LLeimat
ASSOCIACIÓ D'ENSENYANTS DE MATEMÀTIQUES DE LLEIDA

Cinc cèntims de geometria...

Lleida 4 de febrer del 2023

CINC CÈNTIMS DE GEOMETRIA... I UN CÈNTIM D'ALTRES COSES

Lleida 4 de febrer del 2023

Joan Folguera Farré

Professor jubilat

QUADRATS MÀGICS

15

8	1	6
3	5	7
4	9	2

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8	1	6
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QUADRATS GEOMÀGICS

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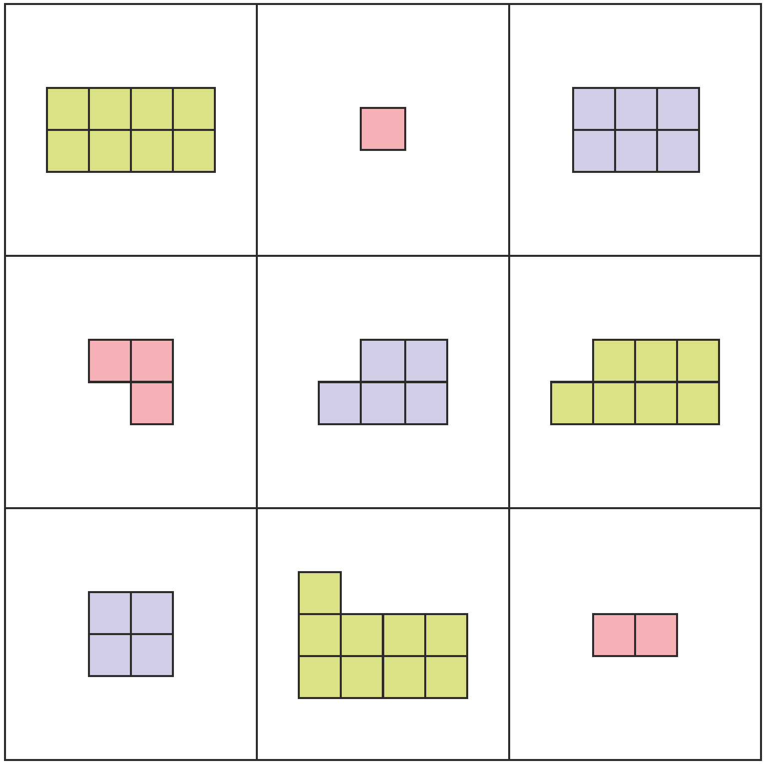

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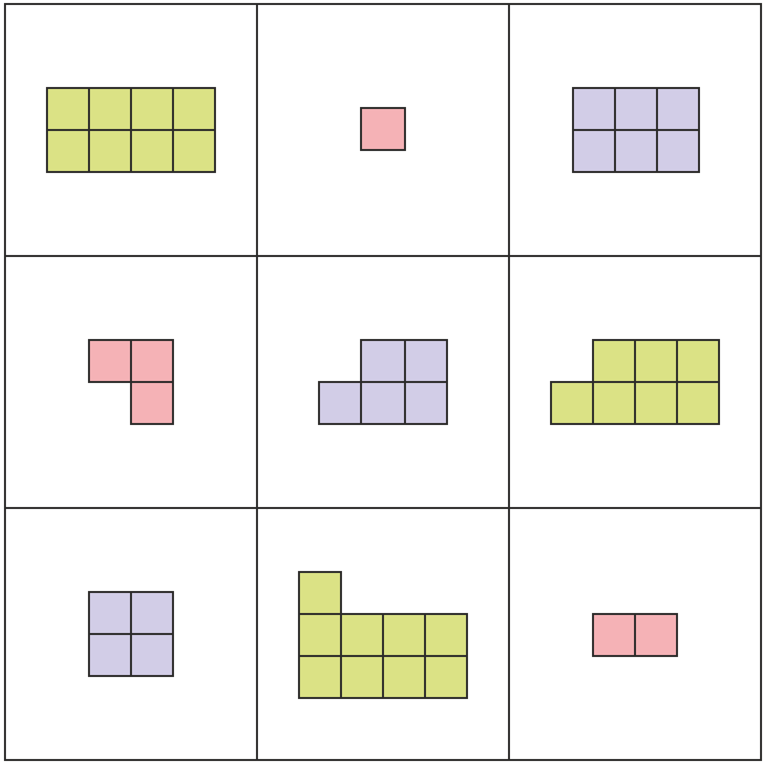

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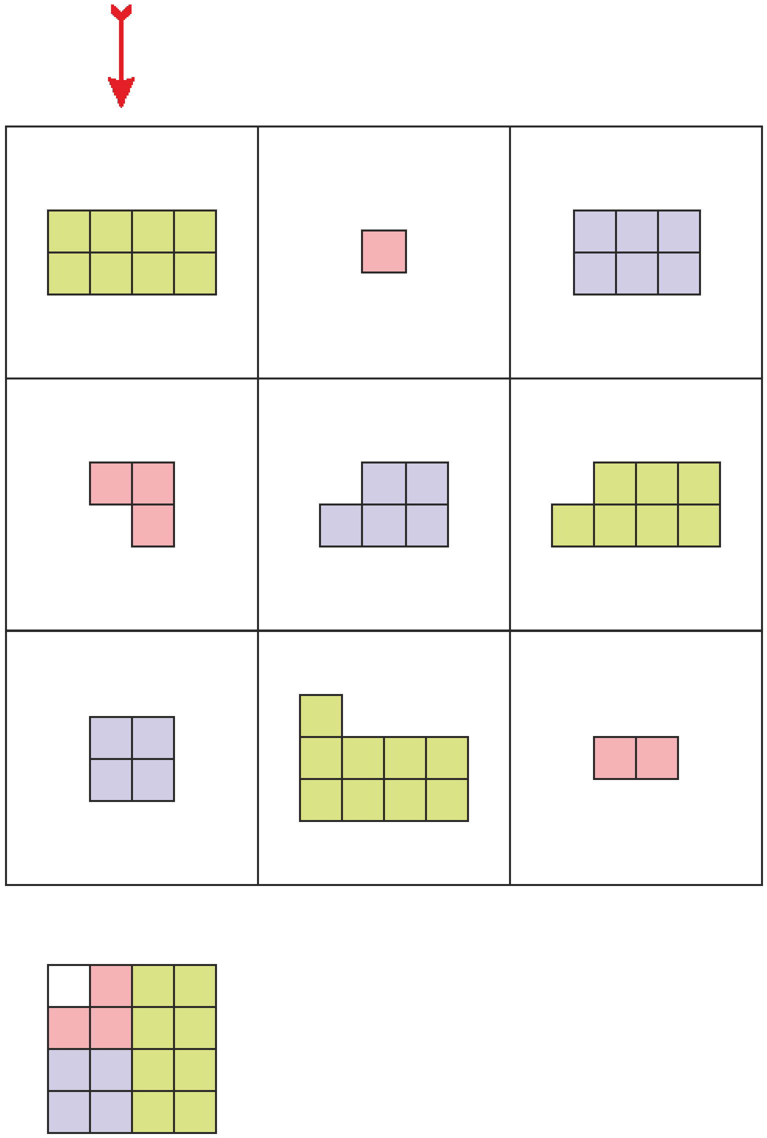

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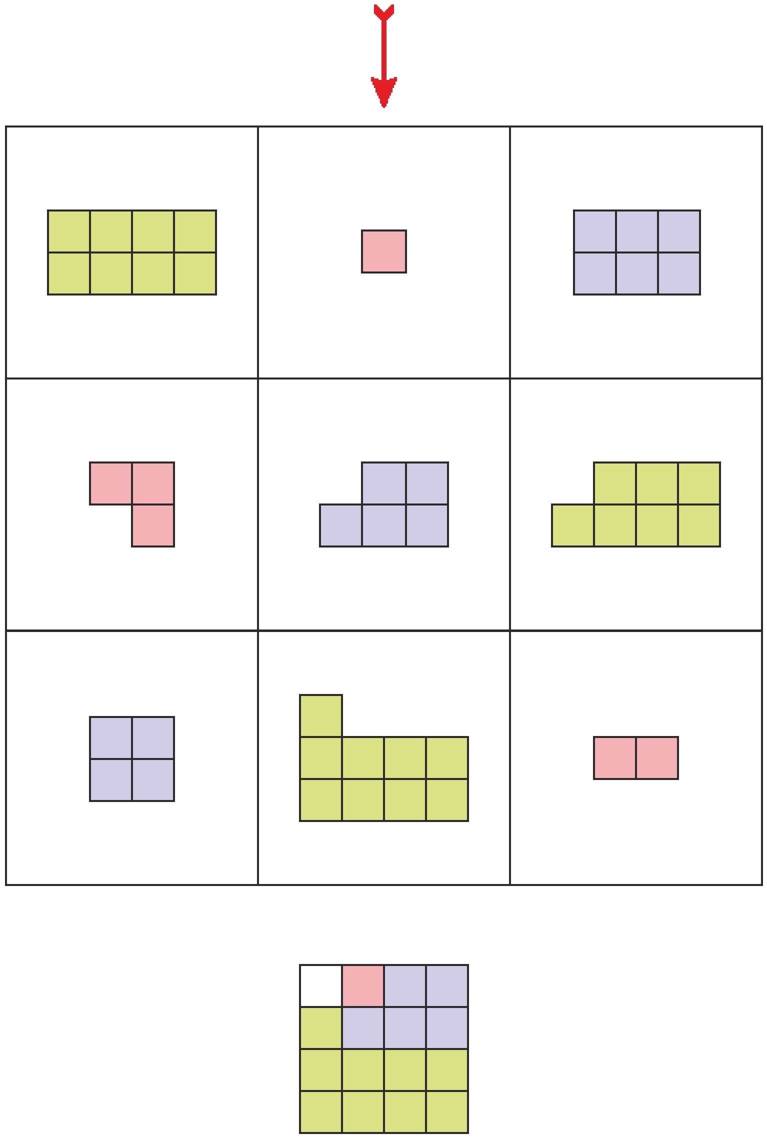

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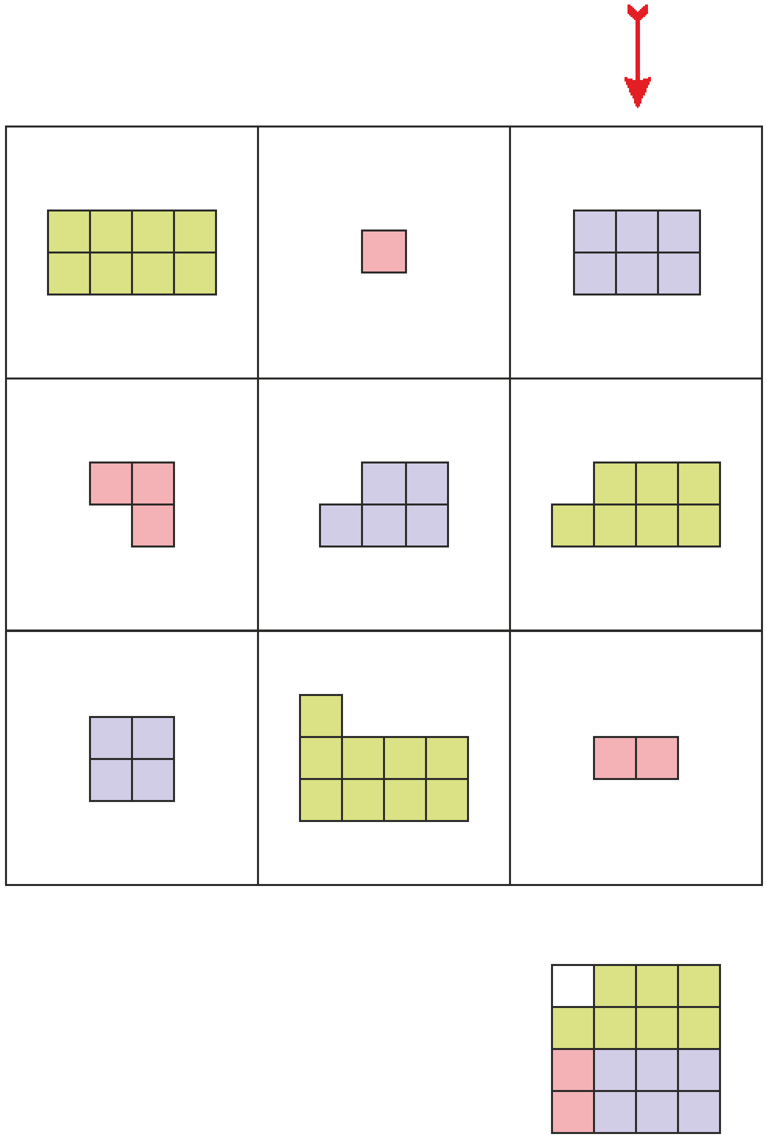

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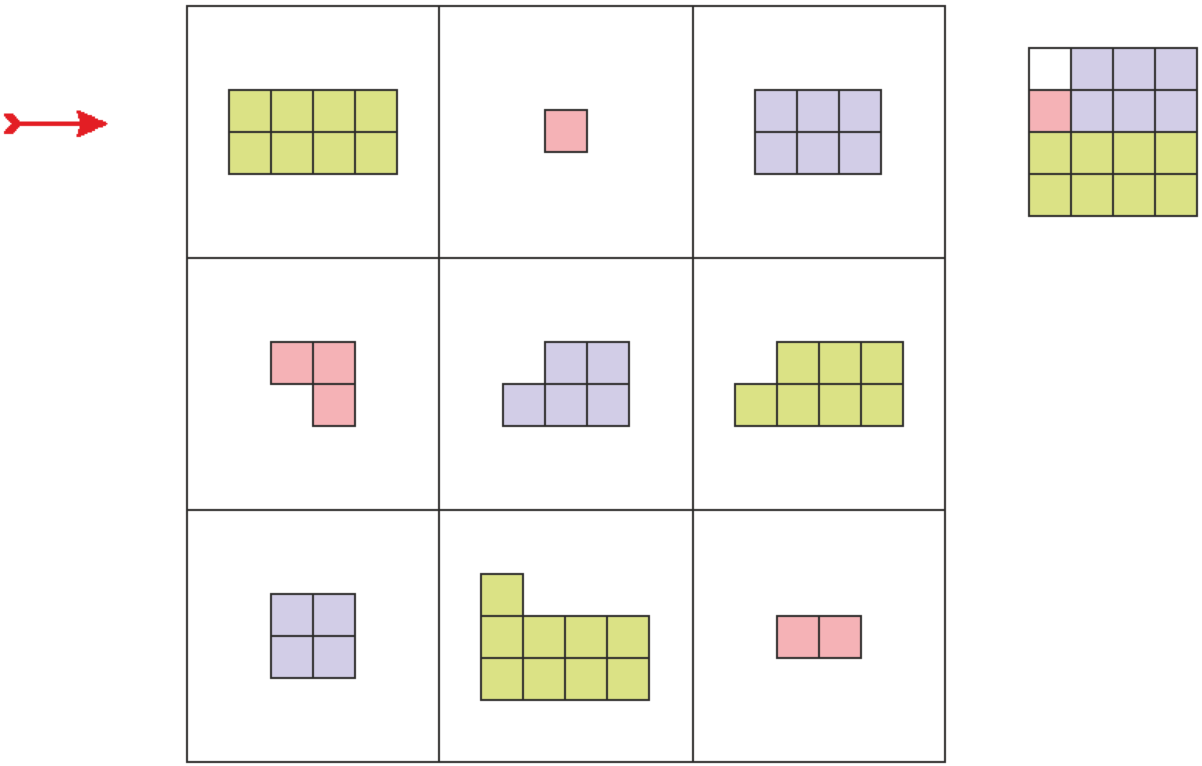

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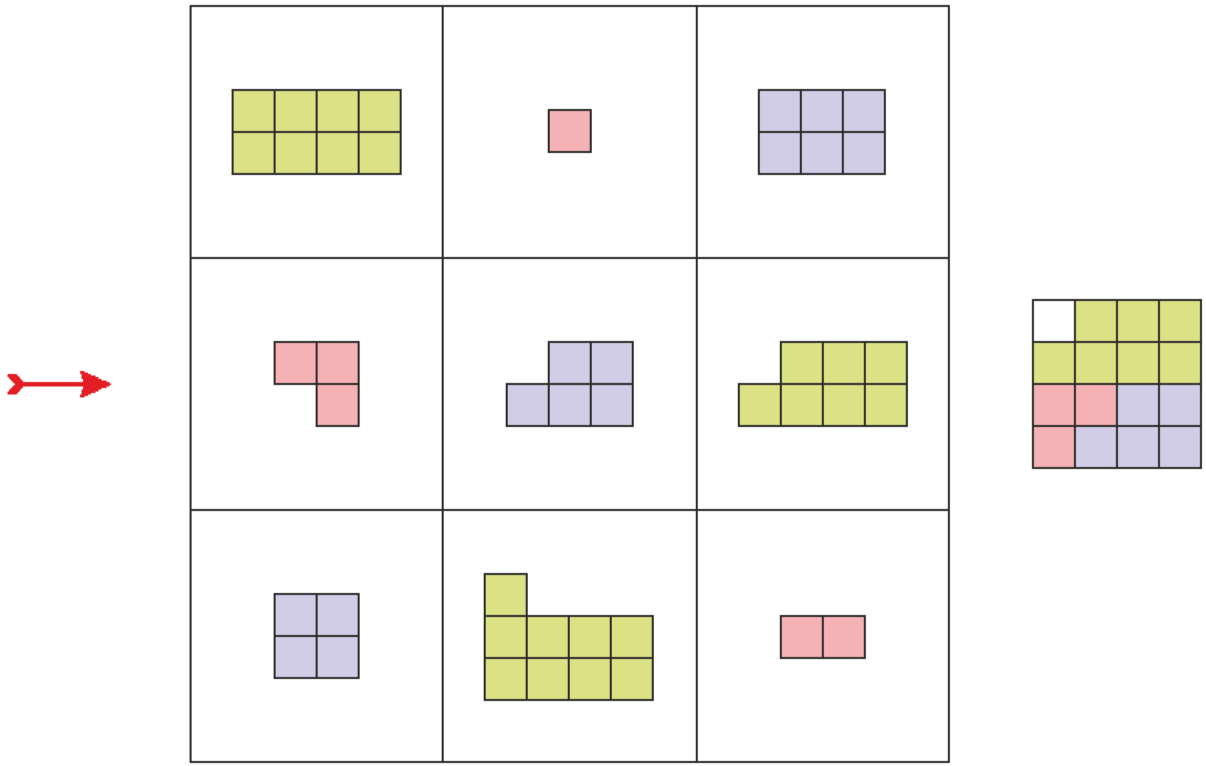

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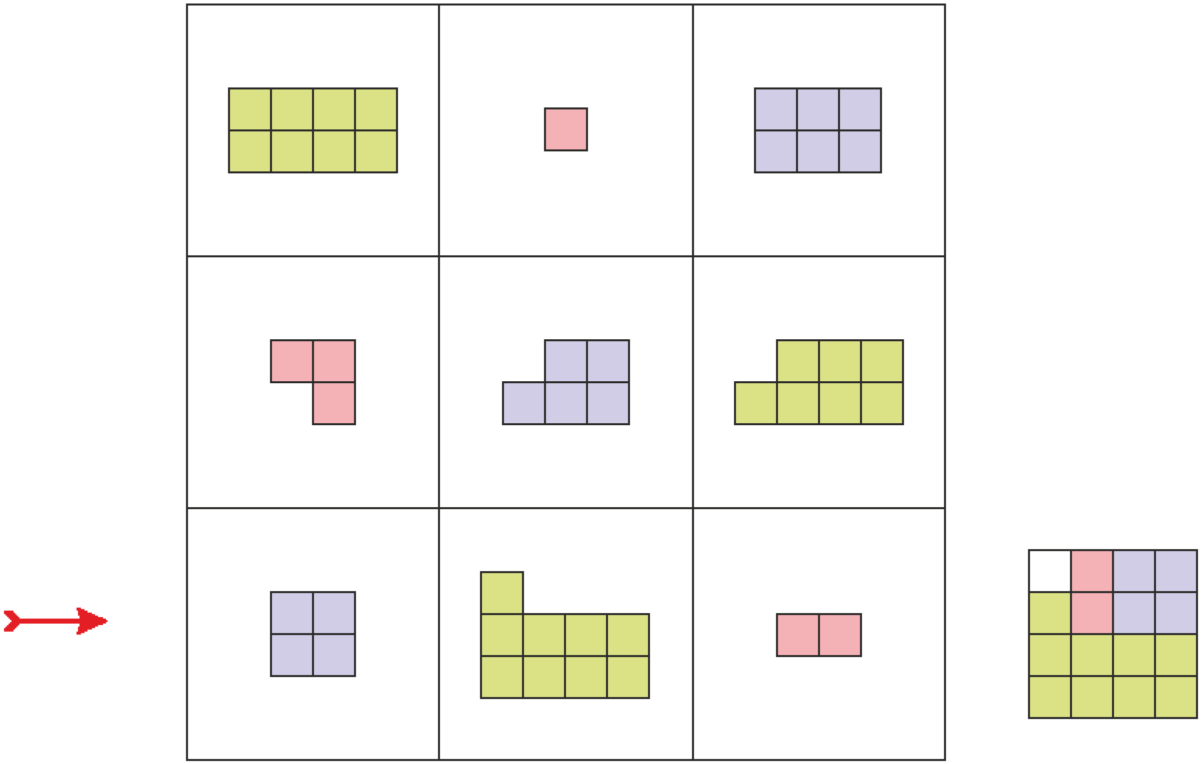

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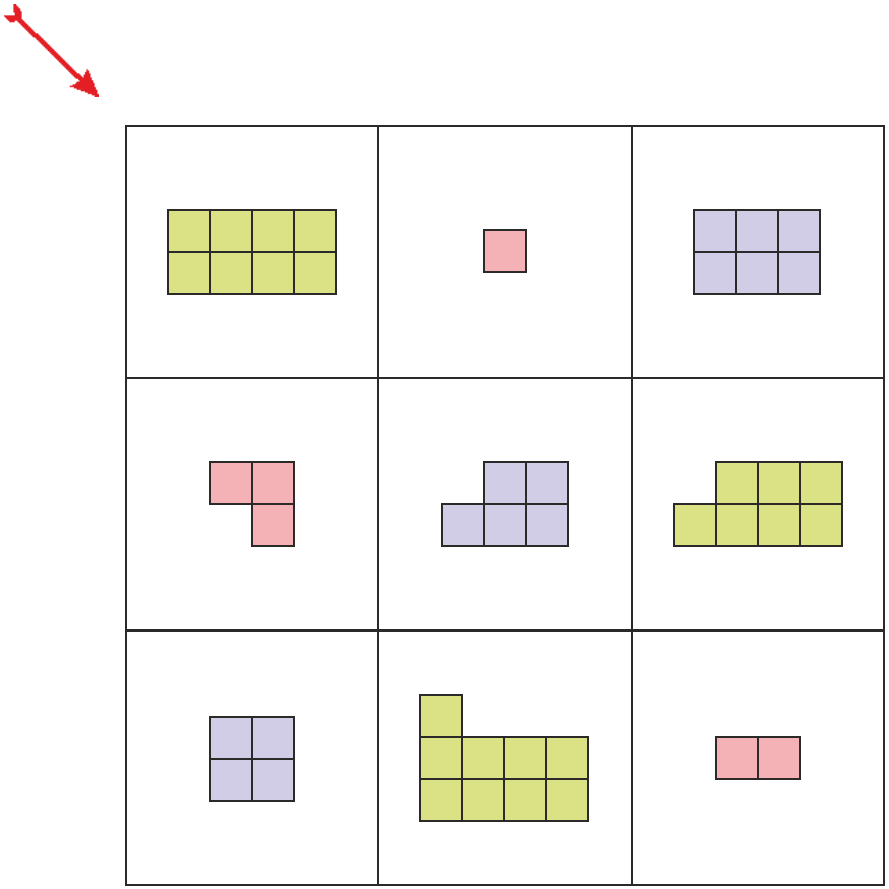

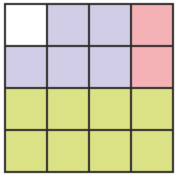

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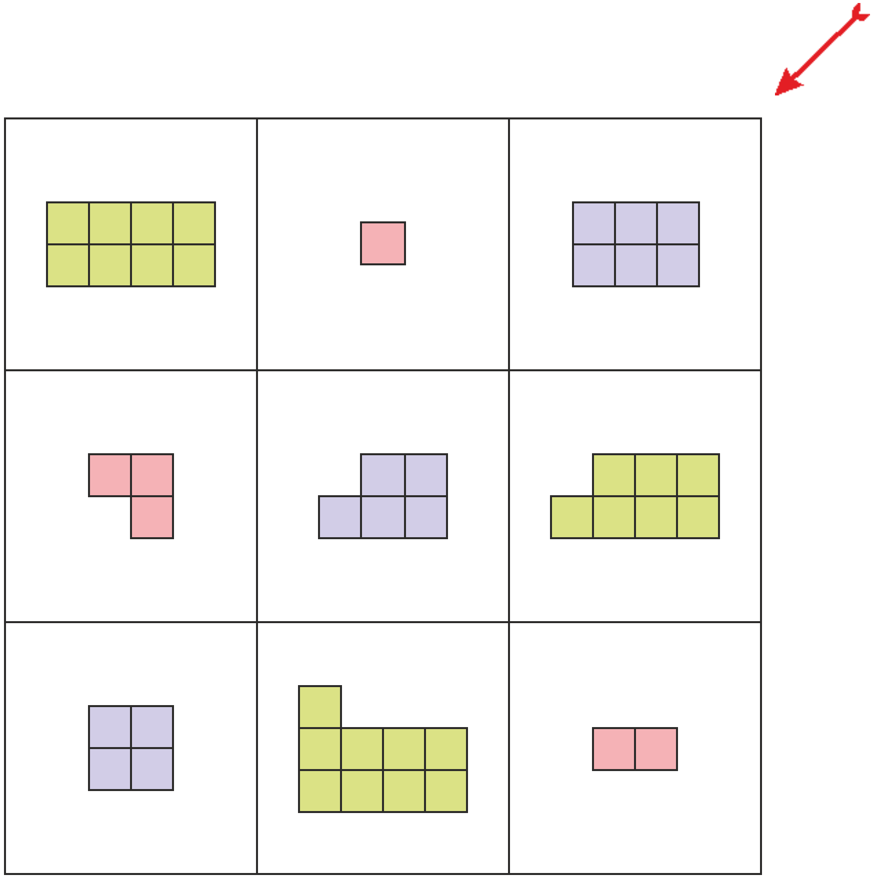

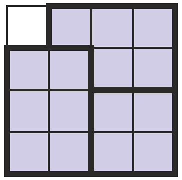

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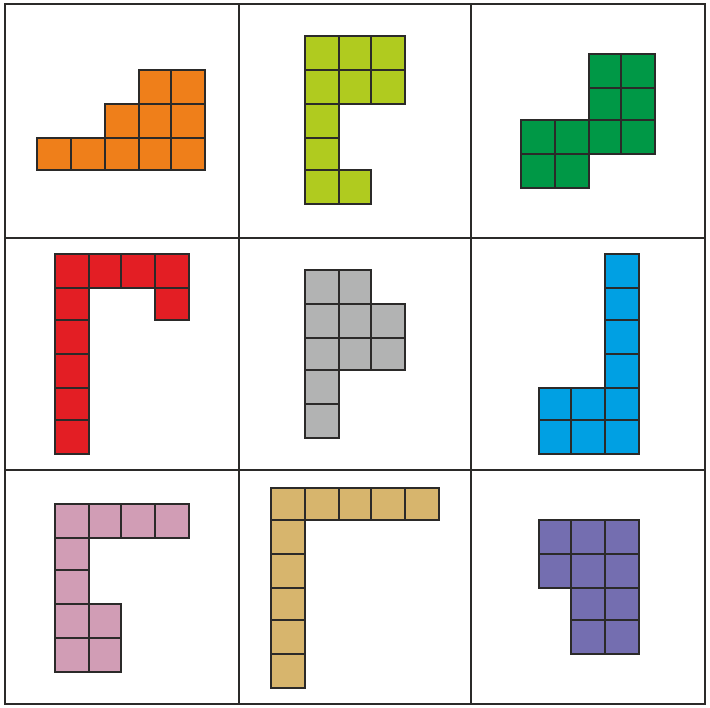

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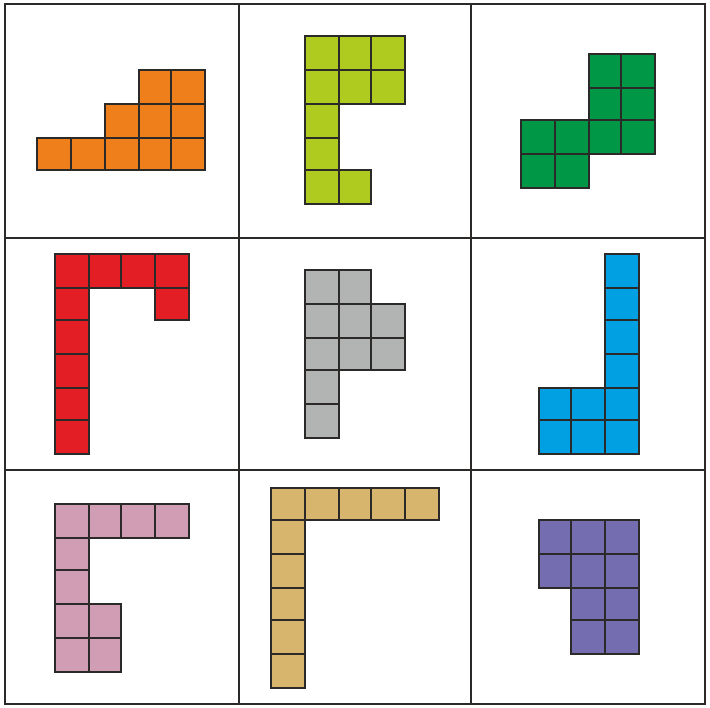

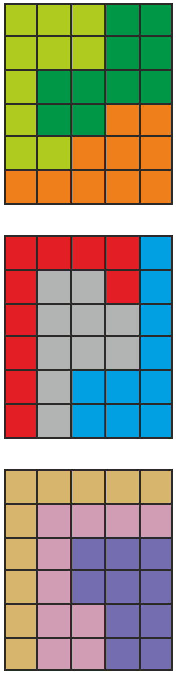

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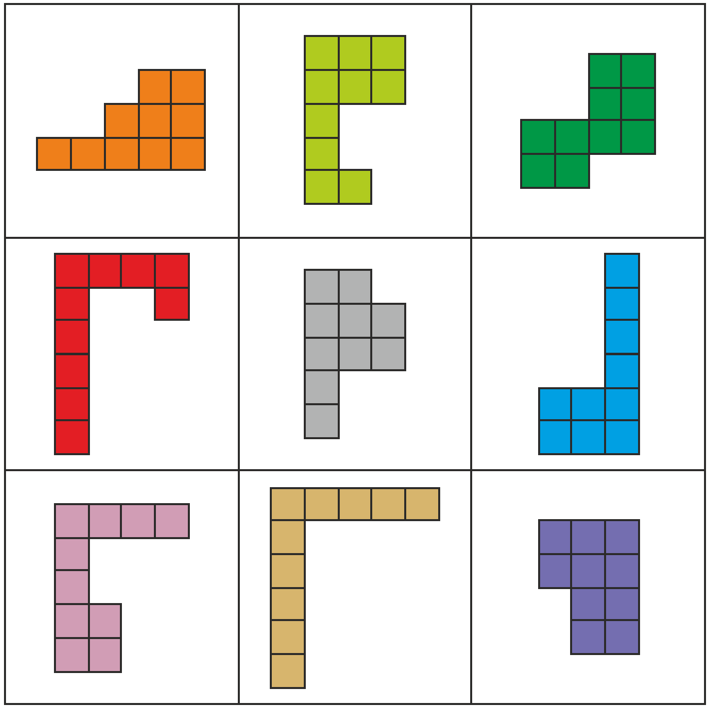

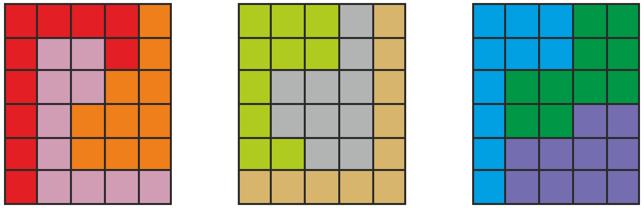

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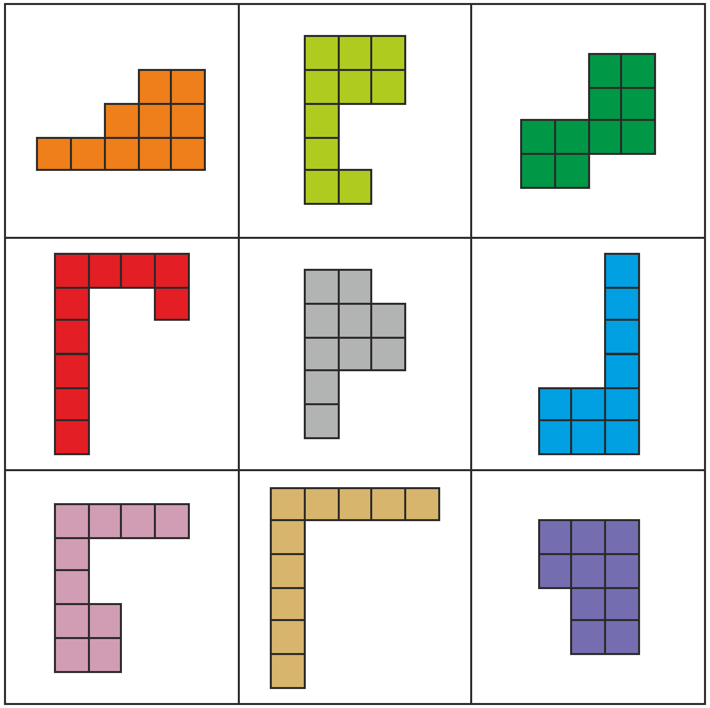

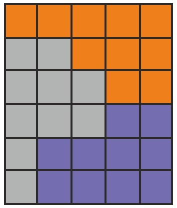

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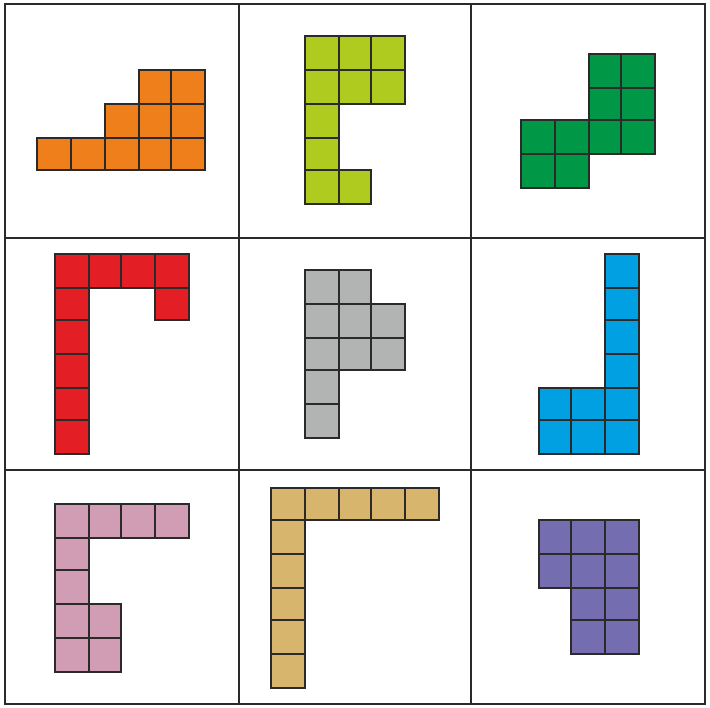

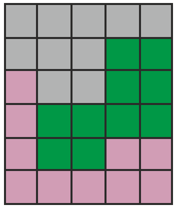

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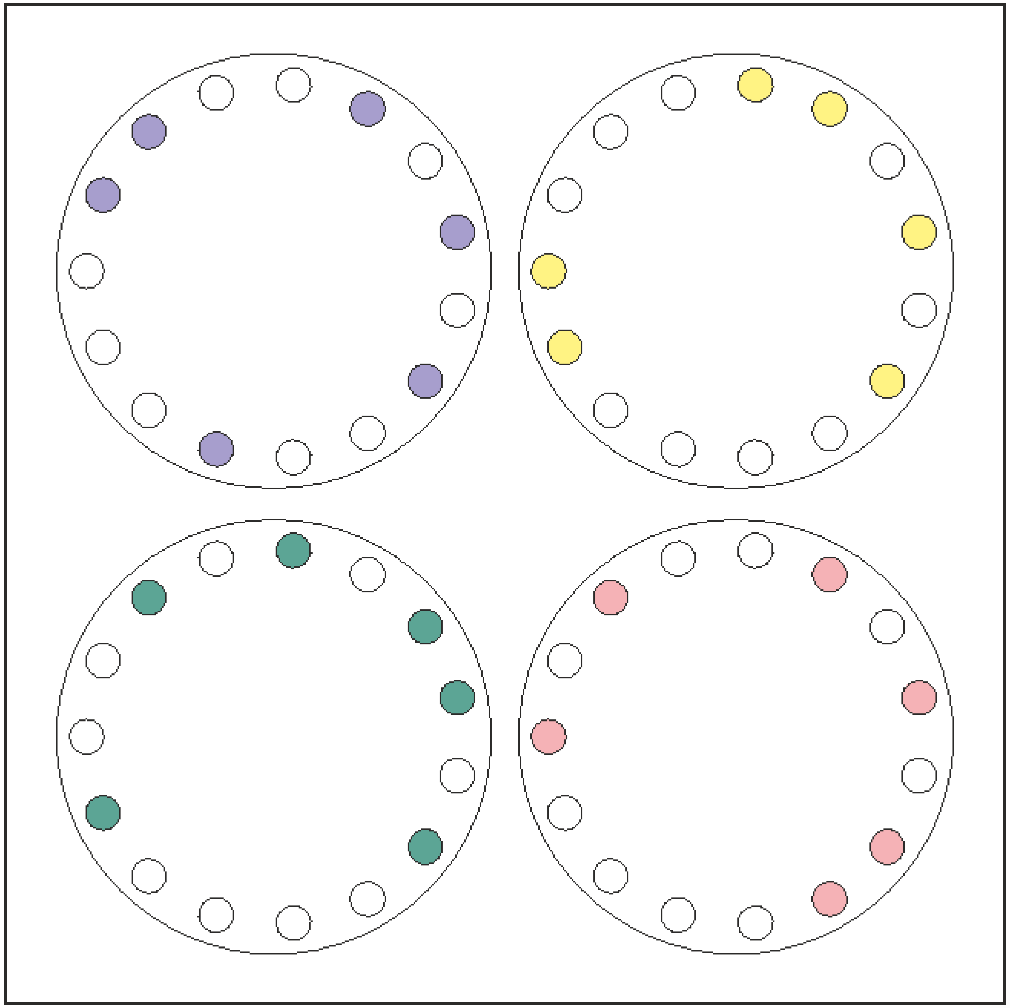

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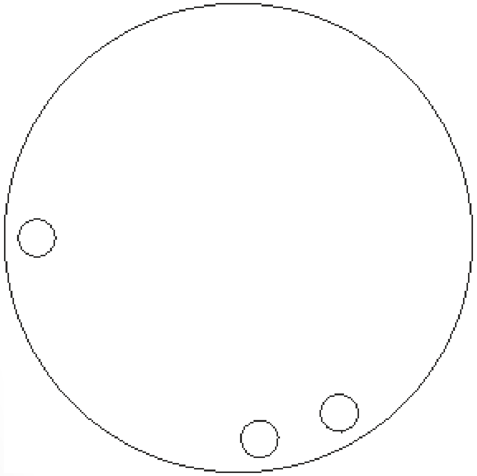

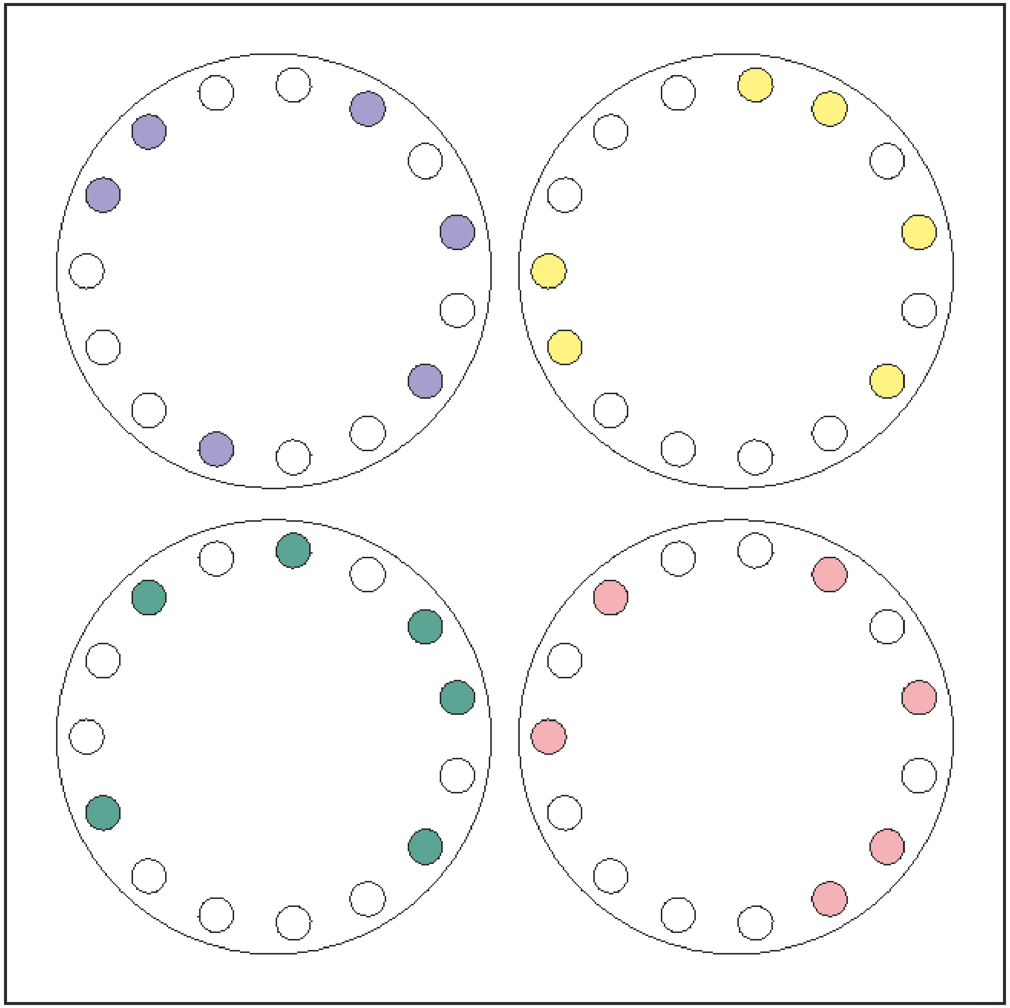

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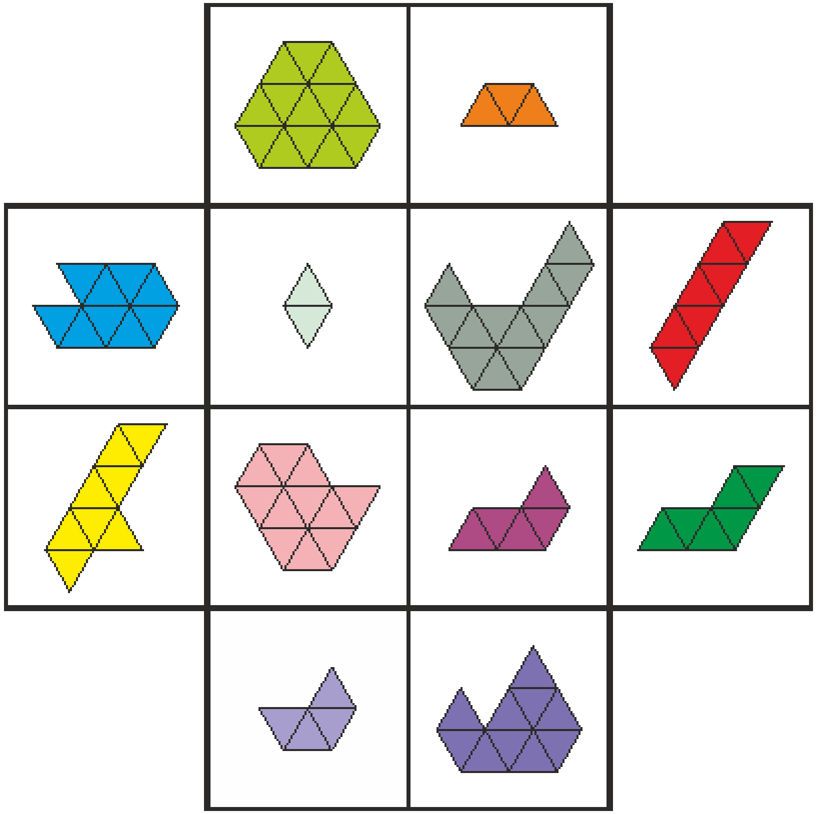

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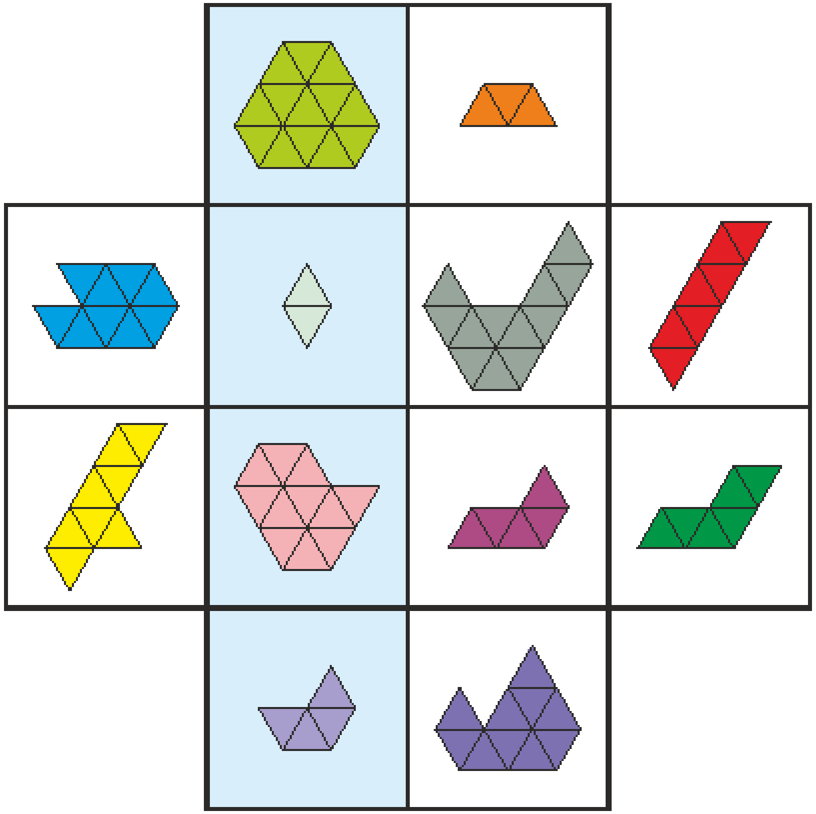

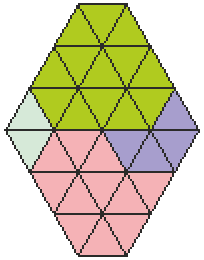

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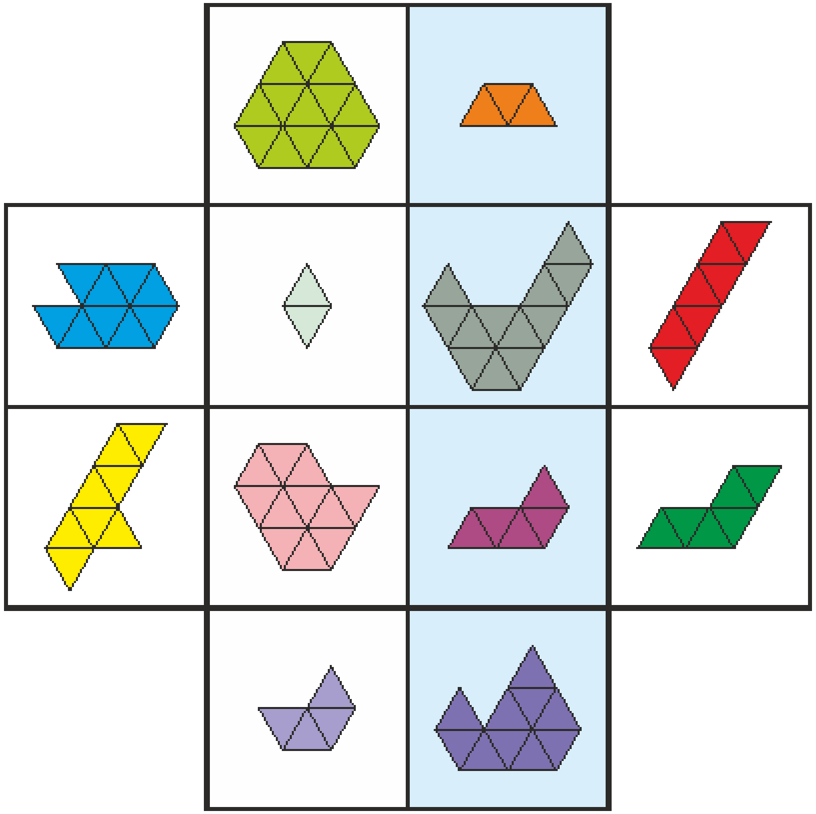

