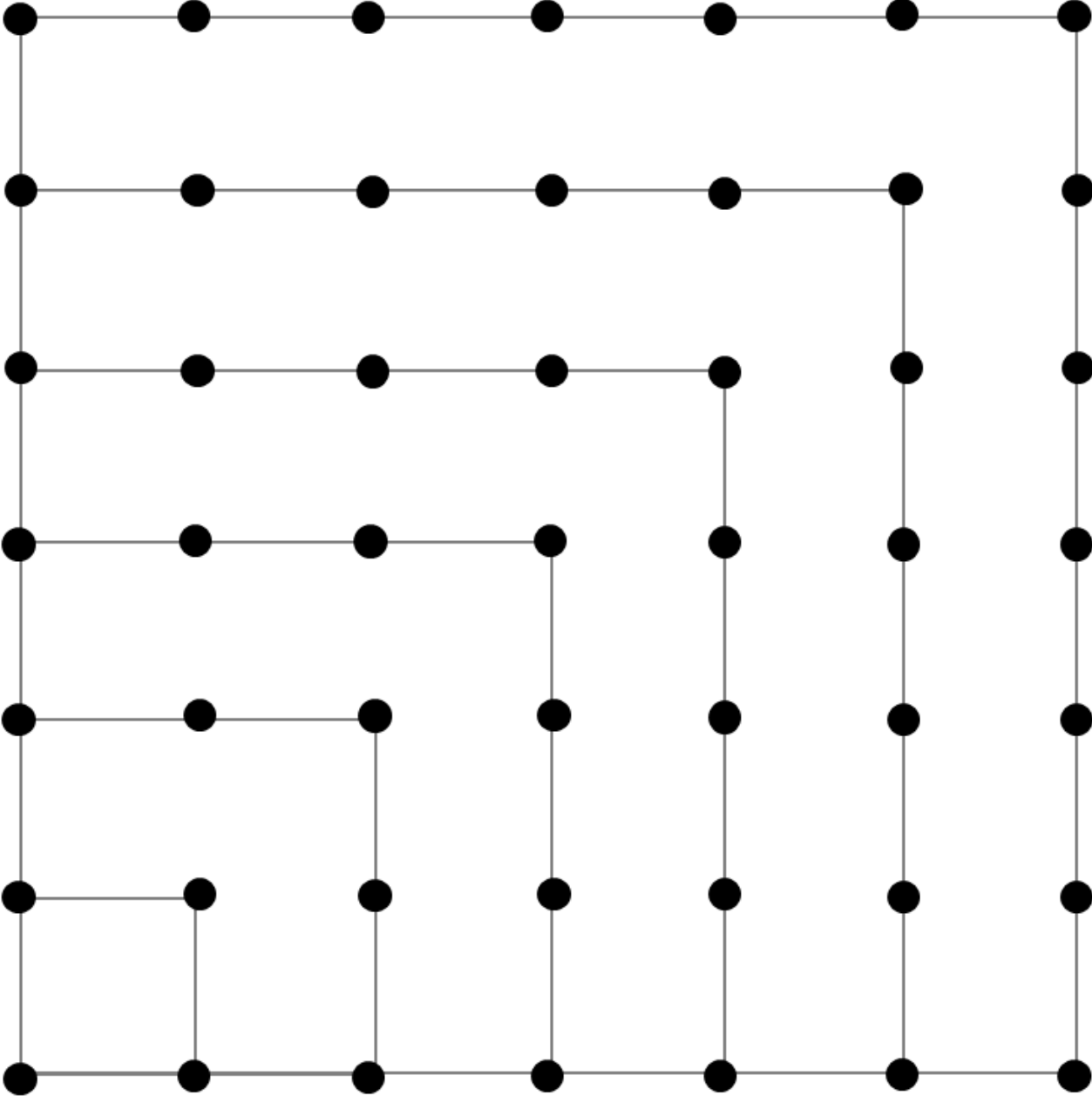
Liczby z kulek

Liczby trójkątne

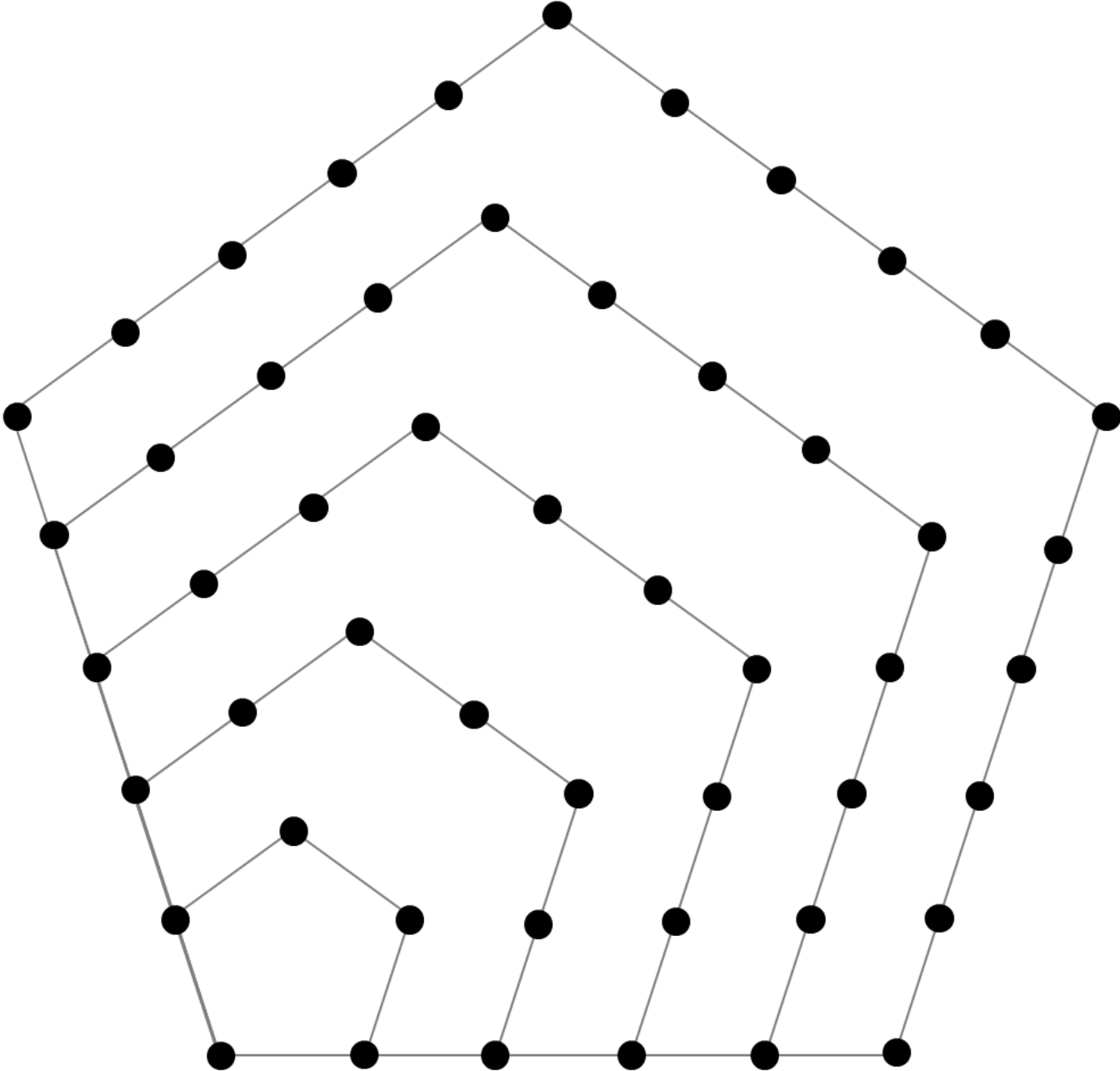


$$T_n = \frac{1}{2} n (n + 1)$$

Liczby
narożne
kwadratowe



Liczby
narożne
pięciokątne



Liczby
narożne
pięciokątne

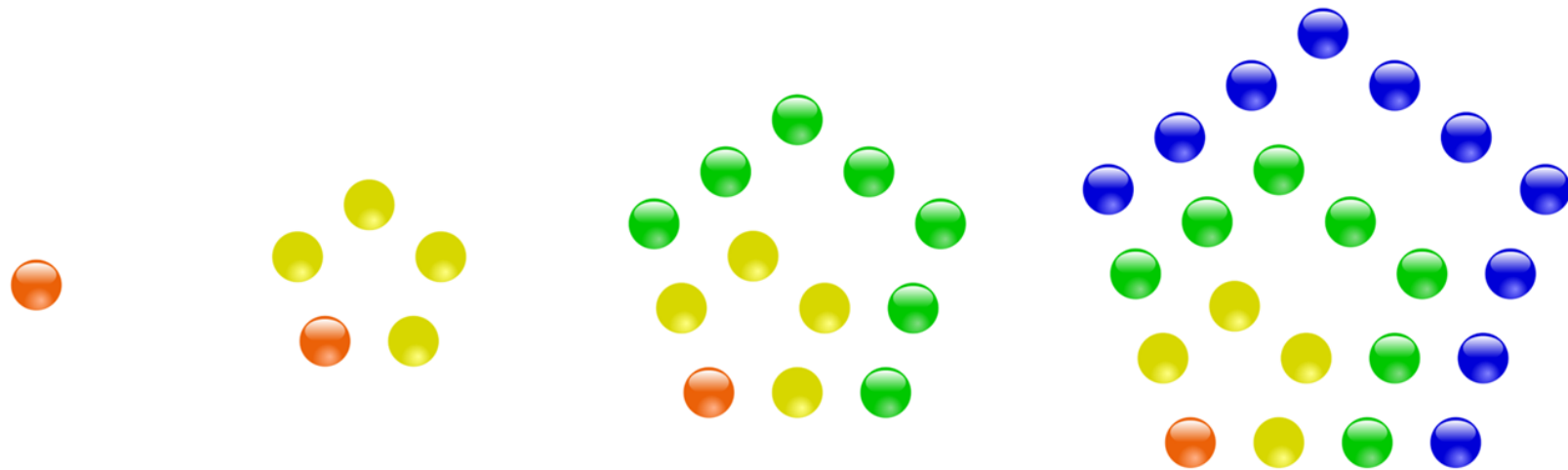
$$n = 1 \quad P_1 = 1$$

$$n = 2 \quad P_2 = 1 + 4 = 5$$

$$n = 3 \quad P_3 = 1 + 4 + 7 = 12$$

