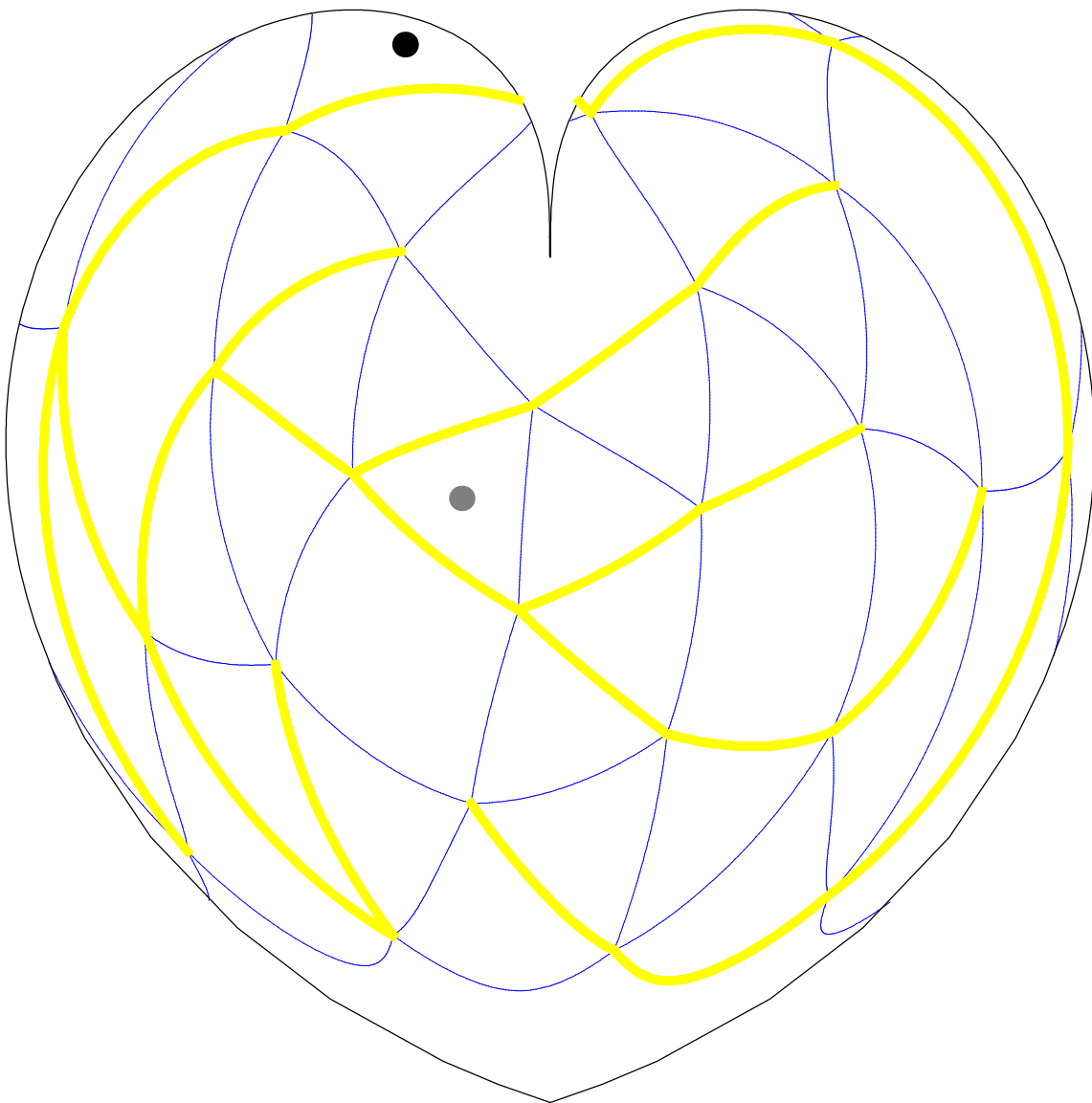
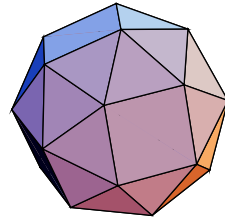
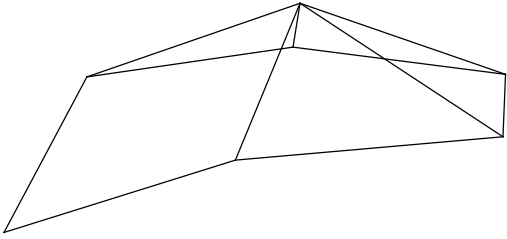