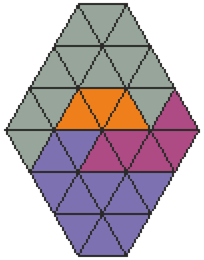

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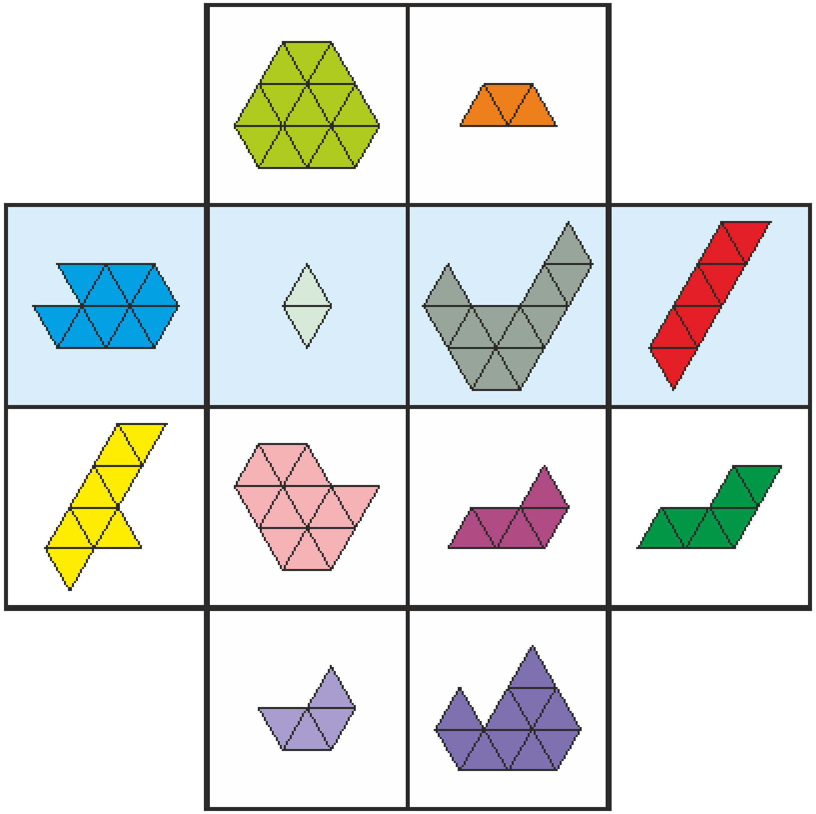

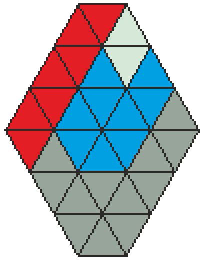

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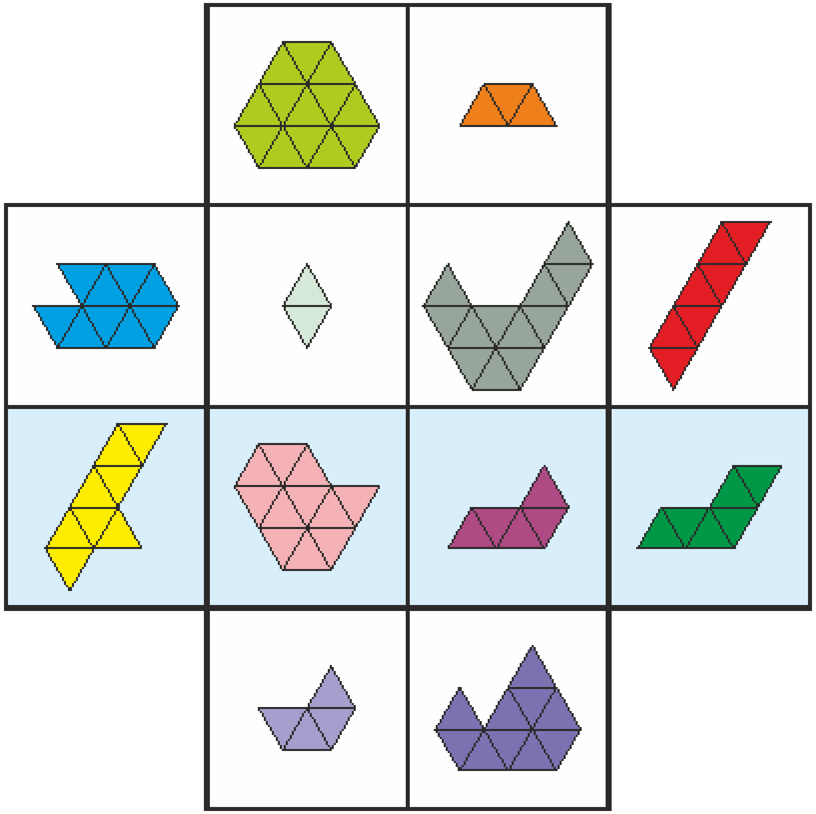

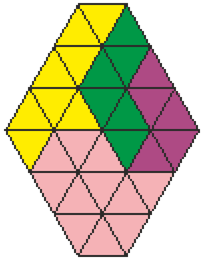

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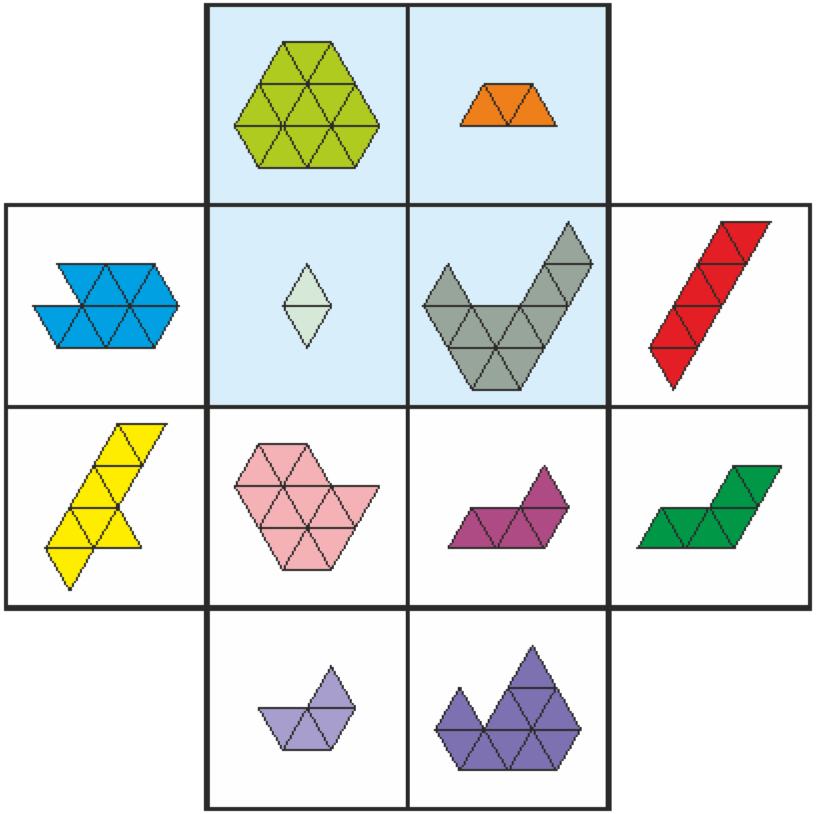

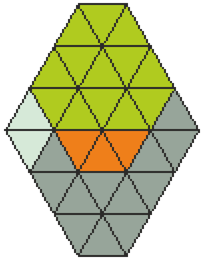

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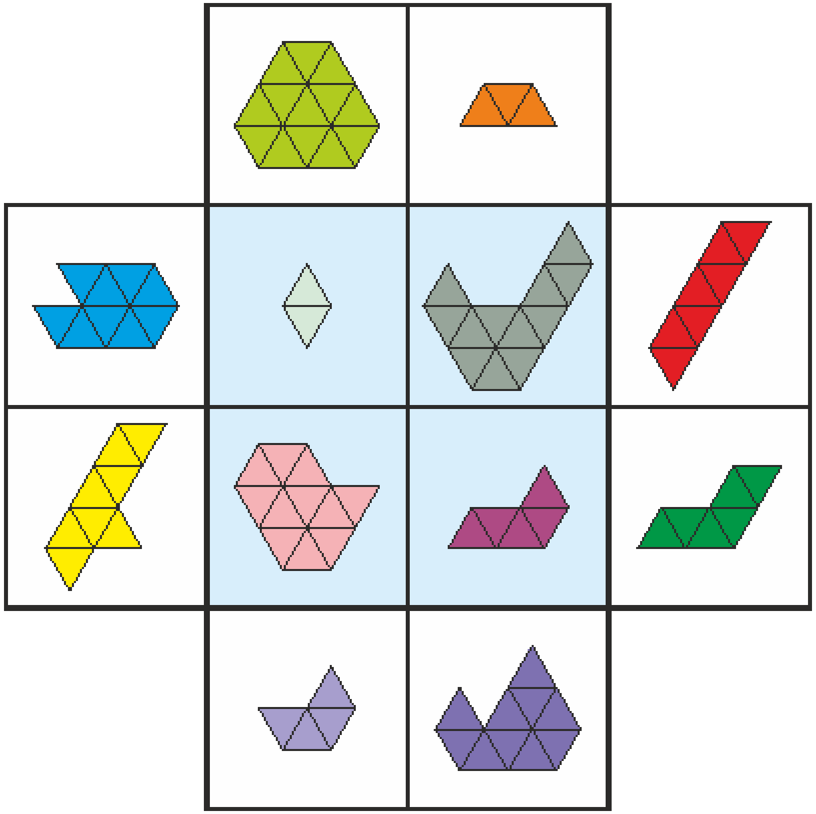

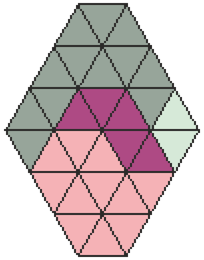

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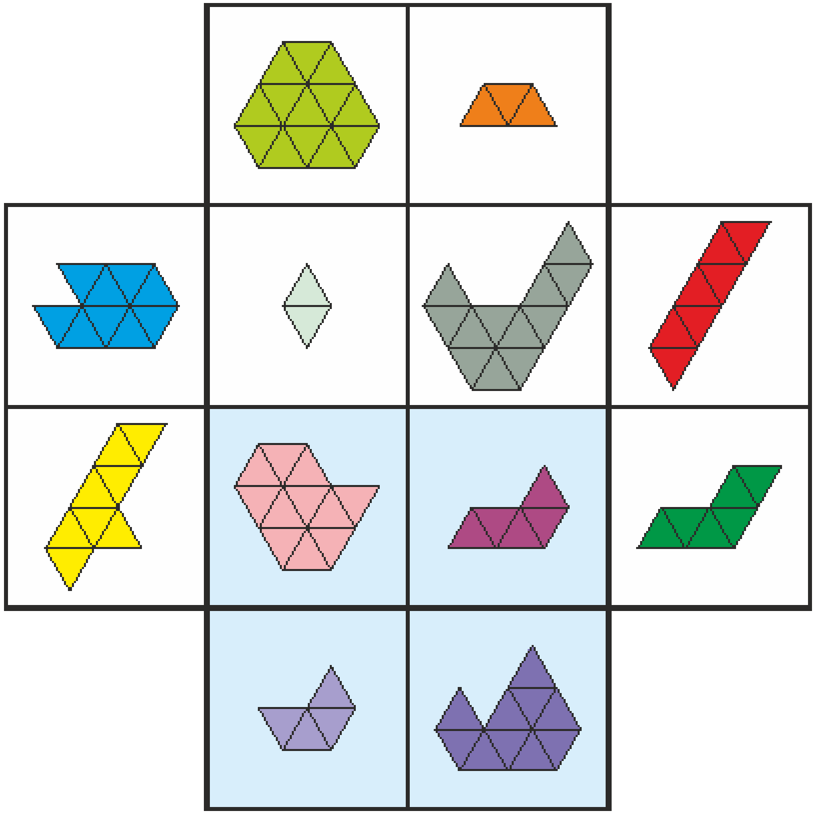

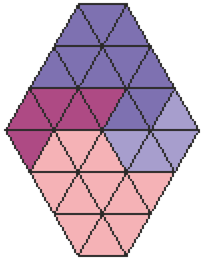

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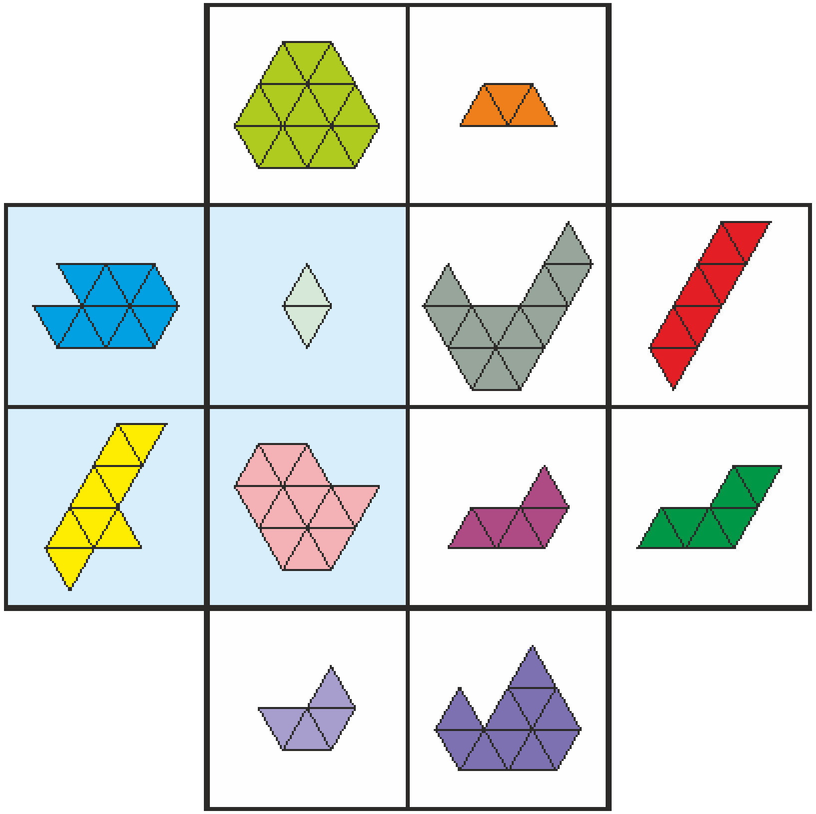

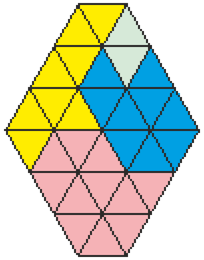

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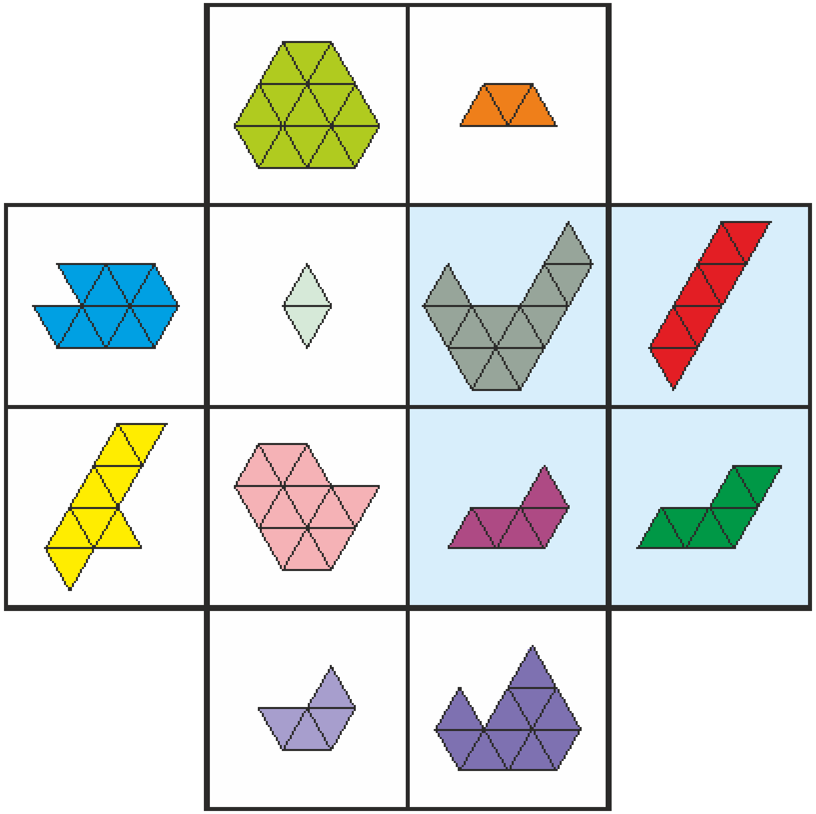

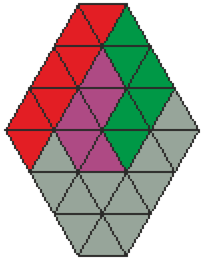

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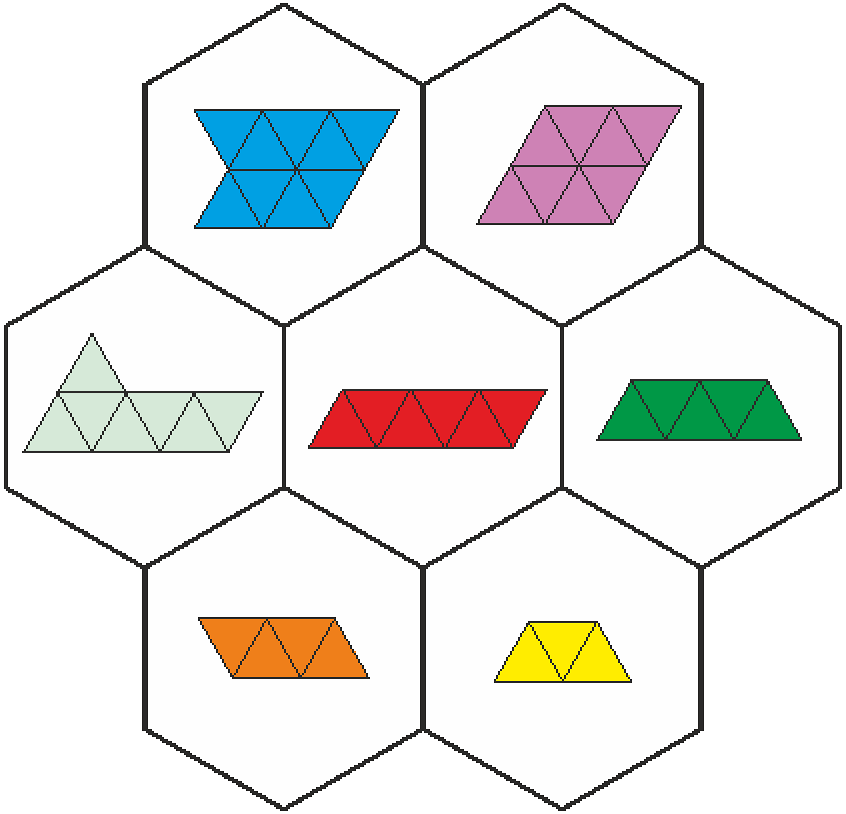

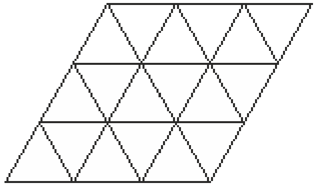

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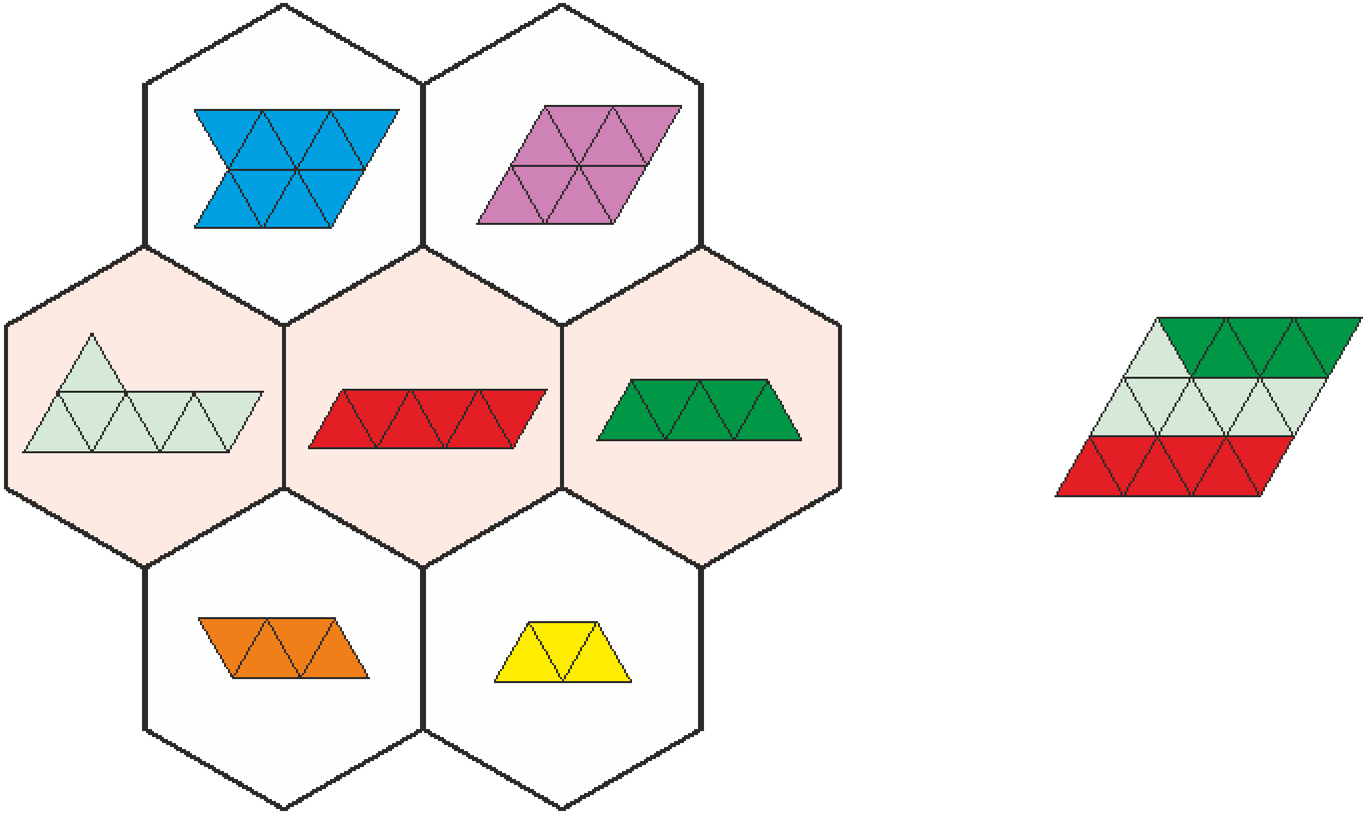

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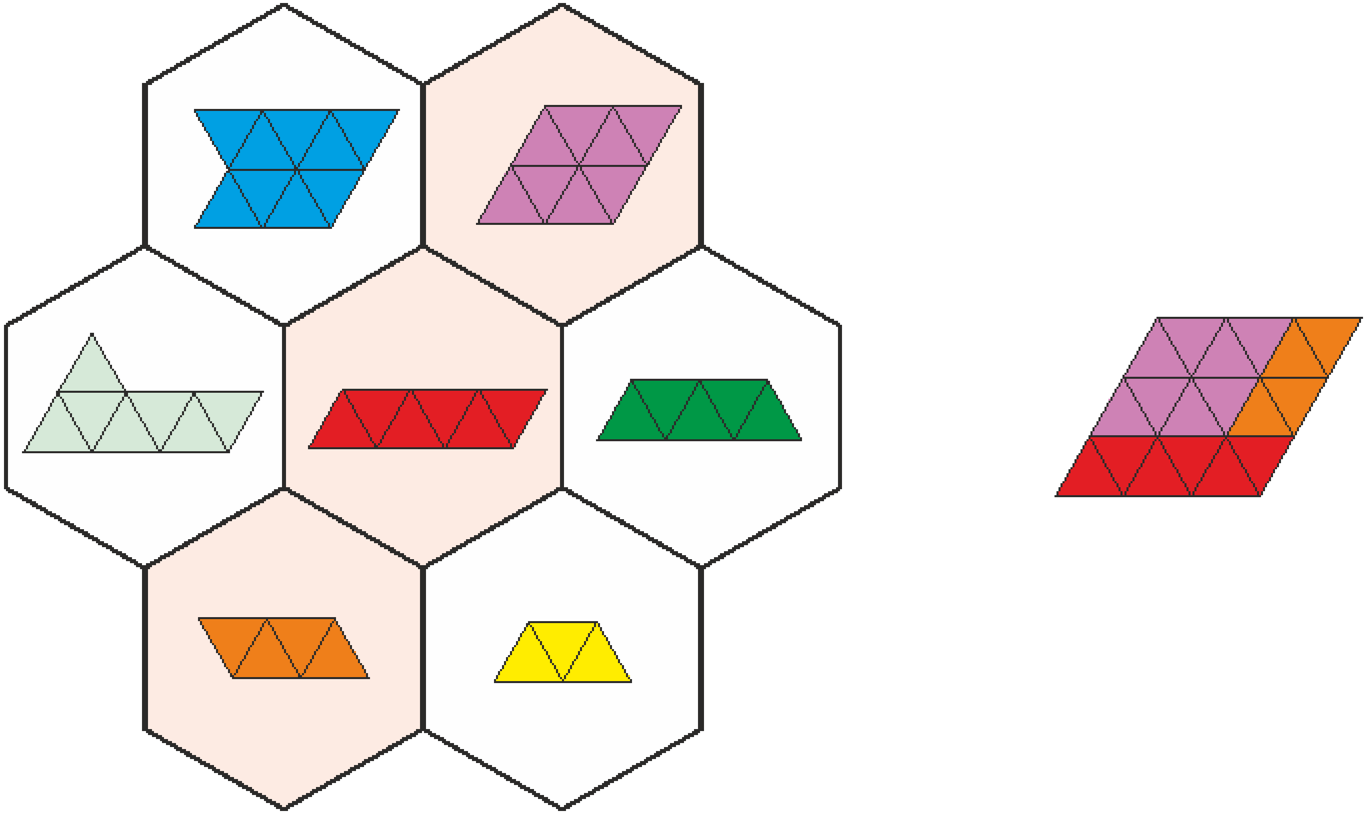

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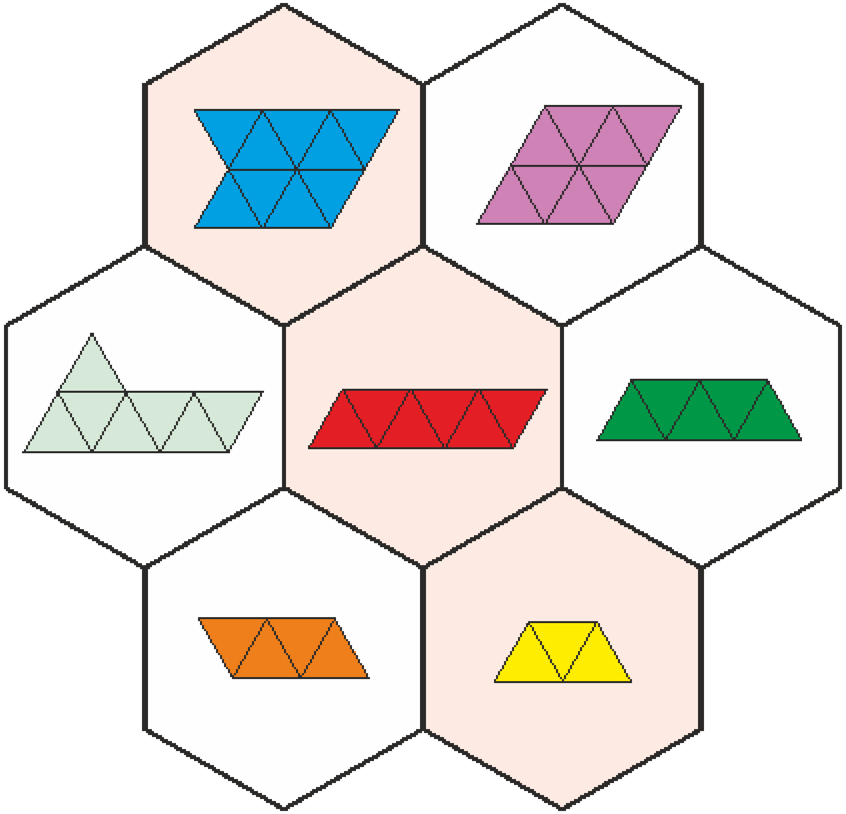

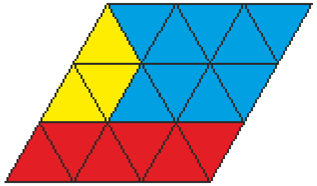

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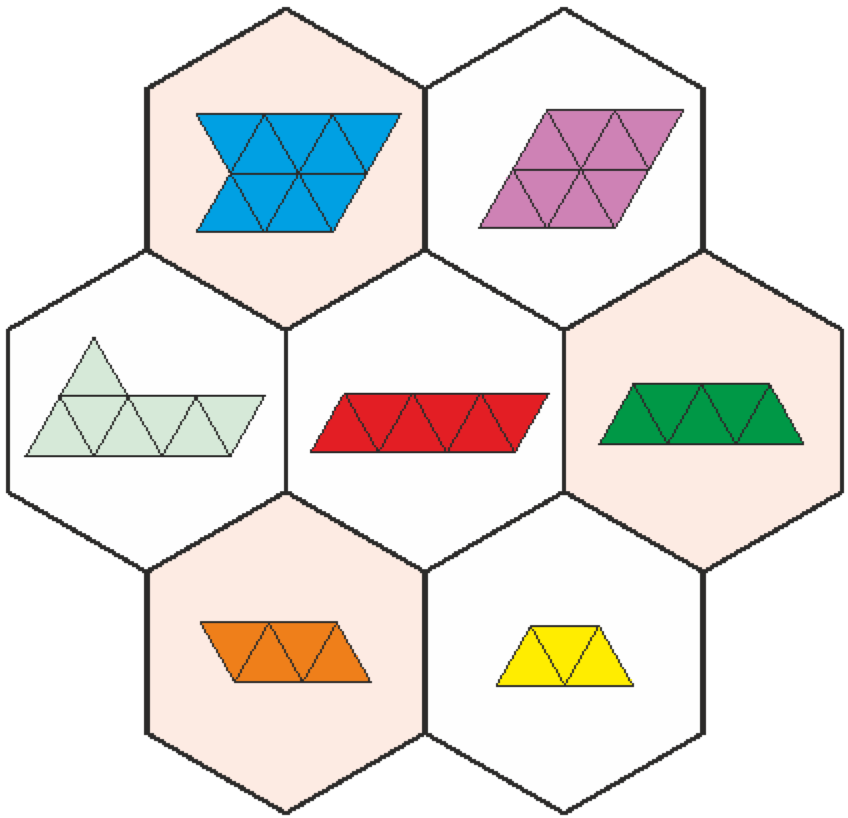

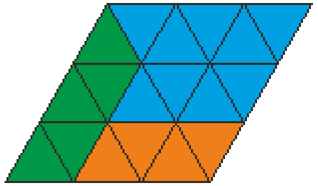

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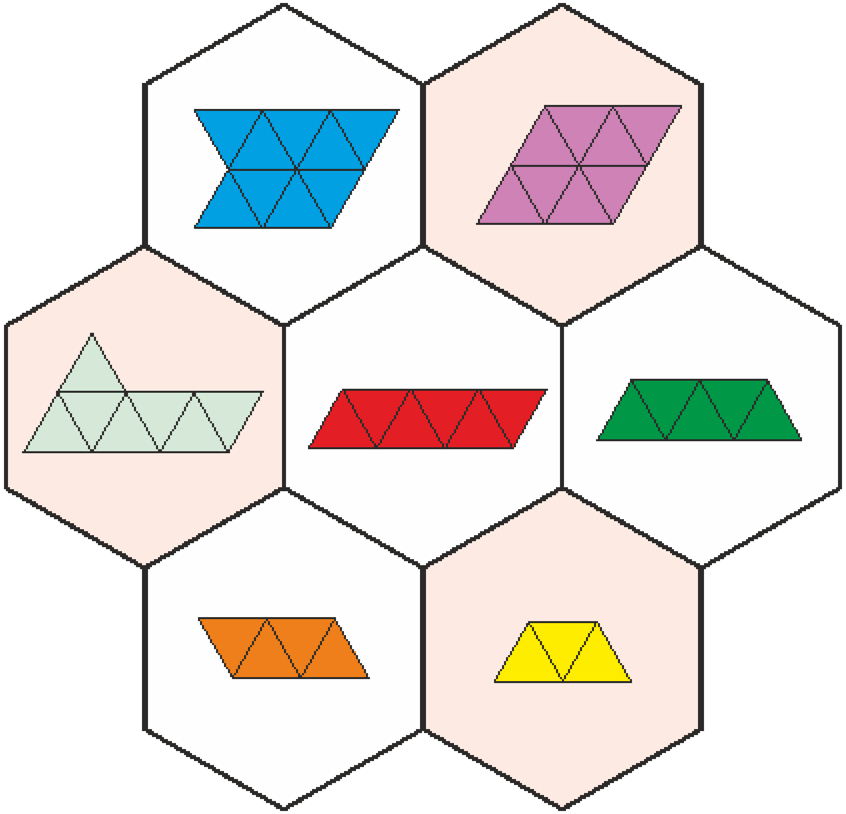

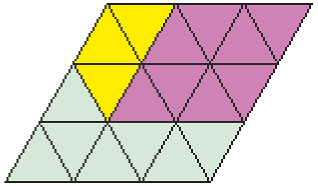

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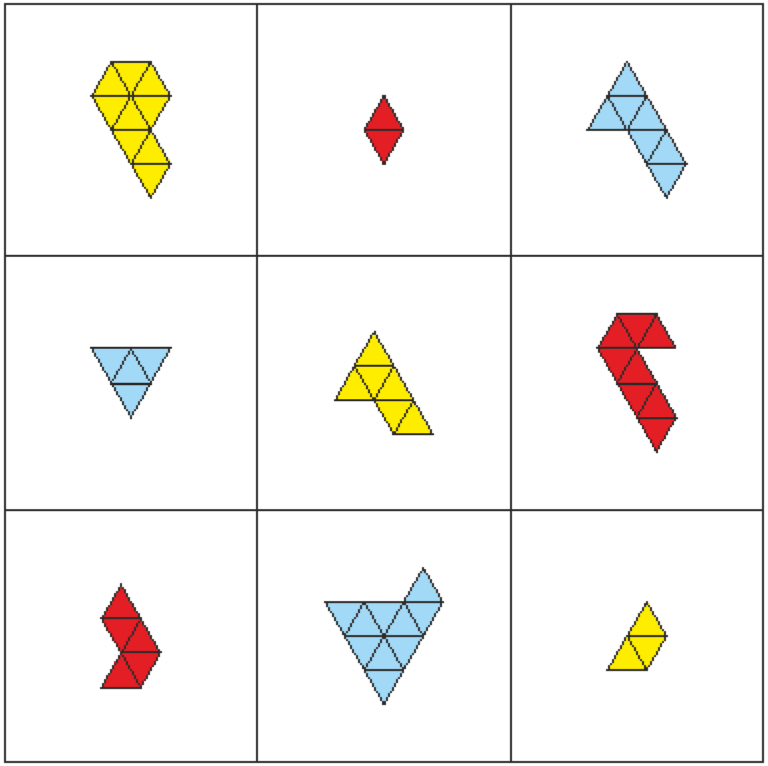

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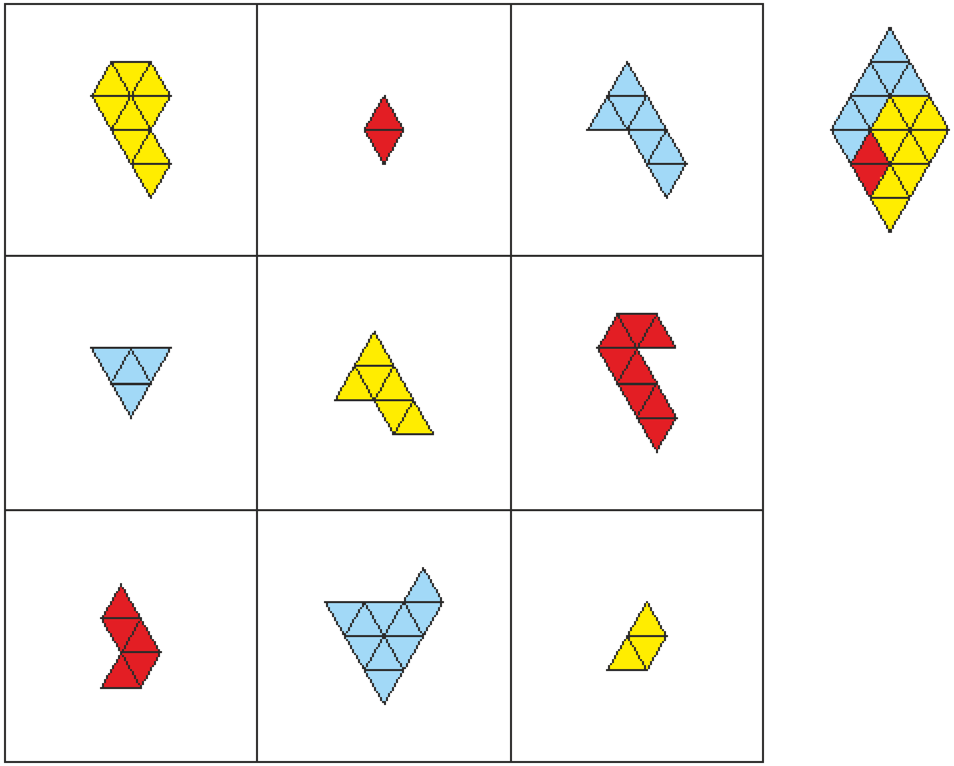

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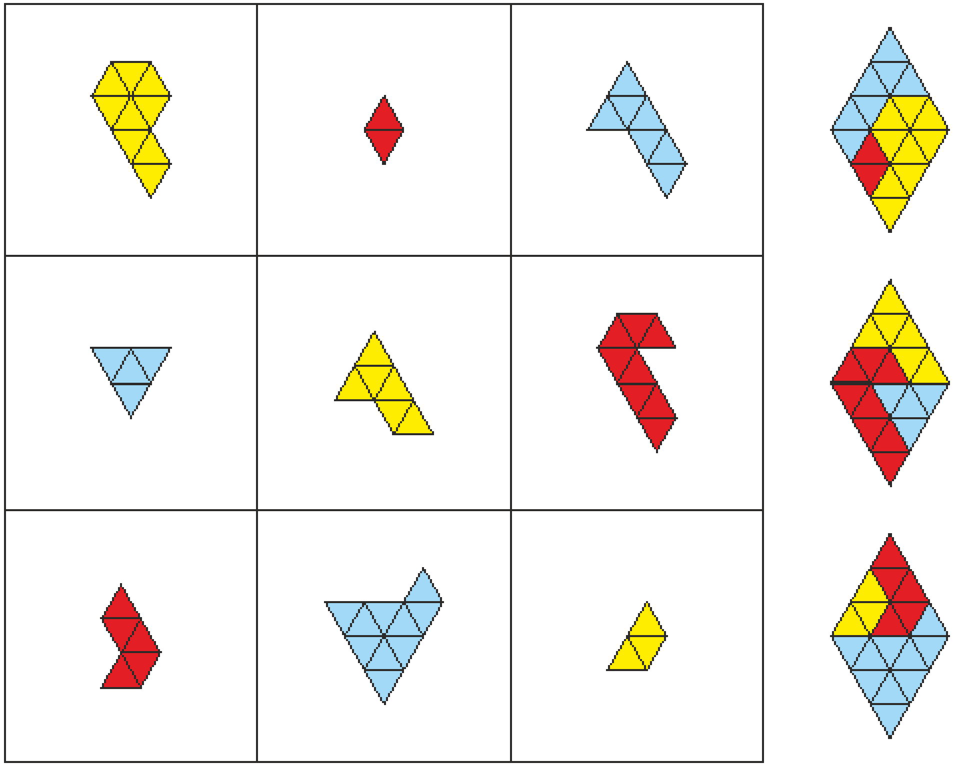

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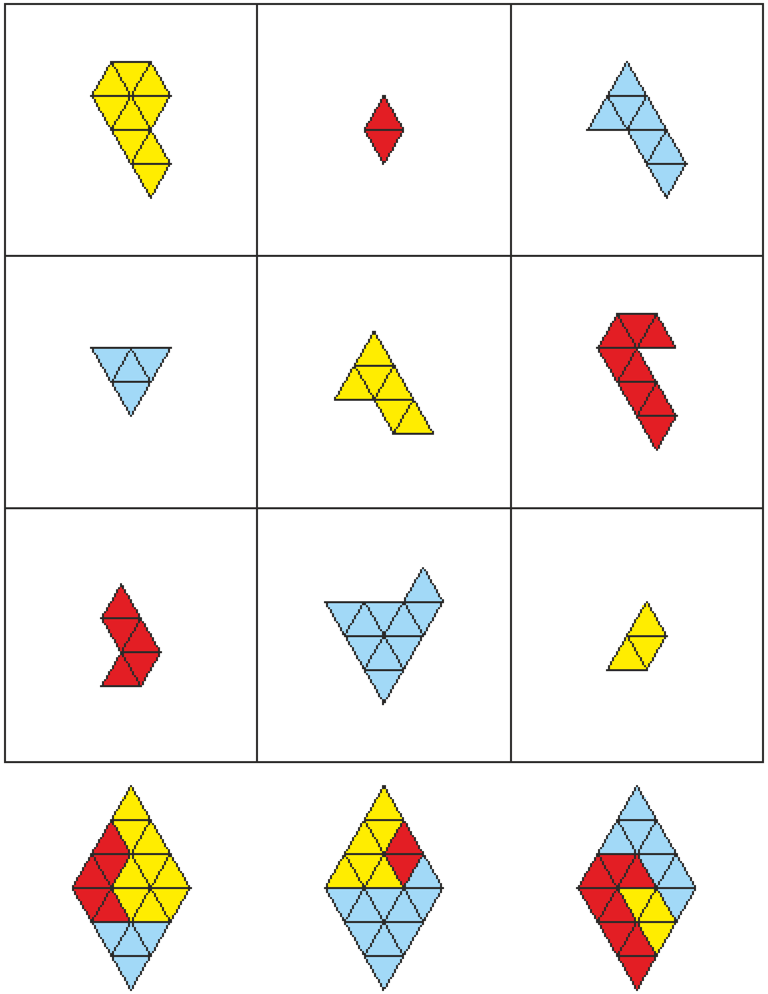

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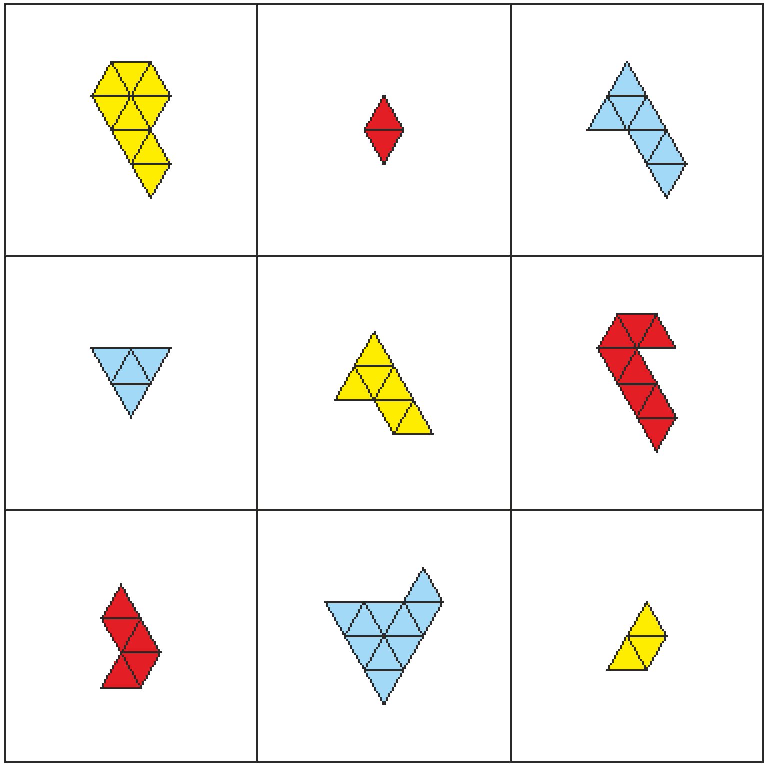

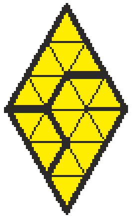

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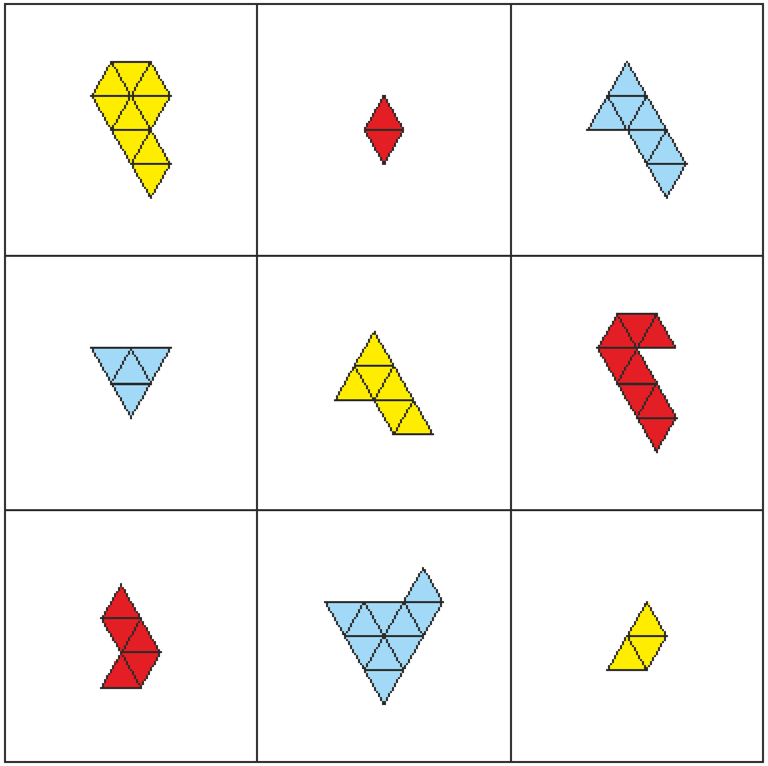