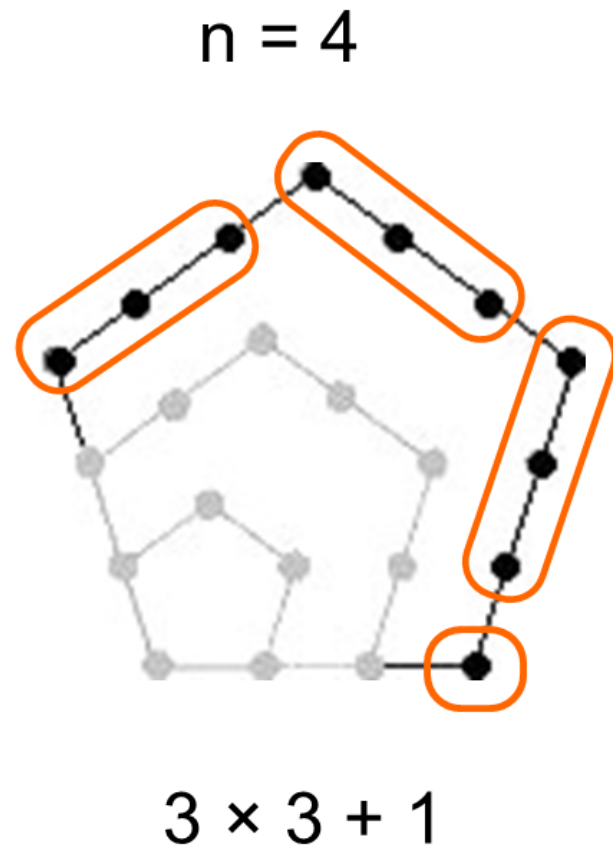
$$n = 4 \quad P_4 = 1 + 4 + 7 + 10 = 22$$

$$n = 5 \quad P_5 = 1 + 4 + 7 + 10 + 13 = 35$$



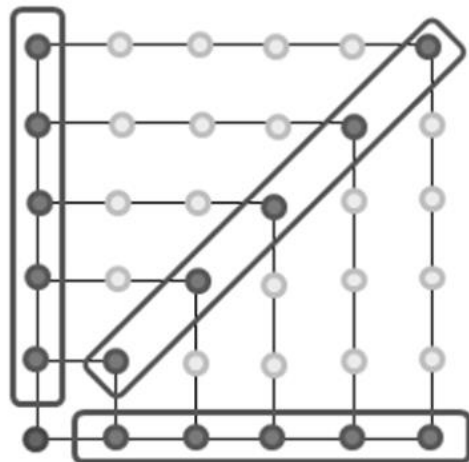
Liczby
narożne
pięciokątne

$n = 1$	$P_1 = 1$		
$n = 2$	$P_2 = 5$	4	
$n = 3$	$P_3 = 12$	7	3
$n = 4$	$P_4 = 22$	10	3
$n = 5$	$P_5 = 35$	13	3
$n = 6$	$P_6 = 51$	16	3

