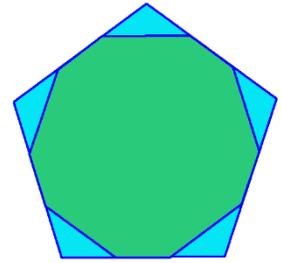


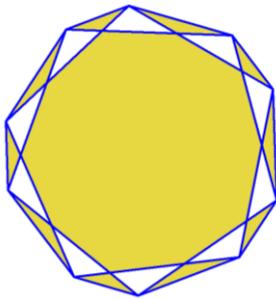
## Spatial Intelligence Test (2D)

### P1. Counting Pentagons

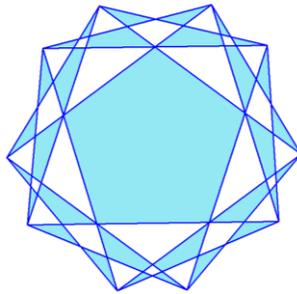
We start with a regular pentagon, which is a regular polygon with five vertices. Then we cut its corners as shown in the image below:



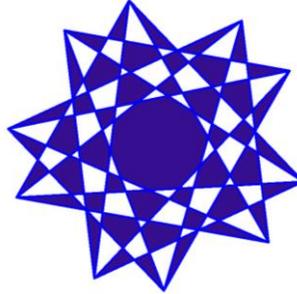
Next, we shall process the green polygon to obtain the following ones:



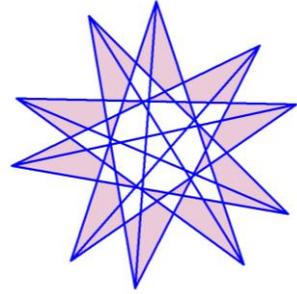
a.



b.



c.



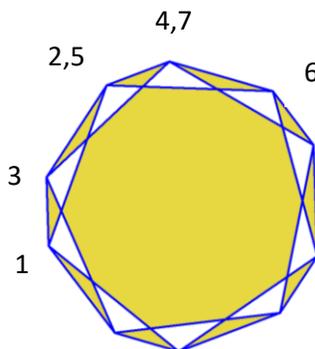
d.

- A. How many regular pentagons can you find in each of the pictures above? Explain your findings.
- B. The stellar polygons in these images have the same set of vertices. Can you find the rule used for their construction? What would be the thing that differentiate them?
- C. Can you draw the polygon in picture a. as a single line segment sequence? Show it by labeling the vertices with numbers showing the visiting order.

### Answers

A. a:2, b:4, c:4, d:3

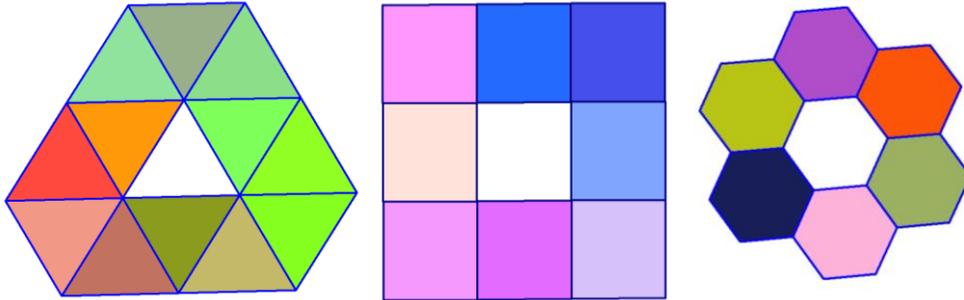
B. They are constructing by starting from a vertex and generated an edge to the next  $k^{\text{th}}$  neighbor. The values of  $k=2,3,4,5$  differentiate them.



C. Hint (follow the pattern):

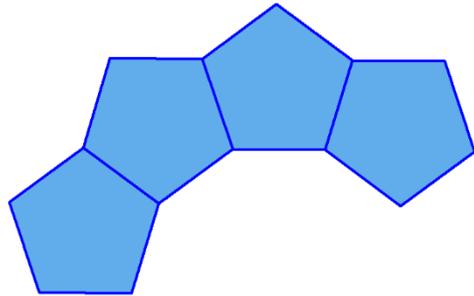
**P2. Circular Frame Construction**

A “circular frame” is a ring made of regular polygons, using a minimal number of polygons. The image below shows a triangle frame, a square frame and a hexagon frame:

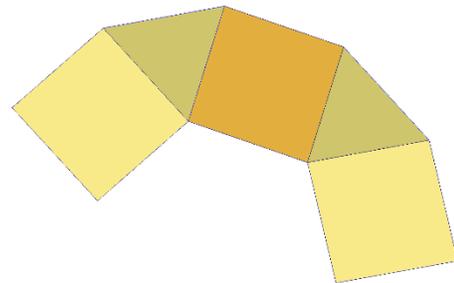


Note that each frame is characterized by the number of edges of the polygon in the middle: 3, 4 and 6 respectively. We call this the kernel number of the frame.