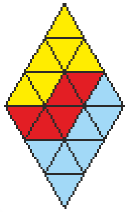

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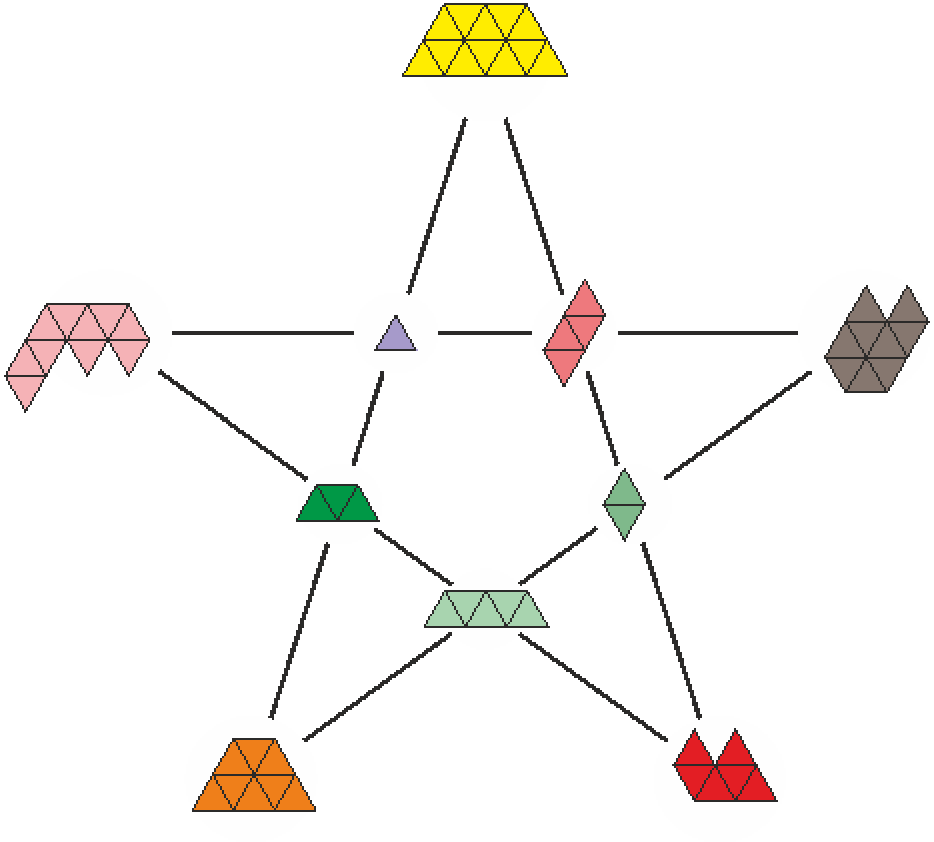

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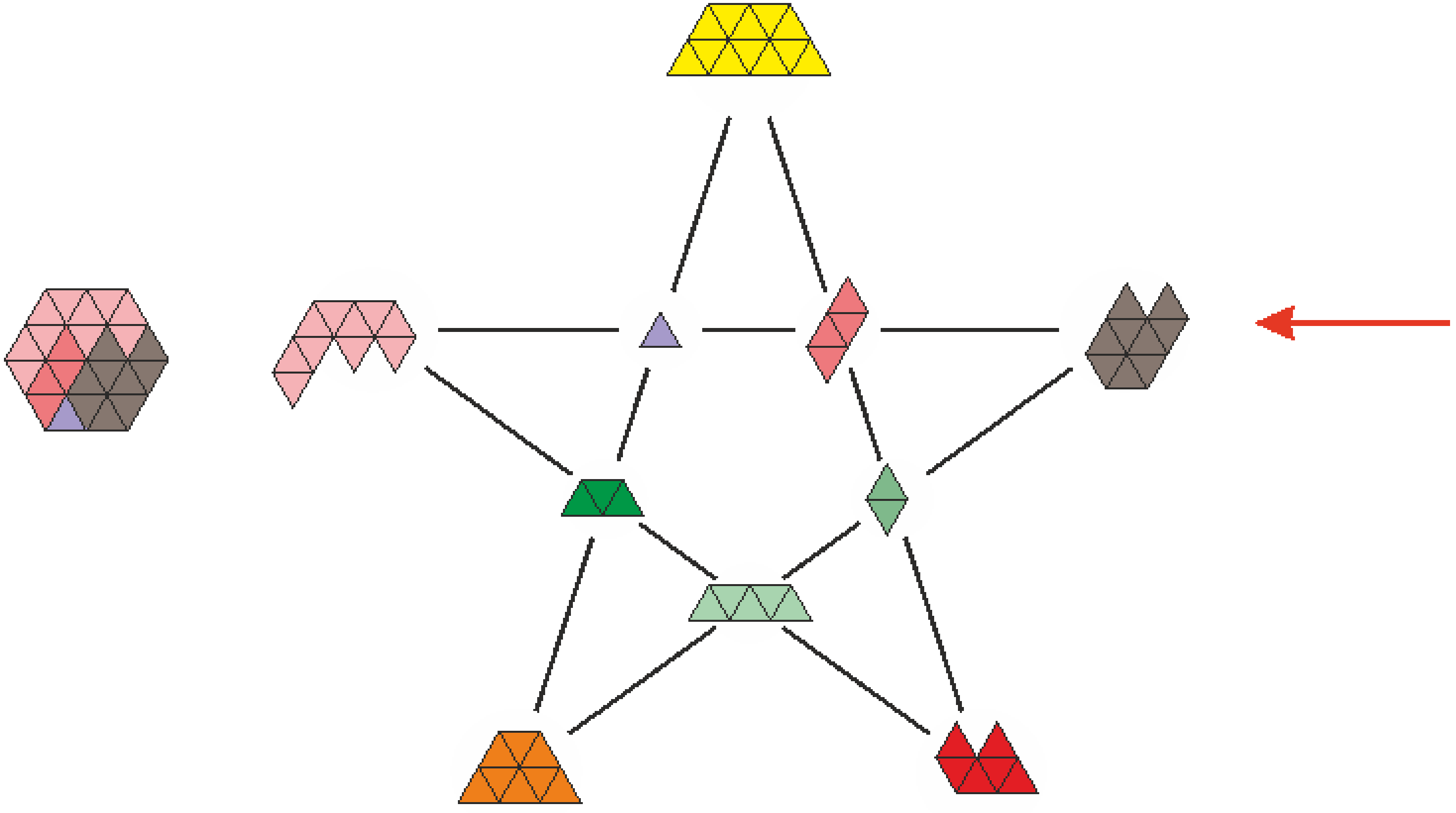

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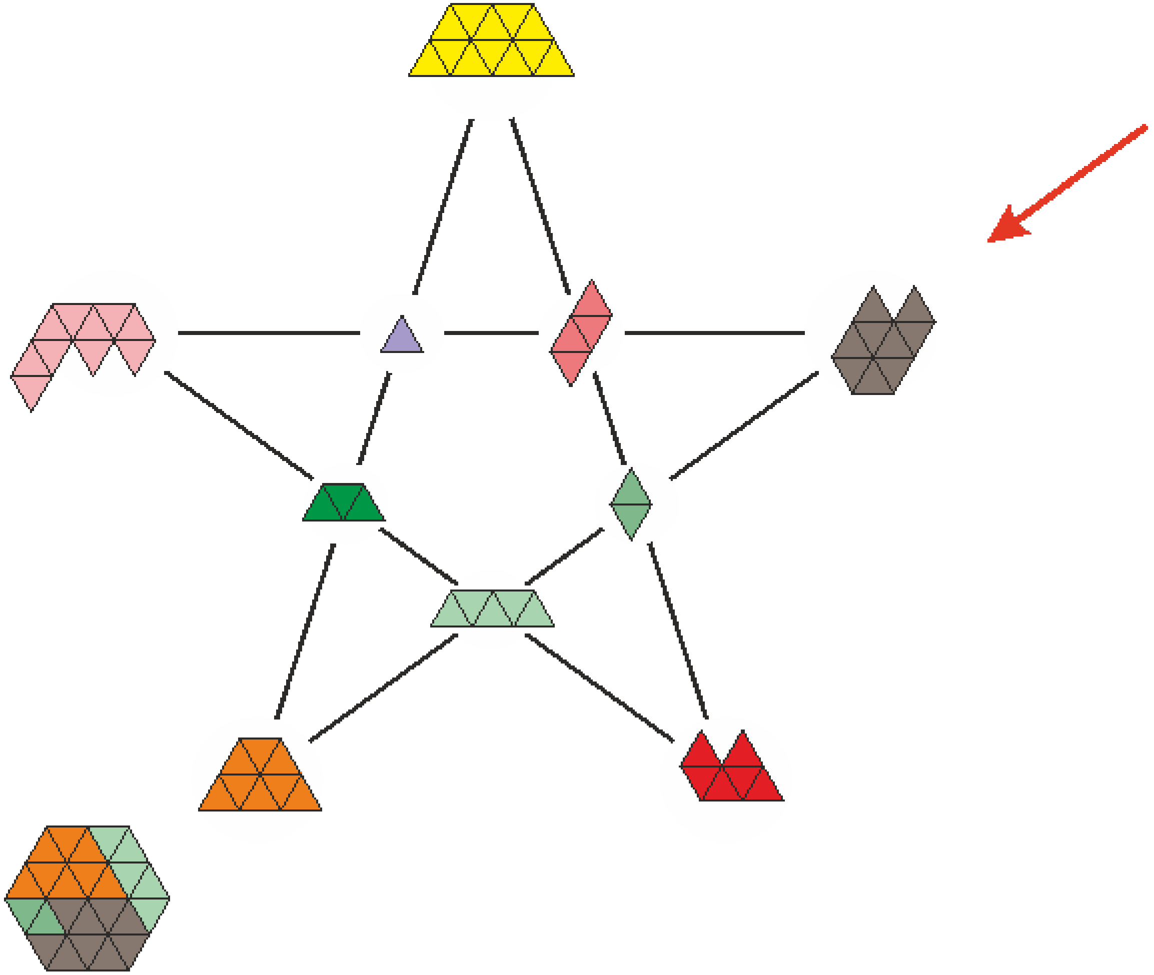

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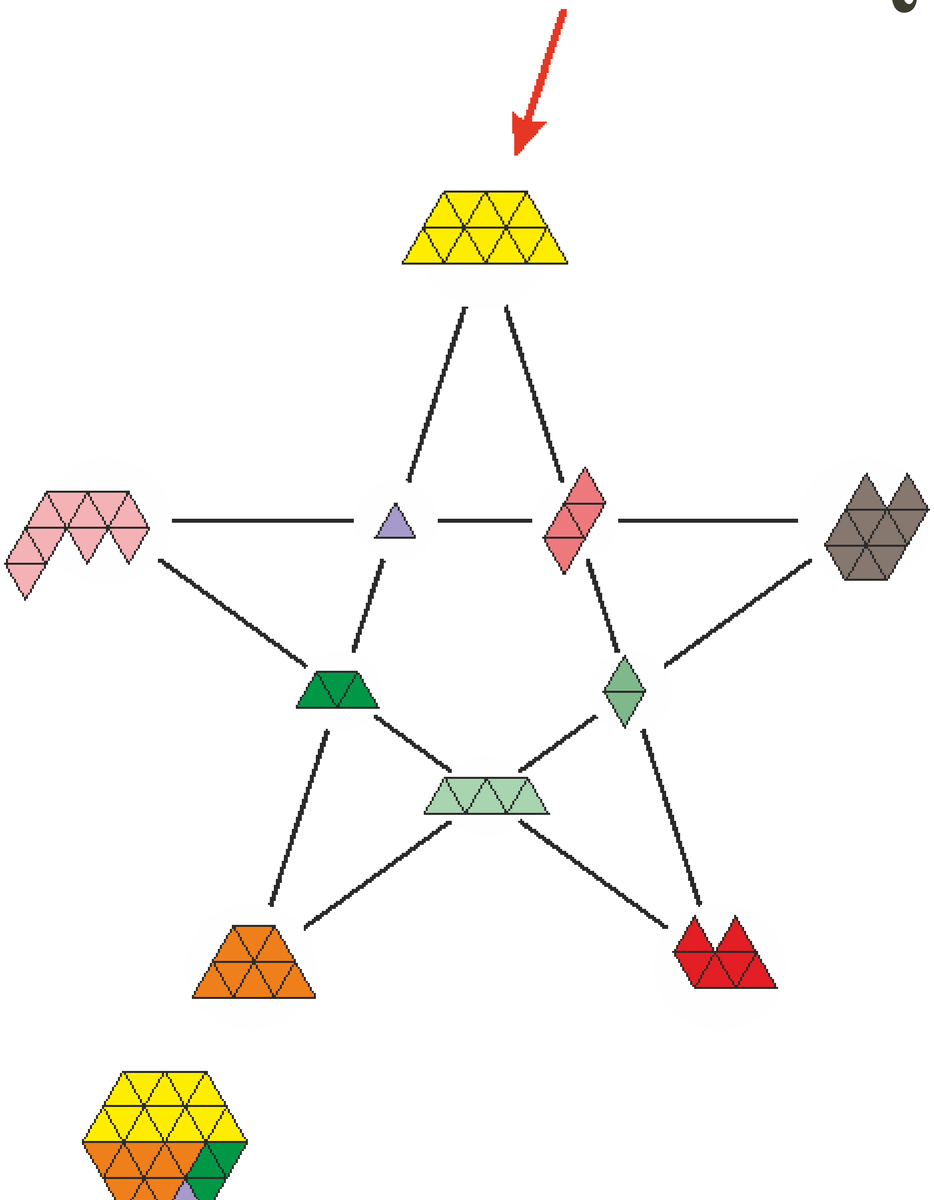

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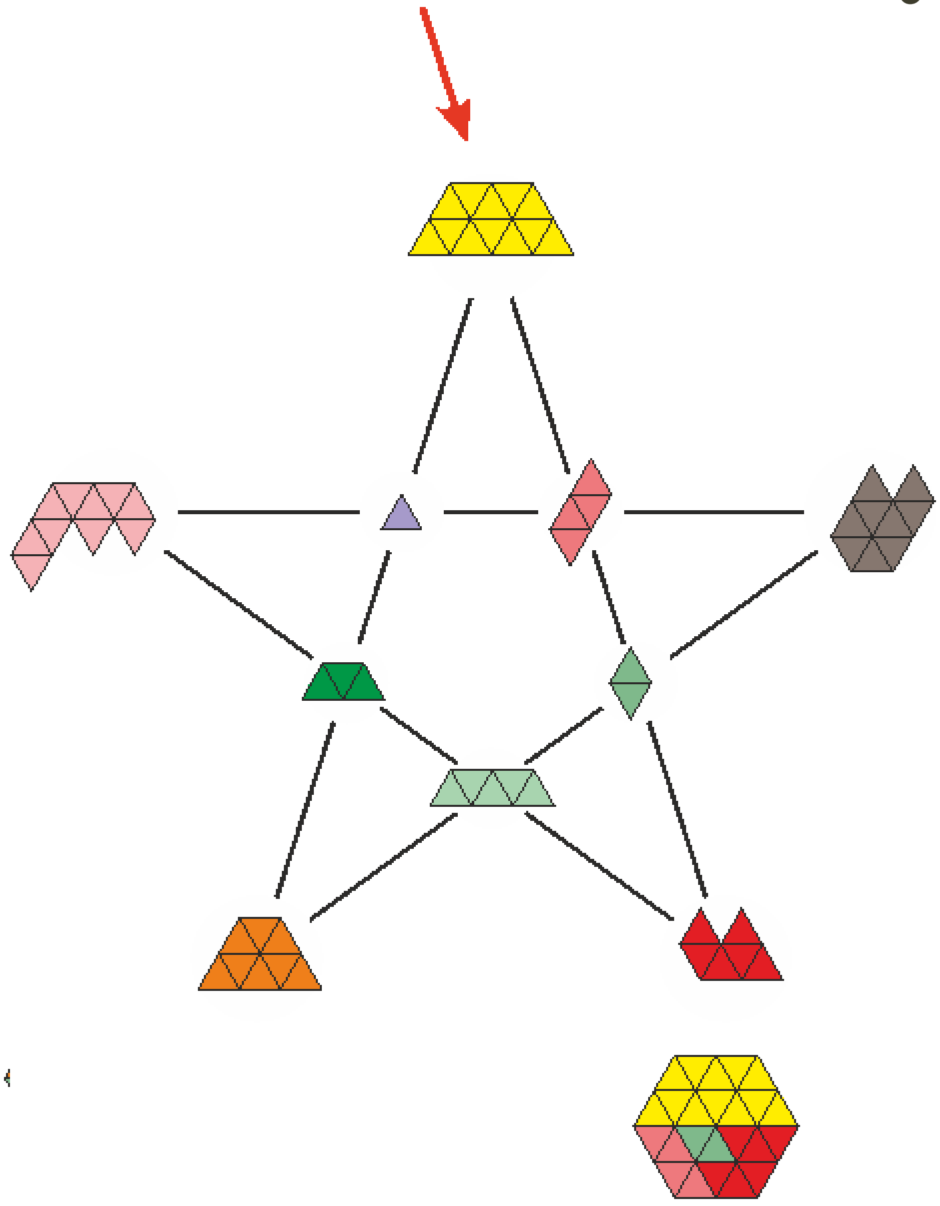

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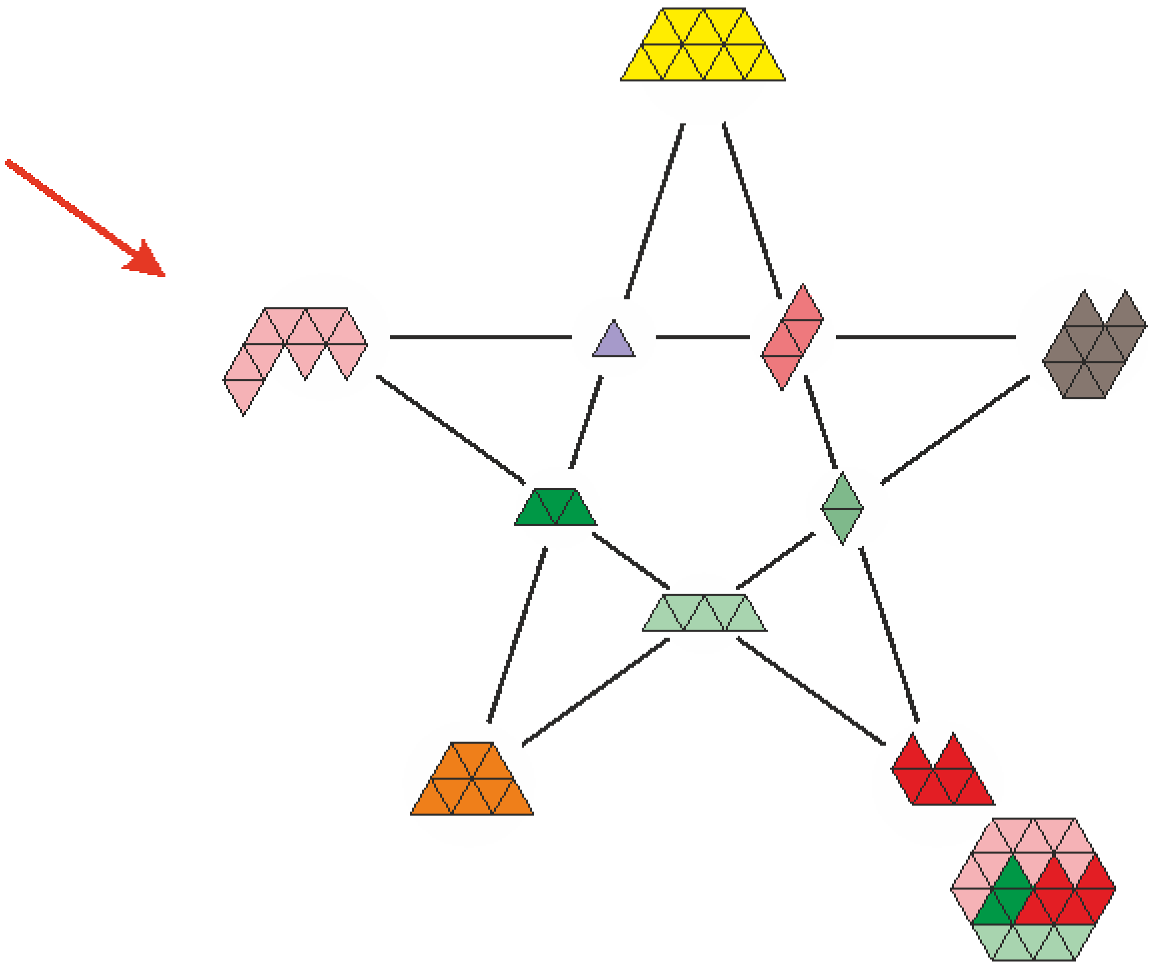

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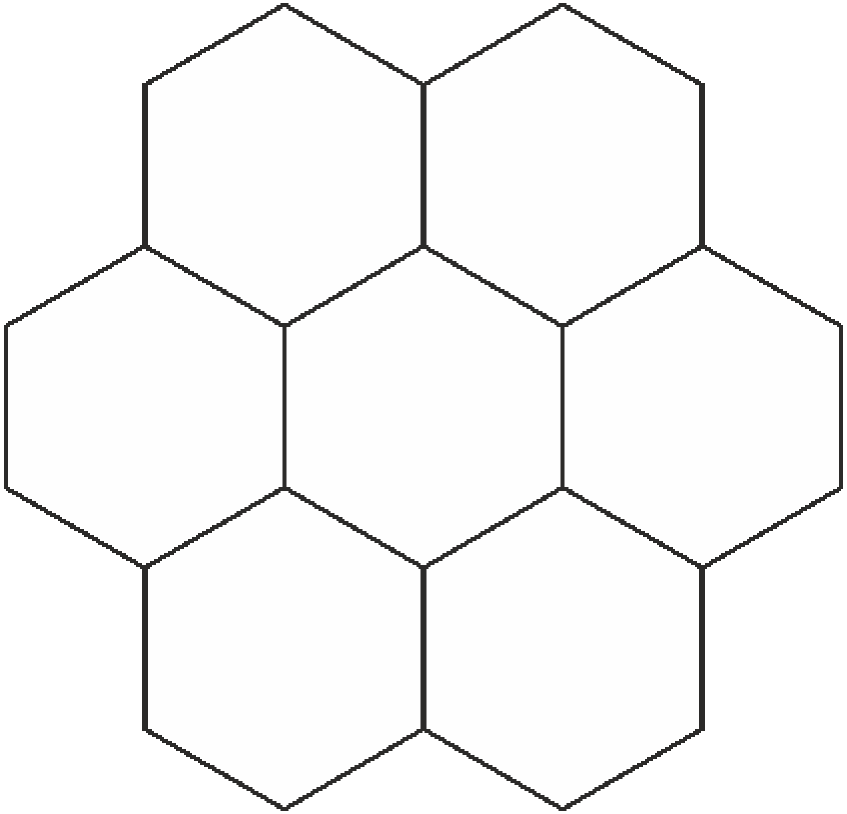

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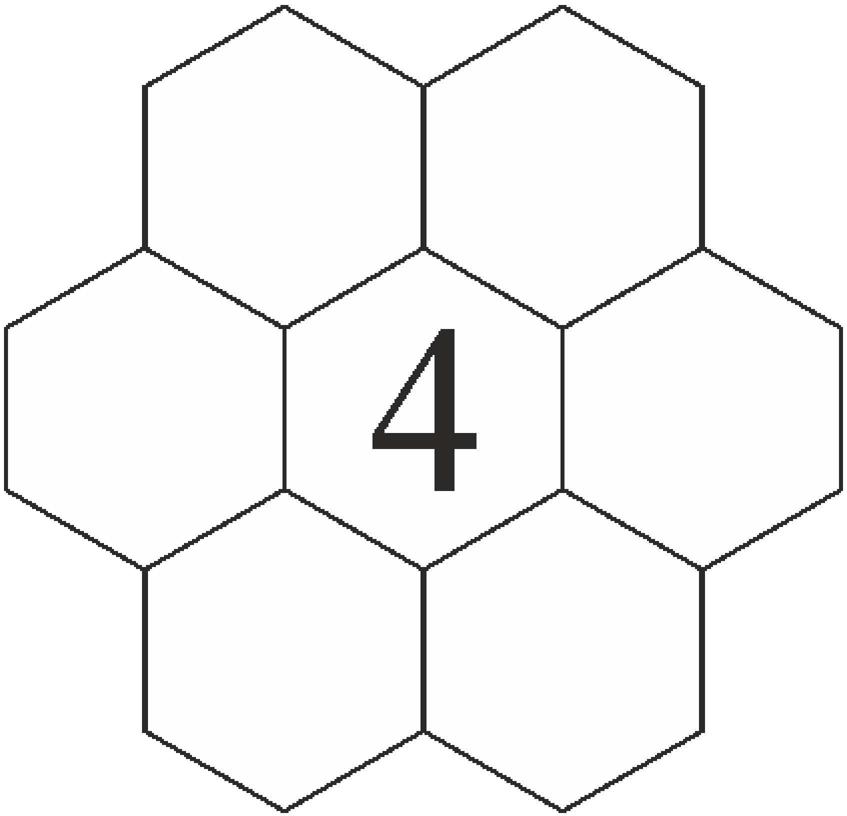

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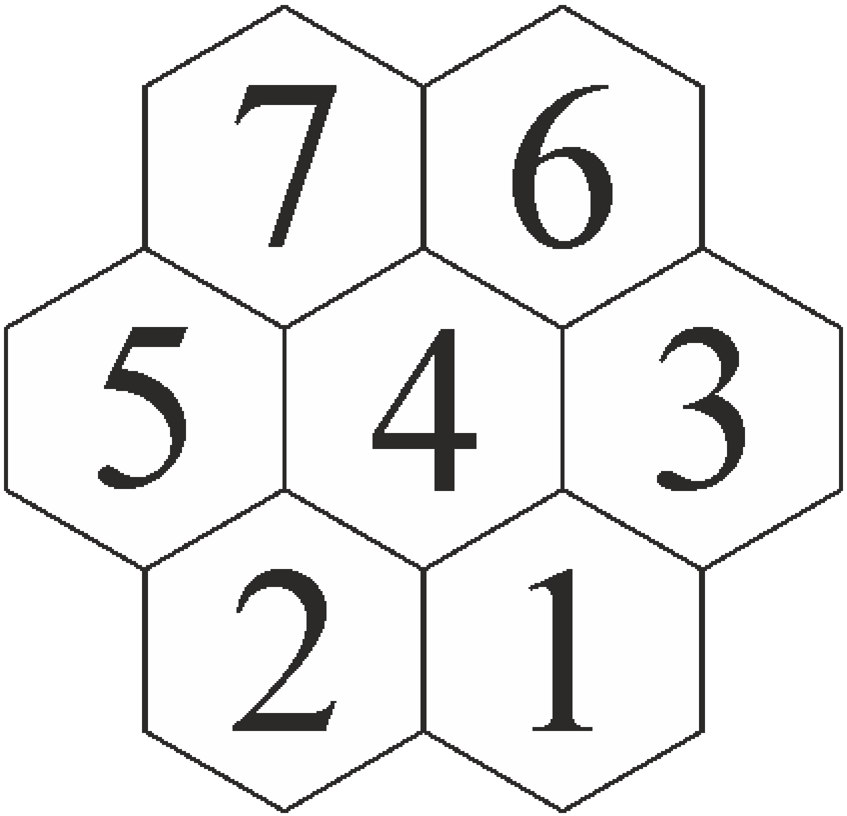

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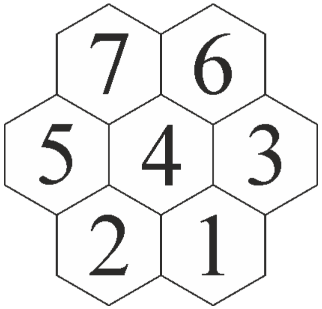

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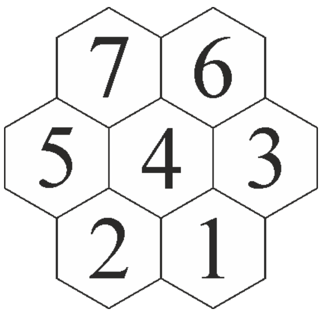

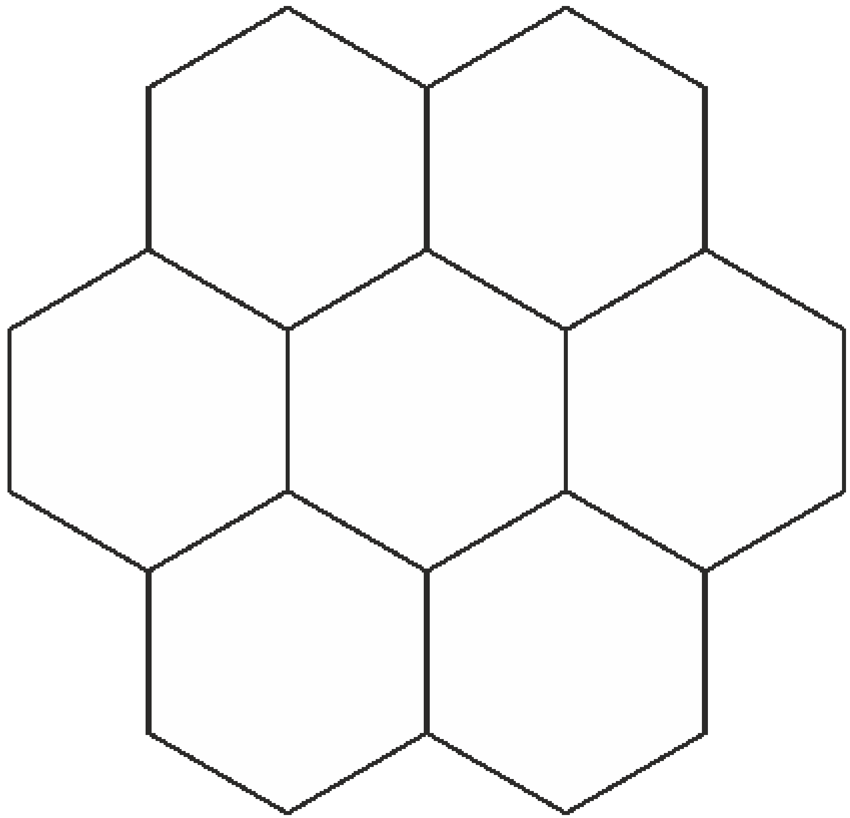

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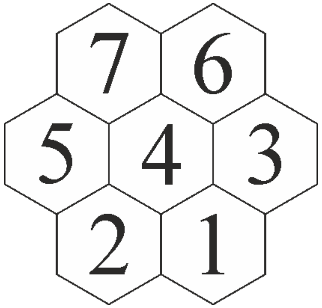

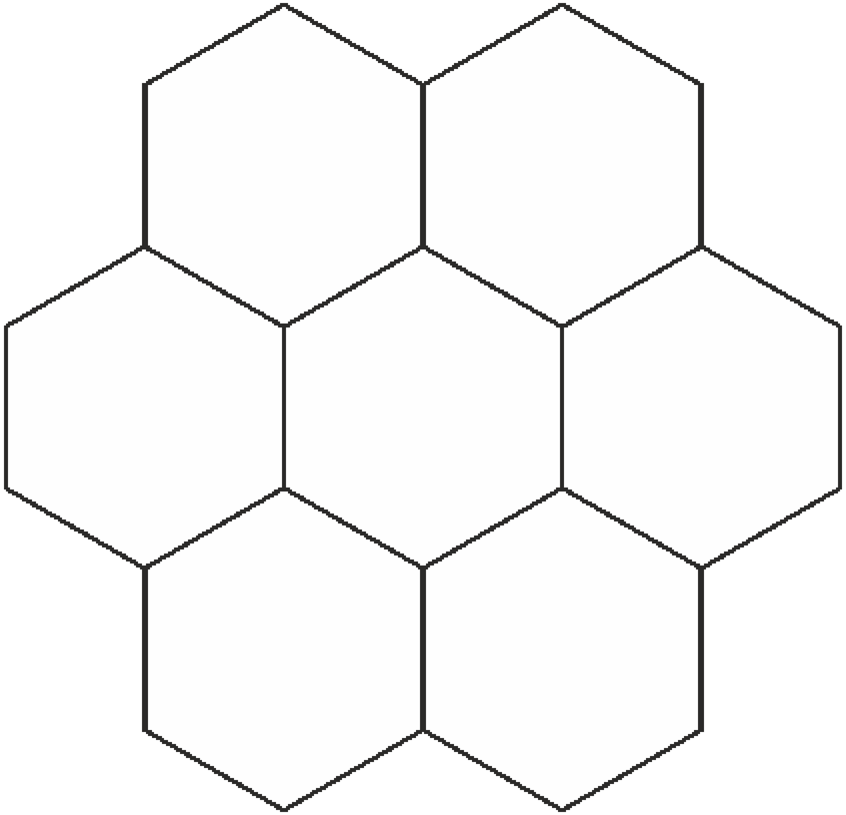

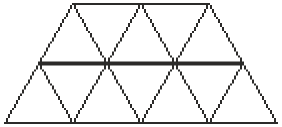

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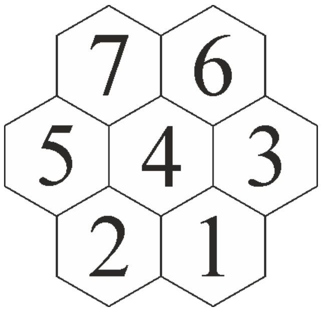

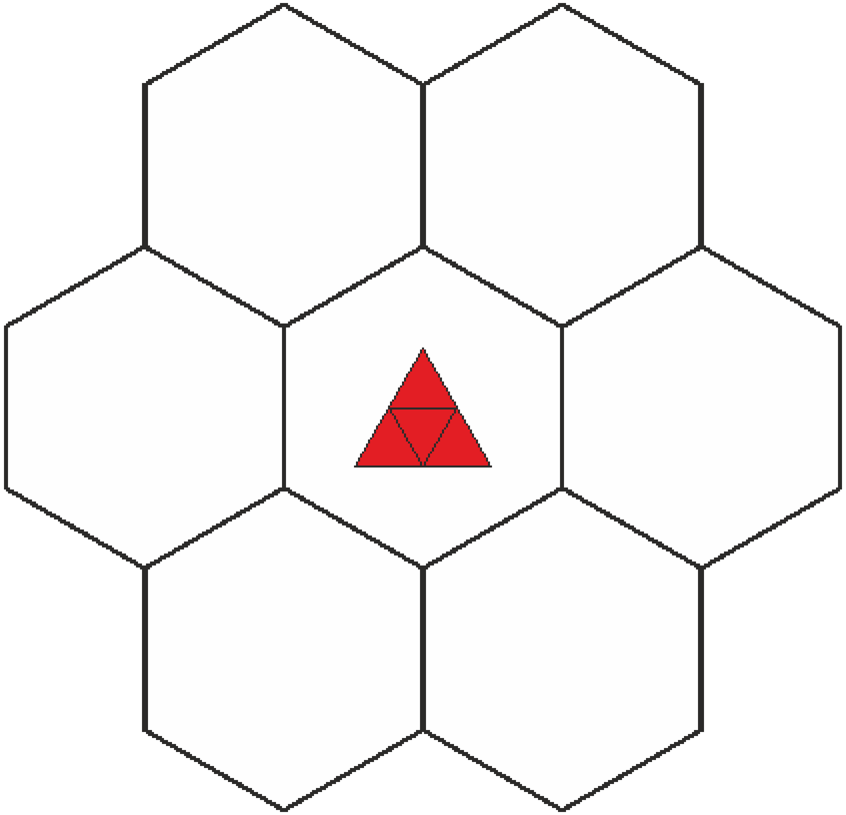

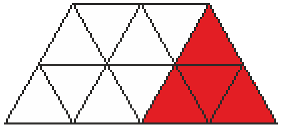

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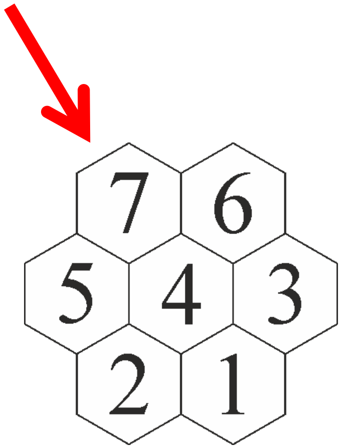

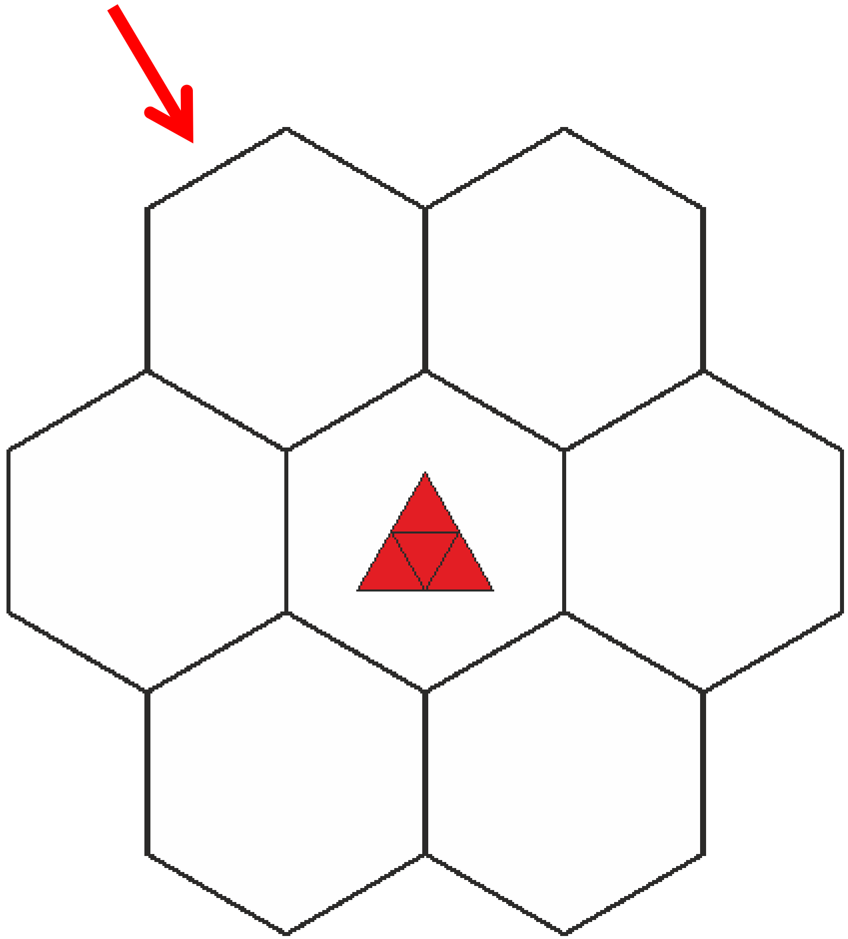

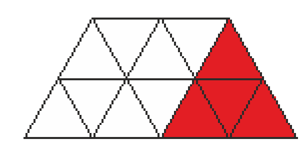

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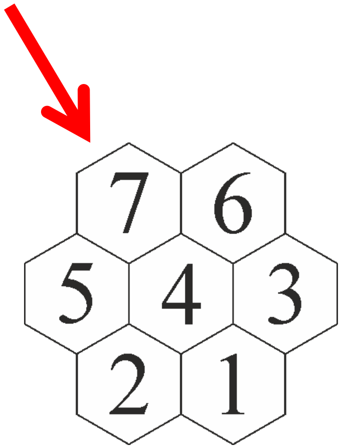

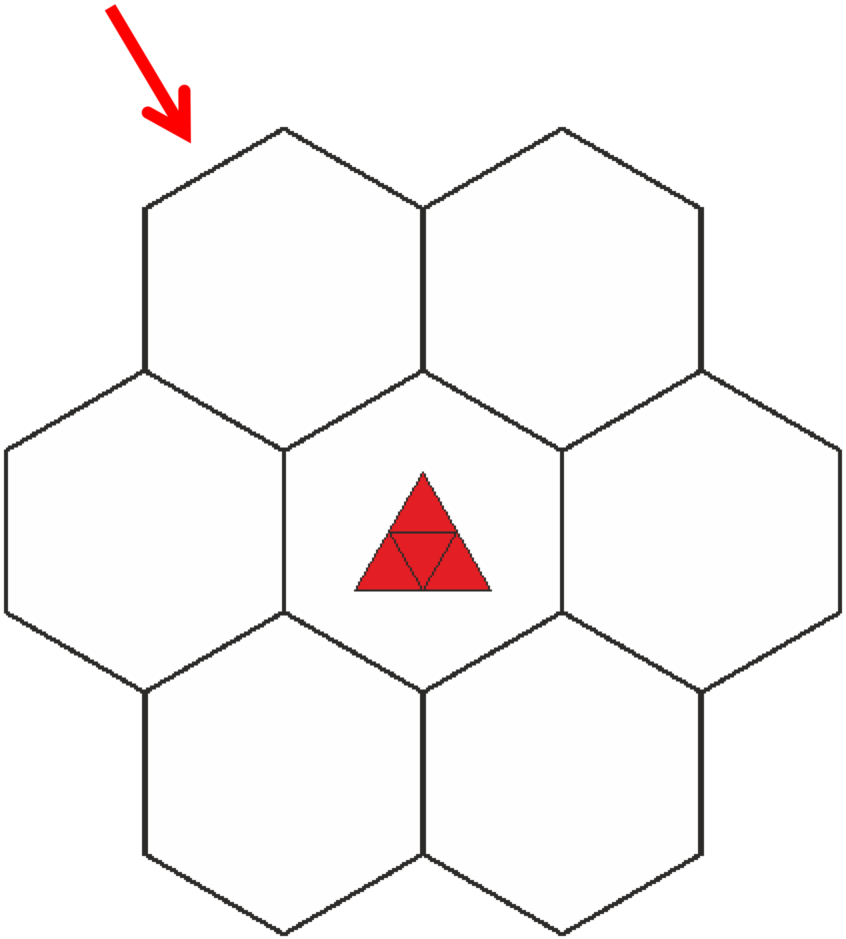

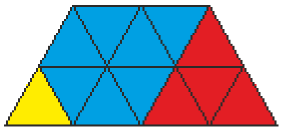

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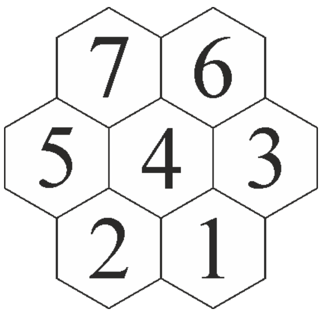

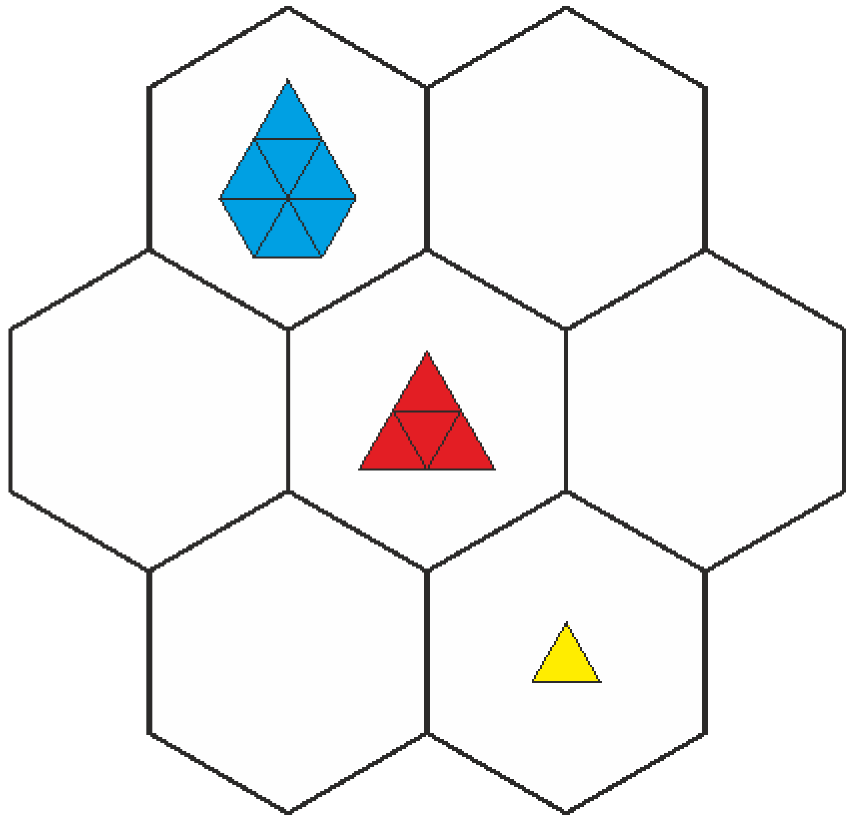

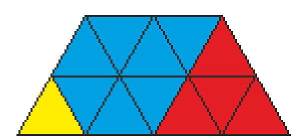

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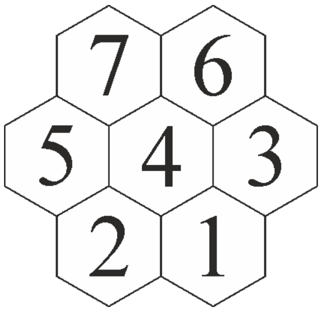

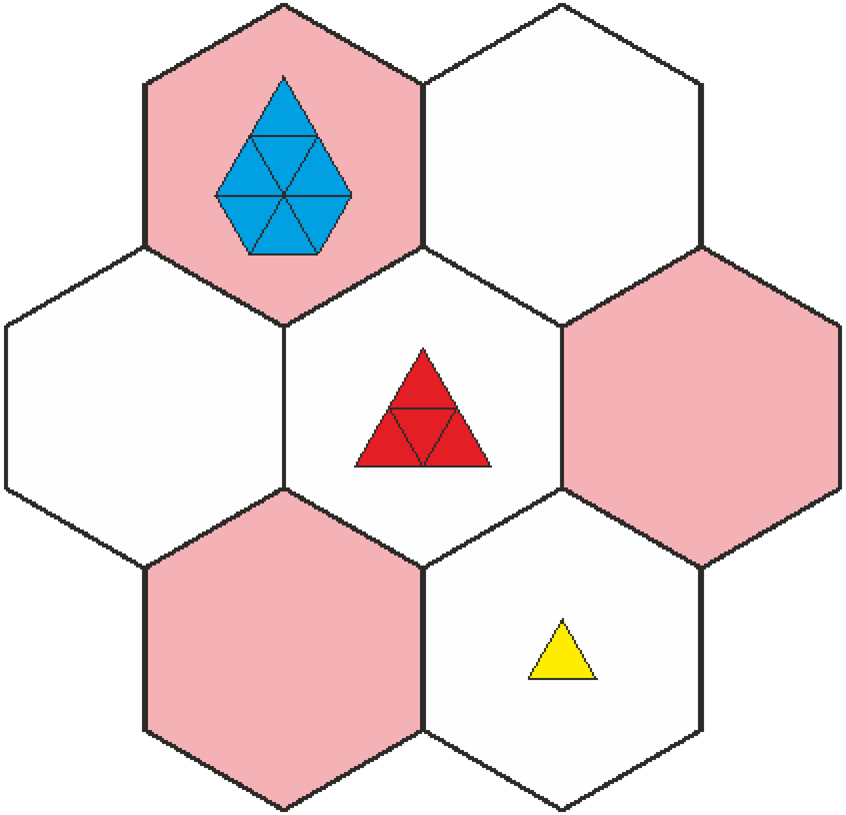

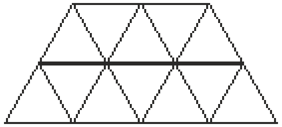

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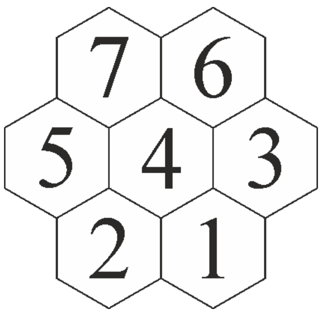

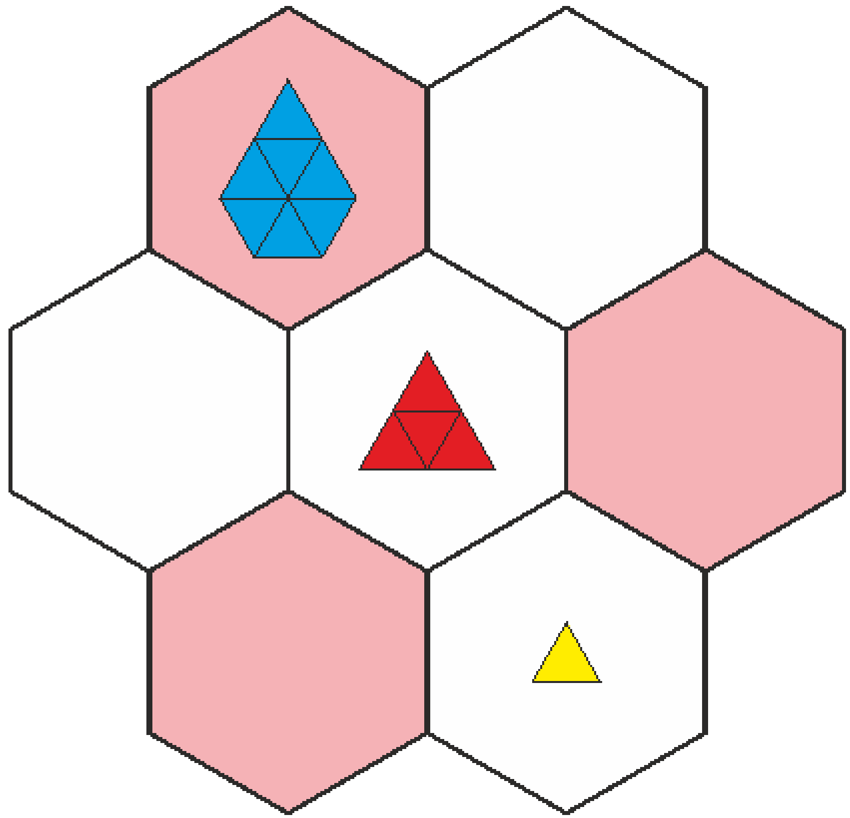

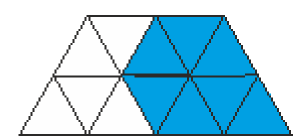

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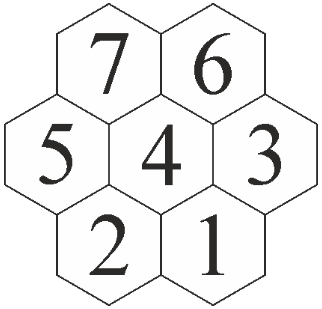