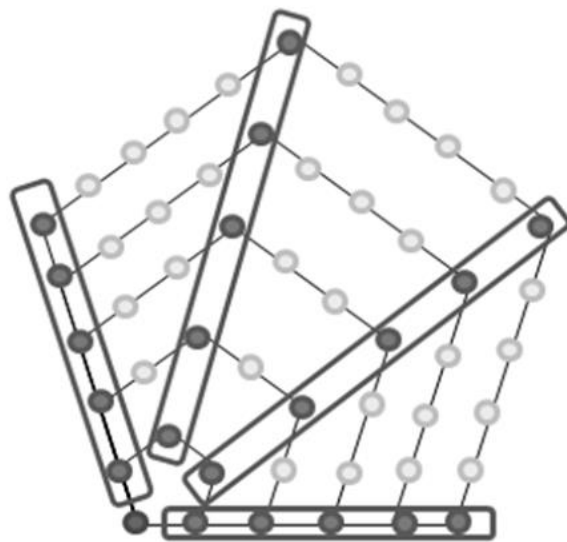


Liczby
narożne

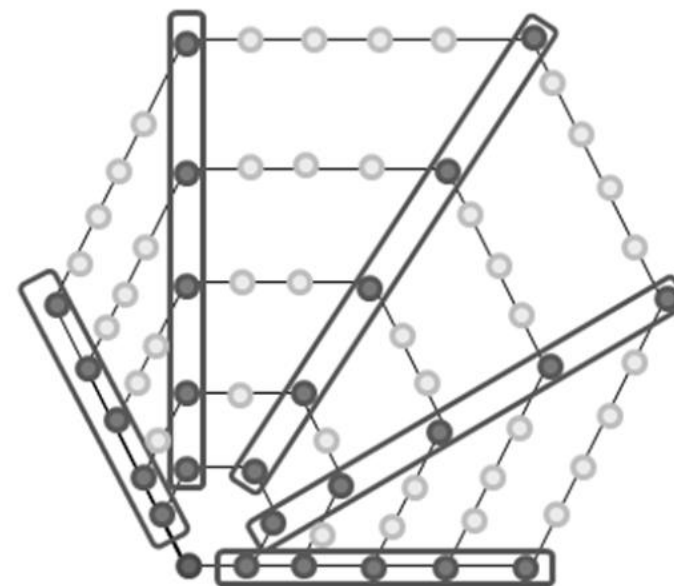
kwadratowe



pięciokątne

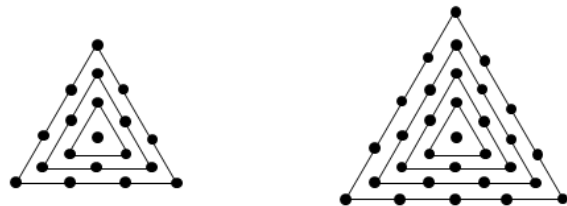
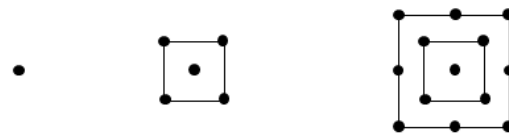


sześciokątne

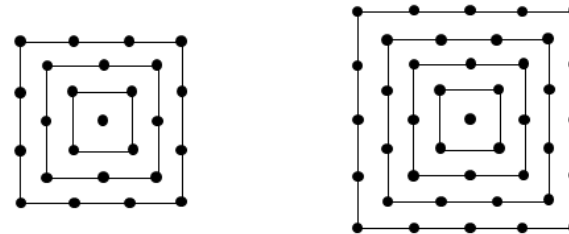


$$t_{n-1} = \frac{1}{2} n(n-1)$$

Liczby
centralne
wielokątne

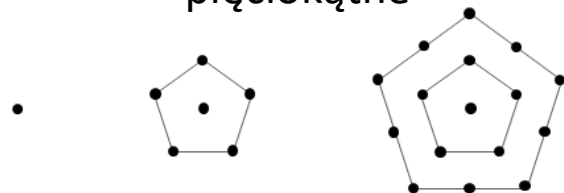


trójkątne

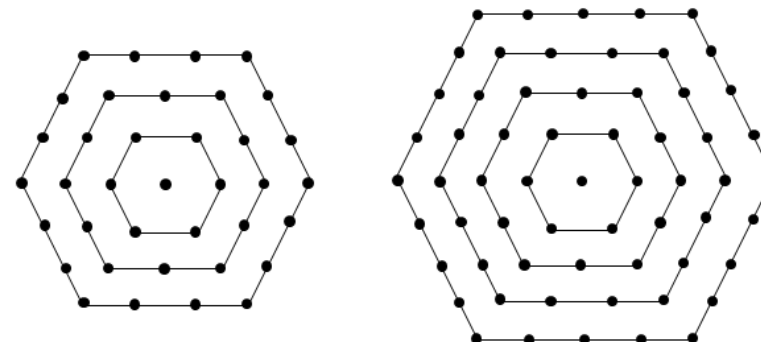
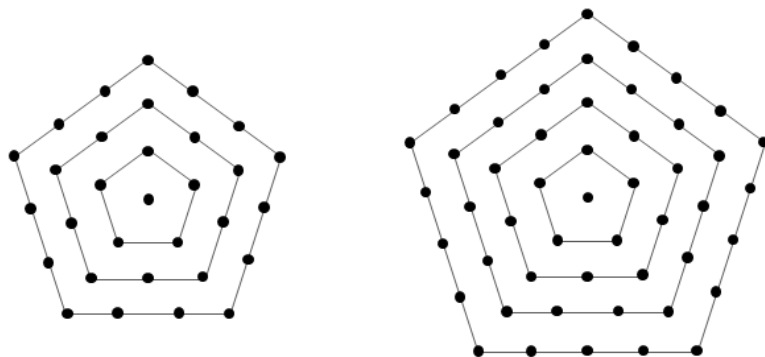
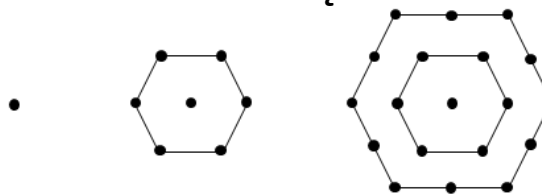