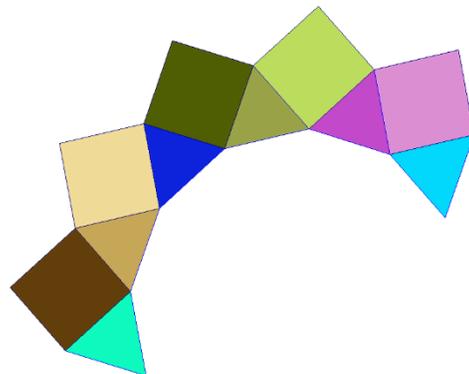
- A. Find the kernel number of the pentagon frame.



- B. Find the kernel number of the square-triangle frame. Here “square-triangle” means that the number of triangles is the same as the number of squares, but the kernel is adjacent with the squares.



- C. Find the kernel number of the triangle-square frame. Here “triangle- square” means that the number of triangles is the same as the number of squares, but the kernel is adjacent with the triangles.

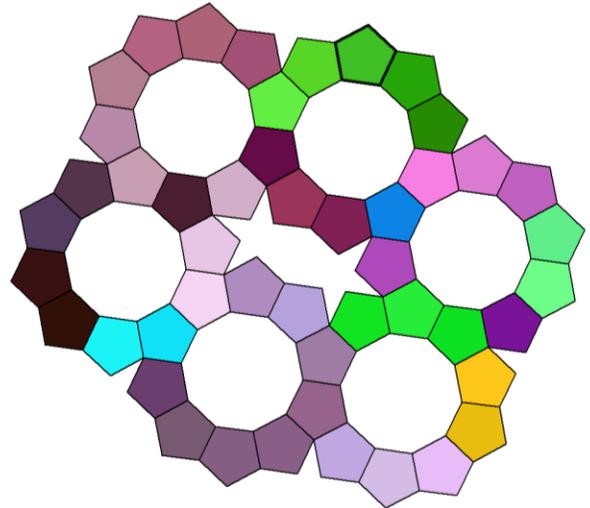


**Answers**

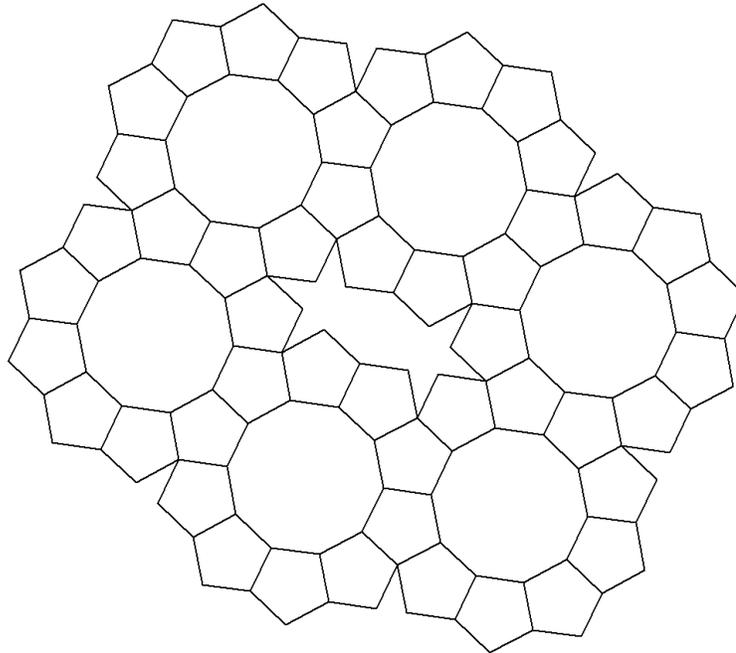
A: 10, B:6, C:12

**P3. Two-Coloring**

Show that the following map can be colored with only two colors. A coloring should not allow two neighbors to share the same color.

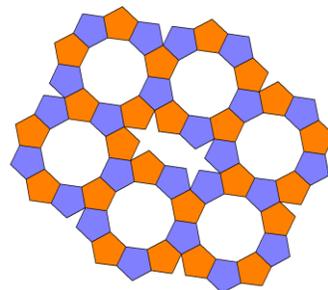


- A. Provide your solution by labeling O (orange) and B(lue) the cells of the following picture



- B. Can you generalize the kind of maps that can be colored with two colors only?

**Answers**



- A.  
B. A map with only even cycles can be colored with only 2 colors.