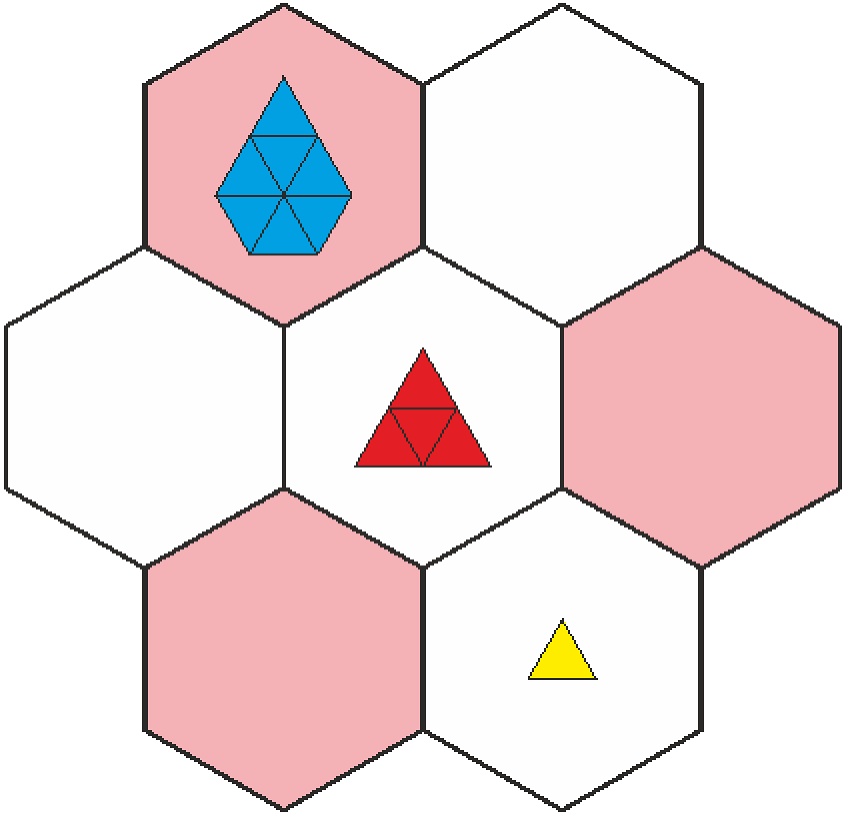

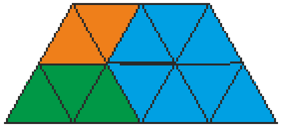

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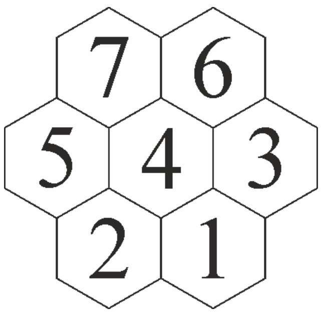

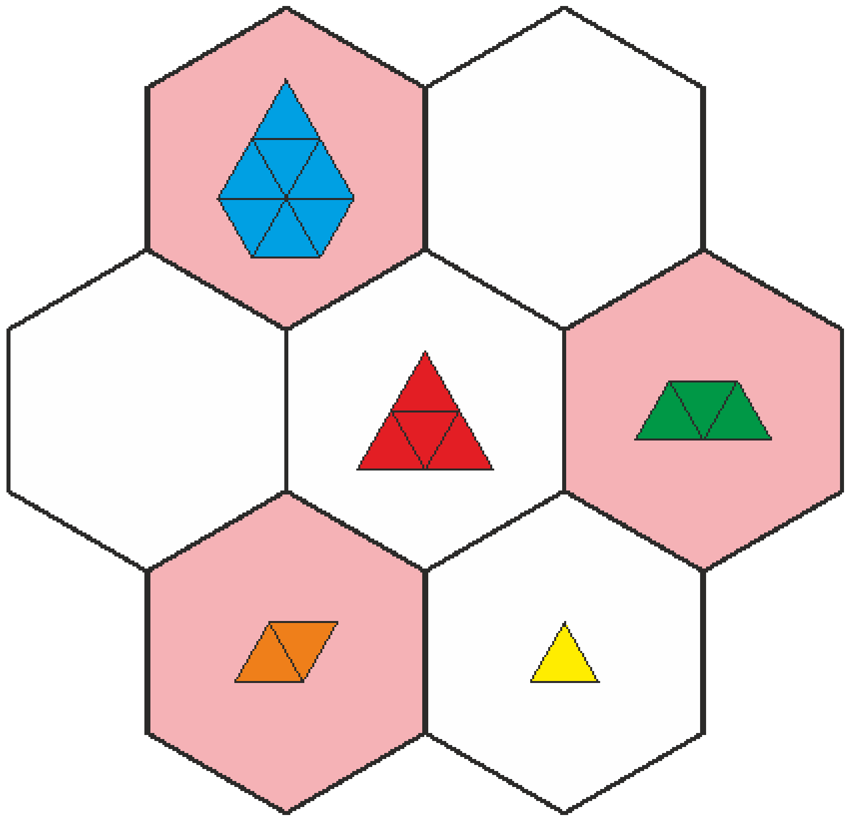

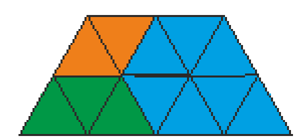

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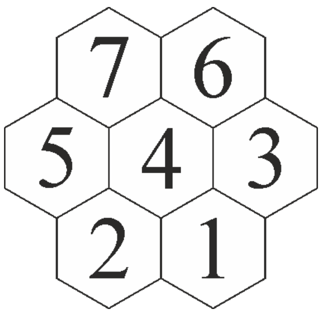

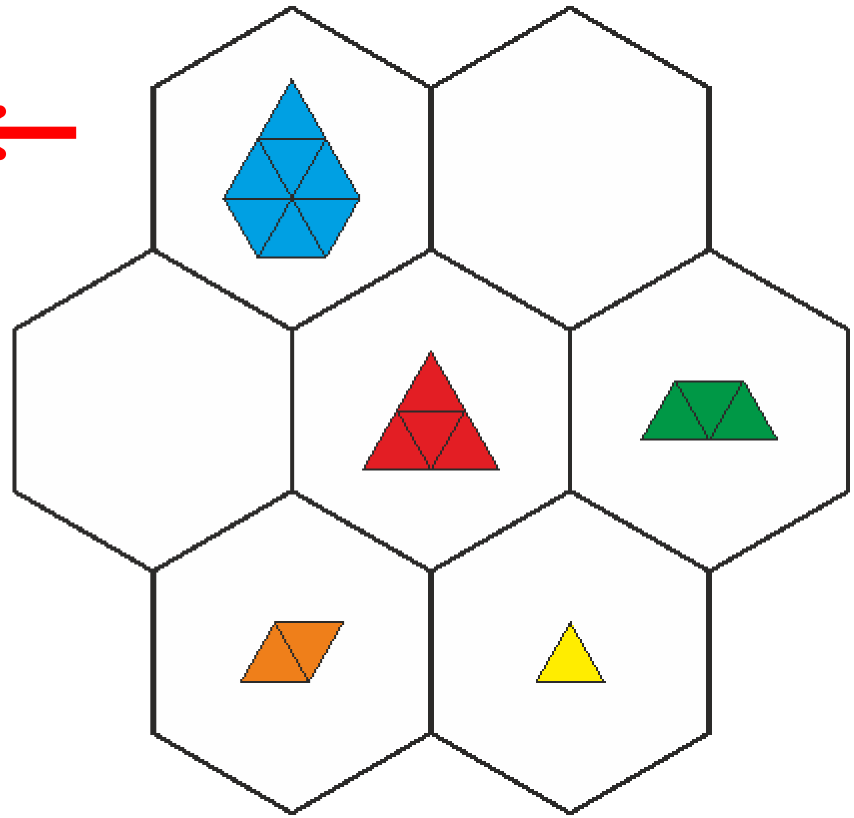

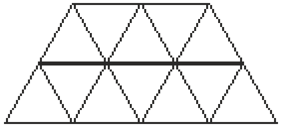

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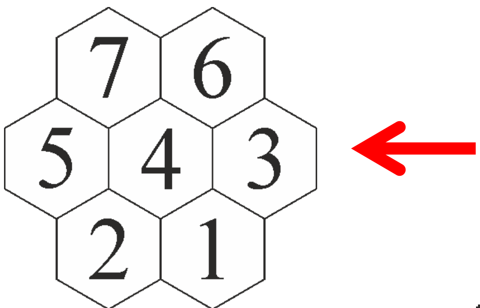

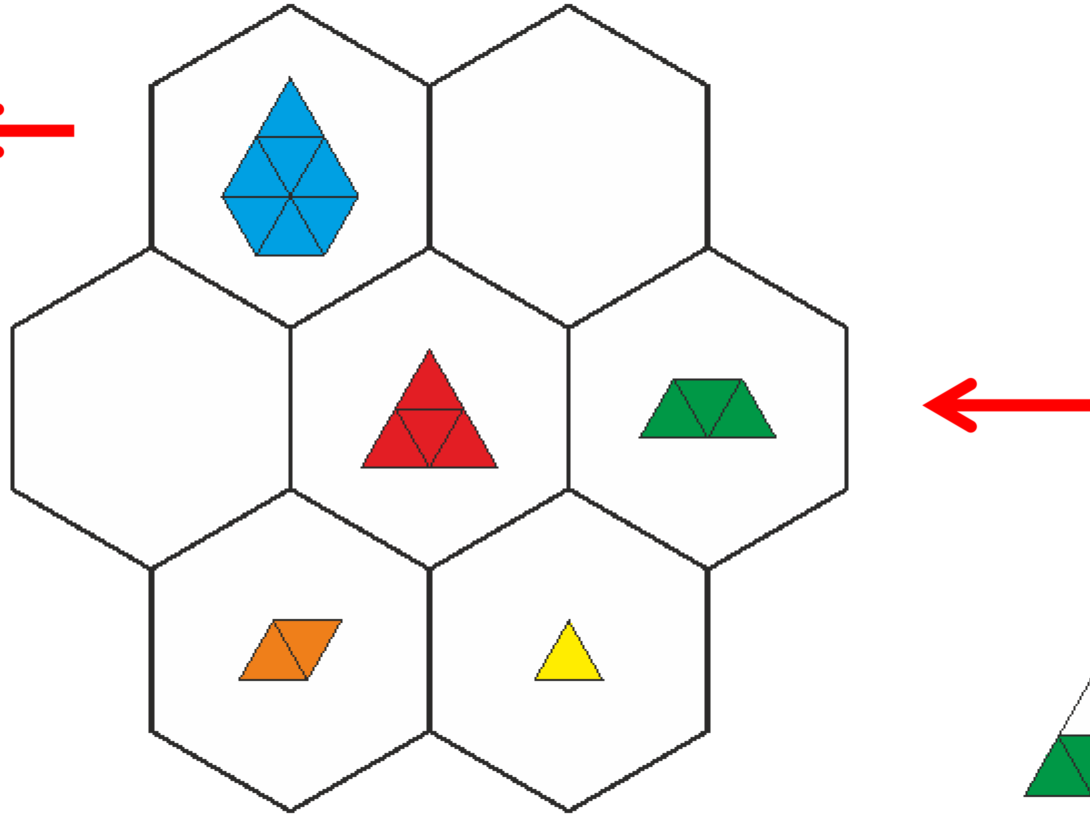

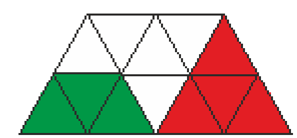

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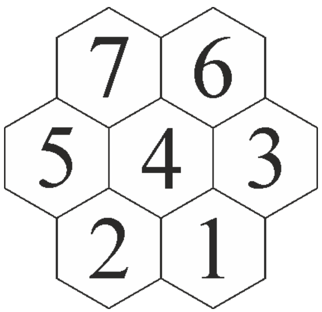

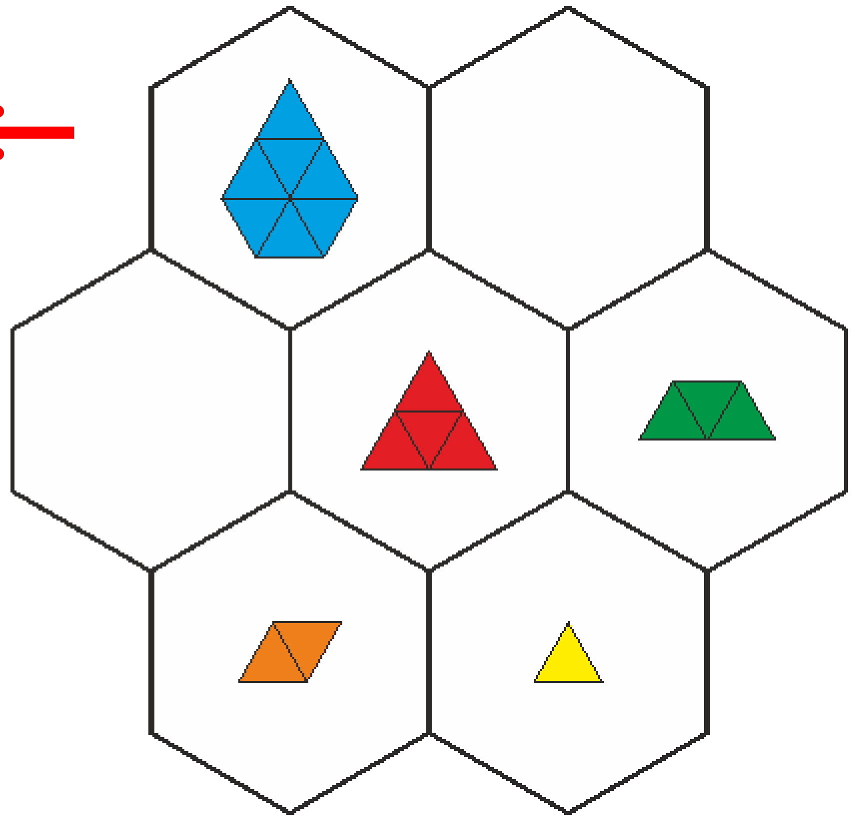

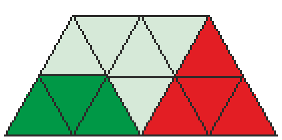

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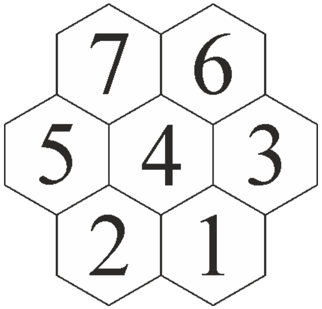

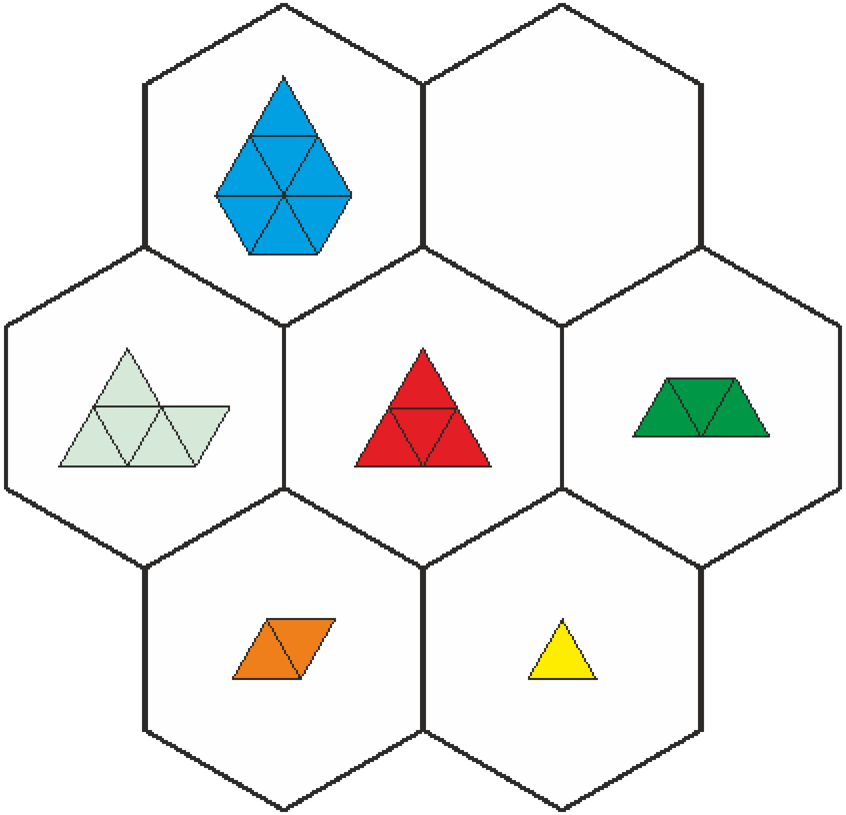

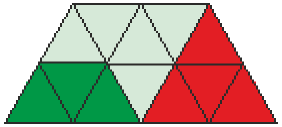

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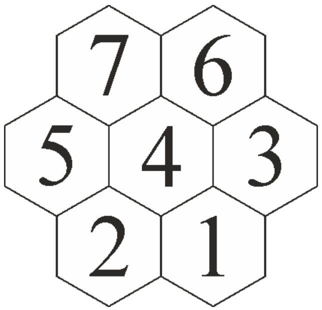

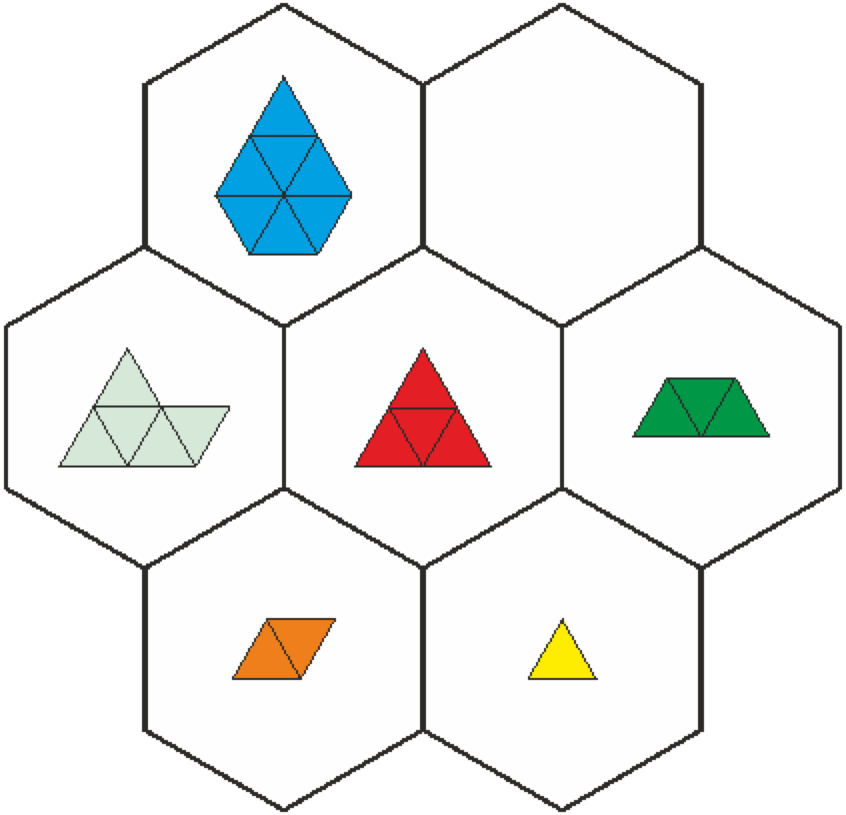

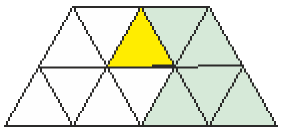

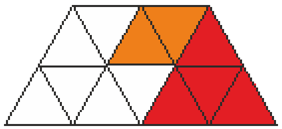

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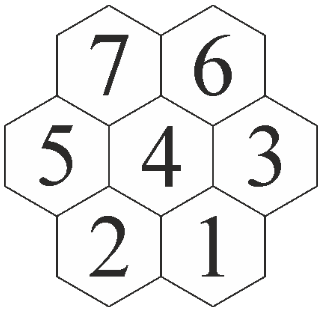

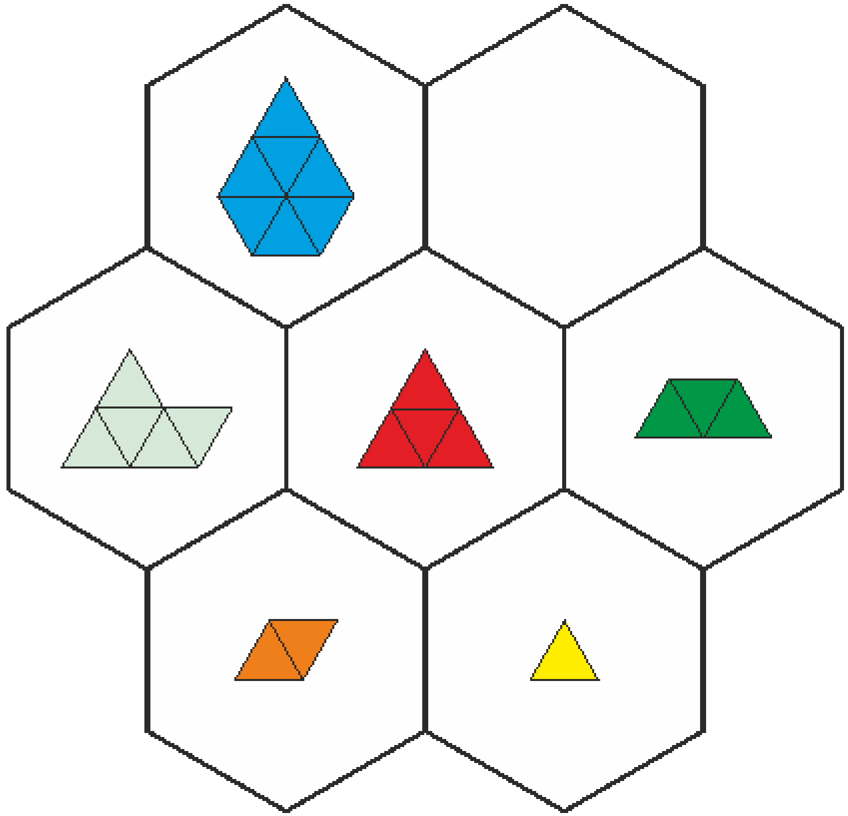

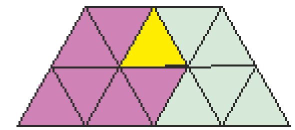

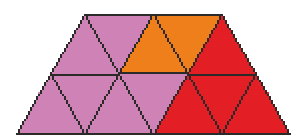

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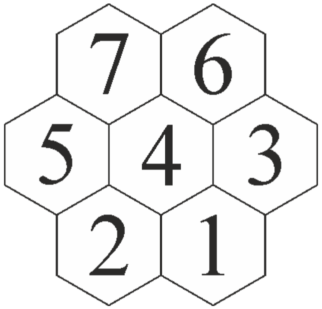

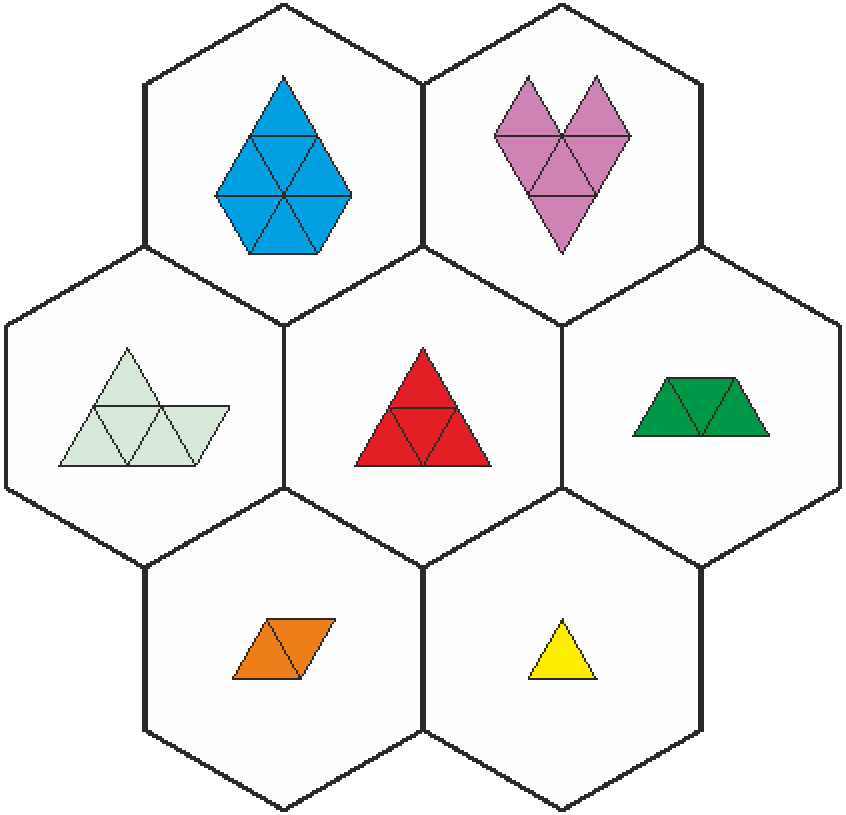

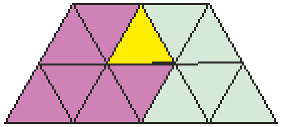

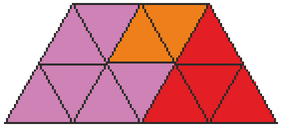

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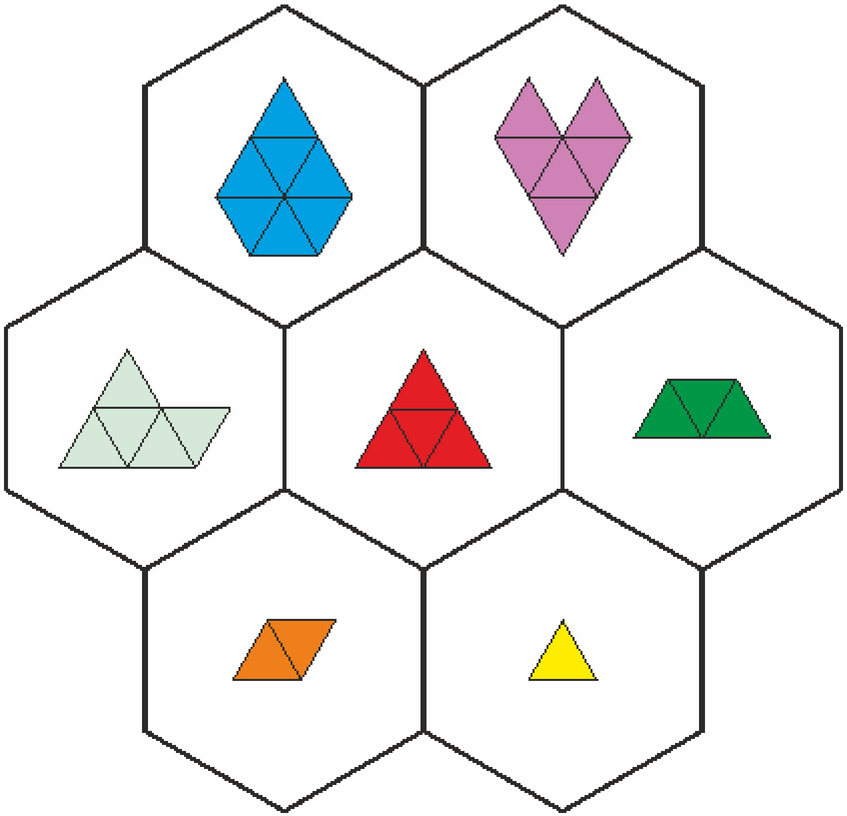

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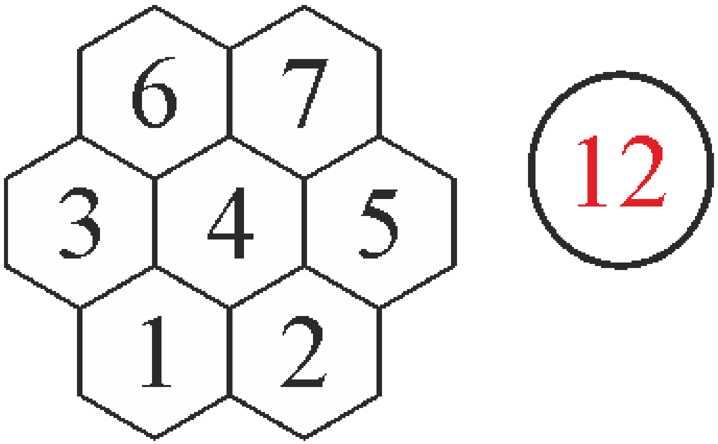

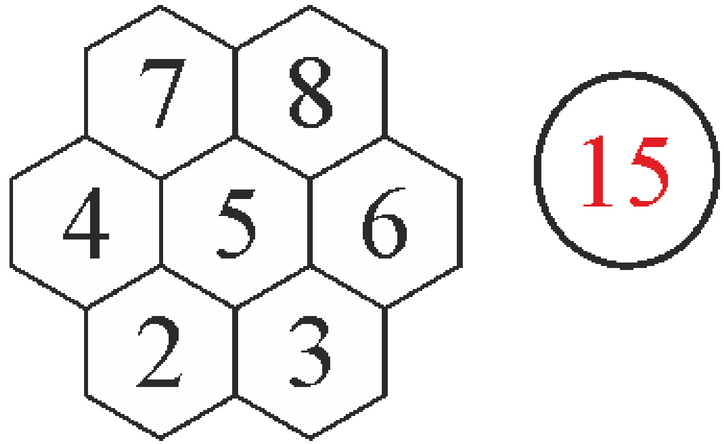

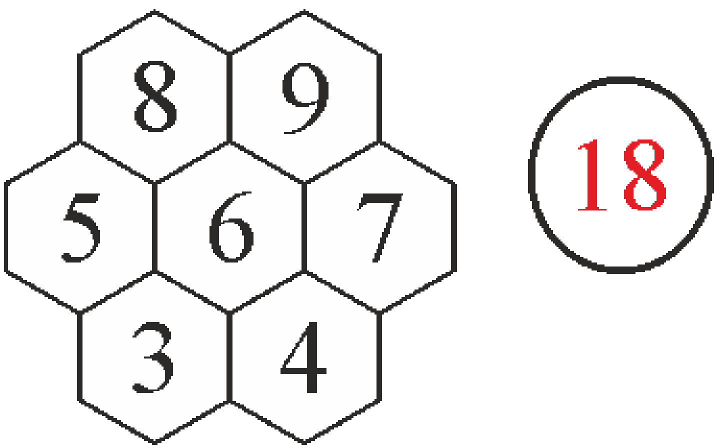

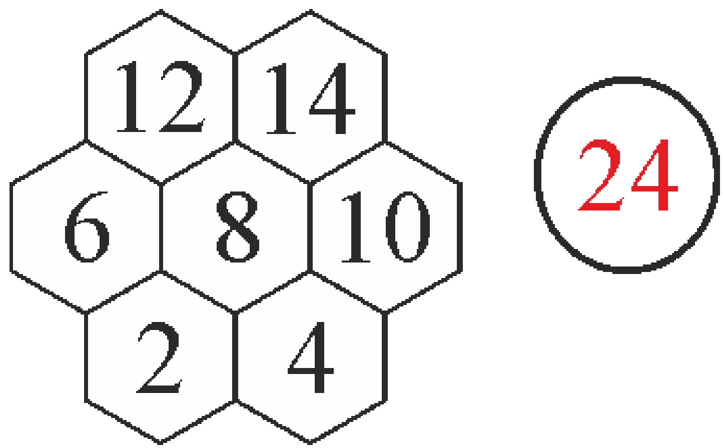

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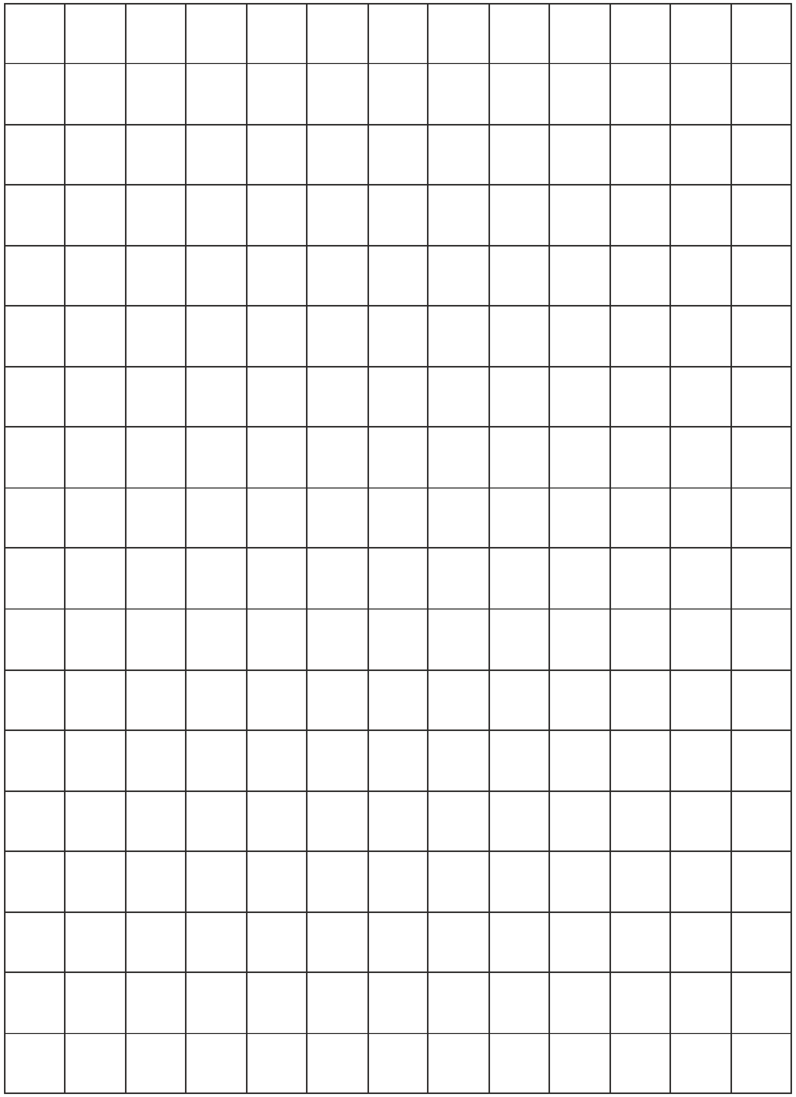

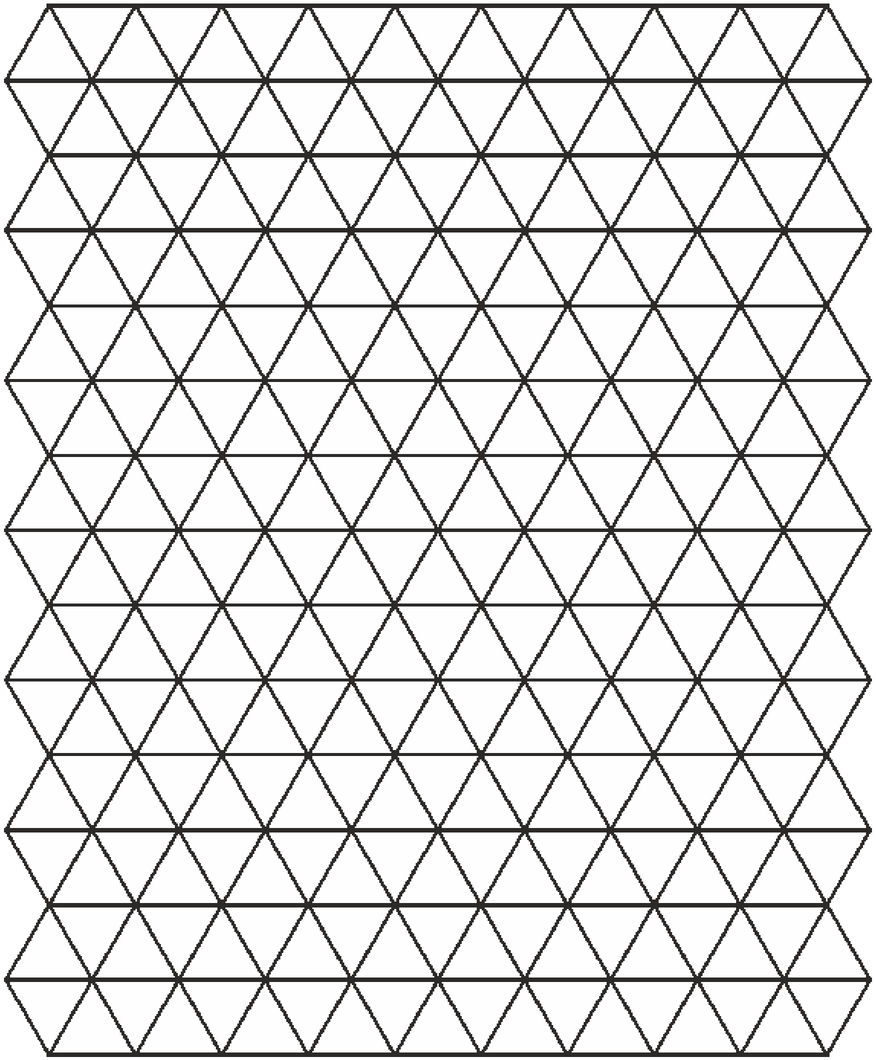

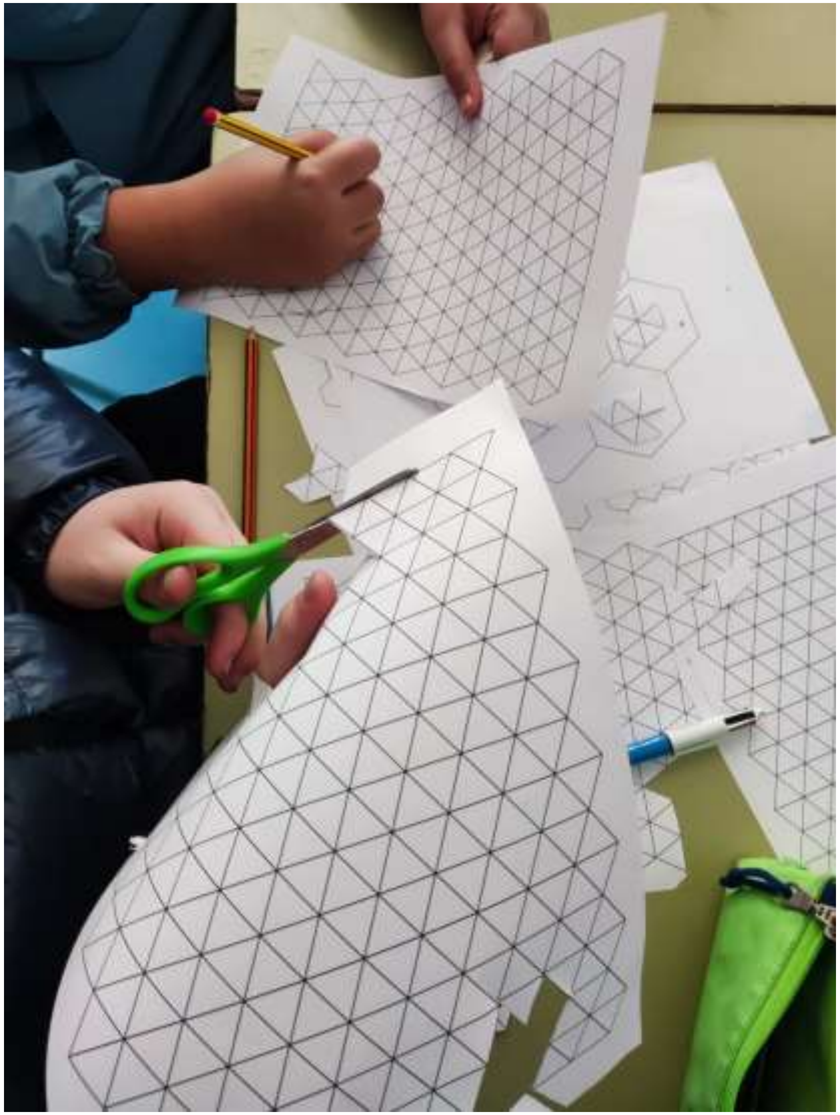
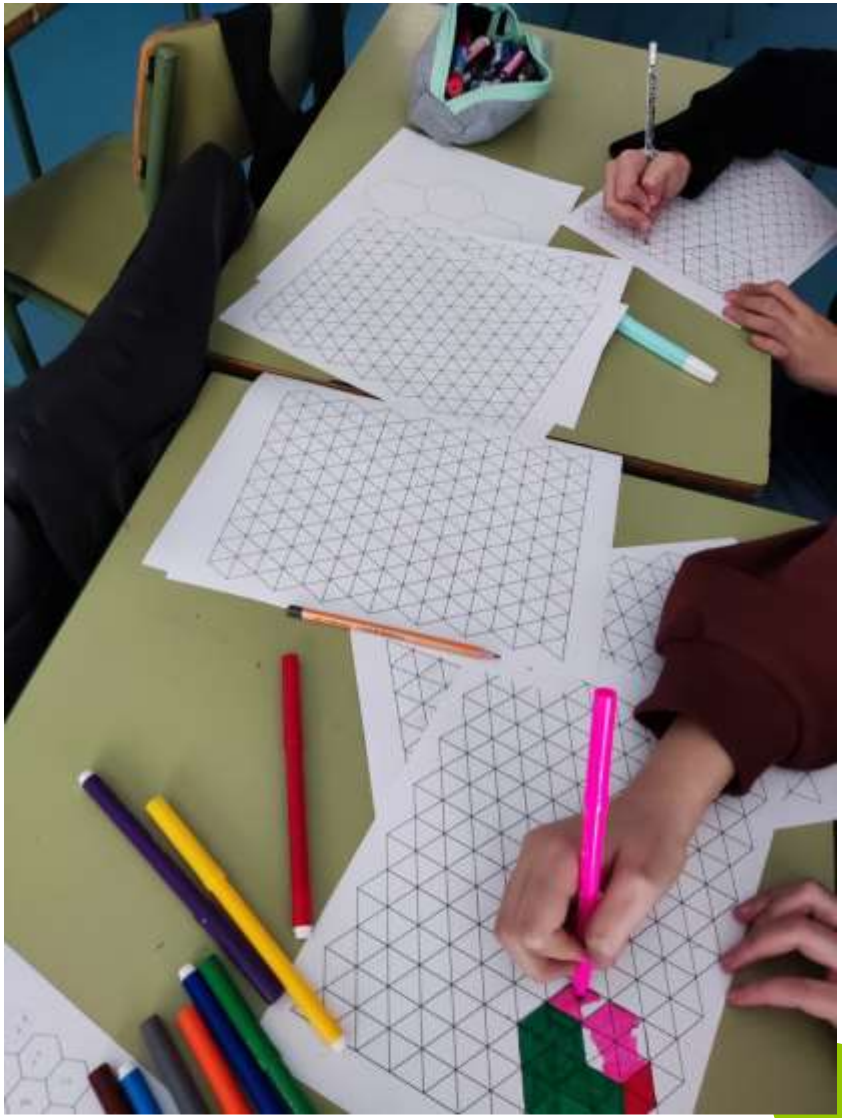