kwadratowe

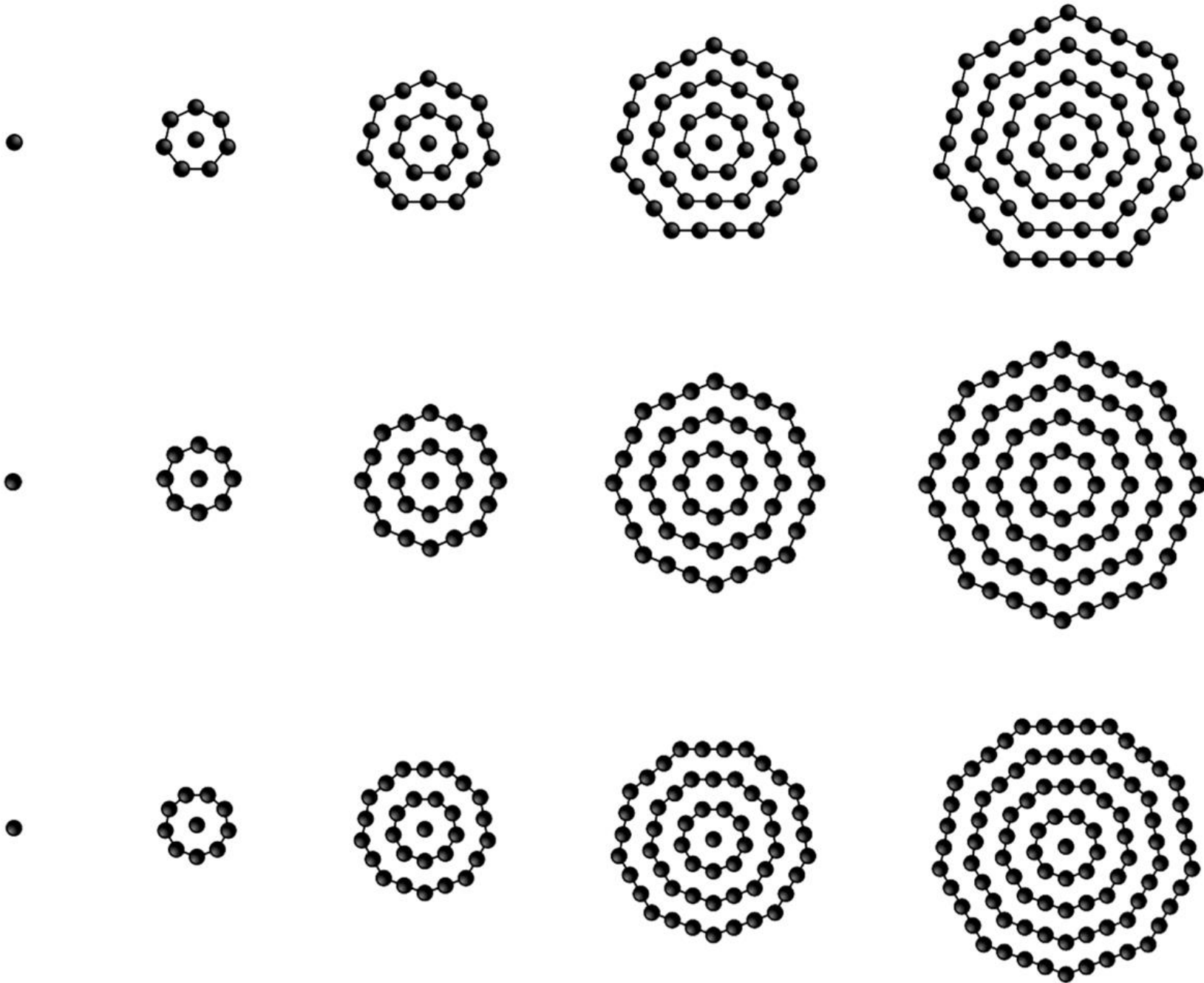
pięciokątne

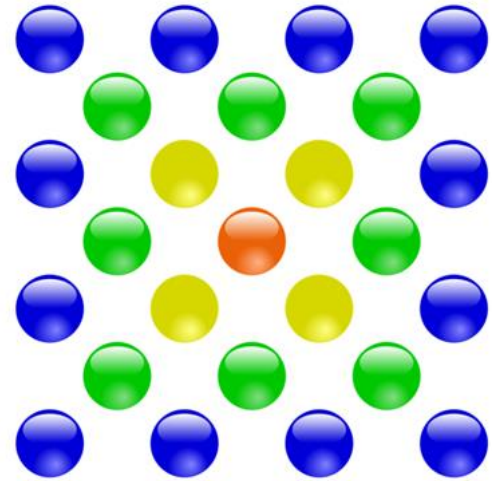
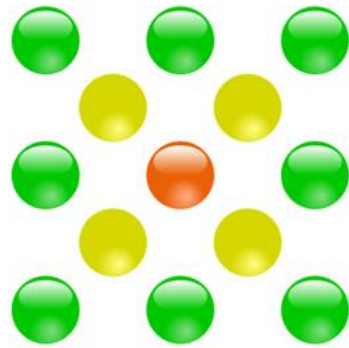
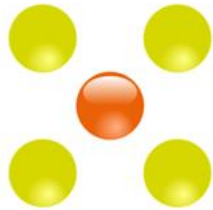
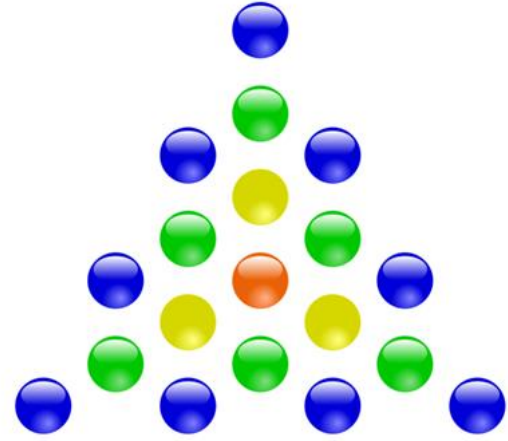
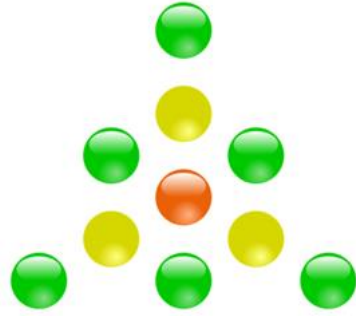
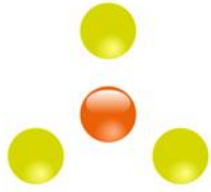