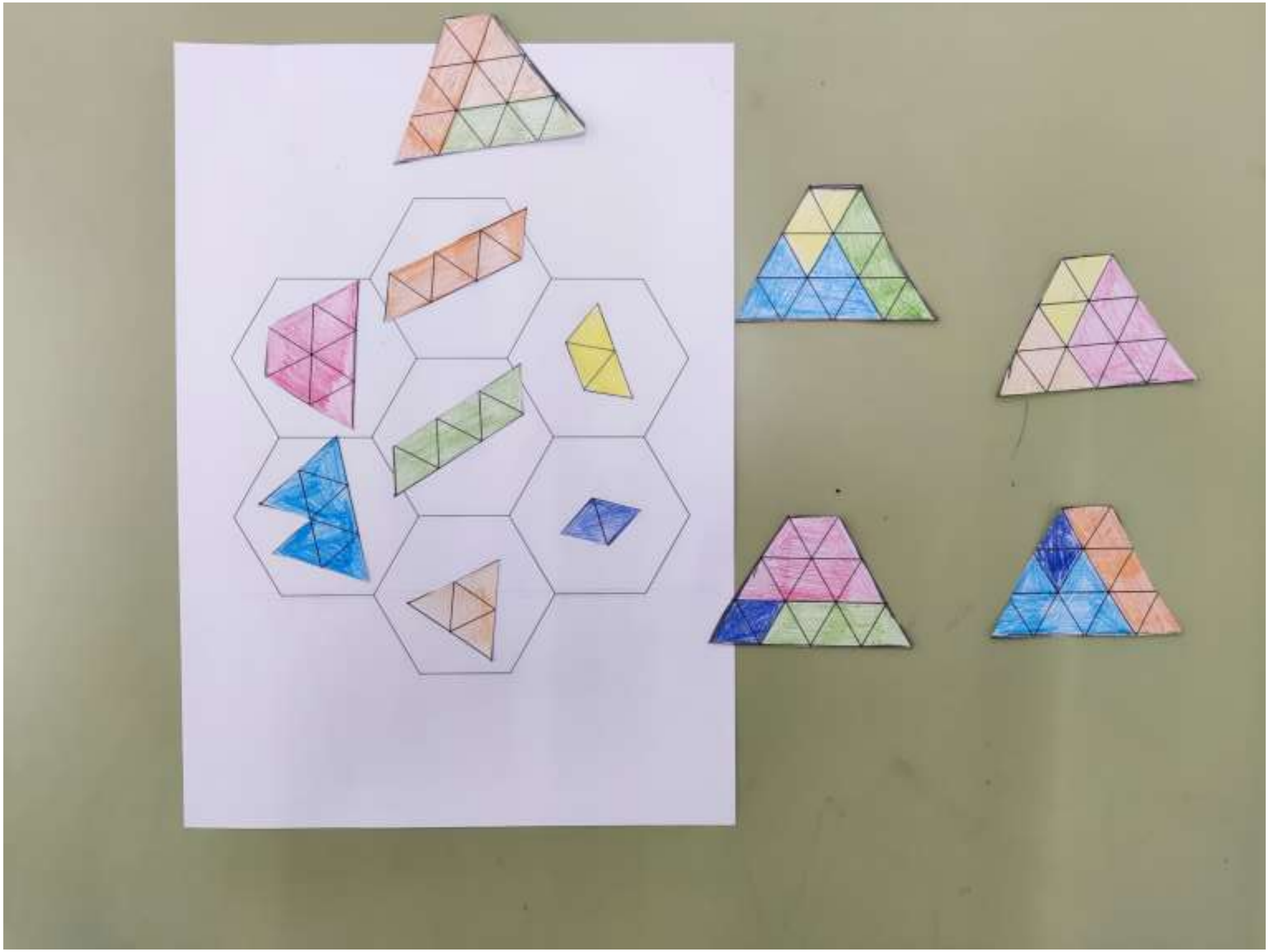

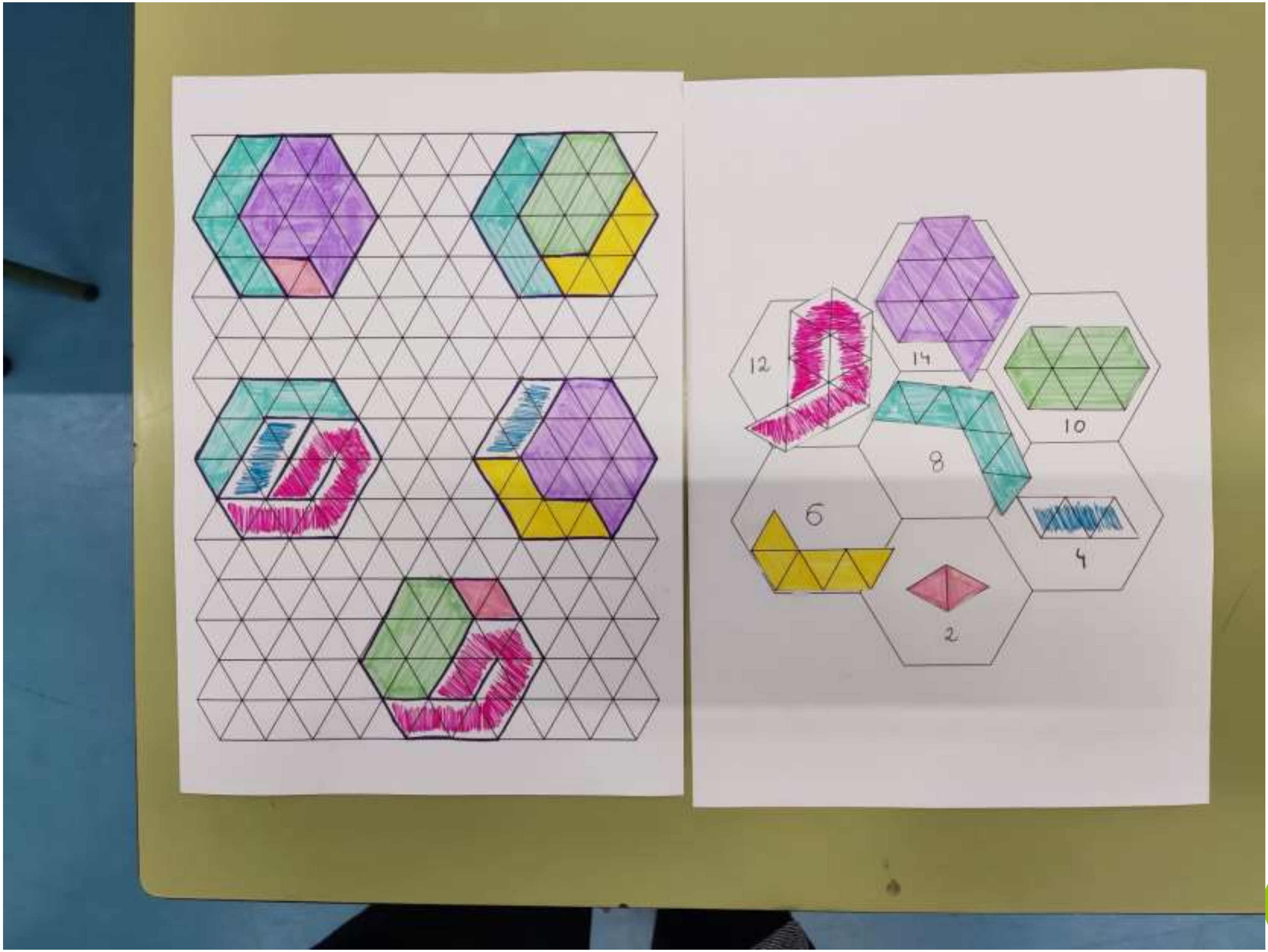
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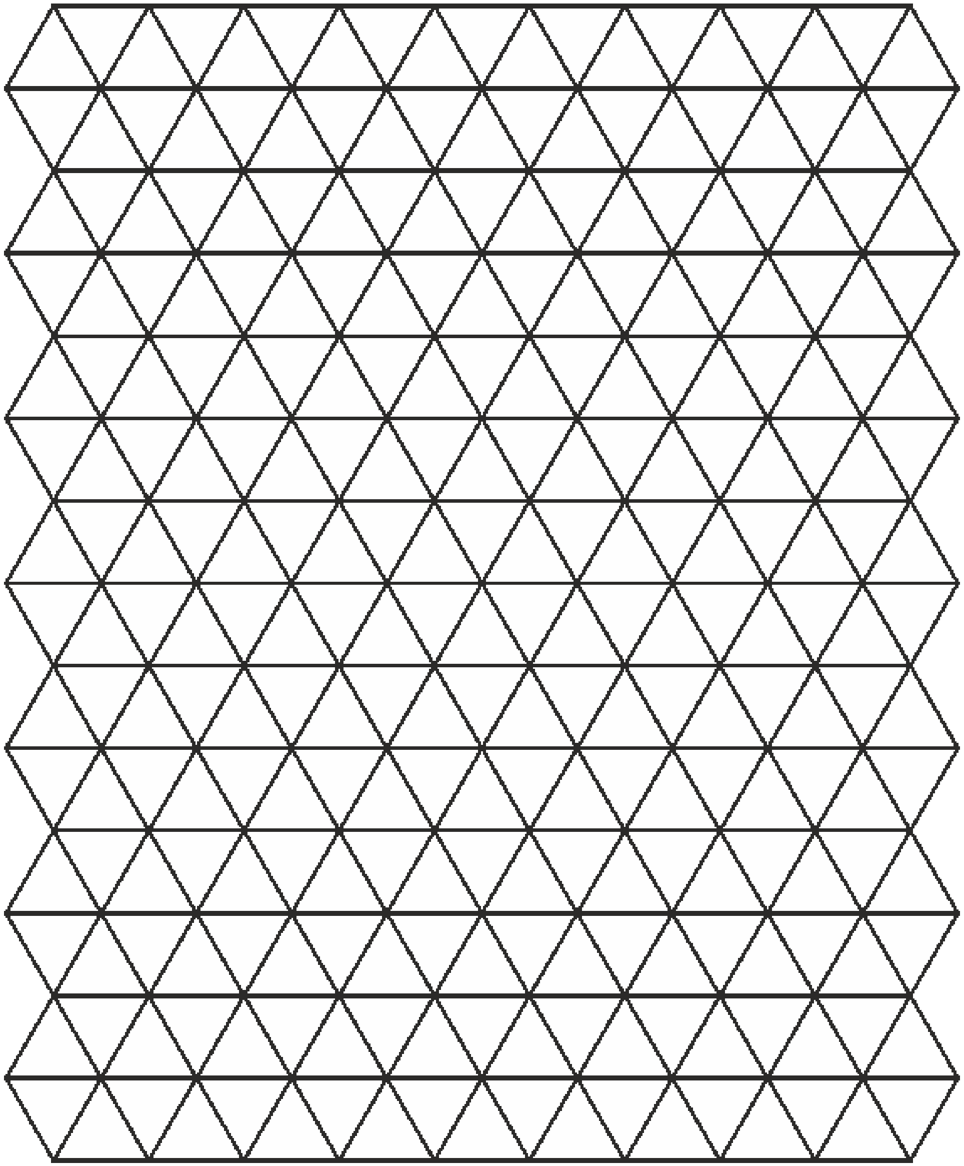

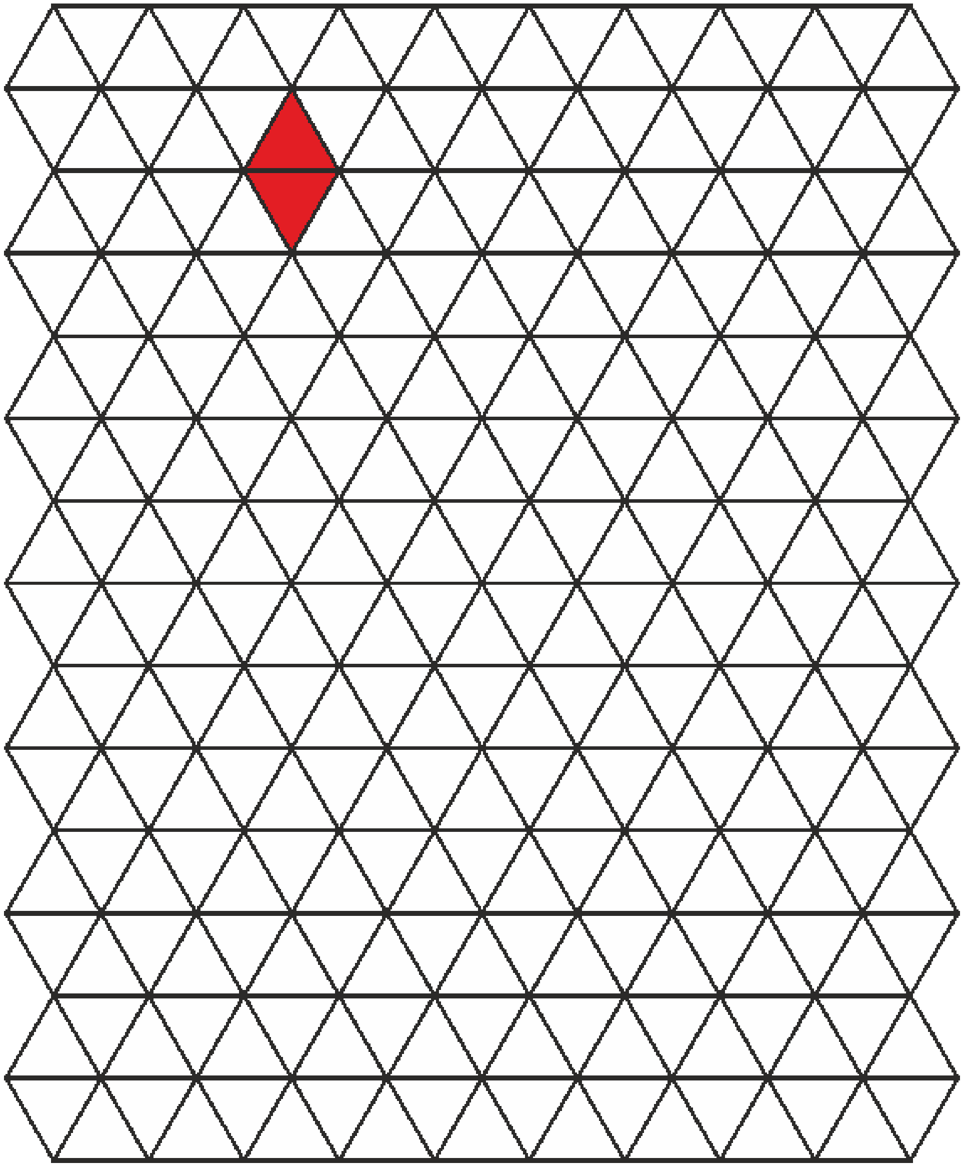

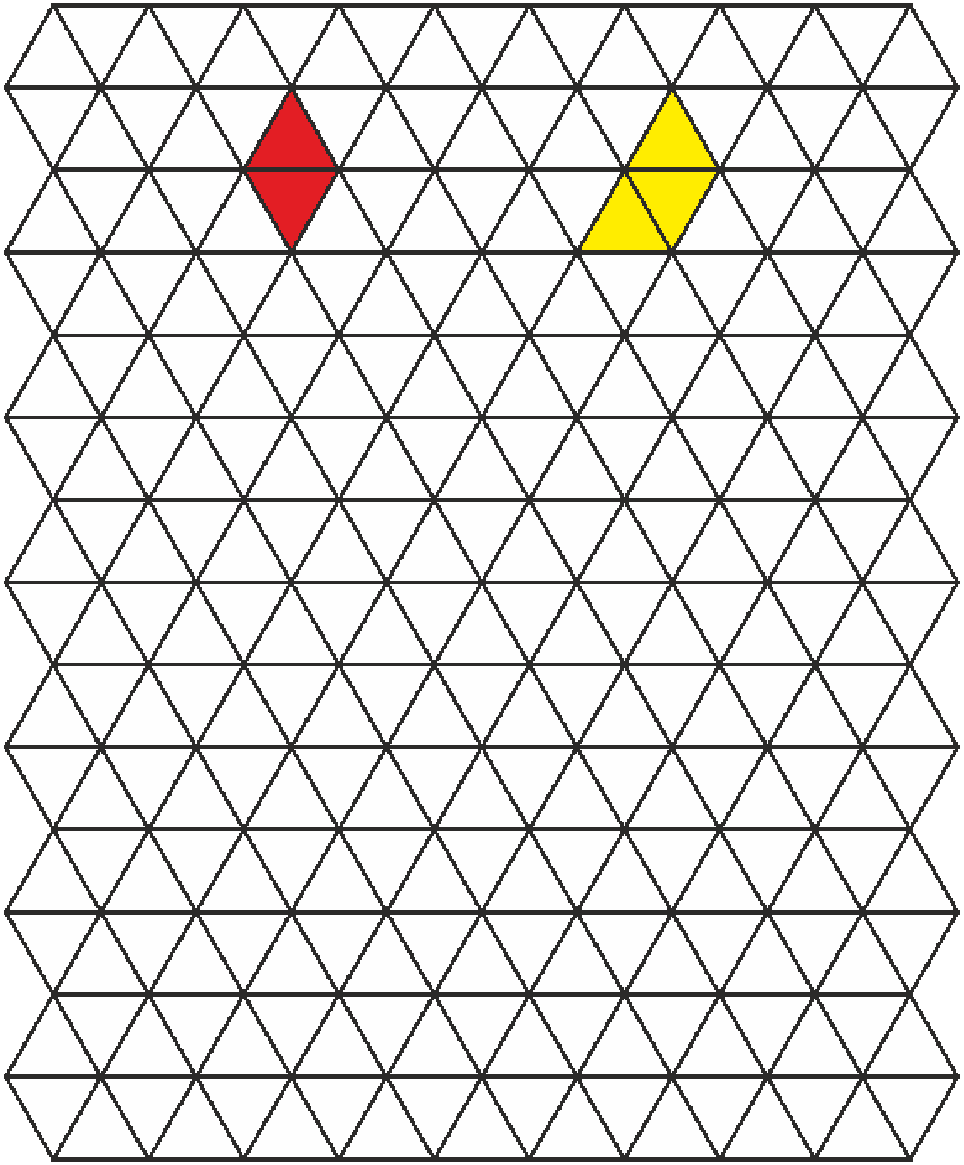

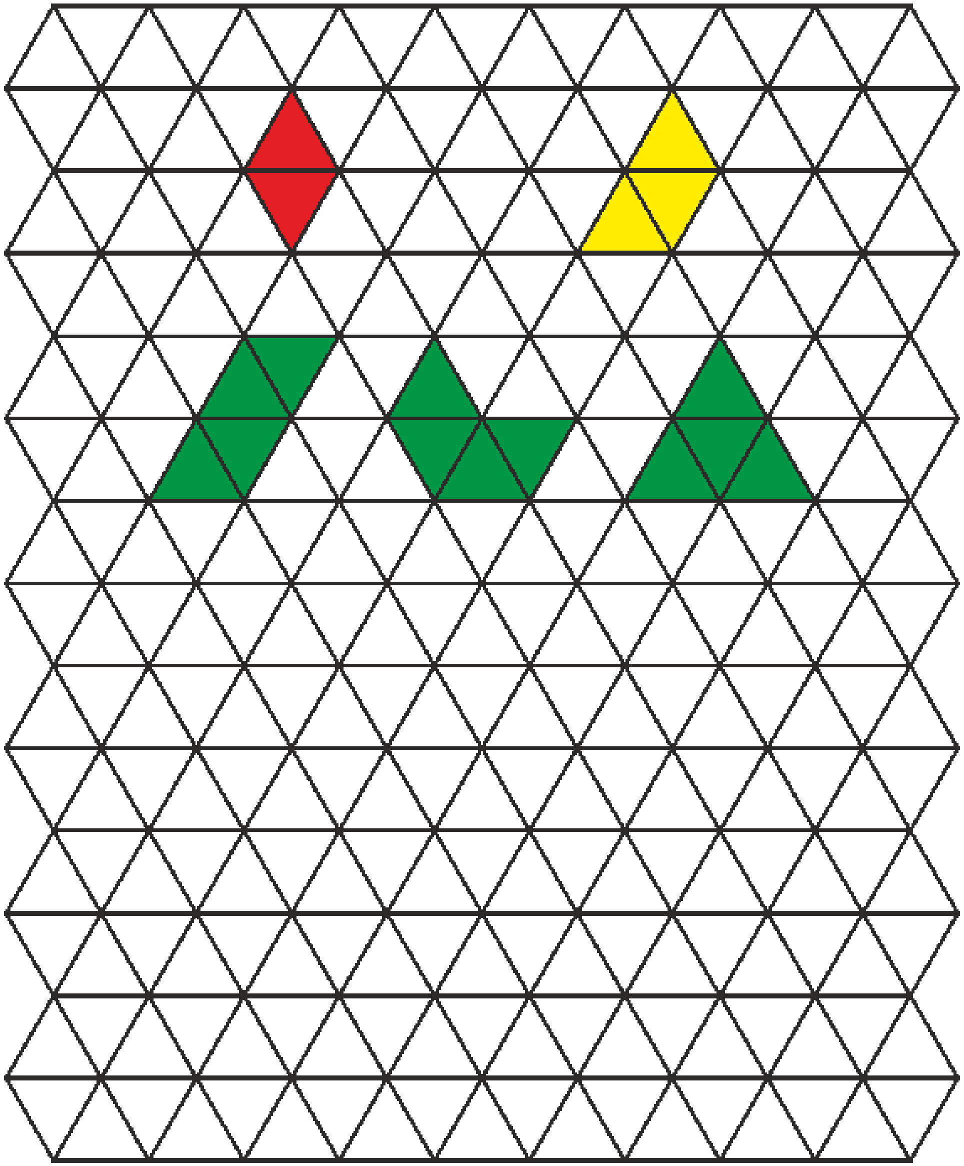

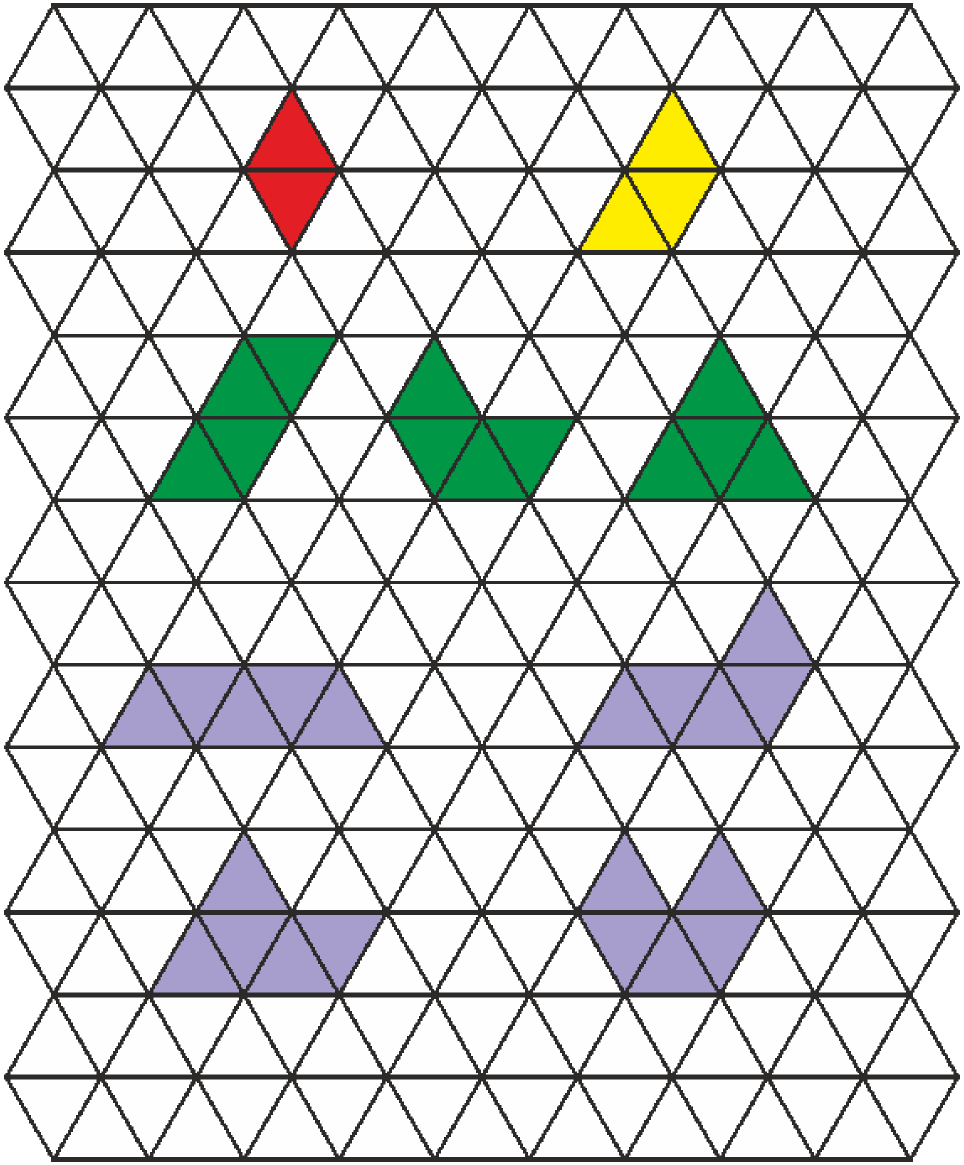

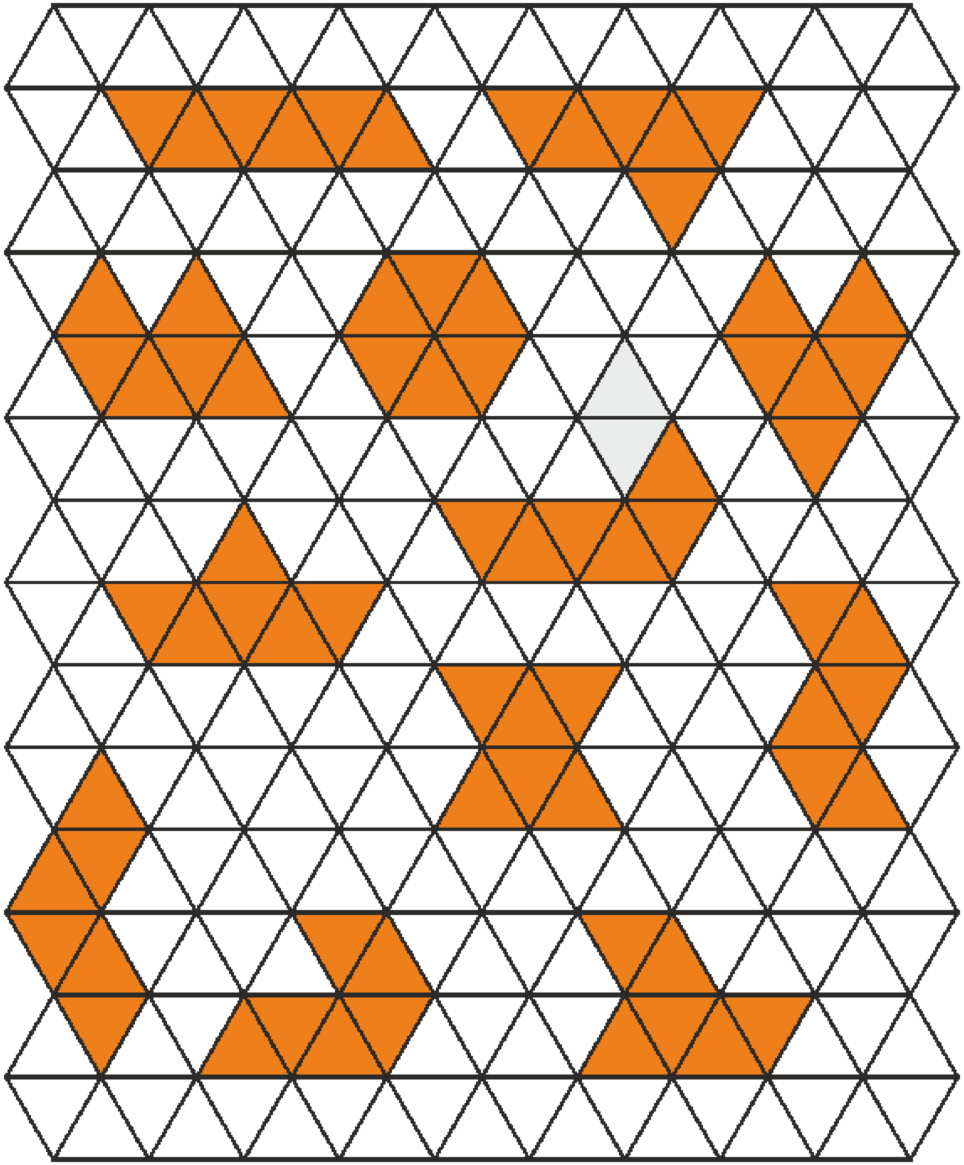

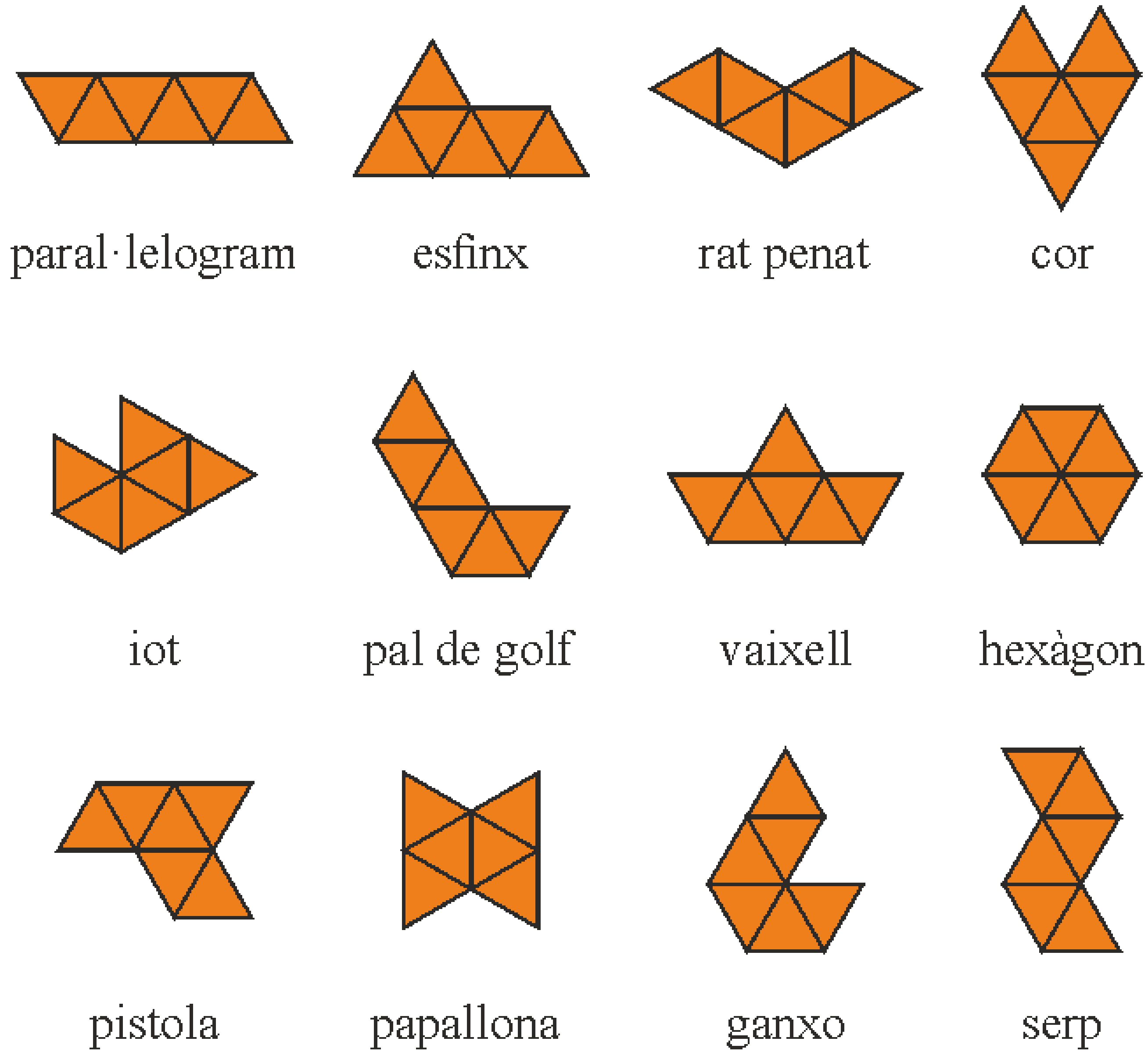
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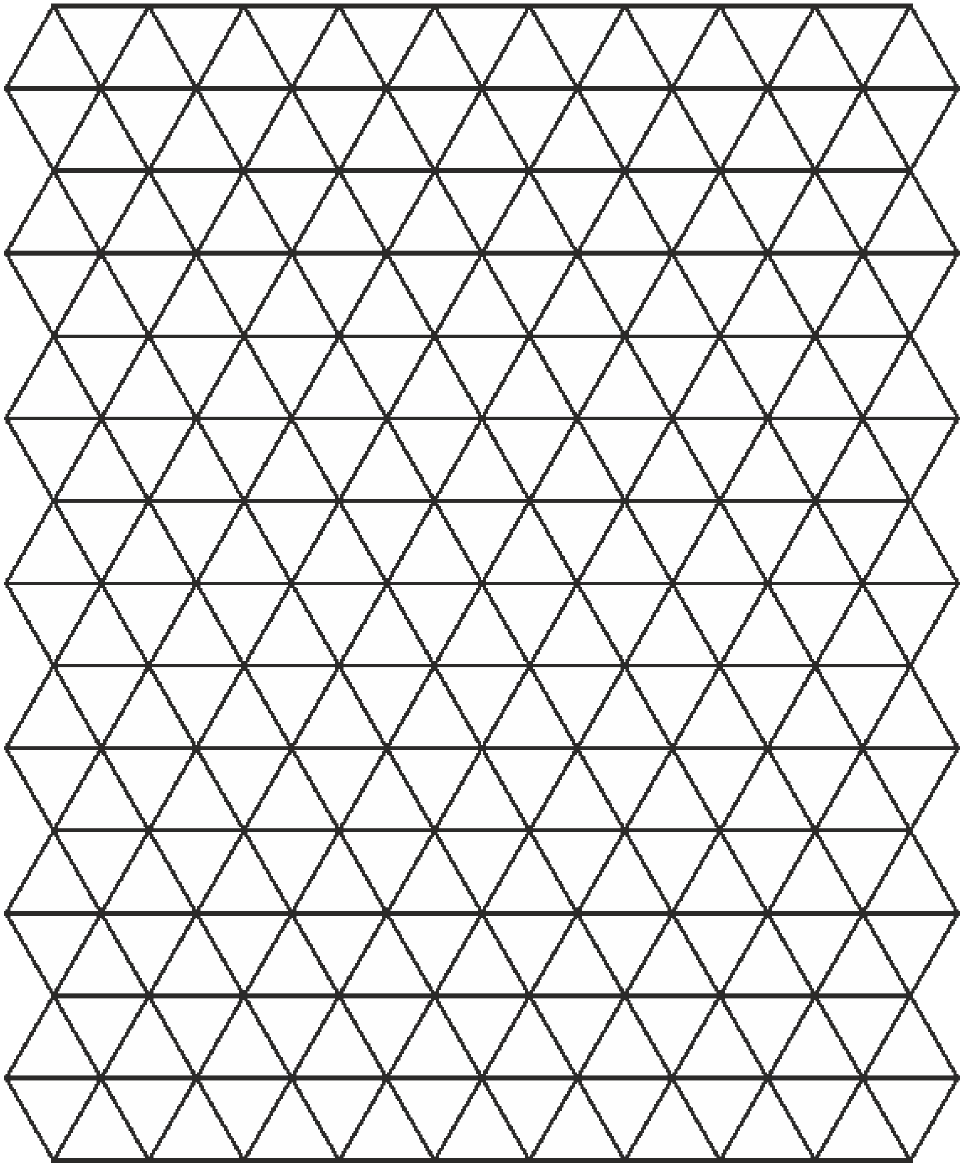
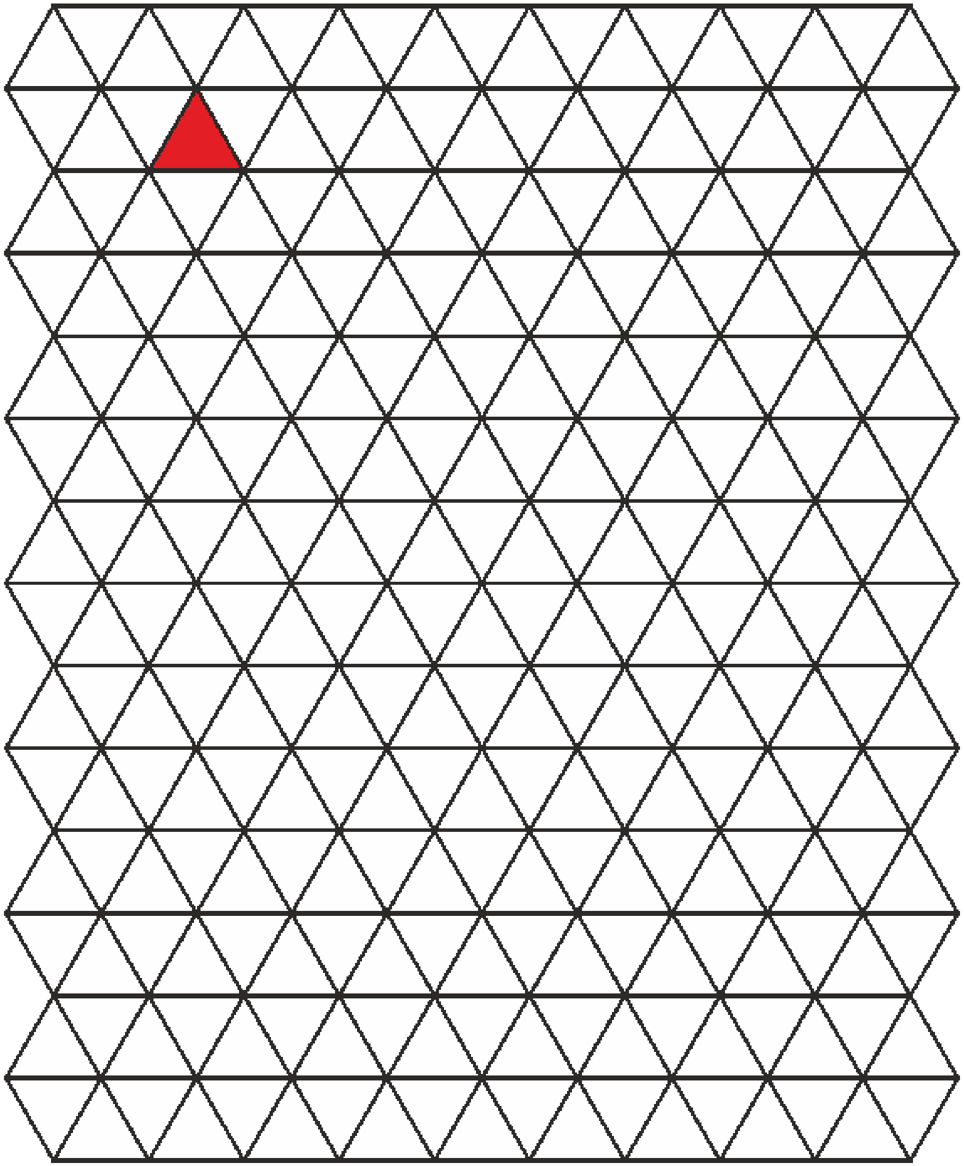
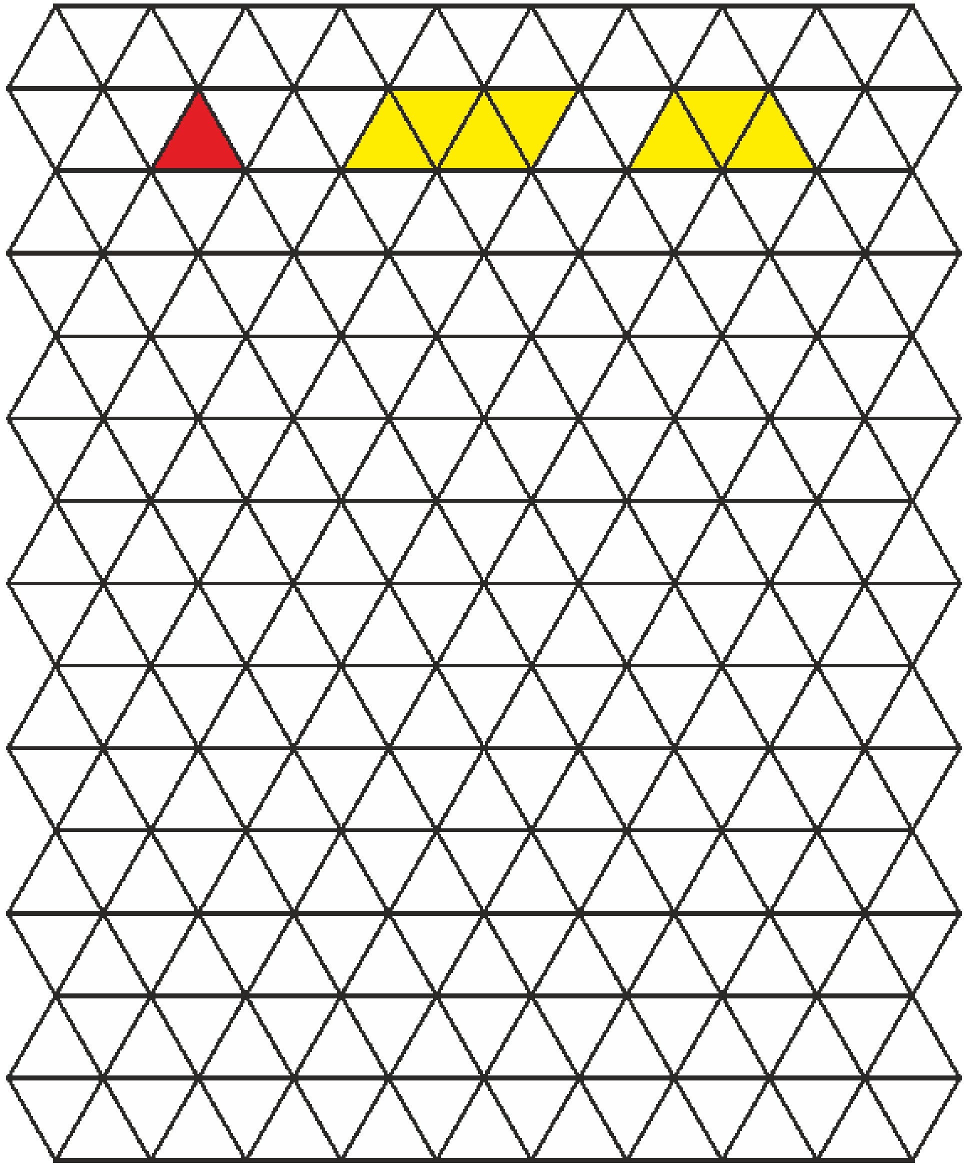
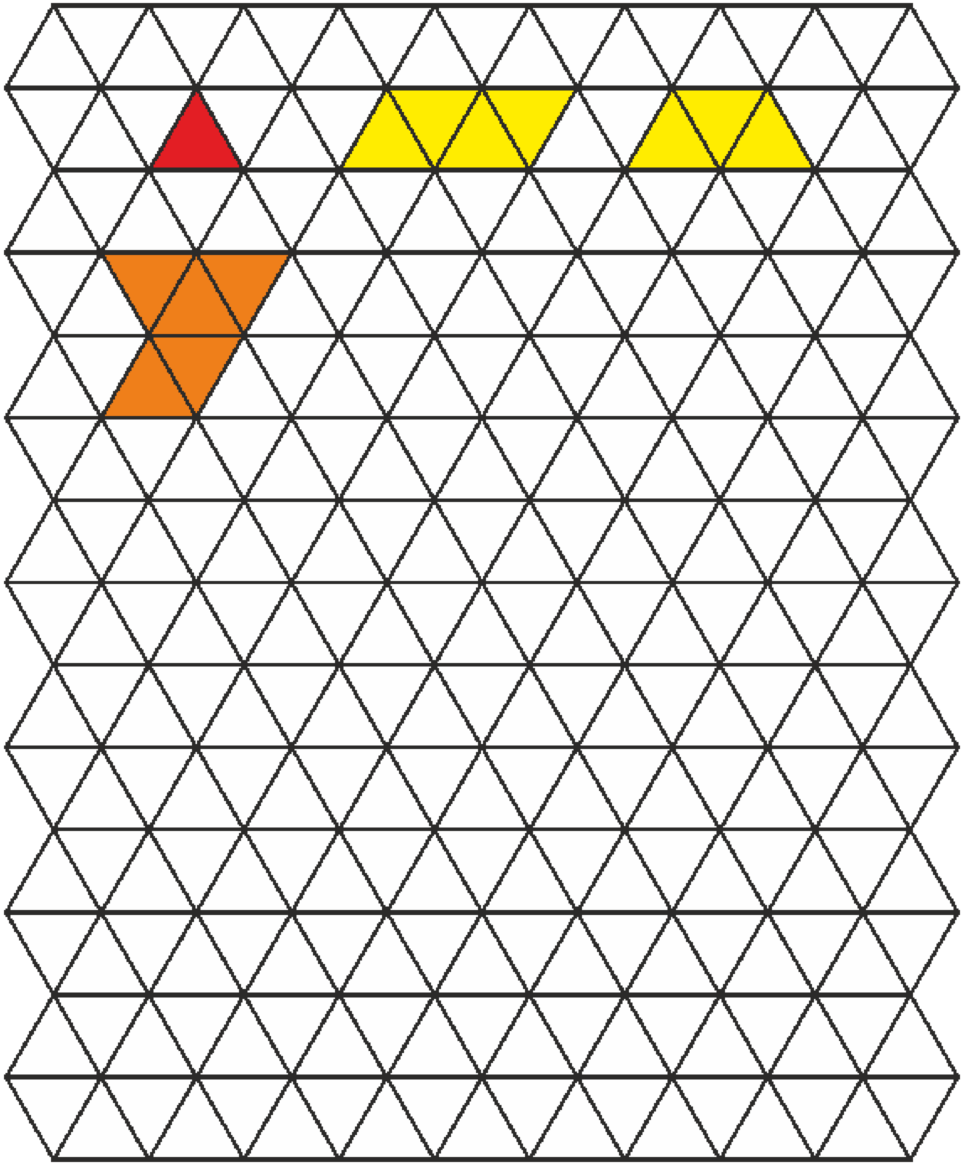
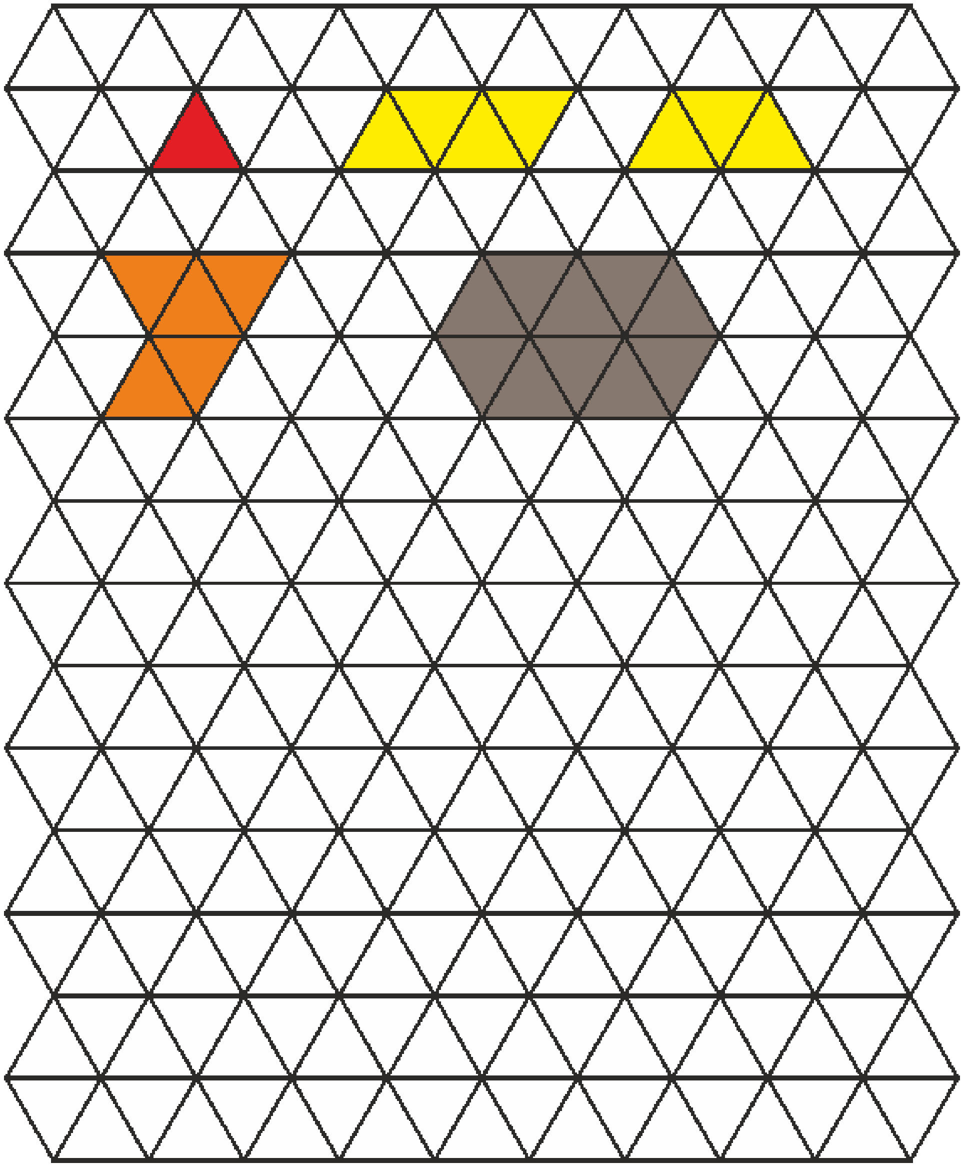
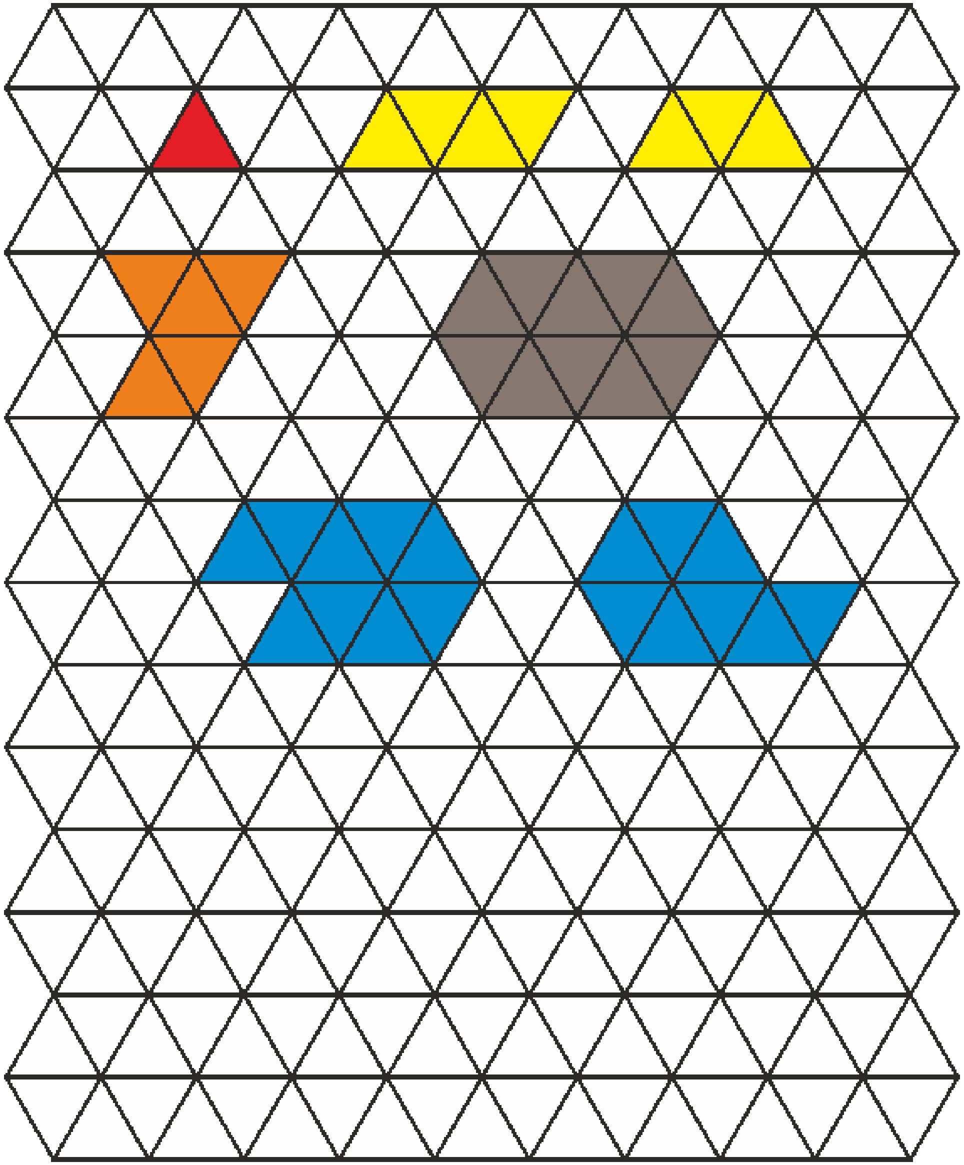


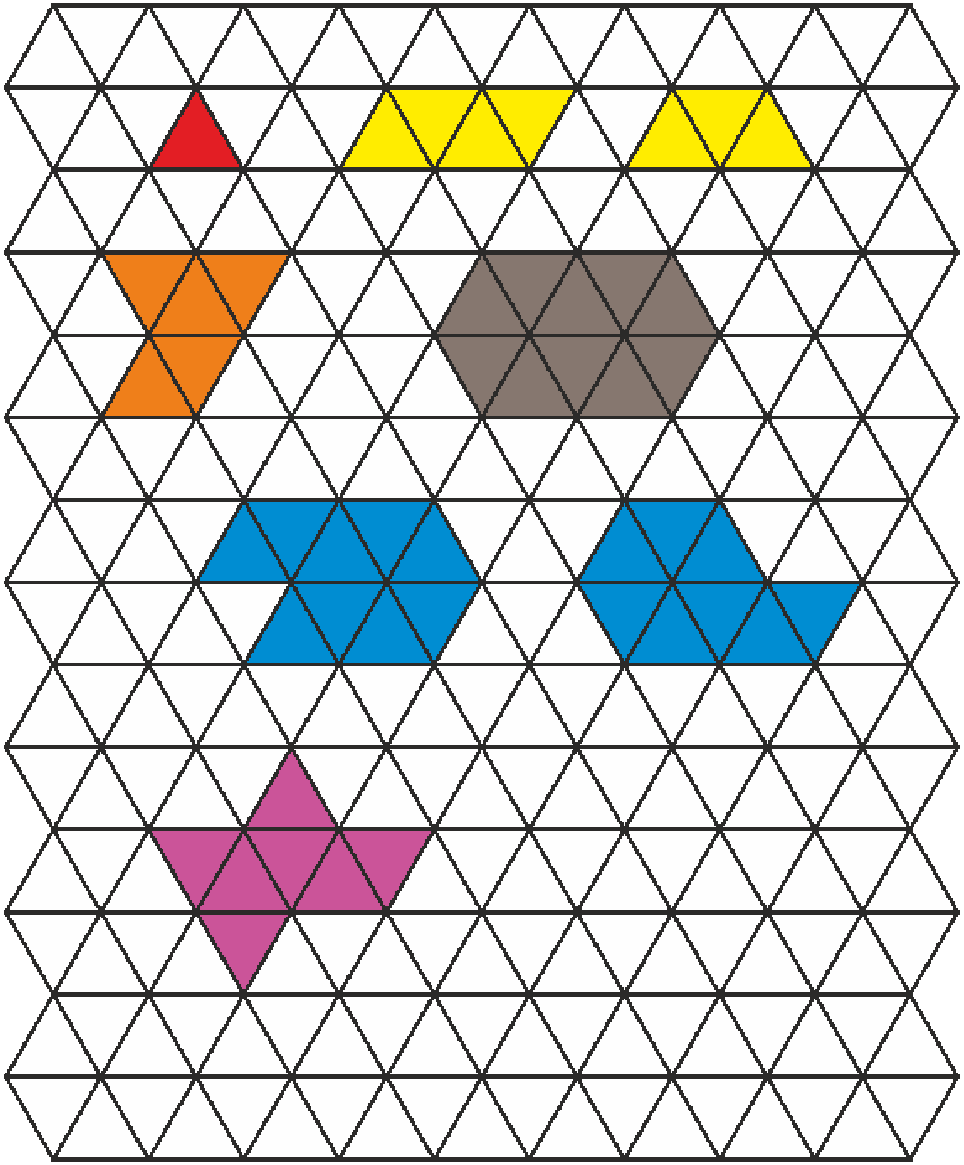


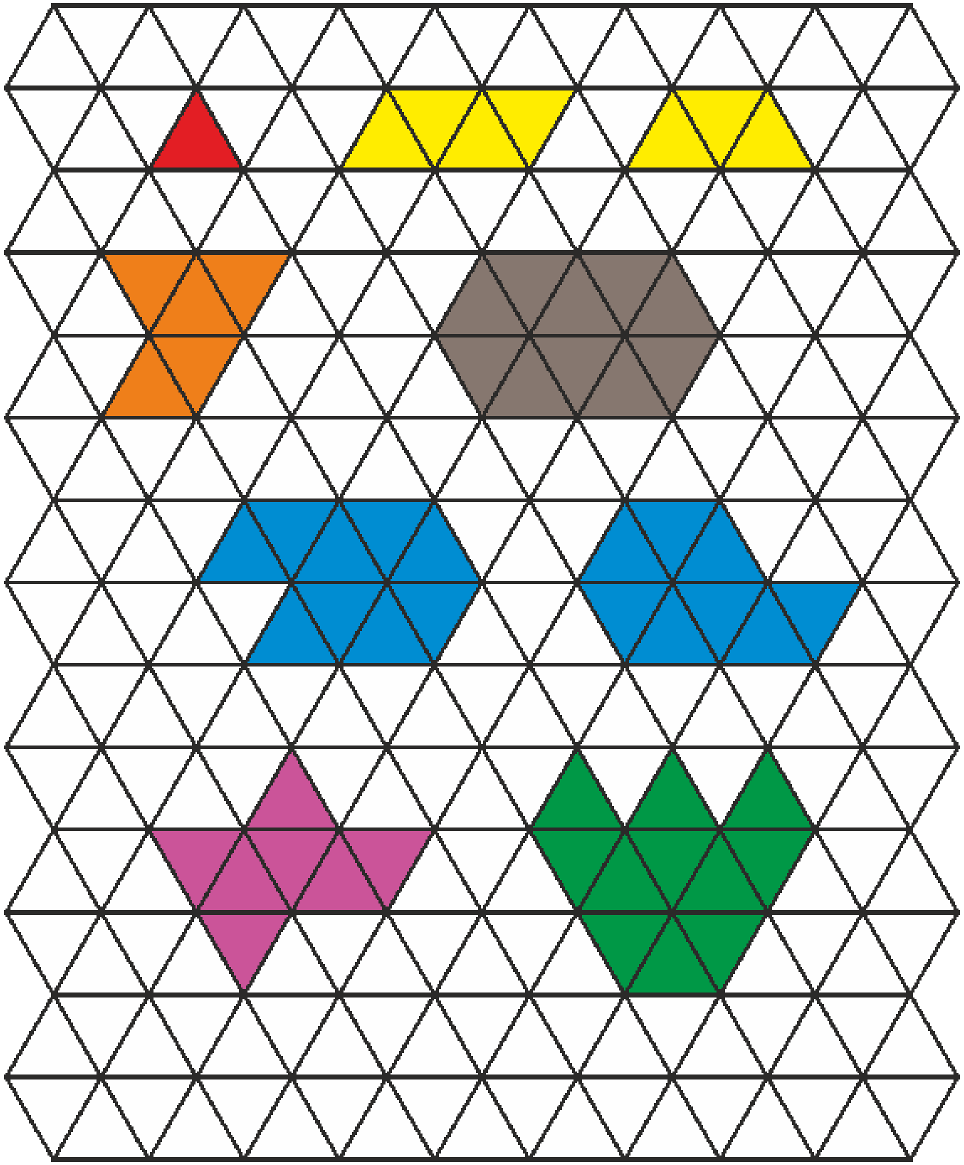




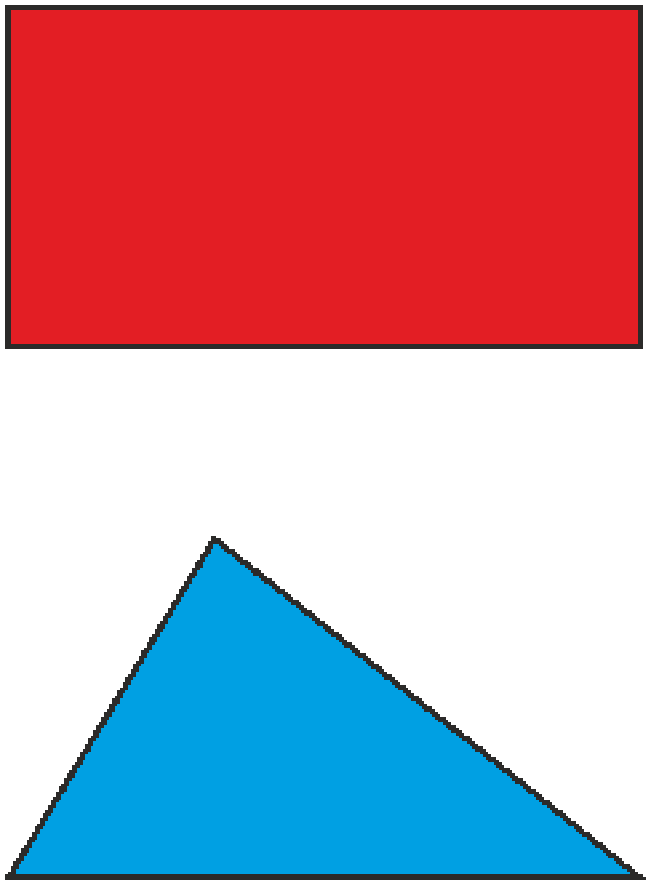




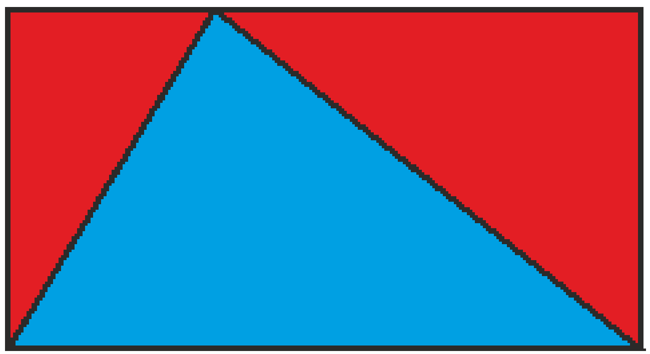




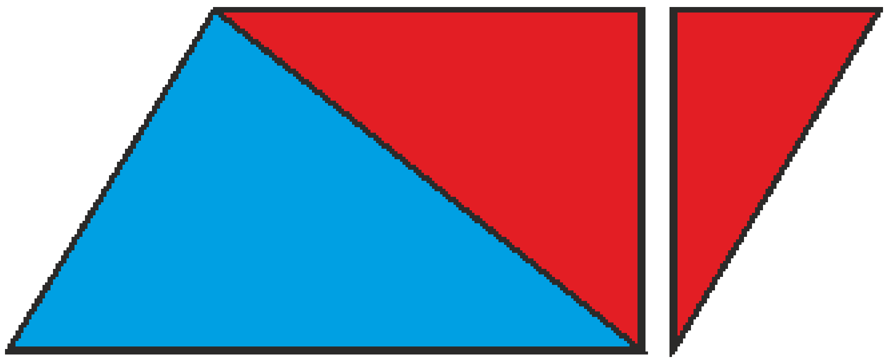
A (triangle) = 1/2 A (Rectangle)



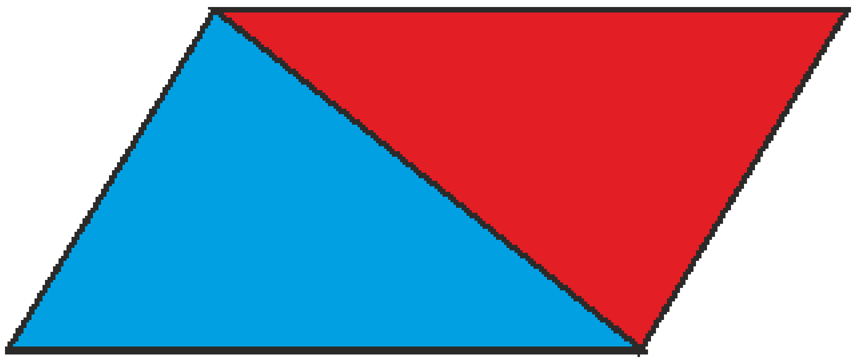
A (triangle) = 1/2 A (Rectangle)



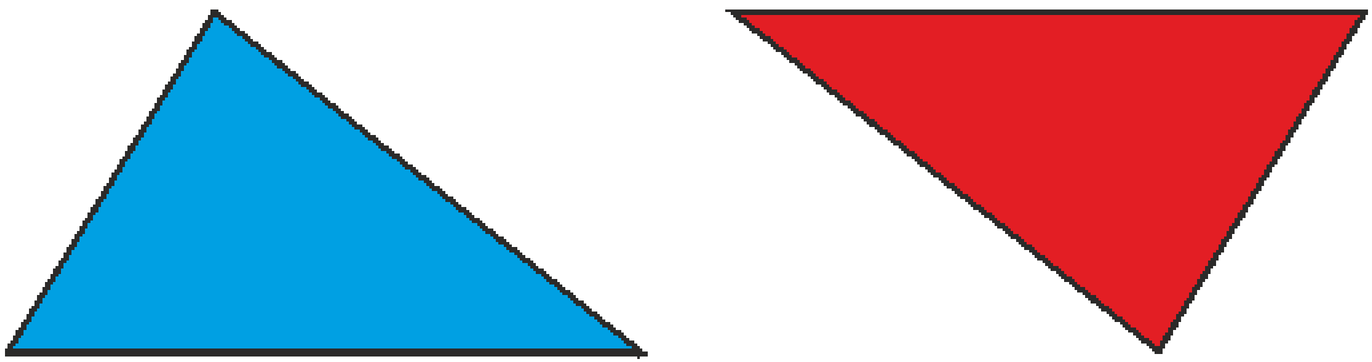
A (triangle) = 1/2 A (Rectangle)



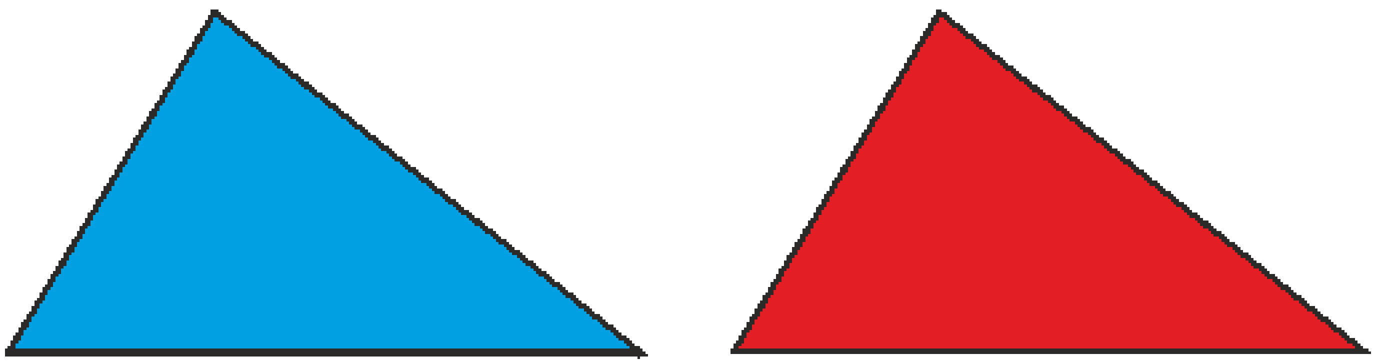
A (triangle) = 1/2 A (Rectangle)



A (triangle) = 1/2 A (Rectangle)



A (triangle) = 1/2 A (Rectangle)

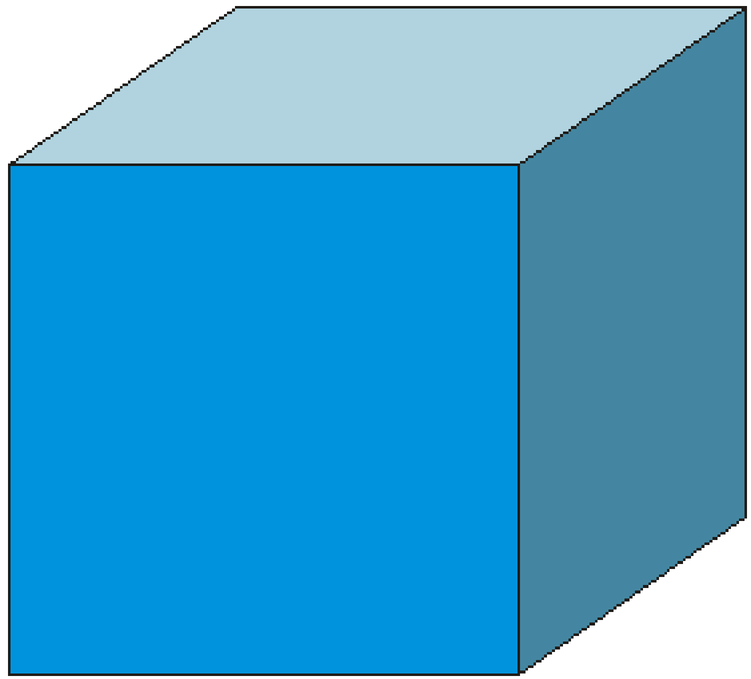


V (Piràmide) = 1/3 V (Prisma)

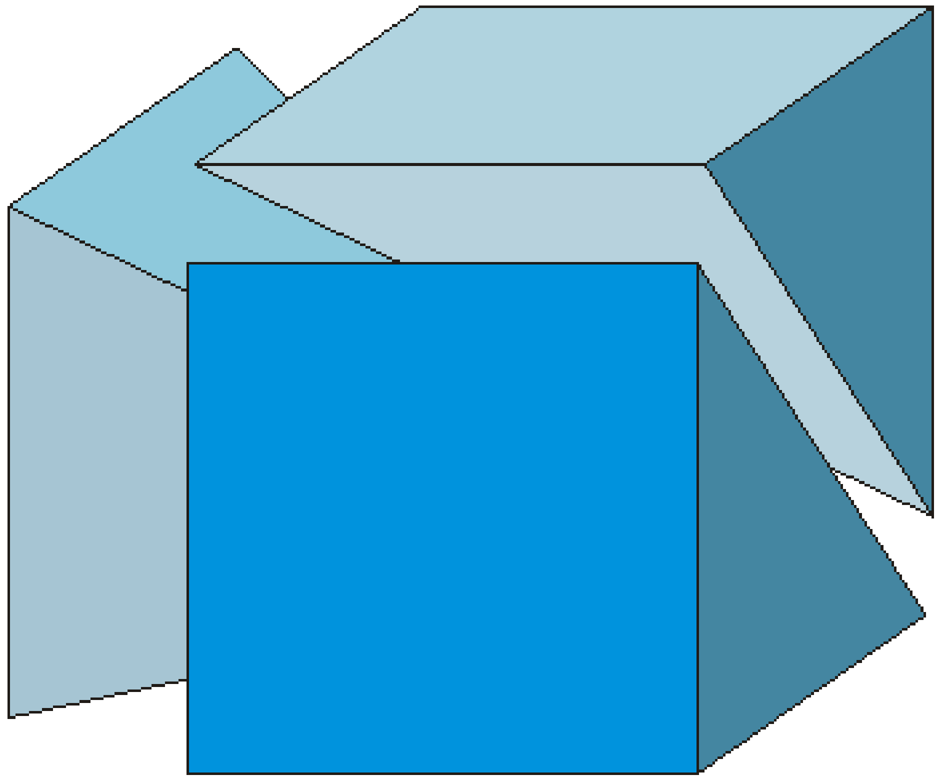
Resposta alumne:

V (Piràmide) = 1/2 V (Prisma)

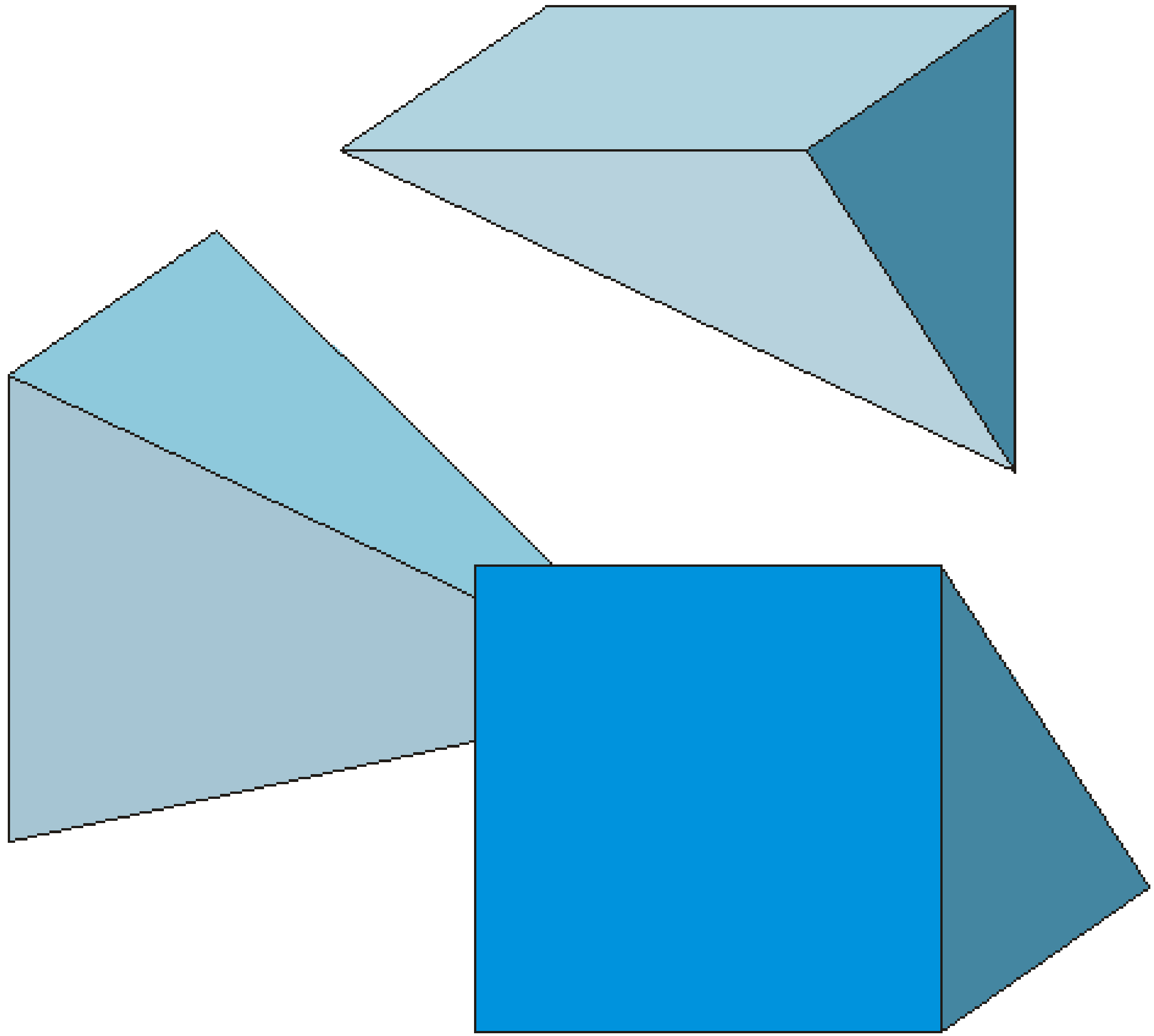
V (Piràmide) = 1/3 V (Prisma)



V (Piràmide) = 1/3 V (Prisma)



V (Piràmide) = 1/3 V (Prisma)

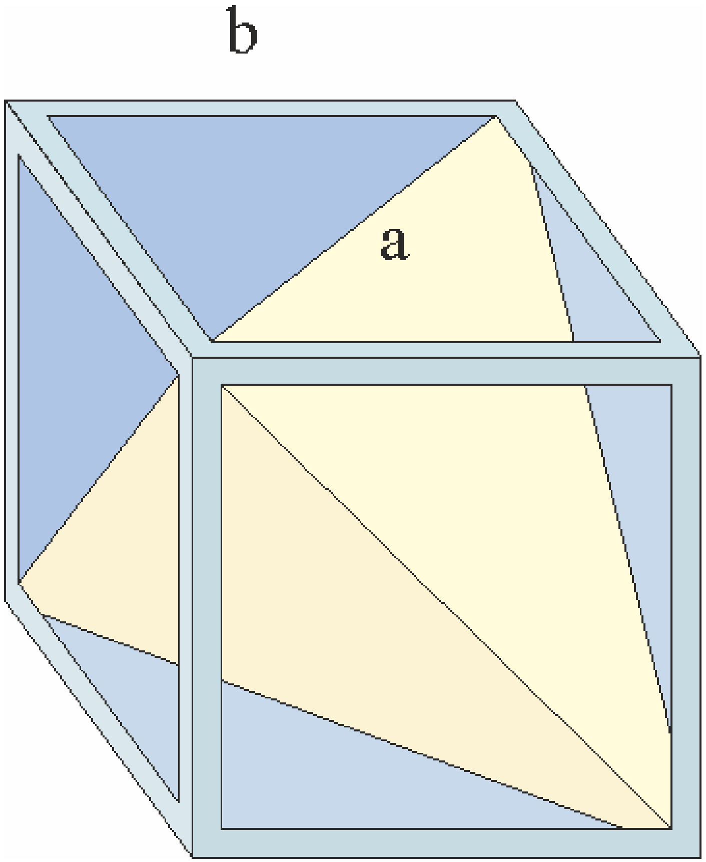


Volum del tetraedre

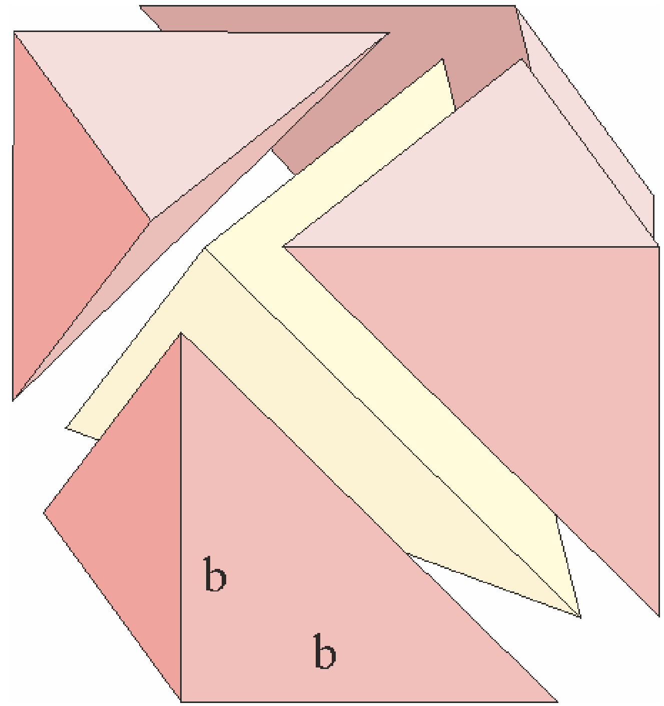
Aresta del tetraedre = a

Aresta del cub = b

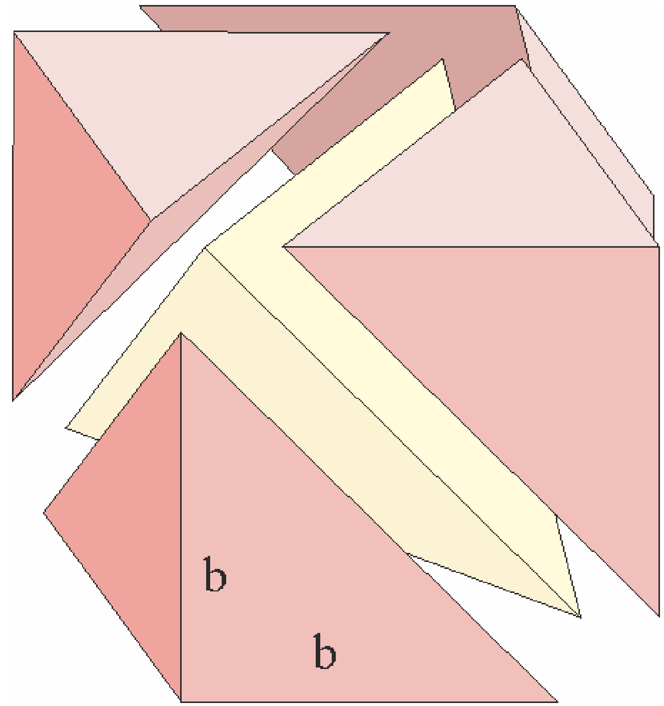
$a/b = \sqrt{2}$



Volum del tetraedre

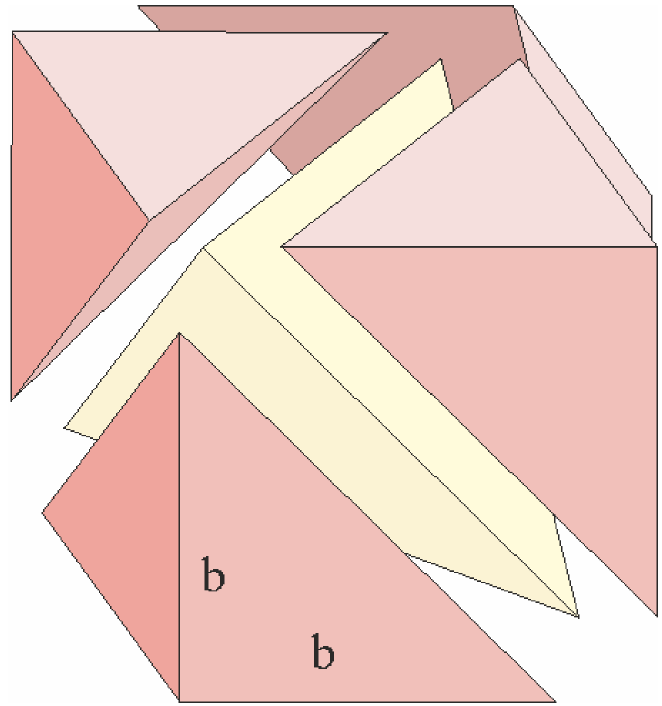


Volum del tetraedre



V (Cub) = 4 V (piràmide roja) + V (tetraedre)

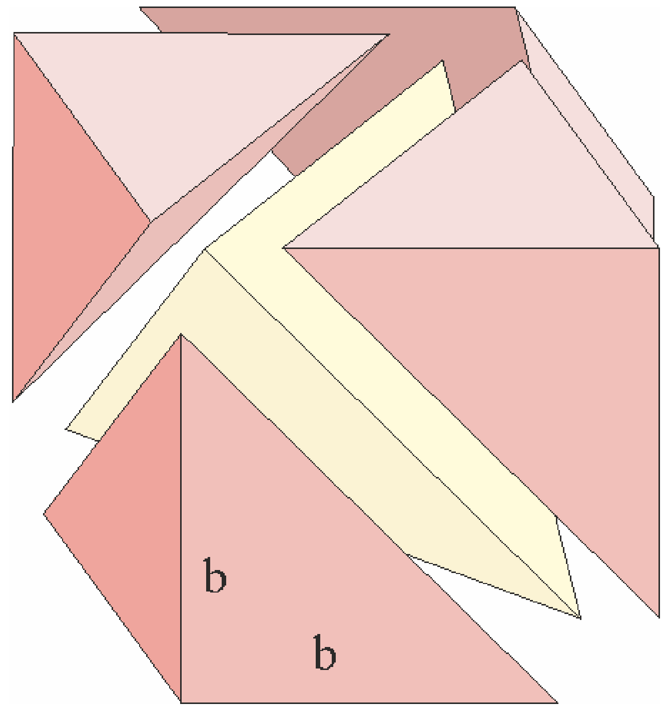
Volum del tetraedre



V (Cub) = 4 V (piràmide roja) + V (tetraedre)

V (tetraedre) = V (Cub) - 4 V (piràmide roja)

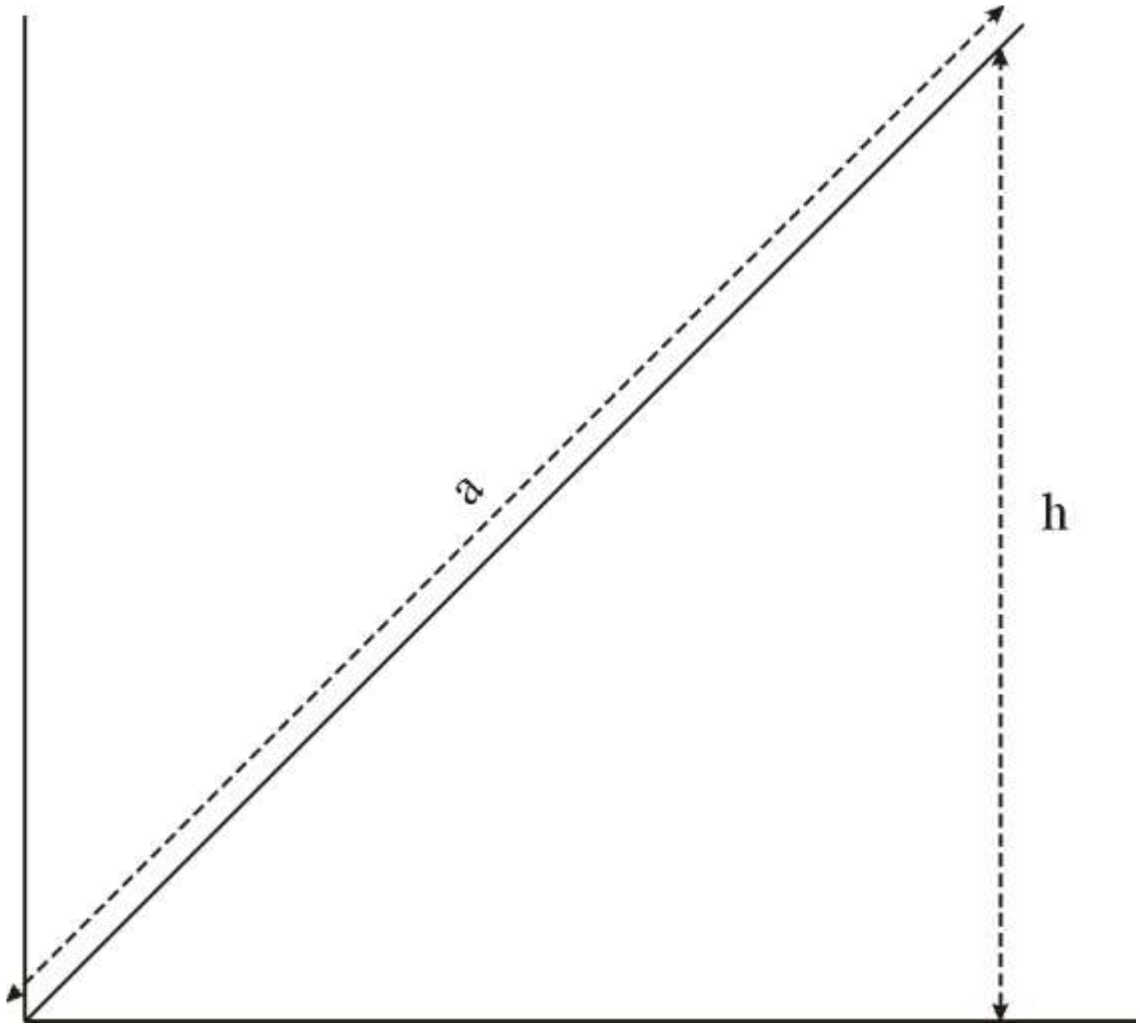
Volum del tetraedre



$$V(\text{piràmide roja}) = \frac{Ab \cdot h}{3} = \frac{b^3}{6} = \frac{V(\text{cub})}{6}$$

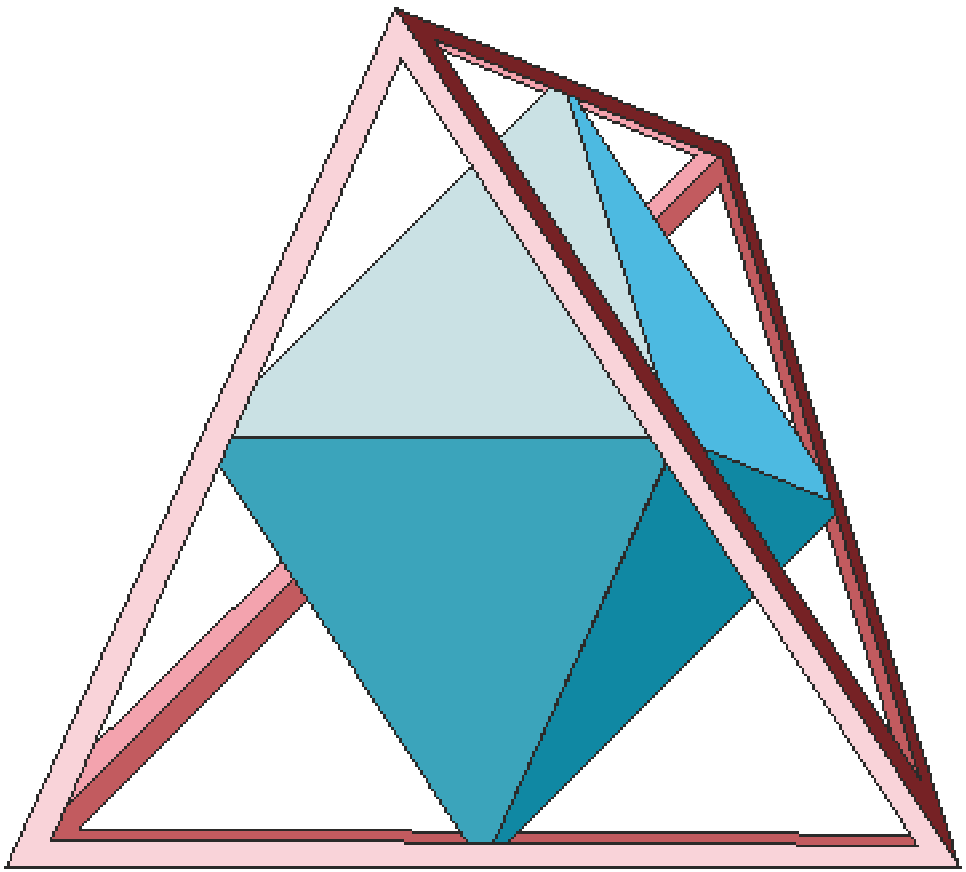
$$V(\text{tetraedre}) = \left(1 - \frac{4}{6}\right) V(\text{cub}) = \frac{b^3}{3} = \frac{a^3}{3 \cdot \left(\sqrt{2}\right)^3} = \frac{\sqrt{2}}{12} \cdot a^3$$

APROXIMACIÓ DEL VOLUM DEL TETRAEDRE

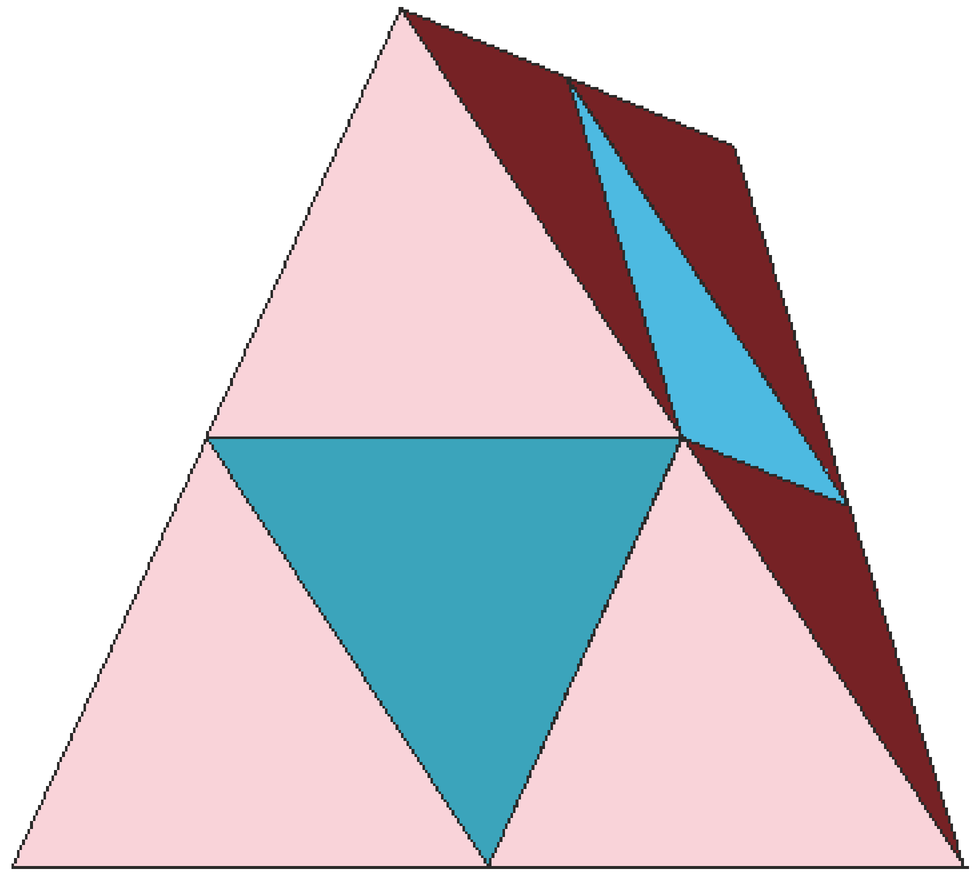


$$V(\text{tetraedre}) = \frac{h^3}{3}$$

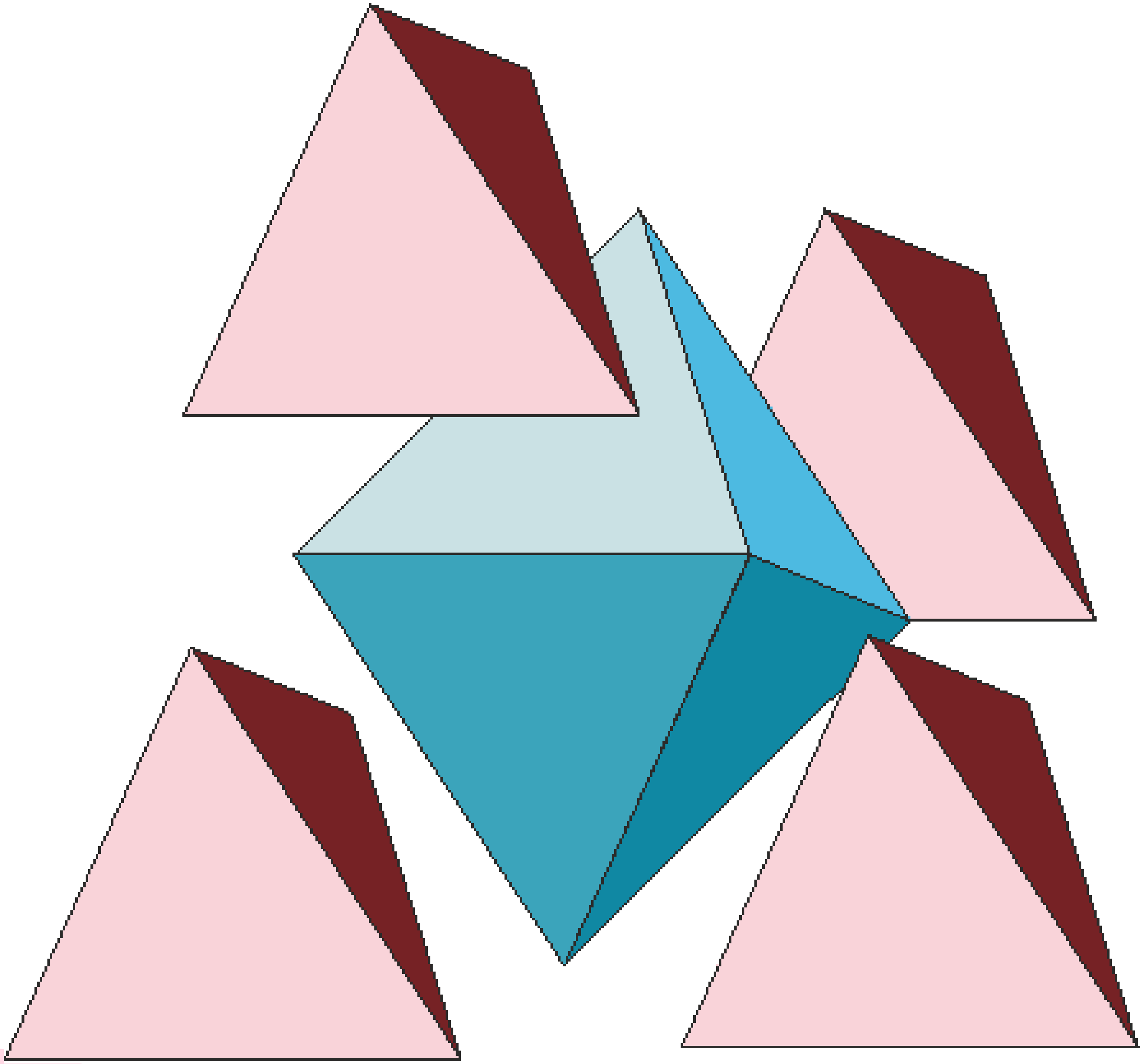
VOLUM DE L'OCTAEDRE



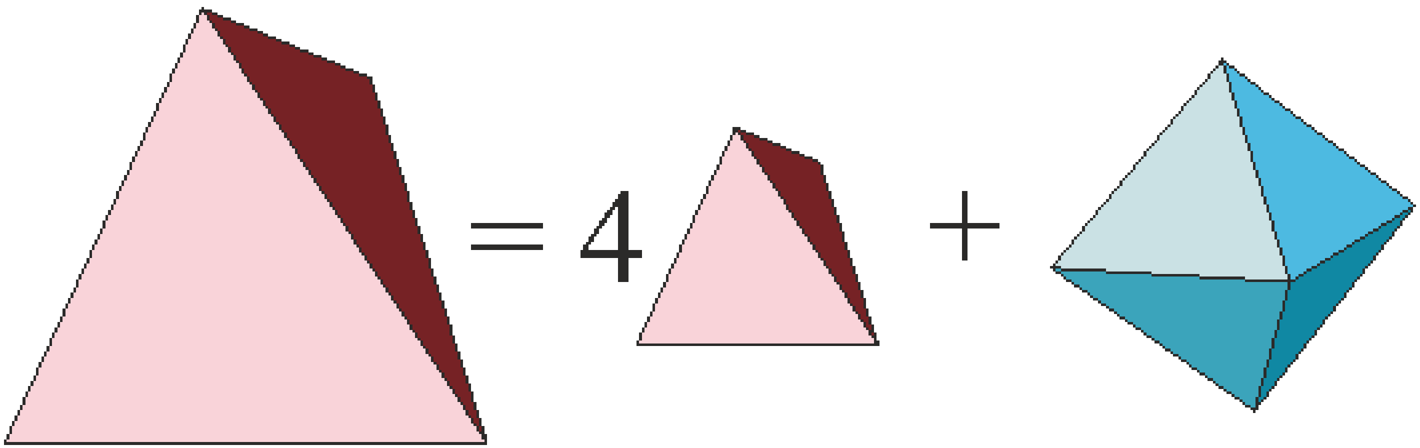
VOLUM DE L'OCTAEDRE



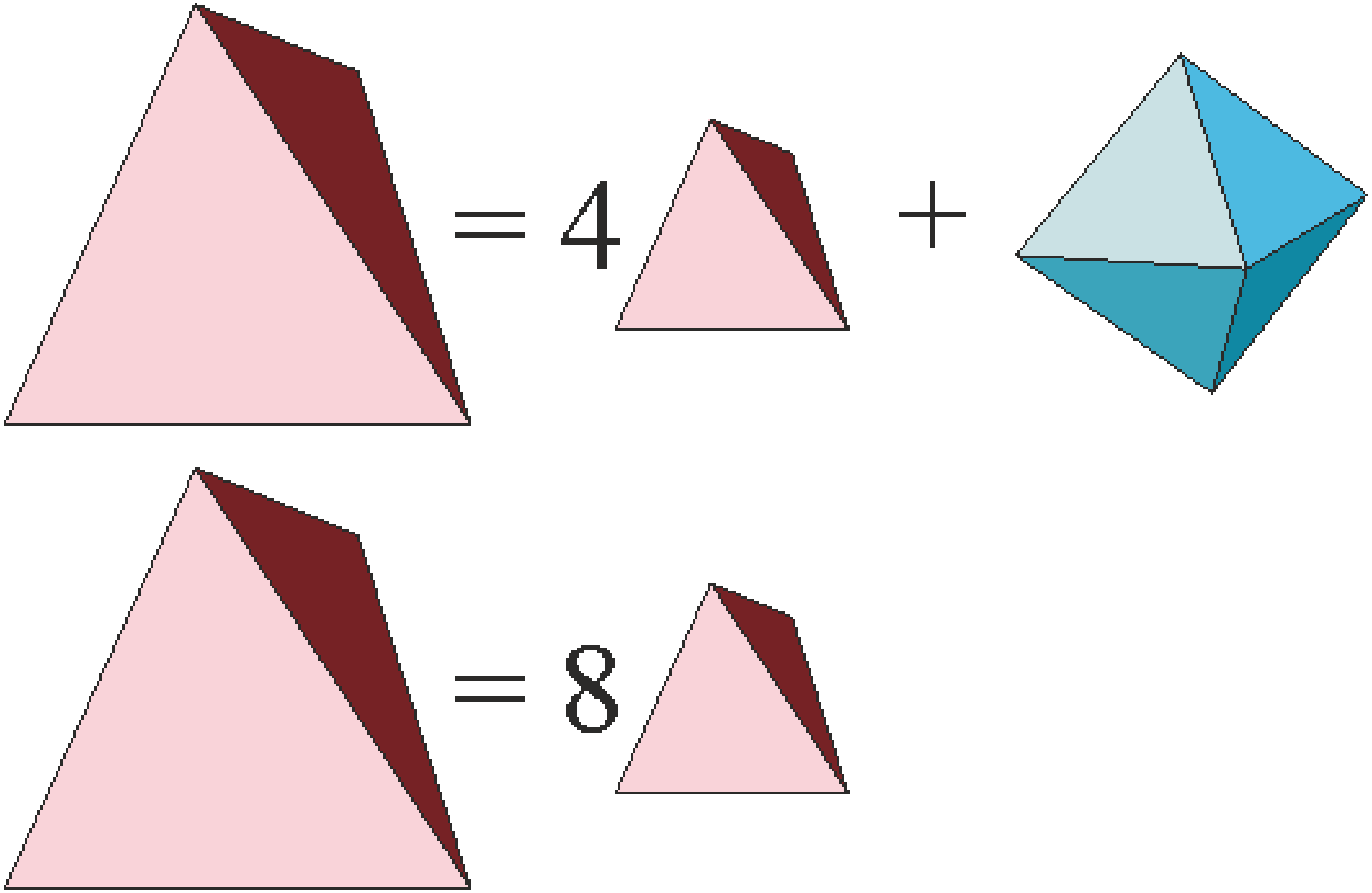
VOLUM DE L'OCTAEDRE



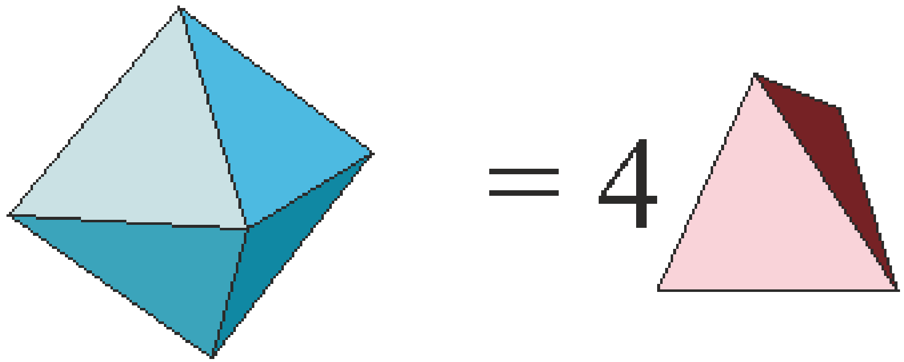
VOLUM DE L'OCTAEDRE



VOLUM DE L’OCTAEDRE

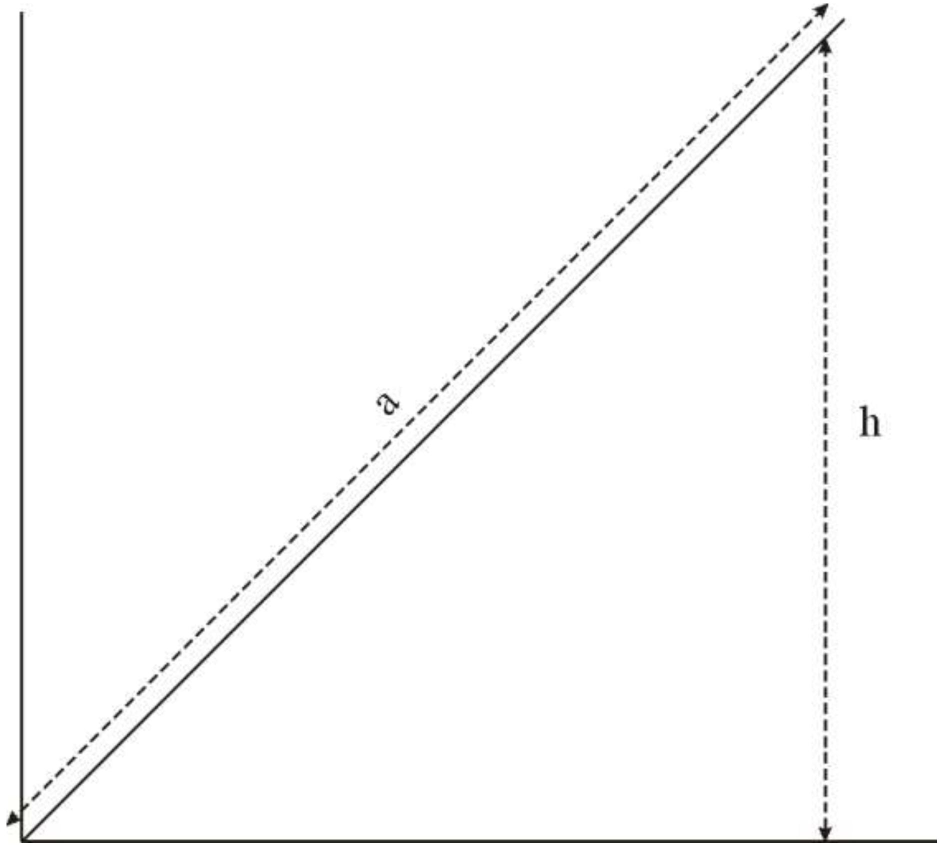


VOLUM DE L'OCTAEDRE



$$V(\text{octaedre}) = 4V(\text{tetraedre}) = 4 \cdot \frac{\sqrt{2}}{12} \cdot a^3 = \frac{\sqrt{2}}{3} \cdot a^3$$