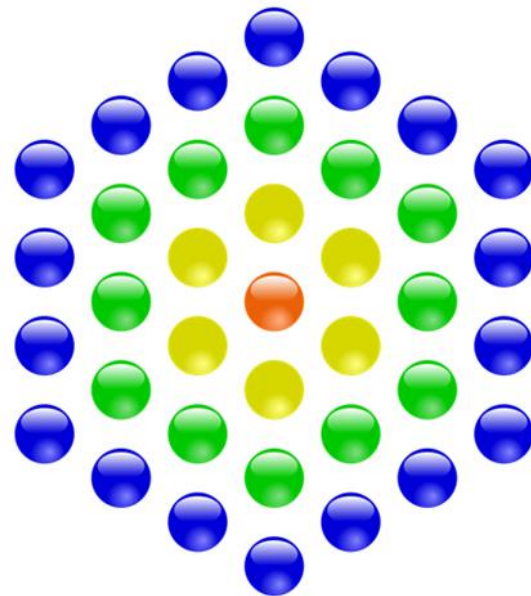
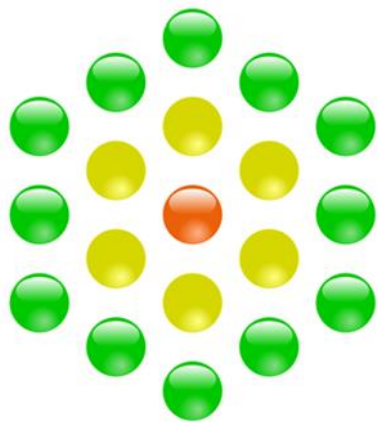
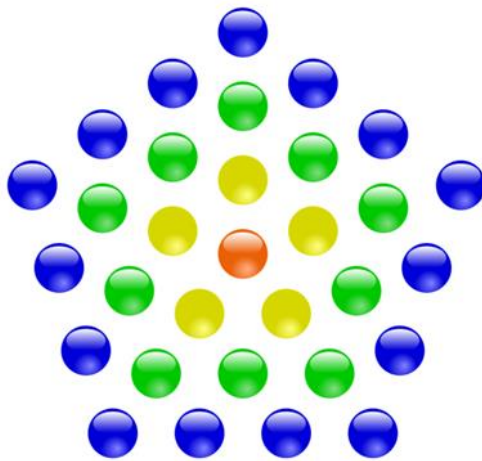
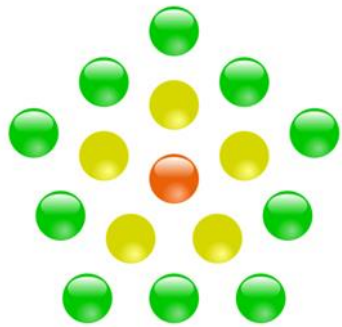
sześciokątne