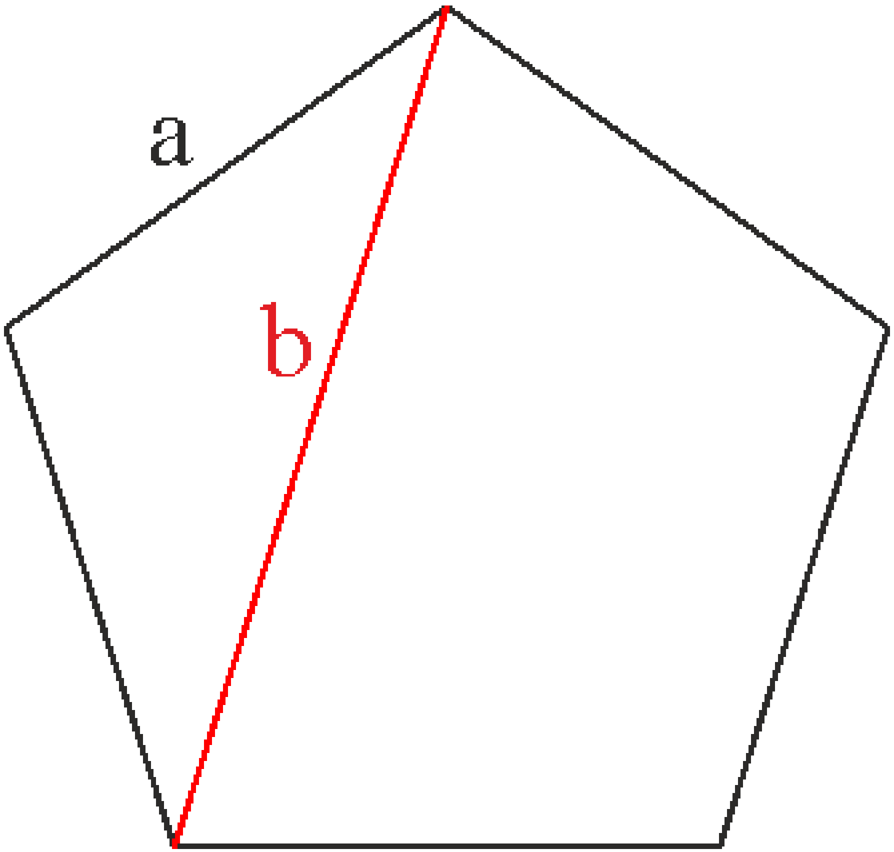
APROXIMACIÓ DEL VOLUM DE L'OCTAEDRE



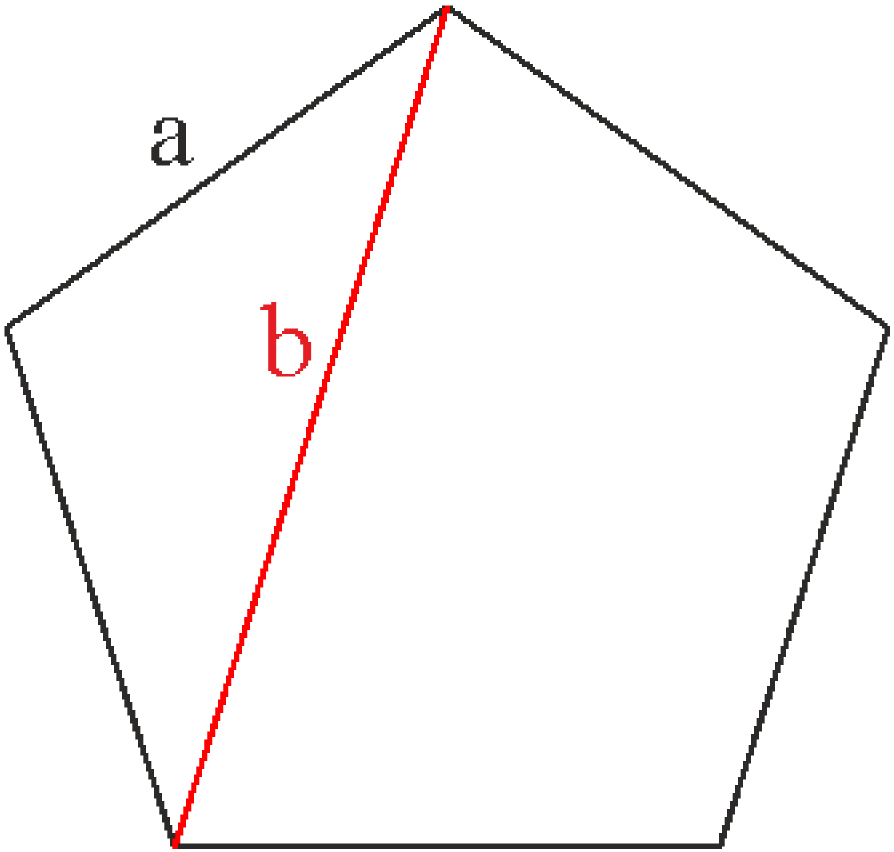
$$V(\text{tetraedre}) = \frac{h^3}{3}$$

$$V(\text{octaedre}) = \frac{4 \cdot h^3}{3}$$

ARESTA I DIAGONAL D'UN PENTÀGON ESTAN EN PROPORCIÓ AURIA



Aresta i diagonal d'un pentàgon estan en proporció auria

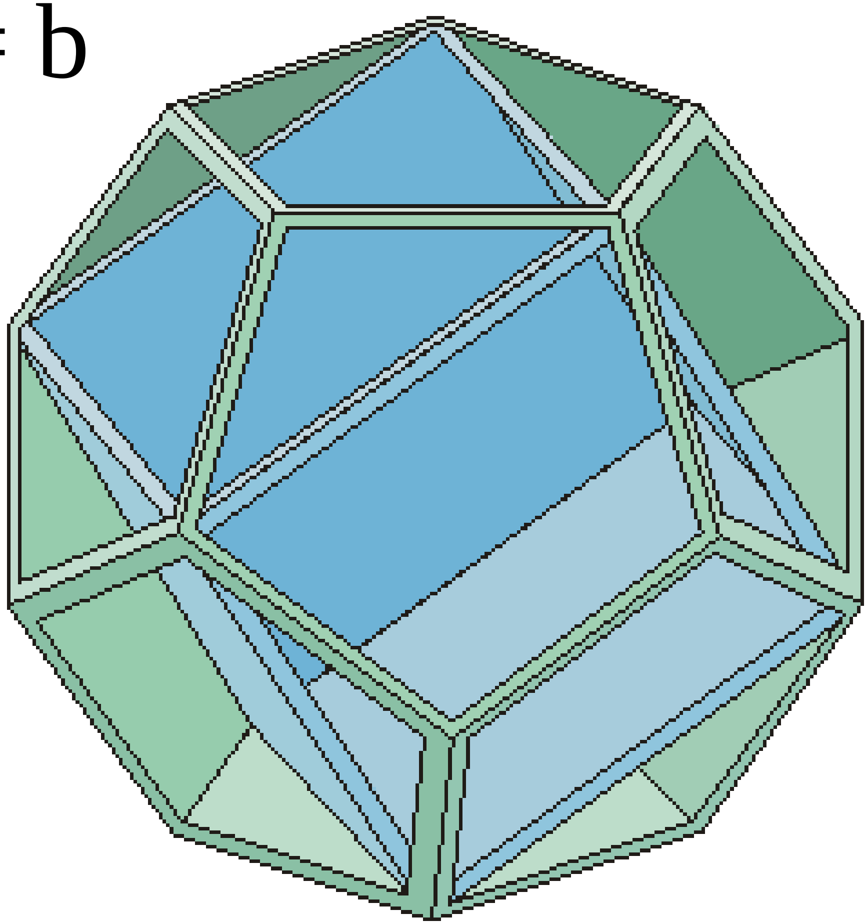


$$\frac{b}{a} = \Phi = \frac{1+\sqrt{5}}{2}$$

Volum del dodecaedre

Aresta del dodecaedre = a

Aresta del cub = b



b/a = Φ

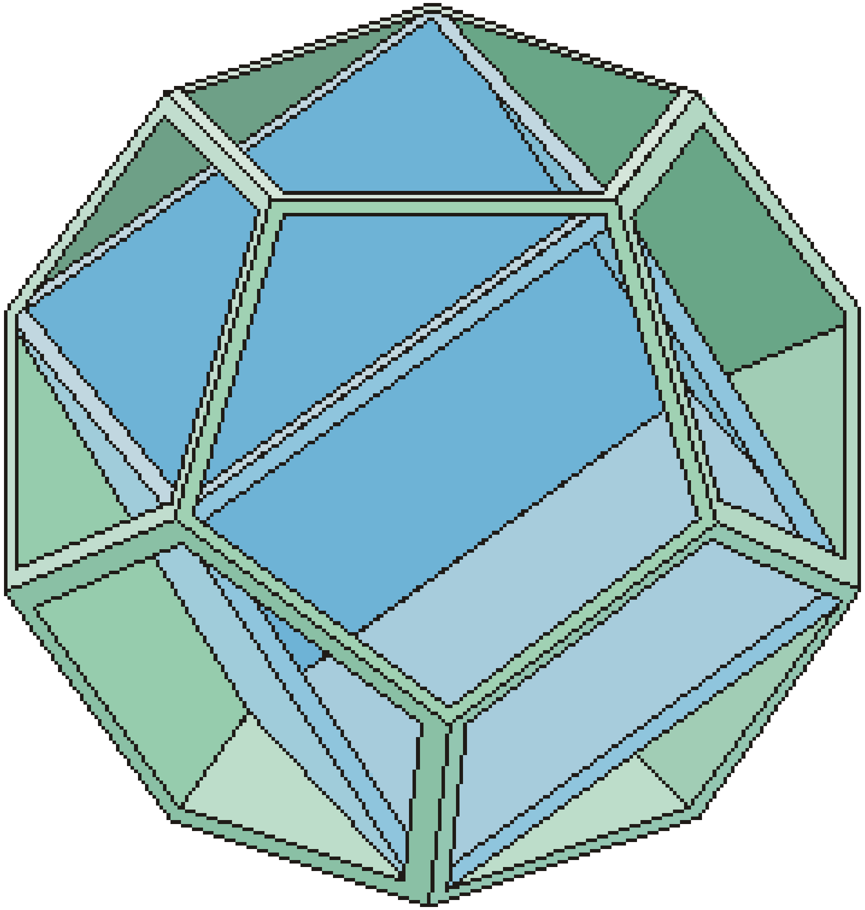
Radi dodecaedre = Radi cub = r

Radi cub = ½ diagonal del cub

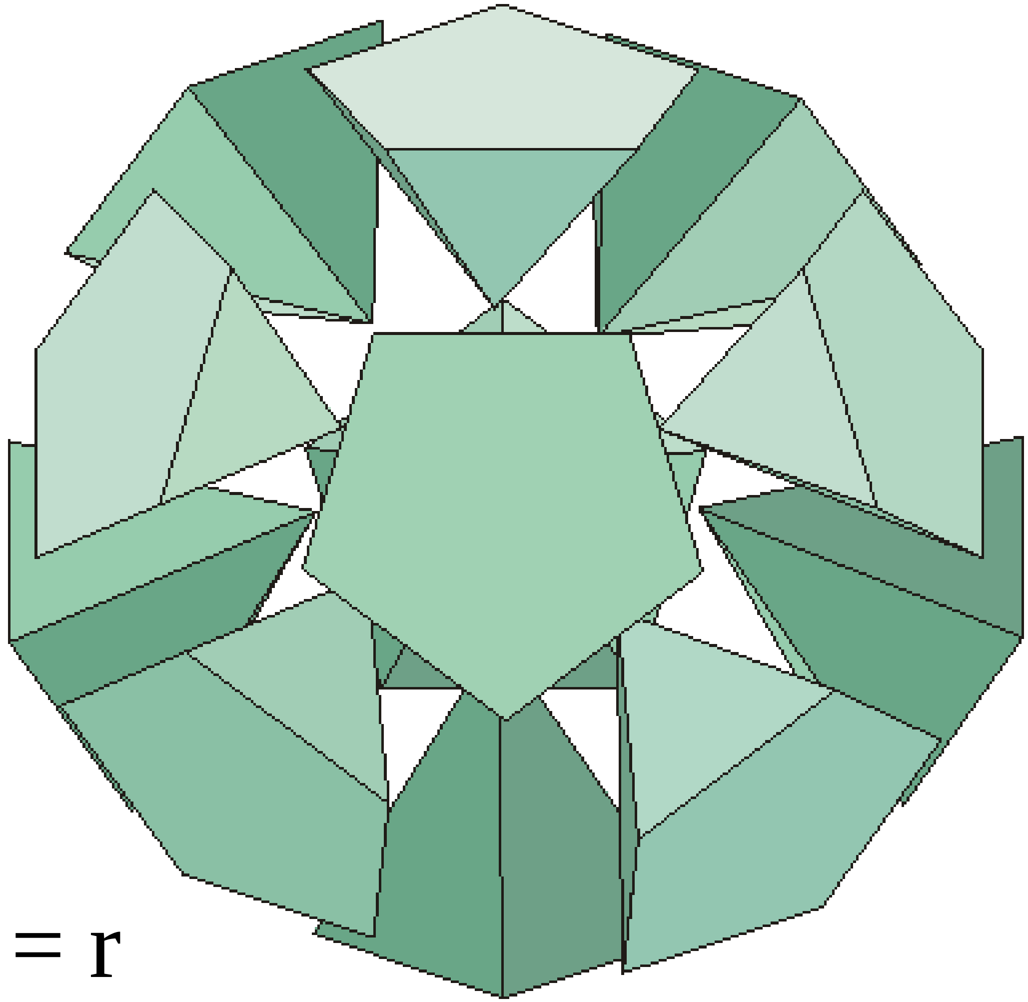
$$r = \frac{1}{2} d = \frac{\sqrt{3}}{2} b =$$

$$= \frac{\sqrt{3}}{2} \cdot \frac{1+\sqrt{5}}{2} a =$$

$$= \frac{\sqrt{3}+\sqrt{15}}{4} a$$

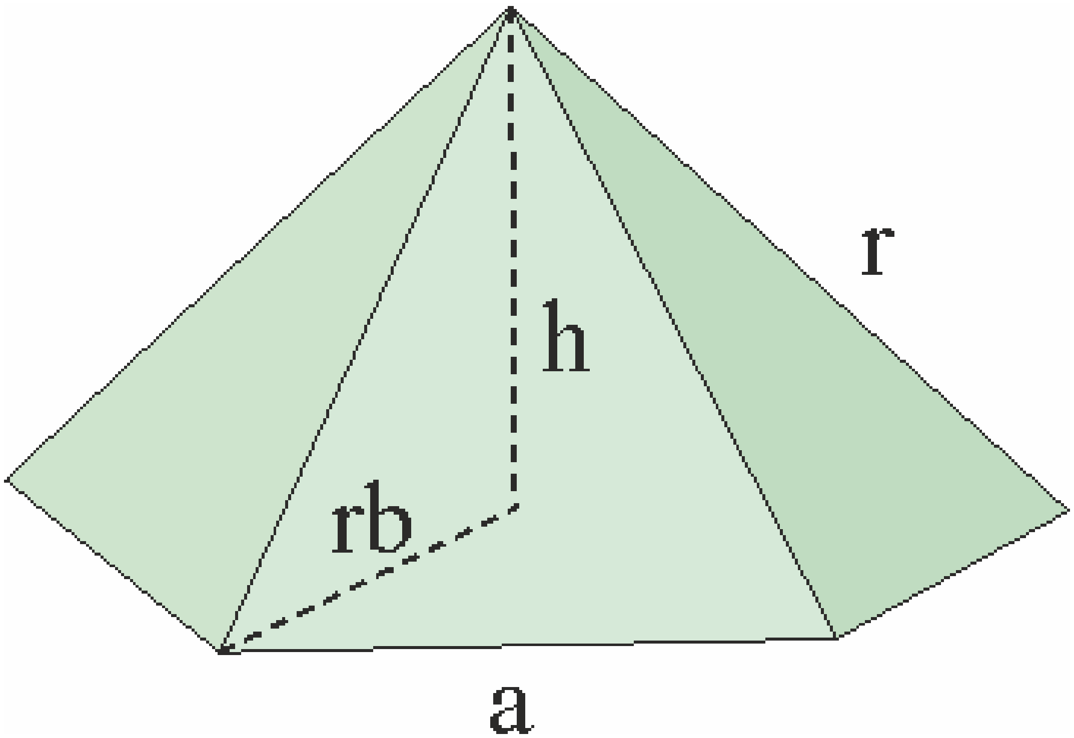


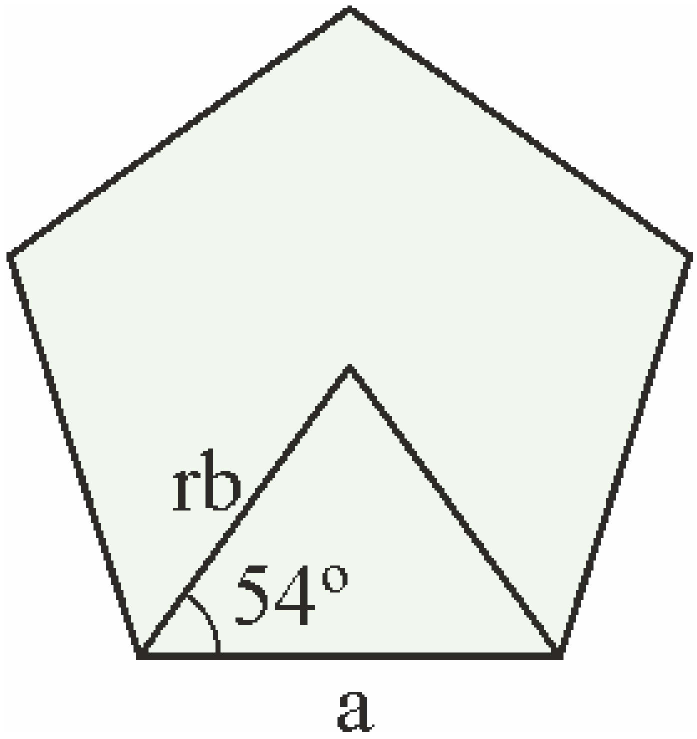
V (dodecaedre) = 12 ·V (Piràmide)



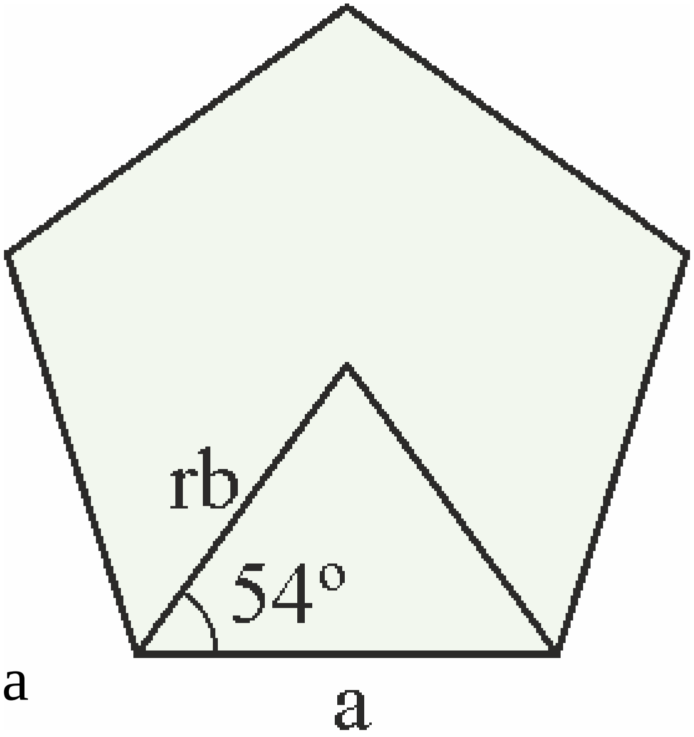
Aresta lateral = r

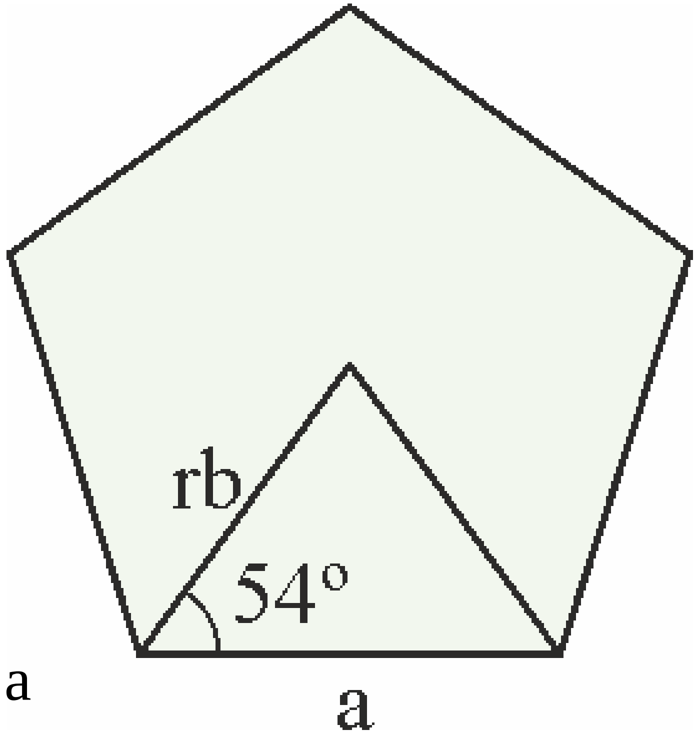
Volum de la piràmide




rb
54°
a

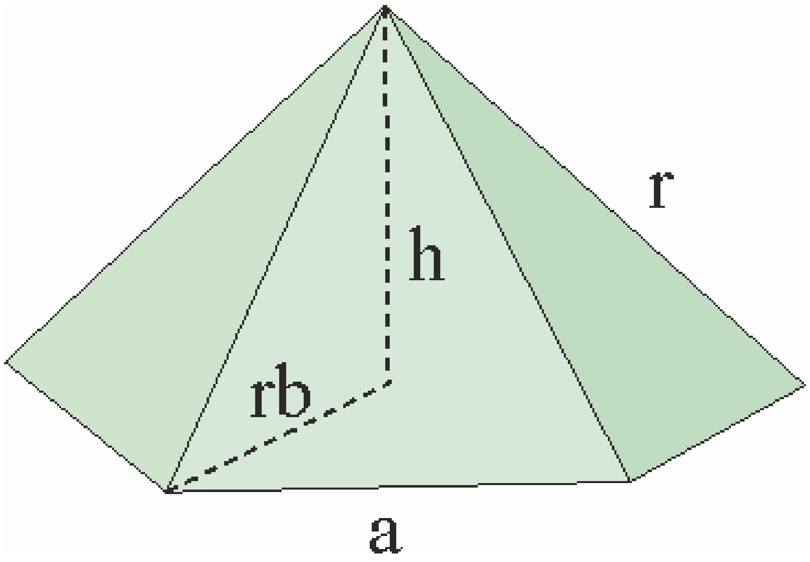
$$rb = \frac{a}{2\cos(54)} = \frac{\sqrt{10 \cdot \sqrt{5} + 50}}{10} \cdot a$$





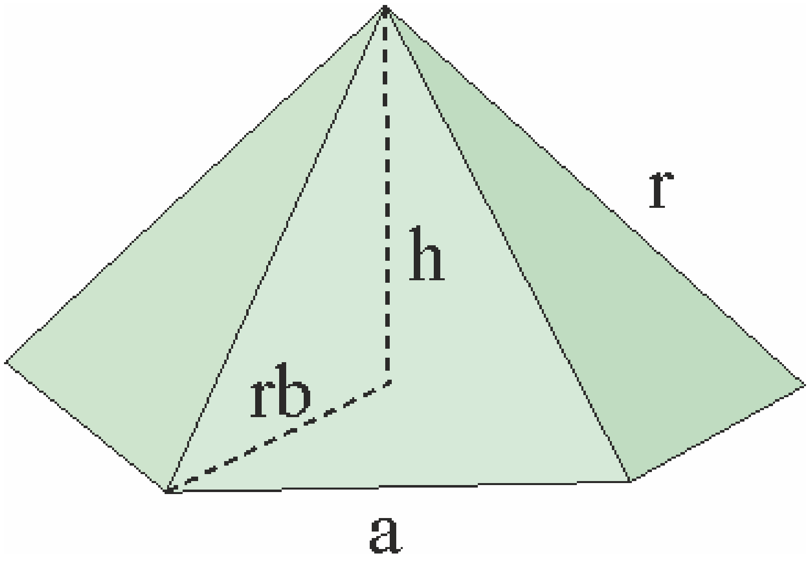
$$rb = \frac{a}{2\cos(54)} = \frac{\sqrt{10\cdot\sqrt{5}+50}}{10}\cdot a$$

$$Ab = 5\cdot\frac{a\cdot rb\cdot \sin(54)}{2} = \left(\frac{5\cdot\sqrt{2\cdot\sqrt{5}+10}}{16}+\frac{\sqrt{10\cdot\sqrt{5}+50}}{16}\right)\cdot a^2$$



$$rb = \frac{a}{2\cos(54)} = \frac{\sqrt{10 \cdot \sqrt{5} + 50}}{10} \cdot a$$

$$Ab = 5 \cdot \frac{a \cdot rb \cdot \sin(54)}{2} = \left(\frac{5 \cdot \sqrt{2 \cdot \sqrt{5} + 10}}{16} + \frac{\sqrt{10 \cdot \sqrt{5} + 50}}{16} \right) \cdot a^2$$



$$rb = \frac{a}{2\cos(54)} = \frac{\sqrt{10\cdot\sqrt{5}+50}}{10}\cdot a$$

$$Ab = 5\cdot\frac{a\cdot rb\cdot\sin(54)}{2} = \left(\frac{5\cdot\sqrt{2\cdot\sqrt{5}+10}}{16}+\frac{\sqrt{10\cdot\sqrt{5}+50}}{16}\right)\cdot a^2$$

$$h = \sqrt{r^2-(rb)^2} = \frac{\sqrt{110\cdot\sqrt{5}+250}}{20}\cdot a$$

$$rb = \frac{a}{2\cos(54)} = \frac{\sqrt{10\cdot\sqrt{5}+50}}{10}\cdot a$$

$$Ab = 5\cdot\frac{a\cdot rb\cdot \sin(54)}{2} = \left(\frac{5\cdot\sqrt{2\cdot\sqrt{5}+10}}{16} + \frac{\sqrt{10\cdot\sqrt{5}+50}}{16}\right)\cdot a^2$$

$$h = \sqrt{r^2 - (rb)^2} = \frac{\sqrt{110\cdot\sqrt{5}+250}}{20}\cdot a$$

$$rb = \frac{a}{2\cos(54)} = \frac{\sqrt{10\cdot\sqrt{5}+50}}{10}\cdot a$$

$$Ab = 5\cdot\frac{a\cdot rb\cdot \sin(54)}{2} = \left(\frac{5\cdot\sqrt{2\cdot\sqrt{5}+10}}{16} + \frac{\sqrt{10\cdot\sqrt{5}+50}}{16}\right)\cdot a^2$$

$$h = \sqrt{r^2 - (rb)^2} = \frac{\sqrt{110\cdot\sqrt{5}+250}}{20}\cdot a$$

$$V(P) = \frac{Ab\cdot h}{3}$$

$$rb = \frac{a}{2\cos(54)} = \frac{\sqrt{10\cdot\sqrt{5}+50}}{10}\cdot a$$

$$Ab = 5\cdot\frac{a\cdot rb\cdot \sin(54)}{2} = \left(\frac{5\cdot\sqrt{2\cdot\sqrt{5}+10}}{16}+\frac{\sqrt{10\cdot\sqrt{5}+50}}{16}\right)\cdot a^2$$

$$h = \sqrt{r^2-\left(rb\right)^2} = \frac{\sqrt{110\cdot\sqrt{5}+250}}{20}\cdot a$$

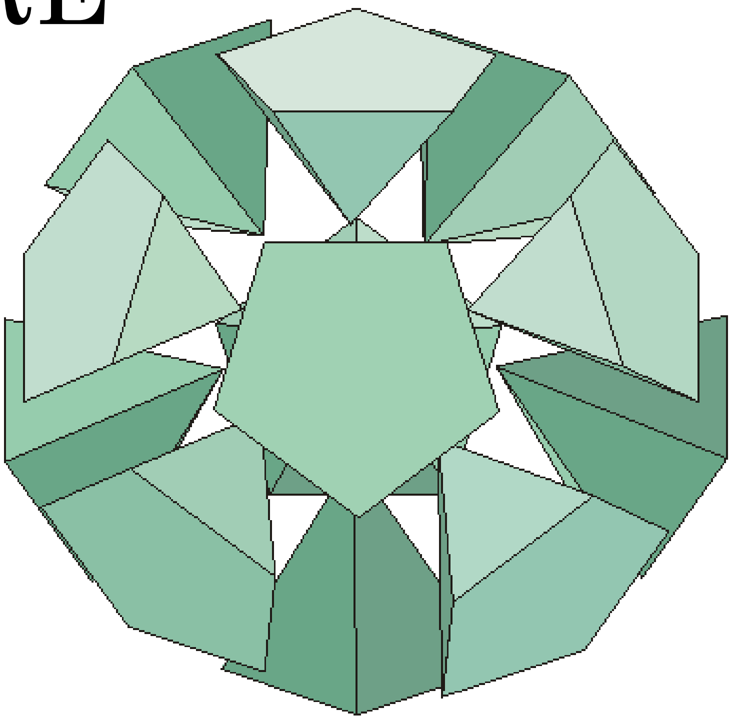
$$V(P) = \frac{Ab\cdot h}{3}$$

$$V(dodeca) = 12\cdot V(P) = 4\cdot Ab\cdot h$$

Volum del dodecaedre

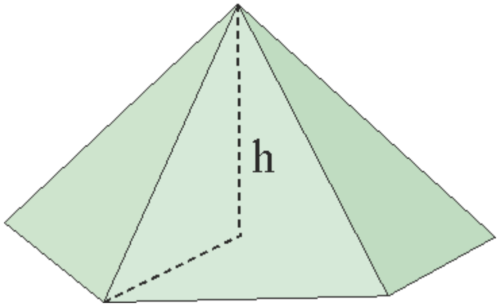
$$V = 4 \cdot Ab \cdot h = \left(\frac{7\sqrt{5}}{4} + \frac{15}{4} \right) \cdot a^3$$

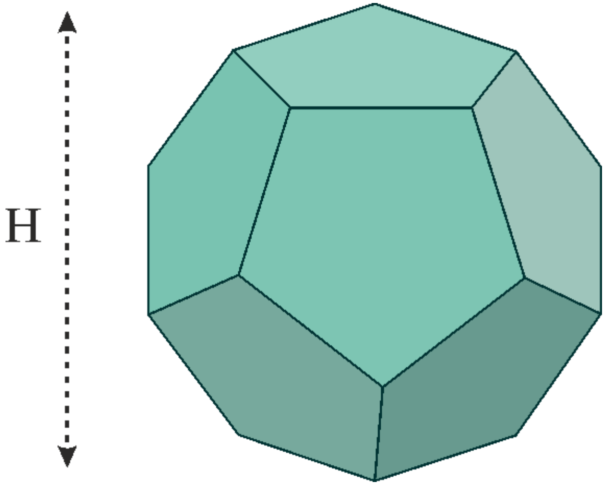
APROXIMACIÓ DEL VOLUM DEL DODECAEDRE



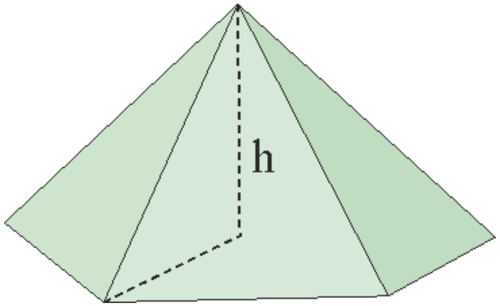
$$V\ (\text{dodecaedre}) = 12 \cdot V\ (\text{Piràmide}) = 12 \cdot \frac{A_B \cdot h}{3}$$

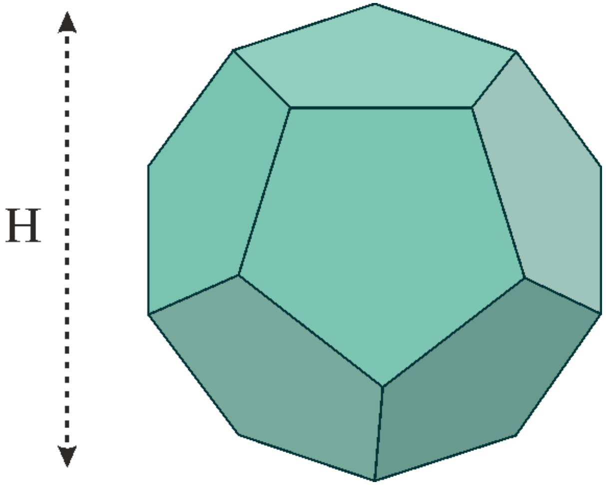
APROXIMACIÓ DEL VOLUM DEL DODECAEDRE





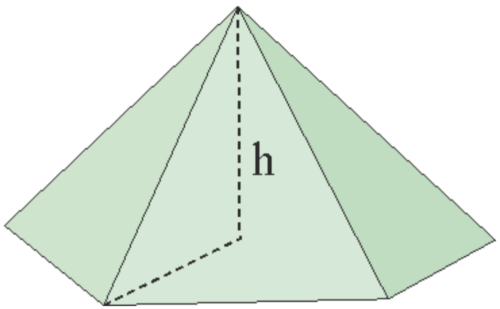
APROXIMACIÓ DEL VOLUM DEL DODECAEDRE

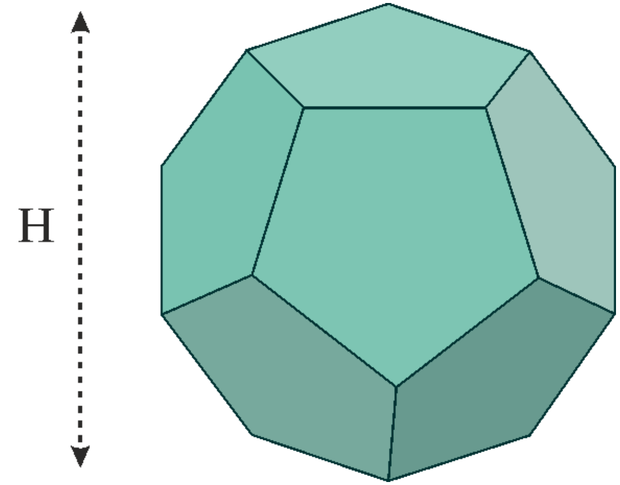




$$h = \frac{H}{2}$$

APROXIMACIÓ DEL VOLUM DEL DODECAEDRE

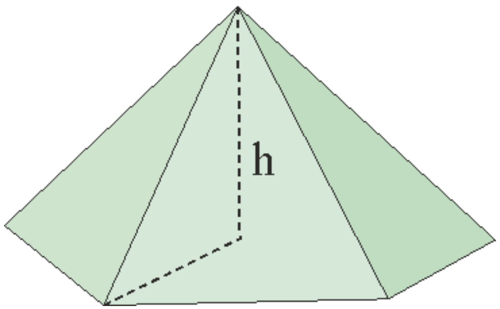


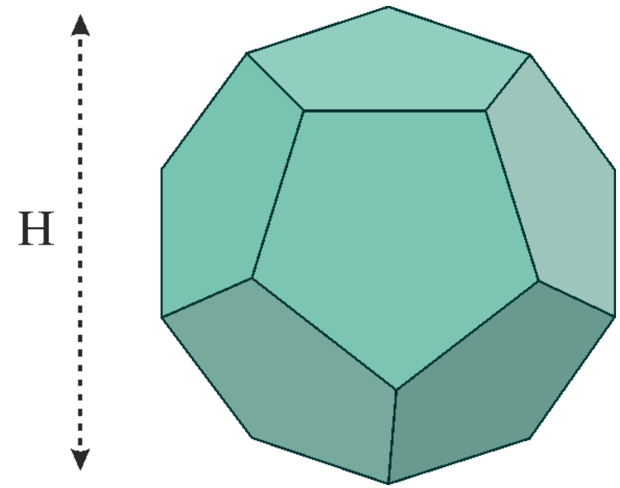


$$h = \frac{H}{2}$$

$$V_{piramide} = \frac{A_B H}{6}$$

APROXIMACIÓ DEL VOLUM DEL DODECAEDRE



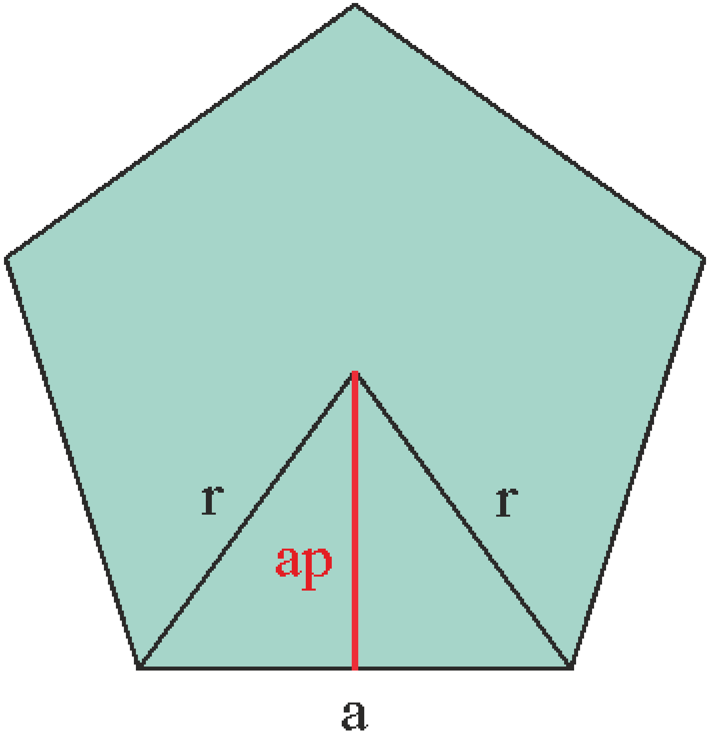


$$h = \frac{H}{2}$$

$$V_{piramide} = \frac{A_B H}{6}$$

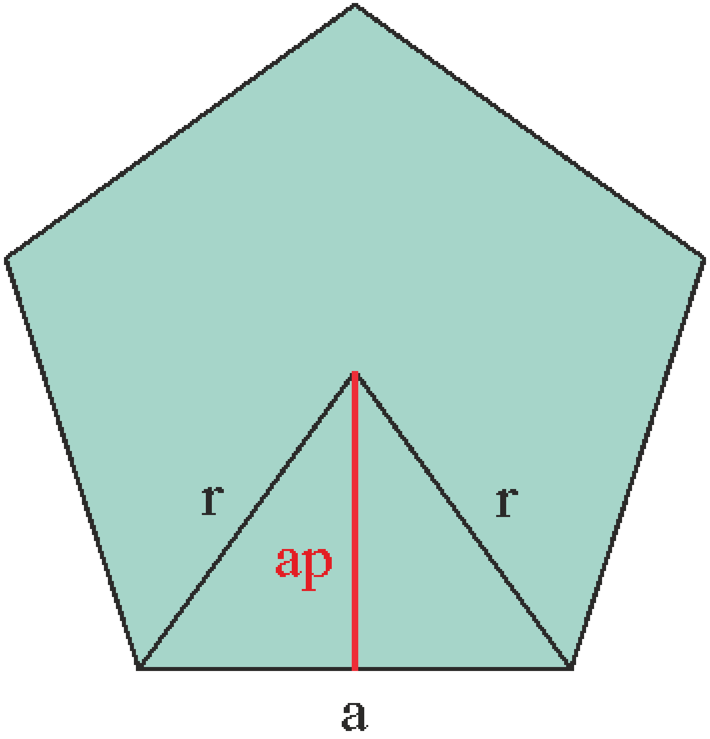
$$V_{dodecaedre} = 2 \cdot A_B H$$

APROXIMACIÓ DEL VOLUM DEL DODECAEDRE



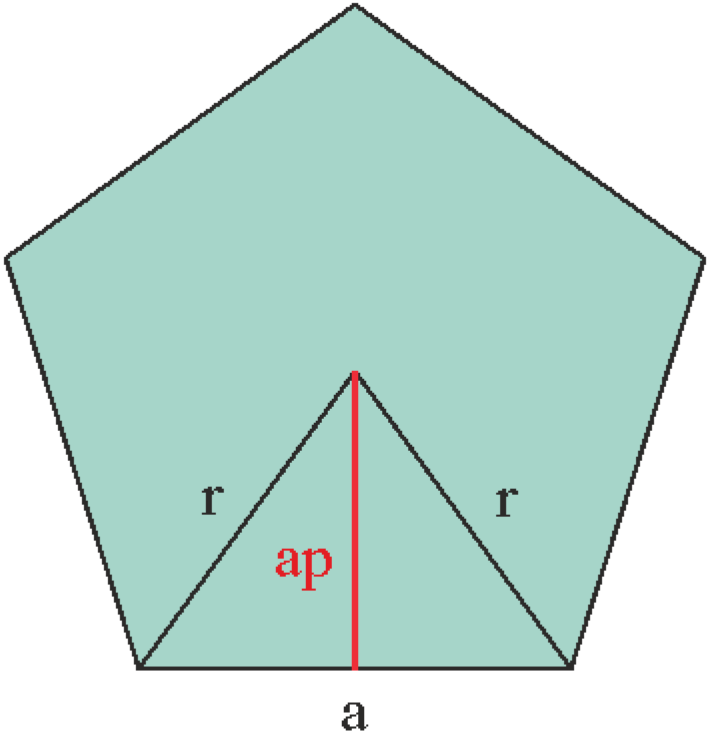
APROXIMACIÓ DEL VOLUM DEL DODECAEDRE

$$\frac{a}{ap} = k$$



APROXIMACIÓ DEL VOLUM DEL DODECAEDRE

costat	apotema	c/ap
3	2,1	1,43
4	2,8	1,43
5	3,4	1,47
6	4,2	1,43
7	4,8	1,46
8	5,5	1,45
9	6,2	1,45
10	6,9	1,45
11	7,6	1,45
12	8,3	1,45
13	8,9	1,46
14	9,6	1,46
15	10,3	1,46