Liczby
centralne
wielokątne







Liczby
centralne
pięciokątne

$$n = 1$$

$$P_1 = 1$$

$$n = 2$$

$$P_2 = 1 + 5 = 6$$

$$n = 3$$

$$P_3 = 1 + 5 + 10 = 16$$

$$n = 4$$

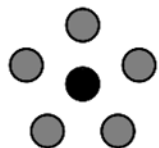
$$P_4 = 1 + 5 + 10 + 15 = 31$$

$$n = 5$$

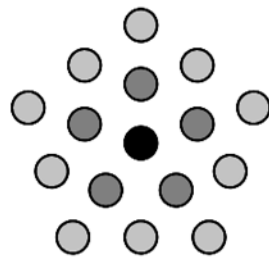
$$P_5 = 1 + 5 + 10 + 15 + 20 = 51$$



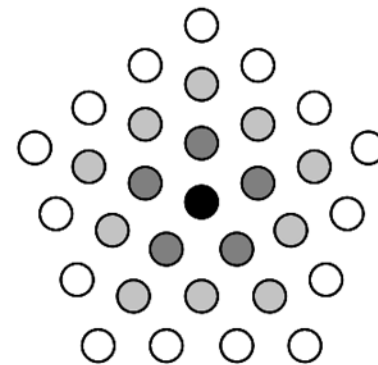
1



6

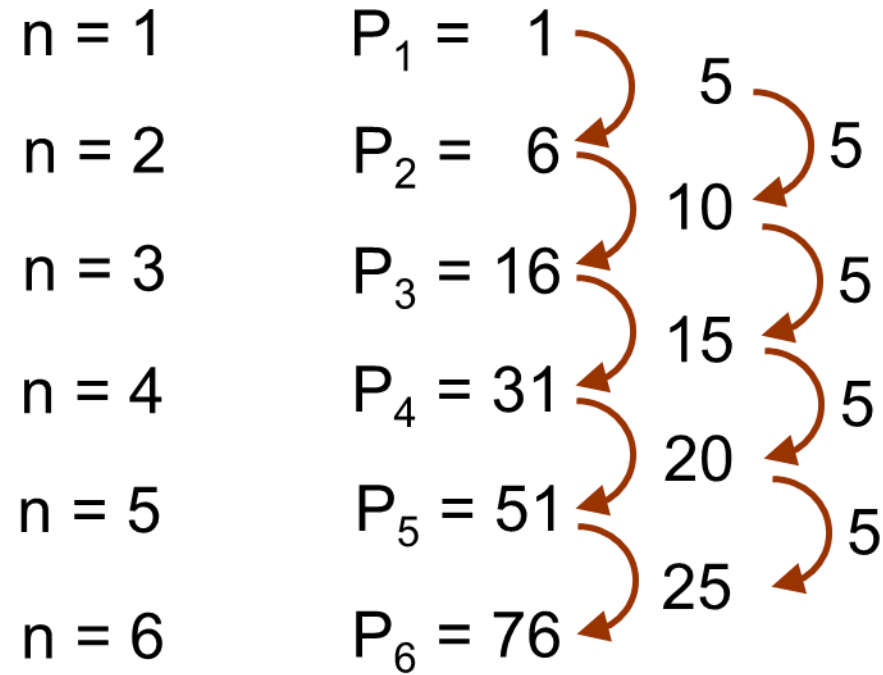


16



31

Liczby
centralne
pięciokątne



$$2a = 5$$

$$a = 2\frac{1}{2}$$

$$3a + b = 5$$

$$b = -2\frac{1}{2}$$

$$a + b + c = 1$$

$$c = 1$$

$$P_n = 2\frac{1}{2}n^2 - 2\frac{1}{2}n + 1$$

Liczby
centralne
sześciokątne

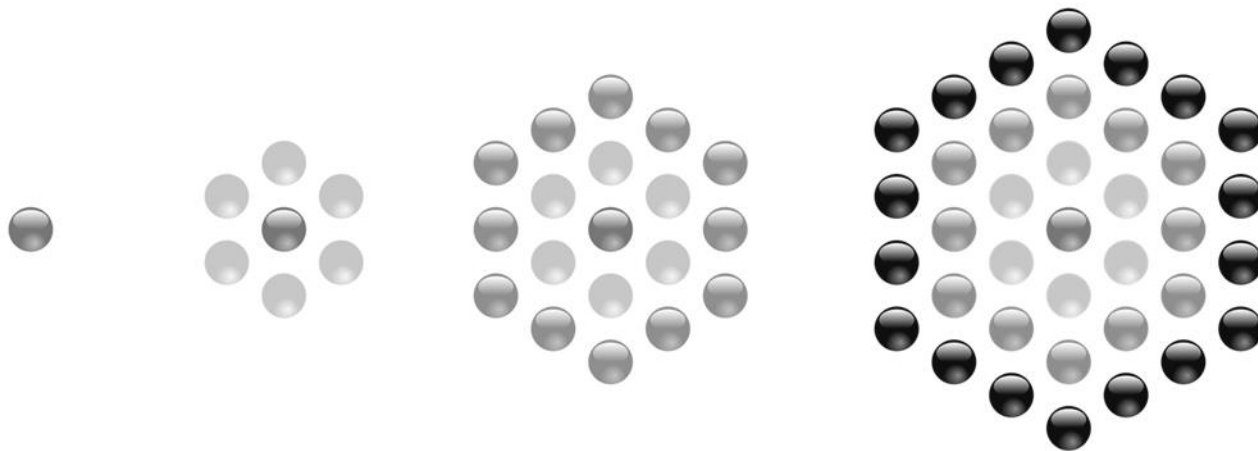
$$n = 1 \quad H_1 = 1$$

$$n = 2 \quad H_2 = 1 + 6 = 7$$

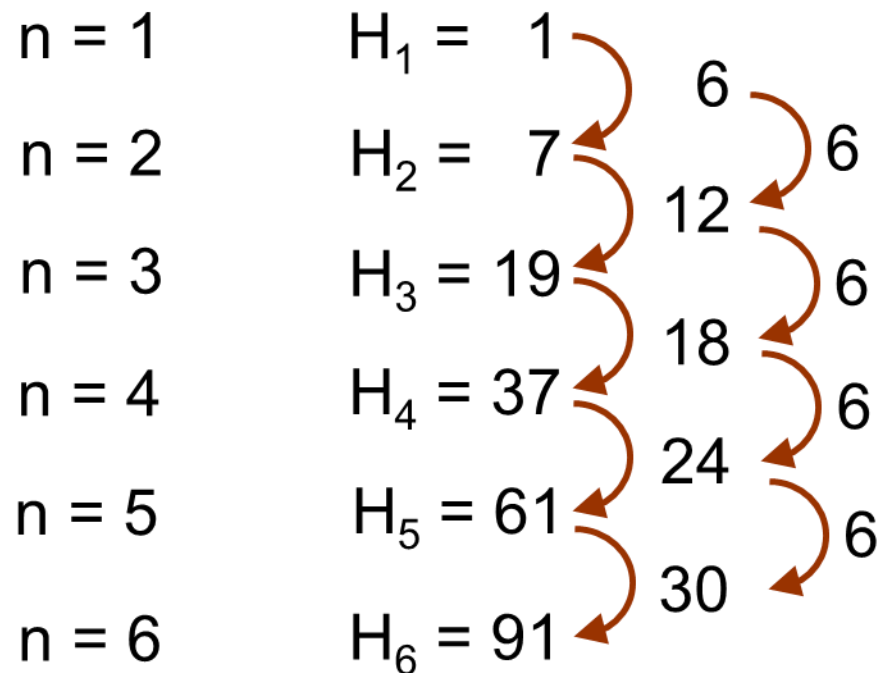
$$n = 3 \quad H_3 = 1 + 6 + 12 = 19$$

$$n = 4 \quad H_4 = 1 + 6 + 12 + 18 = 37$$

$$n = 5 \quad H_5 = 1 + 6 + 12 + 18 + 24 = 61$$



Liczby
centralne
sześciokątne



$$2a = 6$$

$$a = 3$$

$$3a + b = 6$$

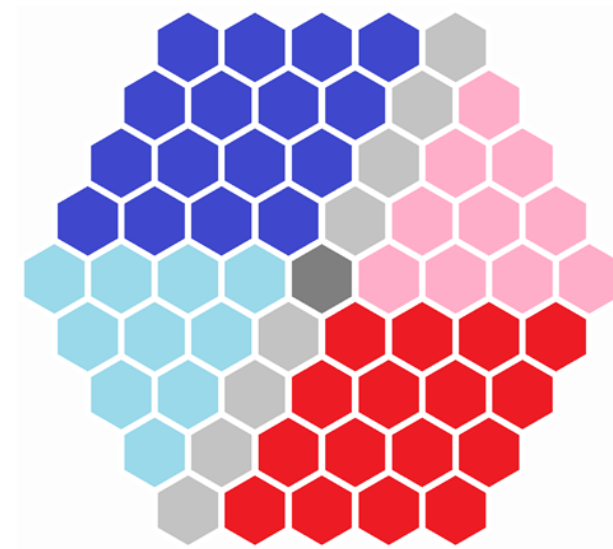
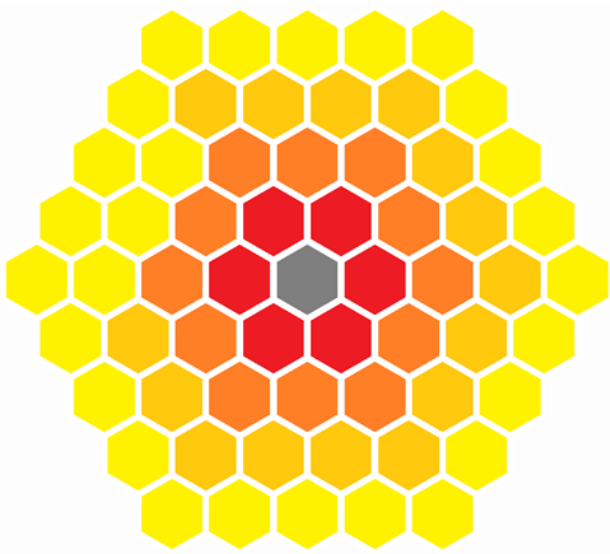
$$b = -3$$

$$a + b + c = 1$$

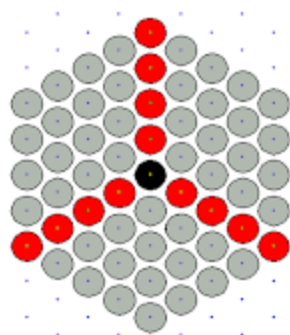
$$c = 1$$

$$P_n = 3n^2 - 3n + 1$$





Uzasadnienie 1



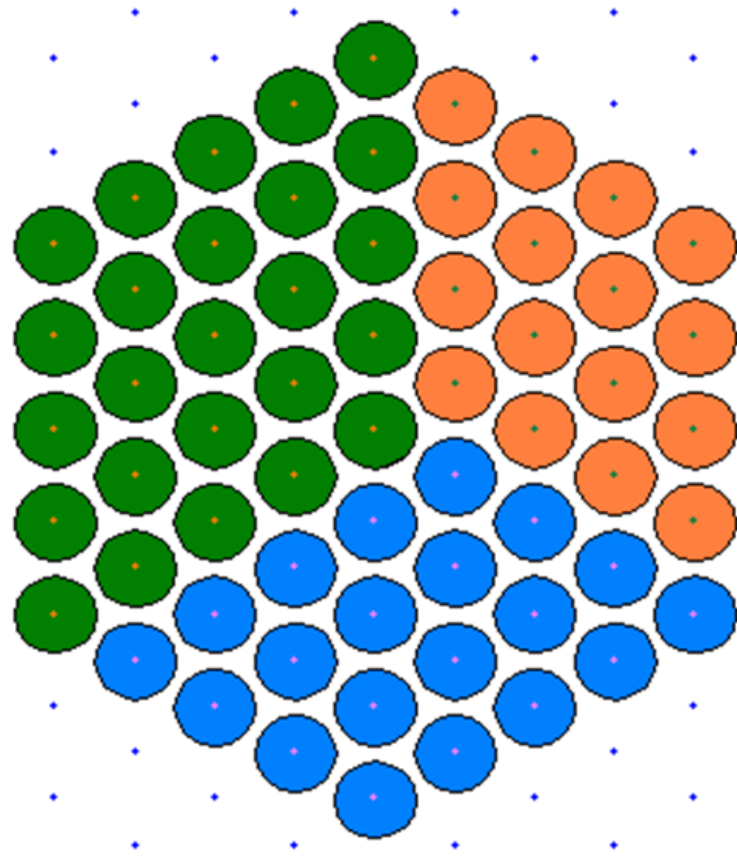
$n = 5$

Jak uzasadnić ten wzór?