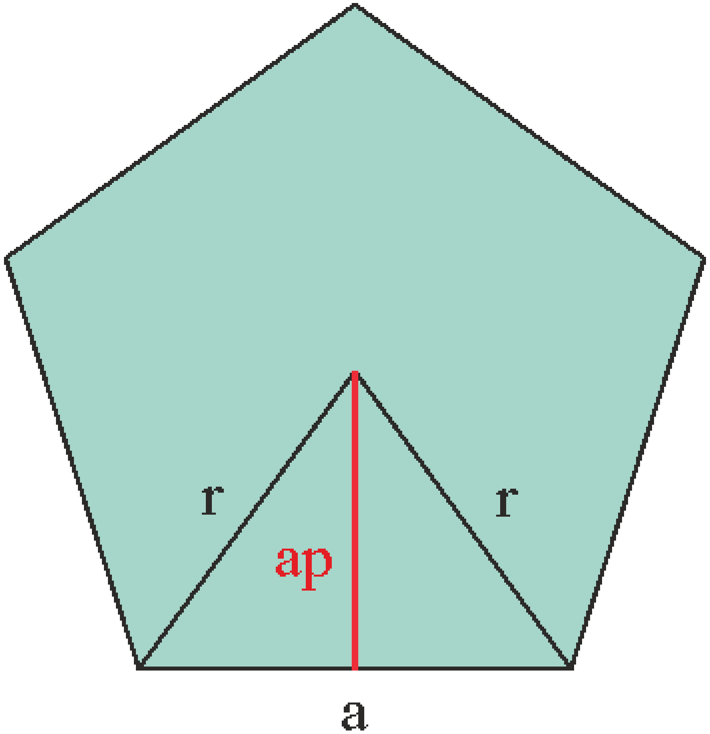
Mitjana c/ap = 1,45

APROXIMACIÓ DEL VOLUM DEL DODECAEDRE

$$\frac{a}{ap} = 1,45$$

$$ap = \frac{a}{1,45}$$

$$\text{En realitat} \quad ap = \frac{a}{1,45309}$$



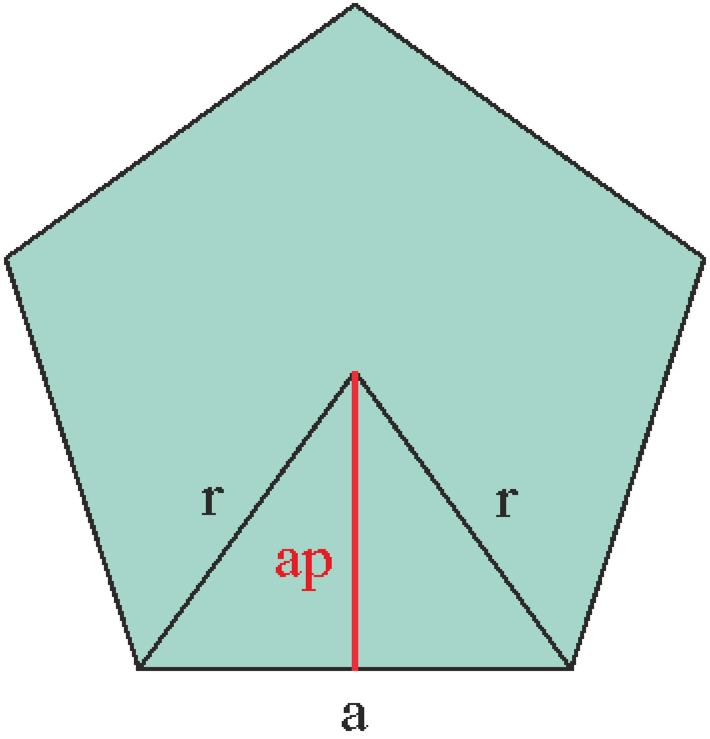
Mitjana c/ap = 1,45

APROXIMACIÓ DEL VOLUM DEL DODECAEDRE

$$\frac{a}{ap} = 1,45$$

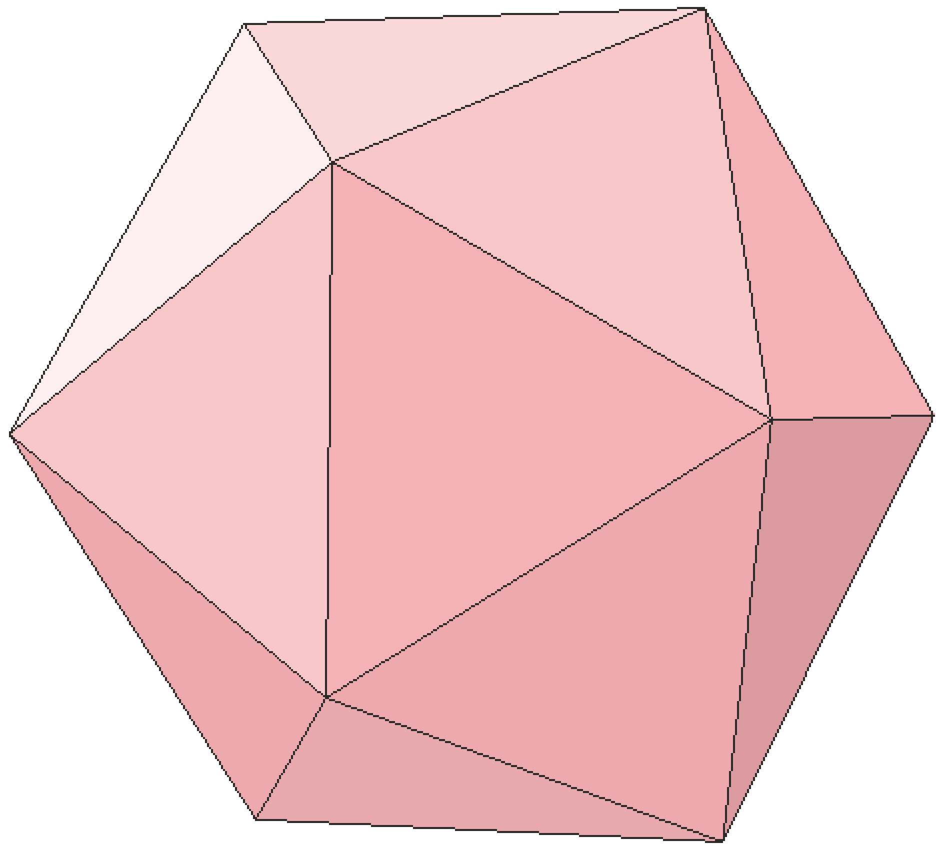
$$ap = \frac{a}{1,45}$$

$$\text{En realitat} \quad ap = \frac{a}{1,45309}$$

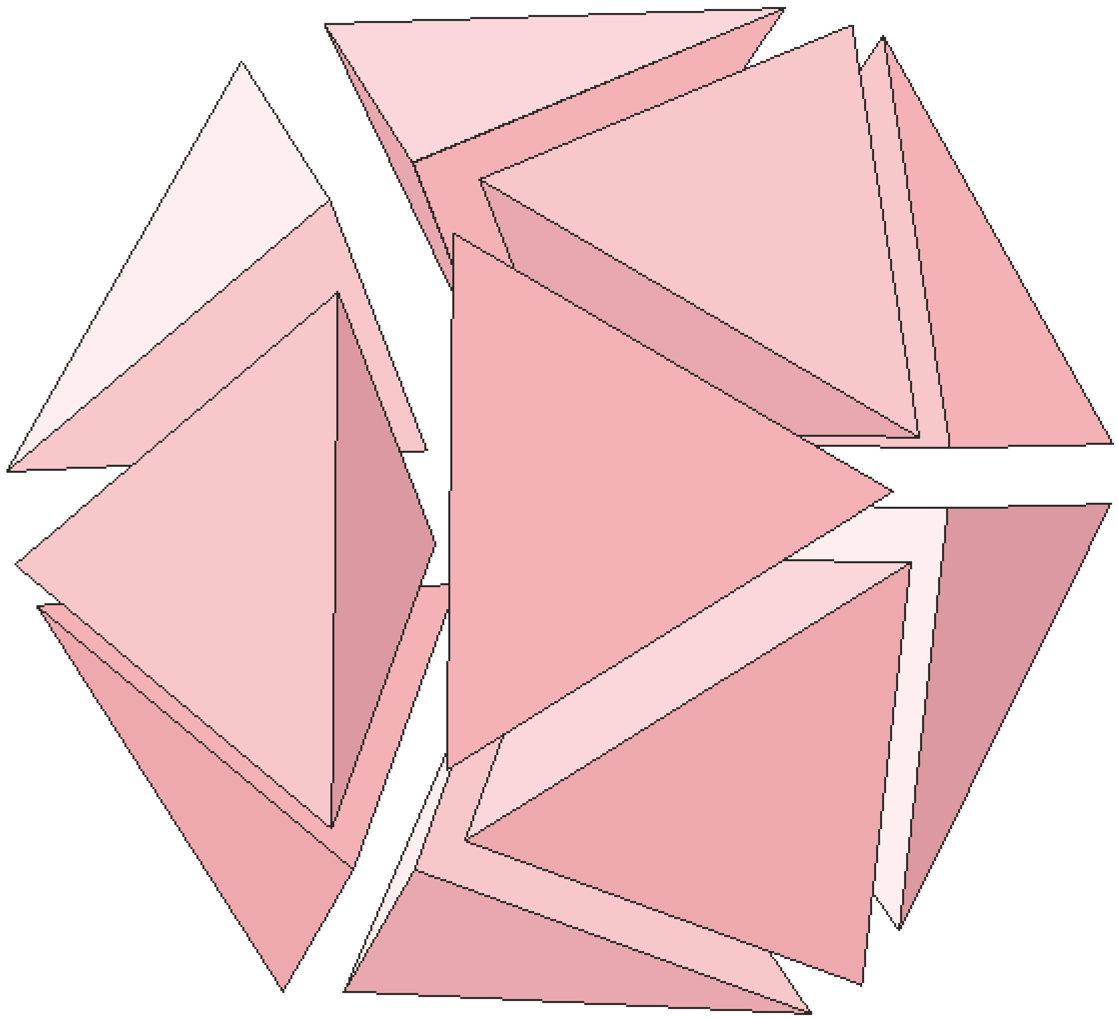


$$A_B = \frac{Per \cdot ap}{2} = \frac{5a \cdot \frac{a}{1,45}}{2} = 1,72a^2$$

VOLUM DE L'ICOSAEDRE

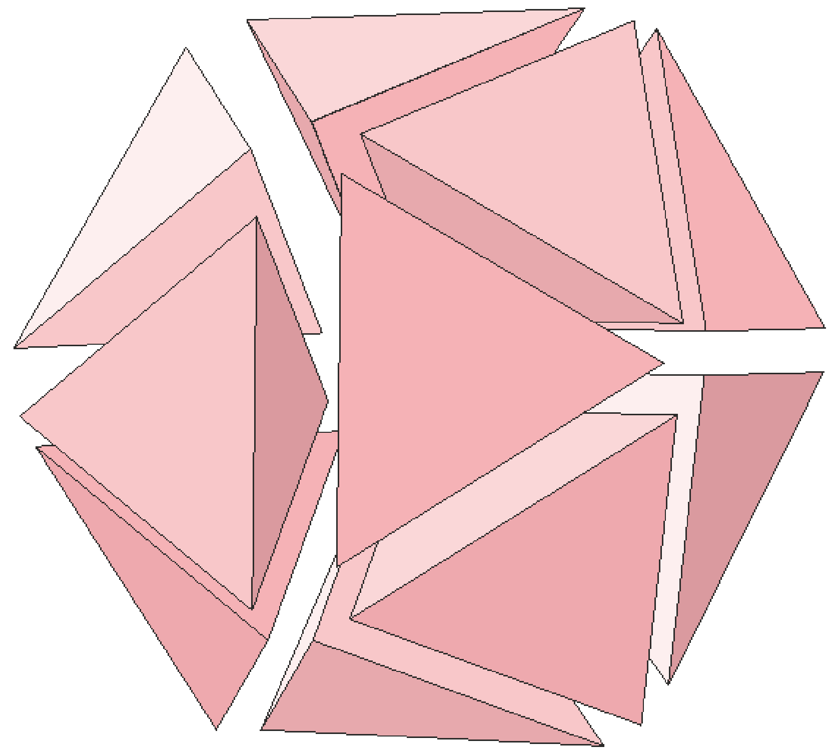


VOLUM DE L'ICOSAEDRE

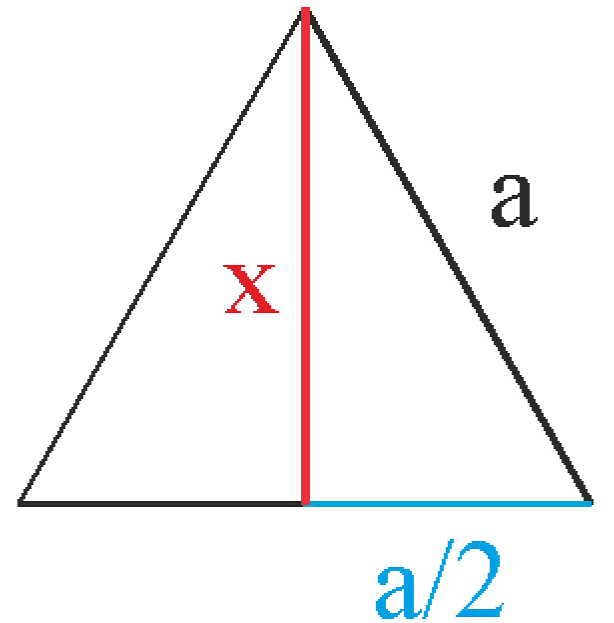


VOLUM DE L'ICOSAEDRE

$$V\ (icosaedre) = 20 \cdot V\ (Piràmide) = 20 \cdot \frac{A_B \cdot h}{3}$$

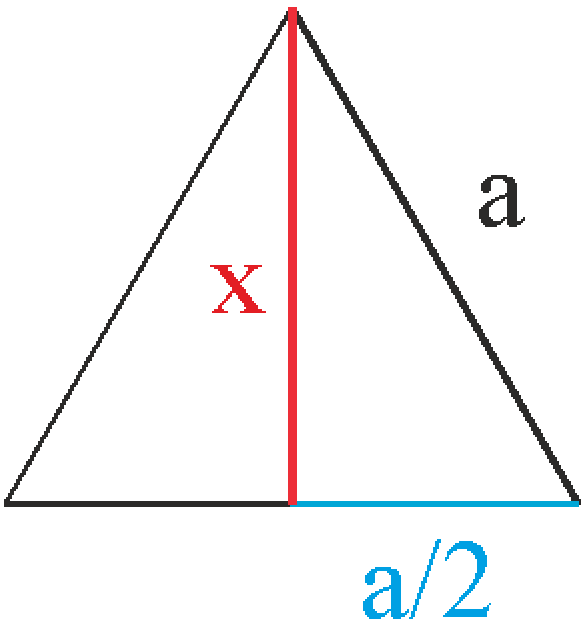


VOLUM DE L'ICOSAEDRE



VOLUM DE L'ICOSAEDRE

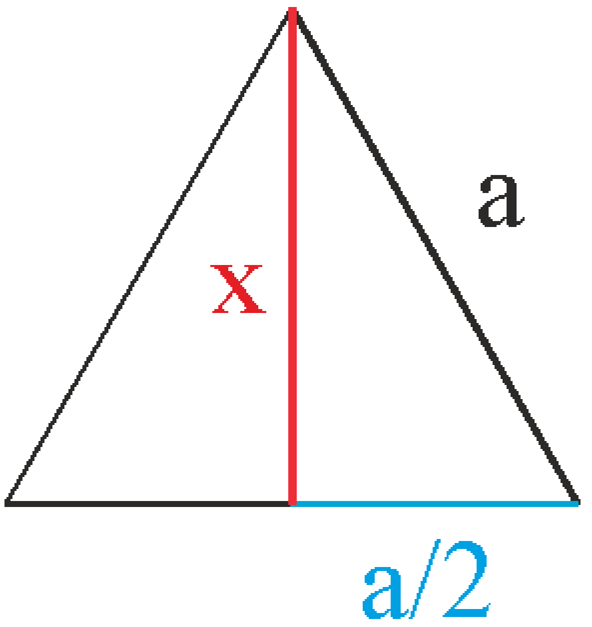
$$x^2 = a^2 - \left(\frac{a}{2}\right)^2$$



VOLUM DE L'ICOSAEDRE

$$x^2 = a^2 - \left(\frac{a}{2}\right)^2$$

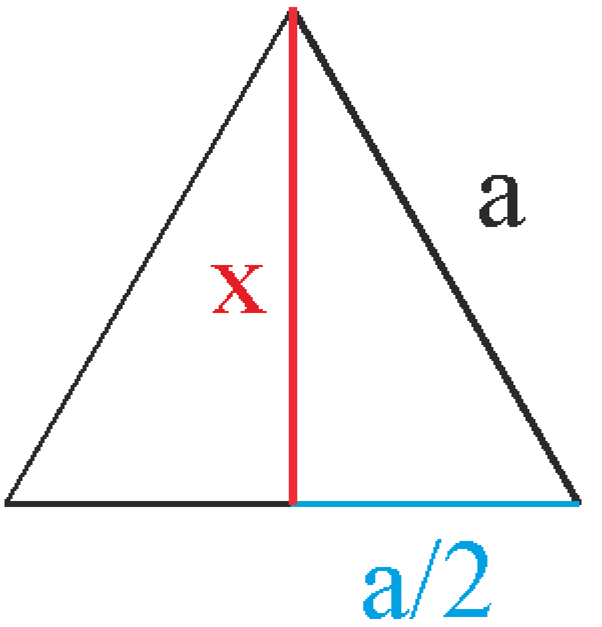
$$x = \frac{\sqrt{3}}{2}a$$



VOLUM DE L'ICOSAEDRE

$$x^2 = a^2 - \left(\frac{a}{2}\right)^2$$

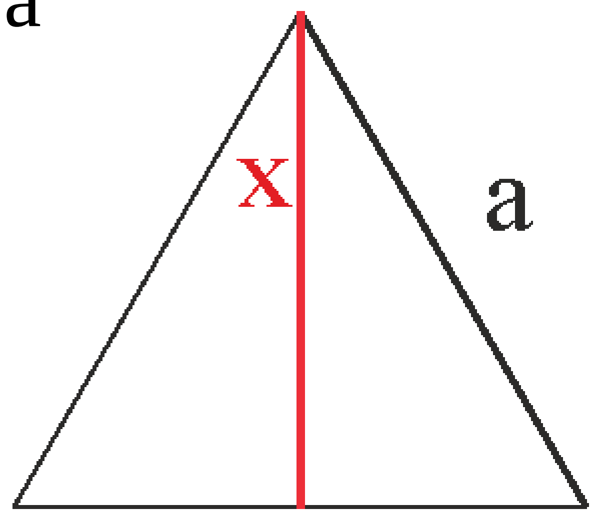
$$x = \frac{\sqrt{3}}{2}a$$



$$A_B = \frac{a \cdot \left(\frac{\sqrt{3}}{2}a\right)}{2} = \frac{\sqrt{3}}{4} \cdot a^2$$

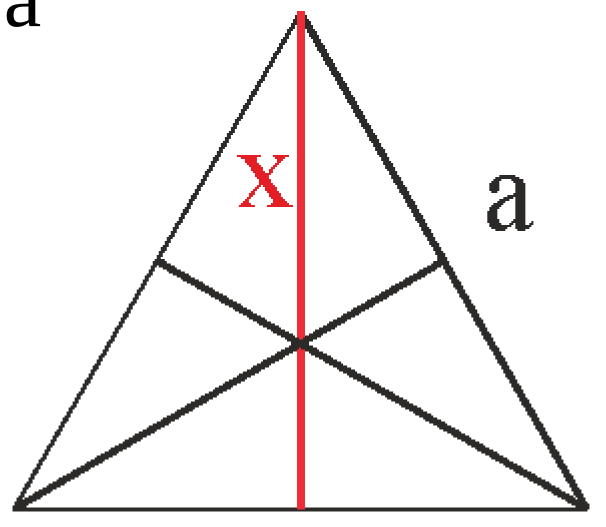
VOLUM DE L'ICOSAEDRE

$$x = \frac{\sqrt{3}}{2} a$$



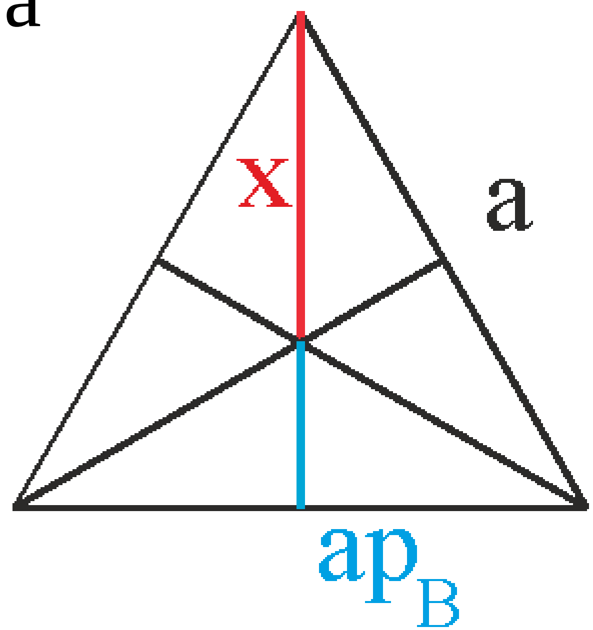
VOLUM DE L'ICOSAEDRE

$$x = \frac{\sqrt{3}}{2}a$$



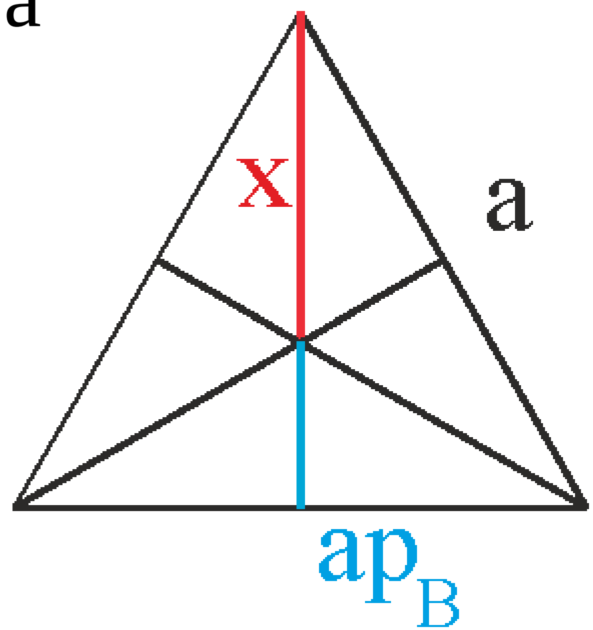
VOLUM DE L'ICOSAEDRE

$$x = \frac{\sqrt{3}}{2} a$$



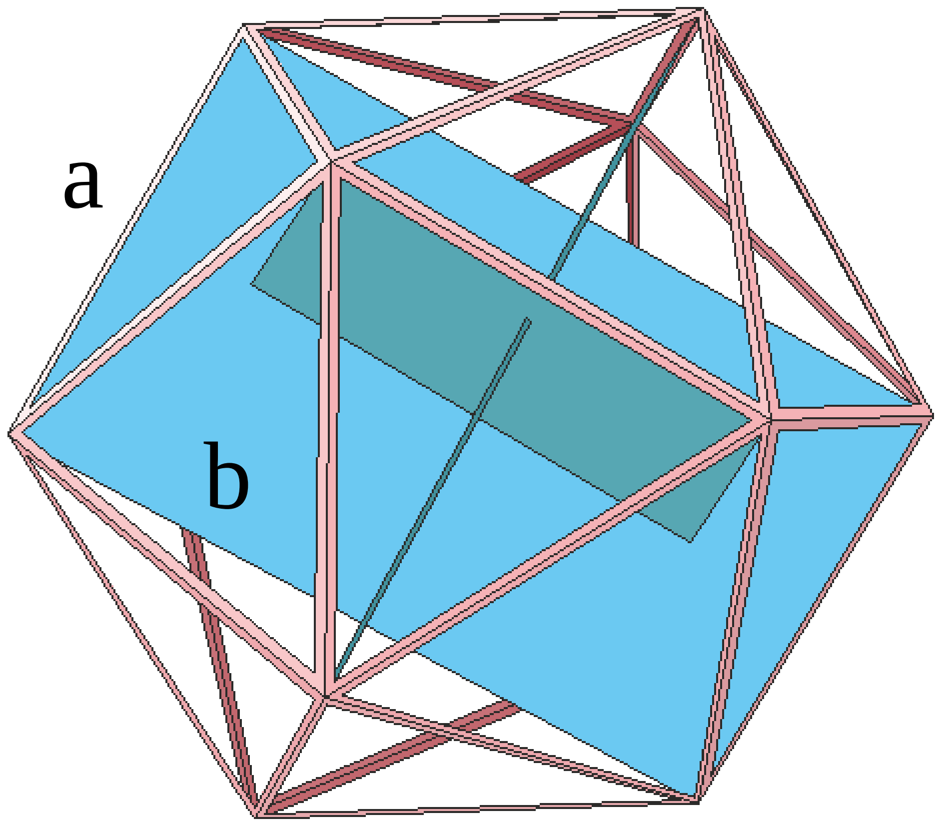
VOLUM DE L'ICOSAEDRE

$$x = \frac{\sqrt{3}}{2}a$$



$$ap_B = \frac{x}{3} = \frac{\sqrt{3}}{6}a$$

VOLUM DE L'ICOSAEDRE



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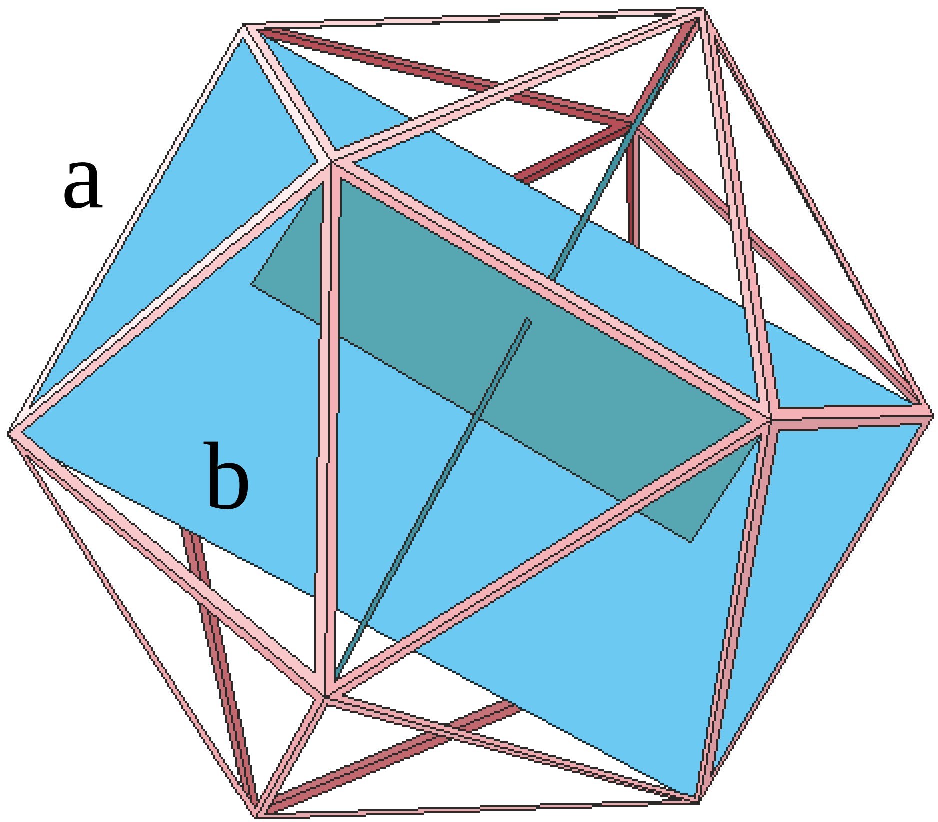
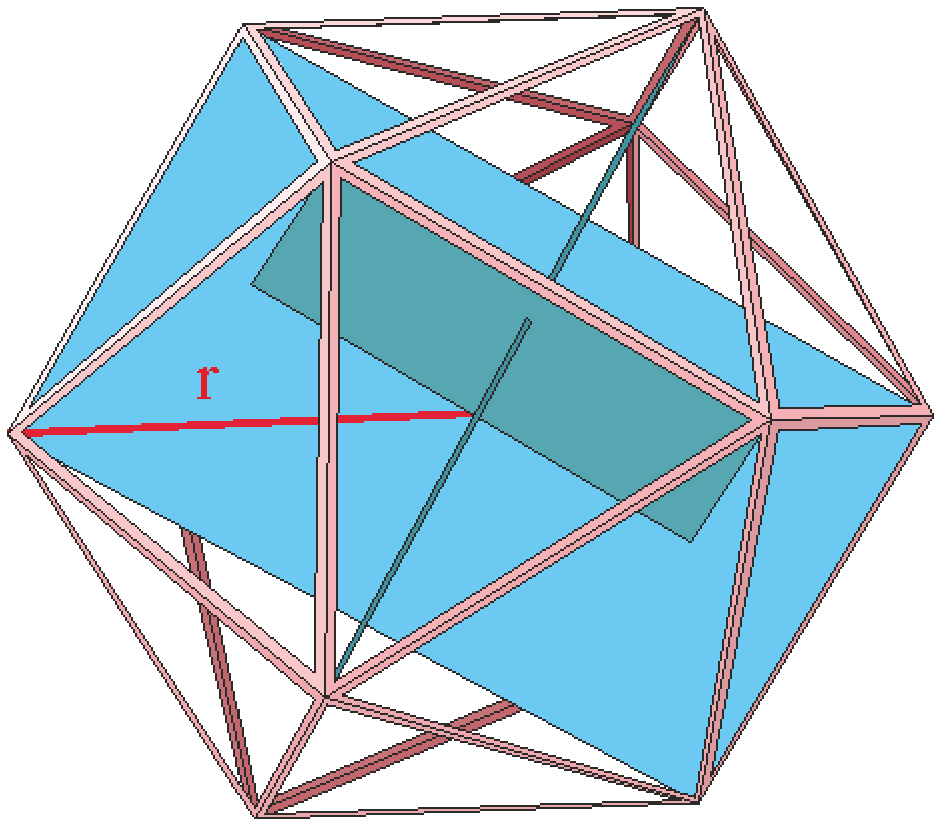


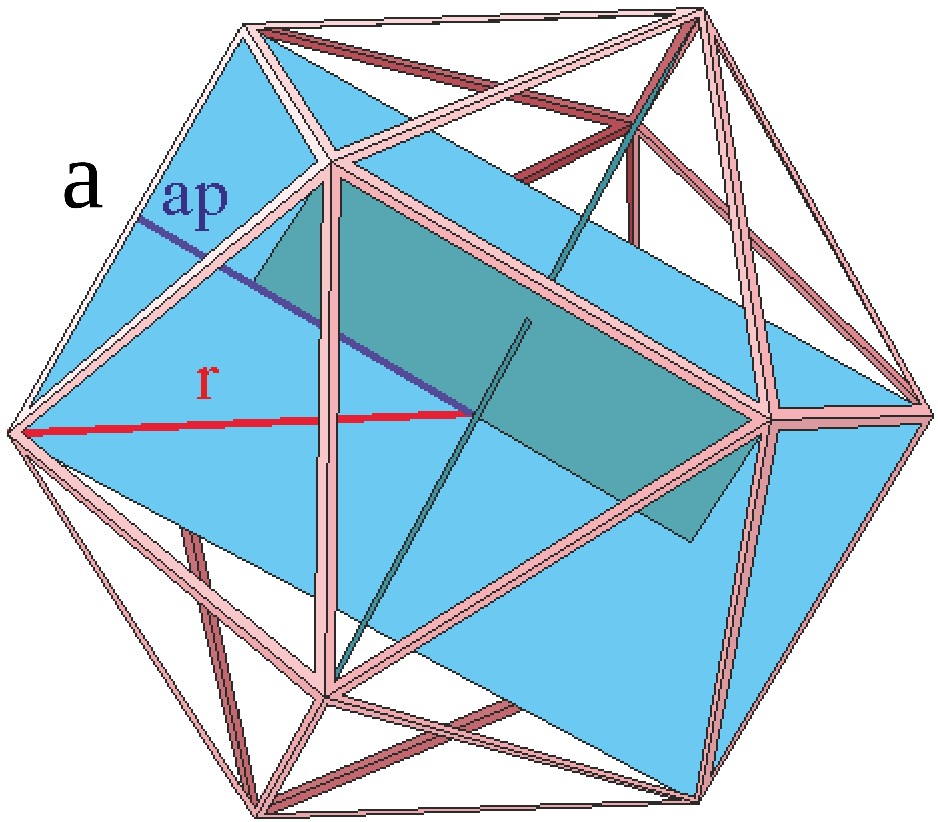
$$\frac{b}{a} = \Phi$$

VOLUM DE L'ICOSAEDRE



$$\frac{b}{a} = \Phi$$

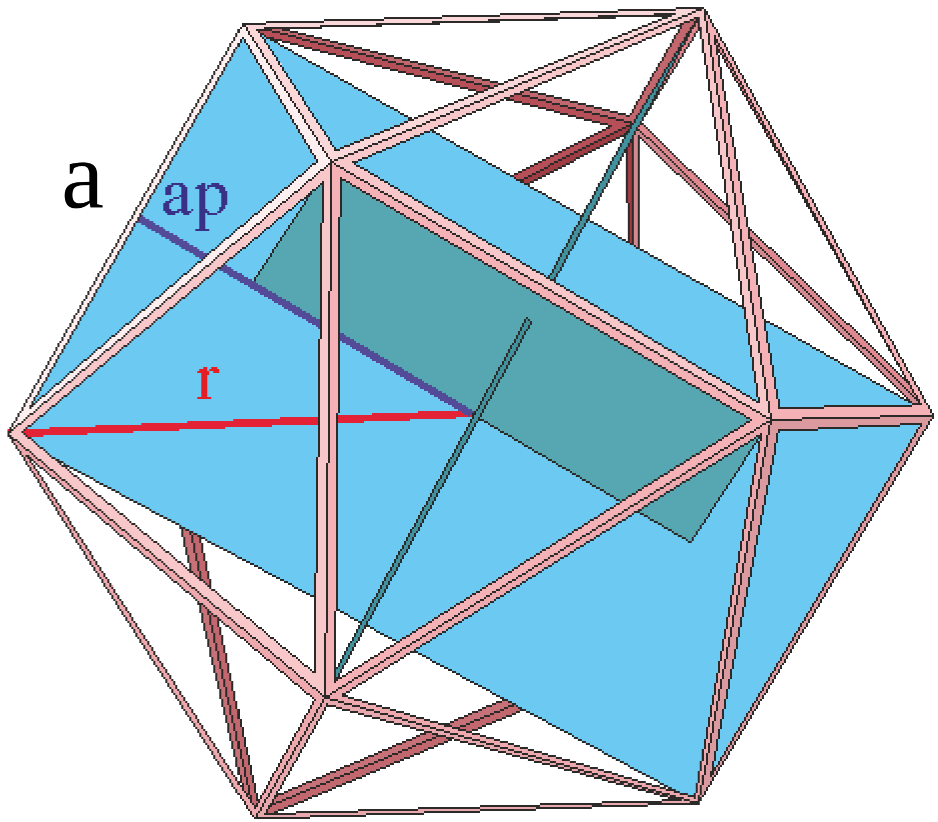
VOLUM DE L'ICOSAEDRE



$$\frac{b}{a} = \Phi$$

$$\frac{ap}{a} = \frac{\Phi}{2}$$

VOLUM DE L'ICOSAEDRE

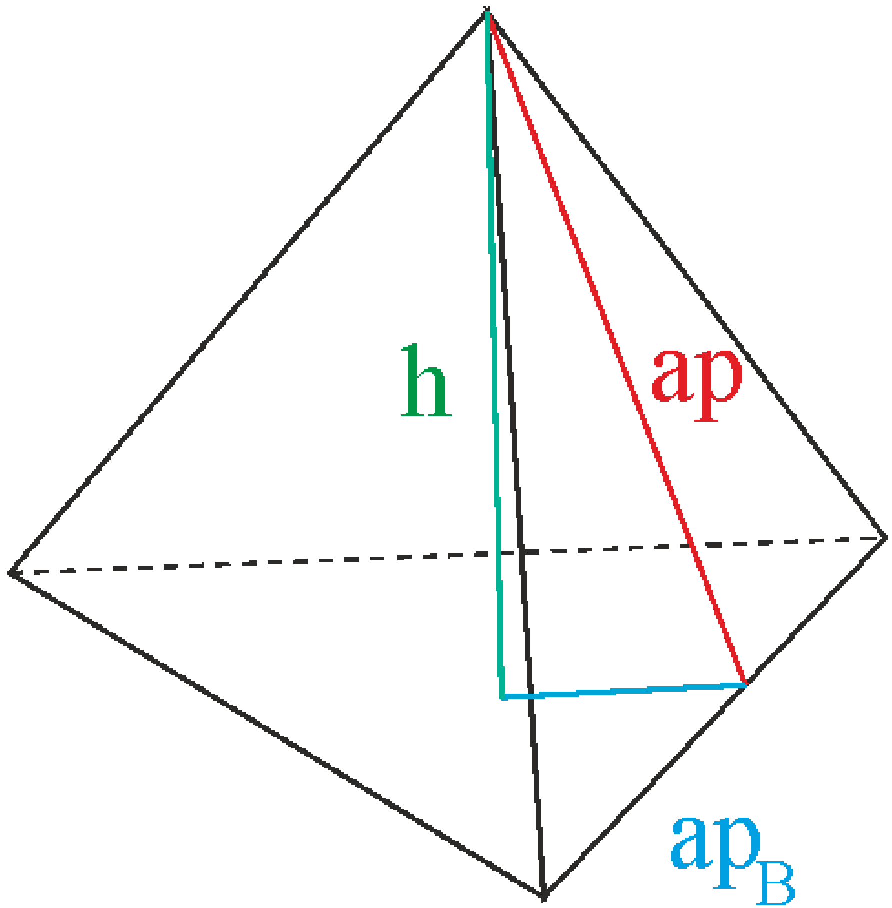


$$\frac{b}{a} = \Phi$$

$$\frac{ap}{a} = \frac{\Phi}{2}$$

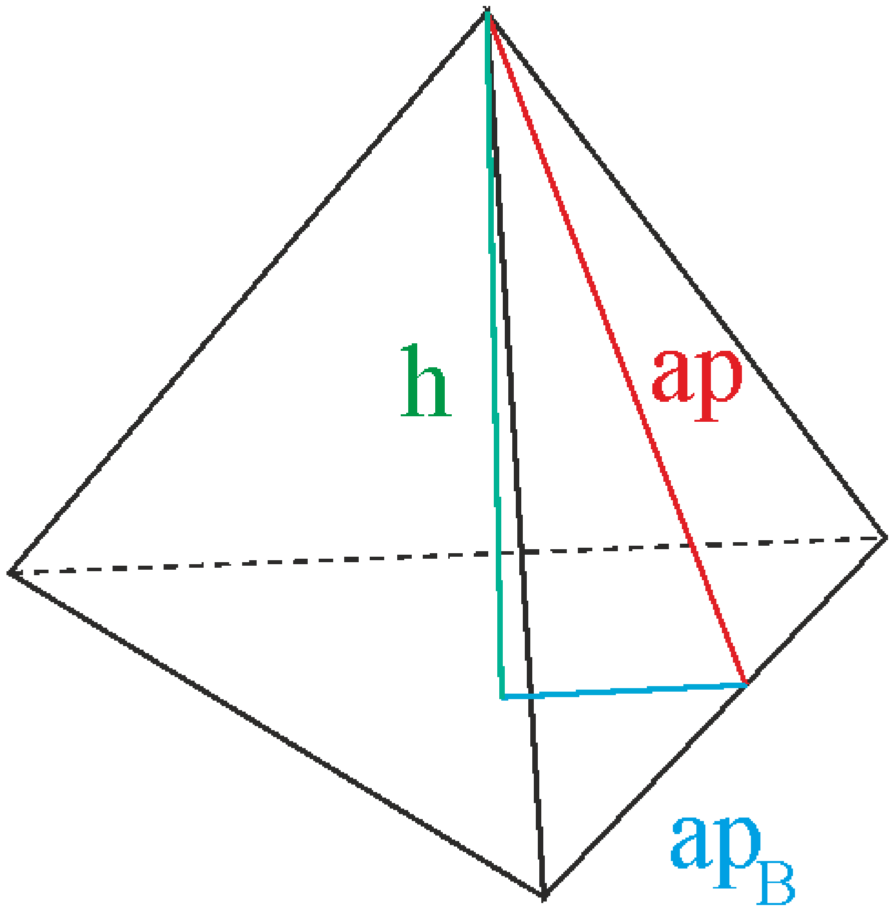
$$ap = \frac{\Phi}{2}a = \frac{1+\sqrt{5}}{4}a$$

VOLUM DE L'ICOSAEDRE



$$h^2 = ap^2 - ap_B^{\ 2}$$

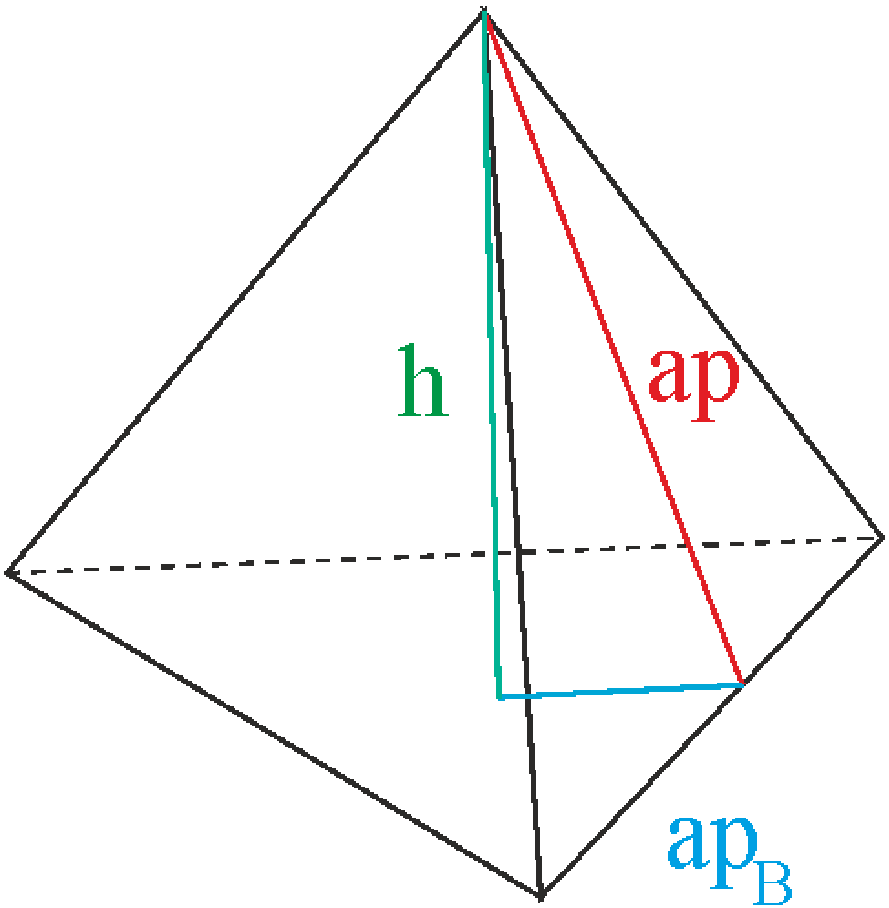
VOLUM DE L'ICOSAEDRE



$$h^2 = ap^2 - ap_B{}^2$$

$$h^2 = \left(\frac{1+\sqrt{5}}{4}\right)^2 \cdot a^2 - \left(\frac{\sqrt{3}}{6}\right)^2 \cdot a^2$$

VOLUM DE L'ICOSAEDRE

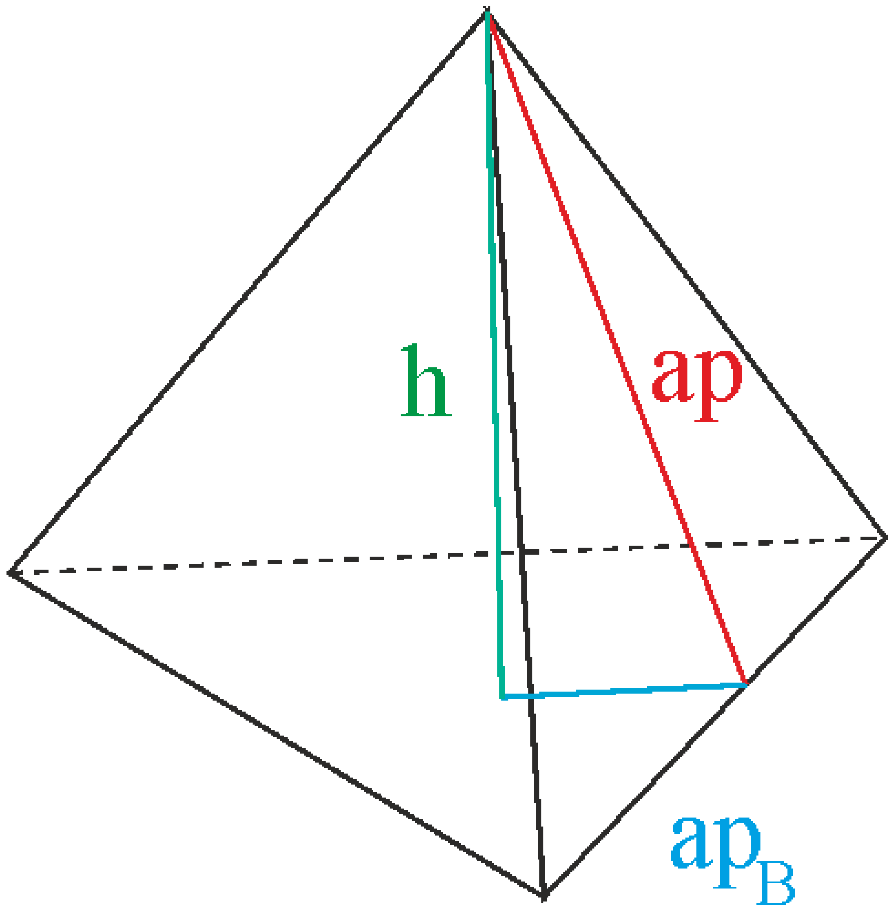


$$h^2 = ap^2 - ap_B{}^2$$

$$h^2 = \left(\frac{1+\sqrt{5}}{4}\right)^2 \cdot a^2 - \left(\frac{\sqrt{3}}{6}\right)^2 \cdot a^2$$

$$h^2 = \left(\frac{3\sqrt{5}+11}{24}\right) \cdot a^2$$

VOLUM DE L'ICOSAEDRE



$$h^2 = ap^2 - ap_B{}^2$$

$$h^2 = \left(\frac{1+\sqrt{5}}{4}\right)^2 \cdot a^2 - \left(\frac{\sqrt{3}}{6}\right)^2 \cdot a^2$$

$$h^2 = \left(\frac{3\sqrt{5}+11}{24}\right) \cdot a^2$$

$$h = \sqrt{\left(\frac{3\sqrt{5}+11}{24}\right)} \cdot a$$

VOLUM DE L'ICOSAEDRE

$$V(\text{Pira}) = \frac{A_B \cdot h}{3} = \frac{\frac{\sqrt{3}}{4} a^2 \sqrt{\left(\frac{3\sqrt{5}+11}{24}\right) \cdot a}}{3} = \frac{\sqrt{3}\sqrt{\left(\frac{6\sqrt{5}+22}{3}\right) \cdot a^3}}{12}$$

VOLUM DE L'ICOSAEDRE

$$V(\text{Pira}) = \frac{A_B \cdot h}{3} = \frac{\frac{\sqrt{3}}{4} a^2 \sqrt{\left(\frac{3\sqrt{5}+11}{24}\right) \cdot a}}{3} = \frac{\sqrt{3}\sqrt{\left(\frac{6\sqrt{5}+22}{3}\right) \cdot a^3}}{12}$$

$$V(\text{I}\cos\text{a}) = 20V(\text{Pira}) = 20 \cdot \frac{\sqrt{3}\sqrt{\left(\frac{6\sqrt{5}+22}{3}\right) \cdot a^3}}{12}$$

Gràcies per la seva atenció

LLeimat
ASSOCIACIÓ D'ENSENYANTS DE MATEMÀTIQUES DE LLEIDA