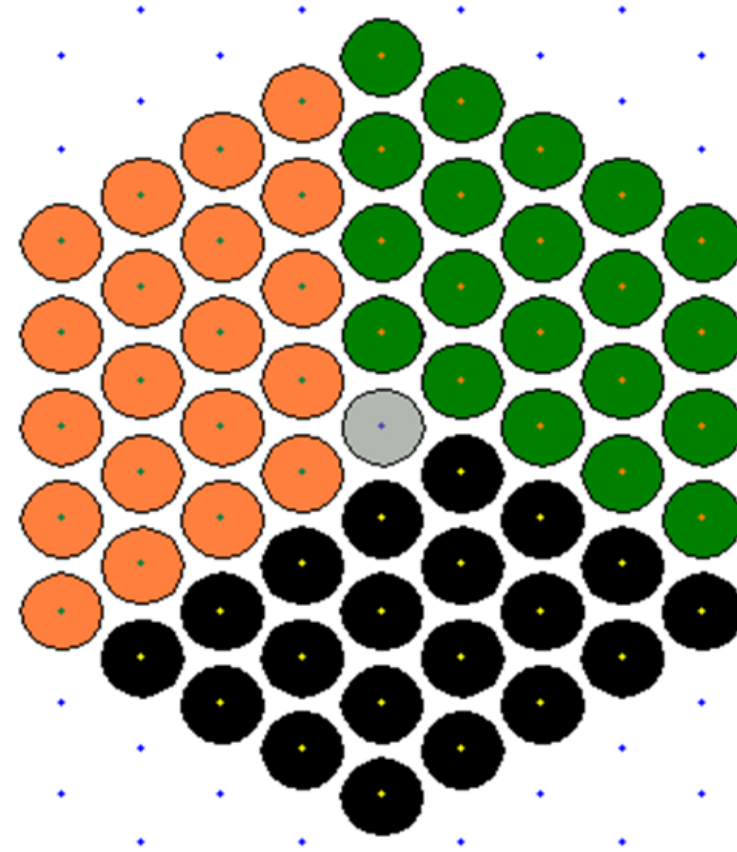
$$3n^2 - 3n + 1$$

$$n = 5$$

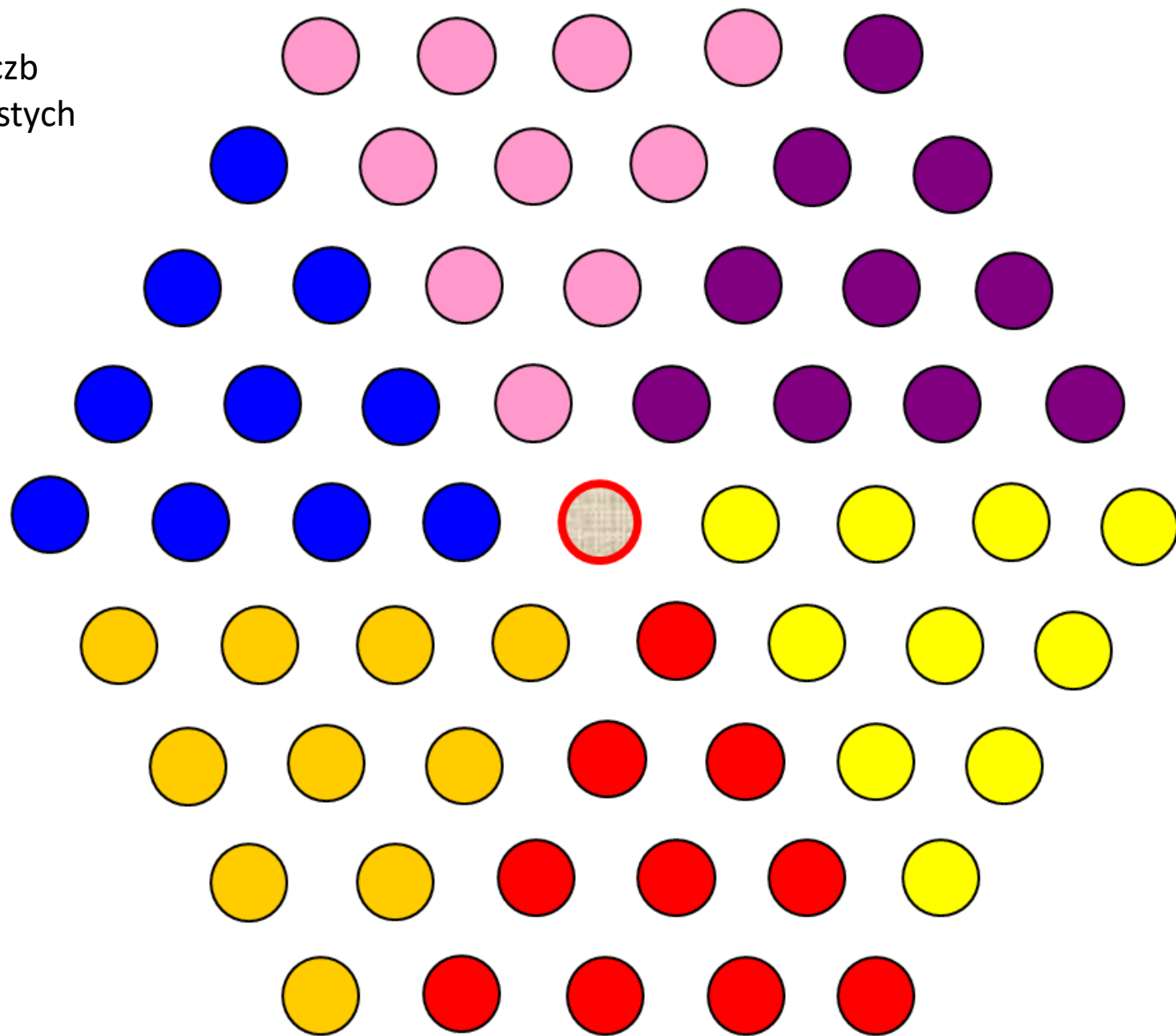
Uzasadnienie 2



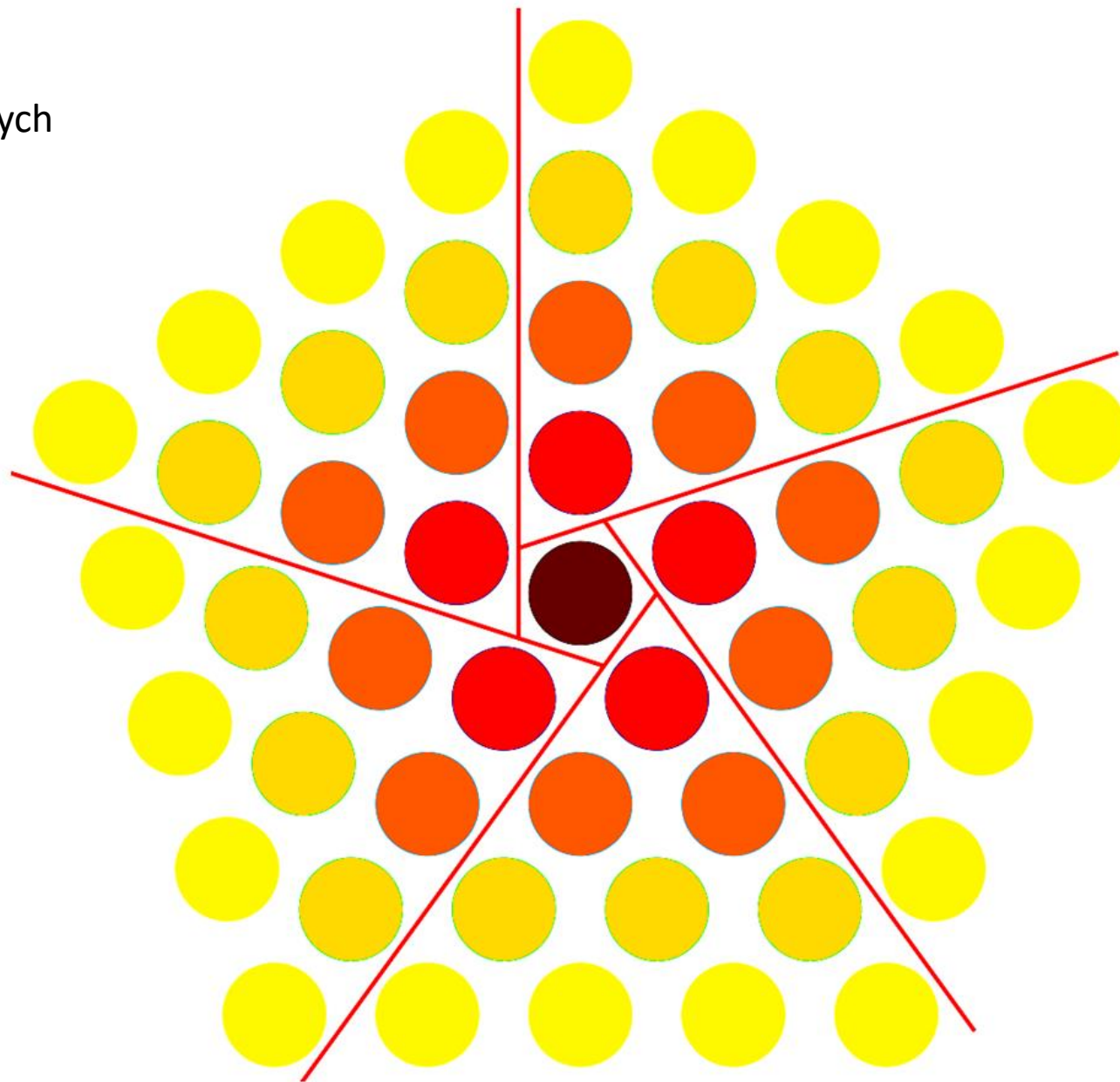
Uzasadnienie 3



Uzasadnienie dla liczb
wielokątnych parzystych



Uzasadnienie dla liczb
wielokątnych nieparzystych



Liczby z zapatek