Izidor Hafner

Mazes on Uniform Polyhedra

Bonnet-Werner projection

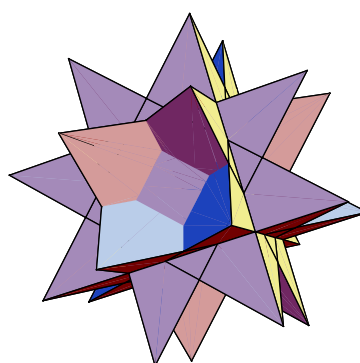
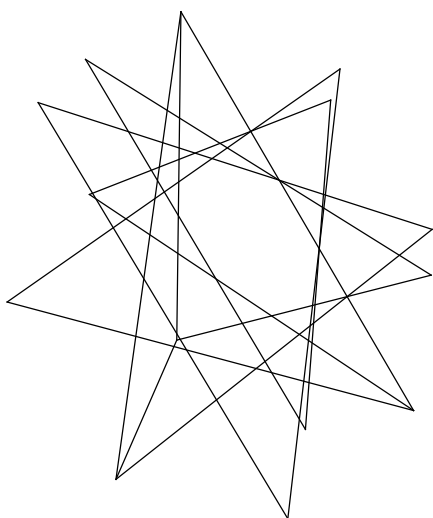


Introduction

Let us take an example. We are given a uniform polyhedron.

stellated truncated hexahedron

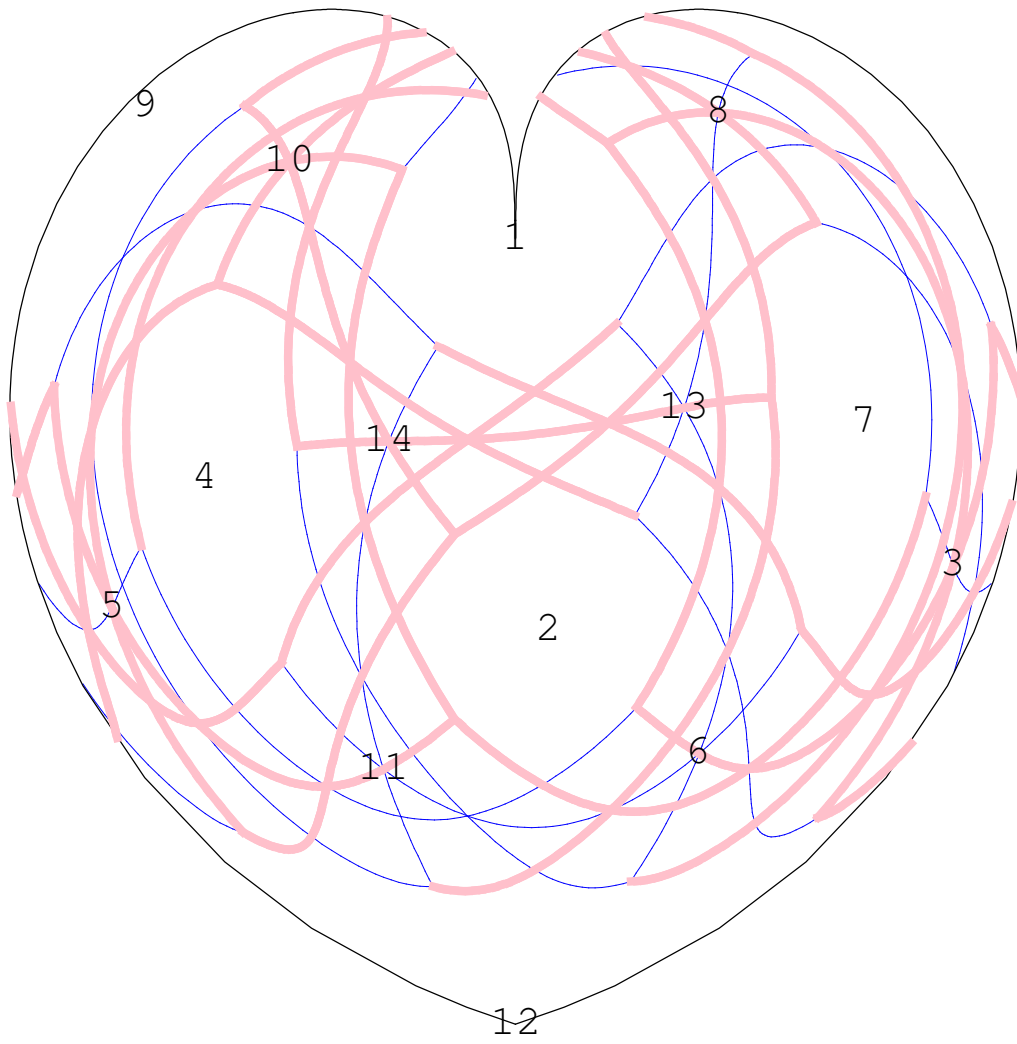
$$\left\{ \frac{8}{3}, \frac{8}{3}, 3 \right\}$$

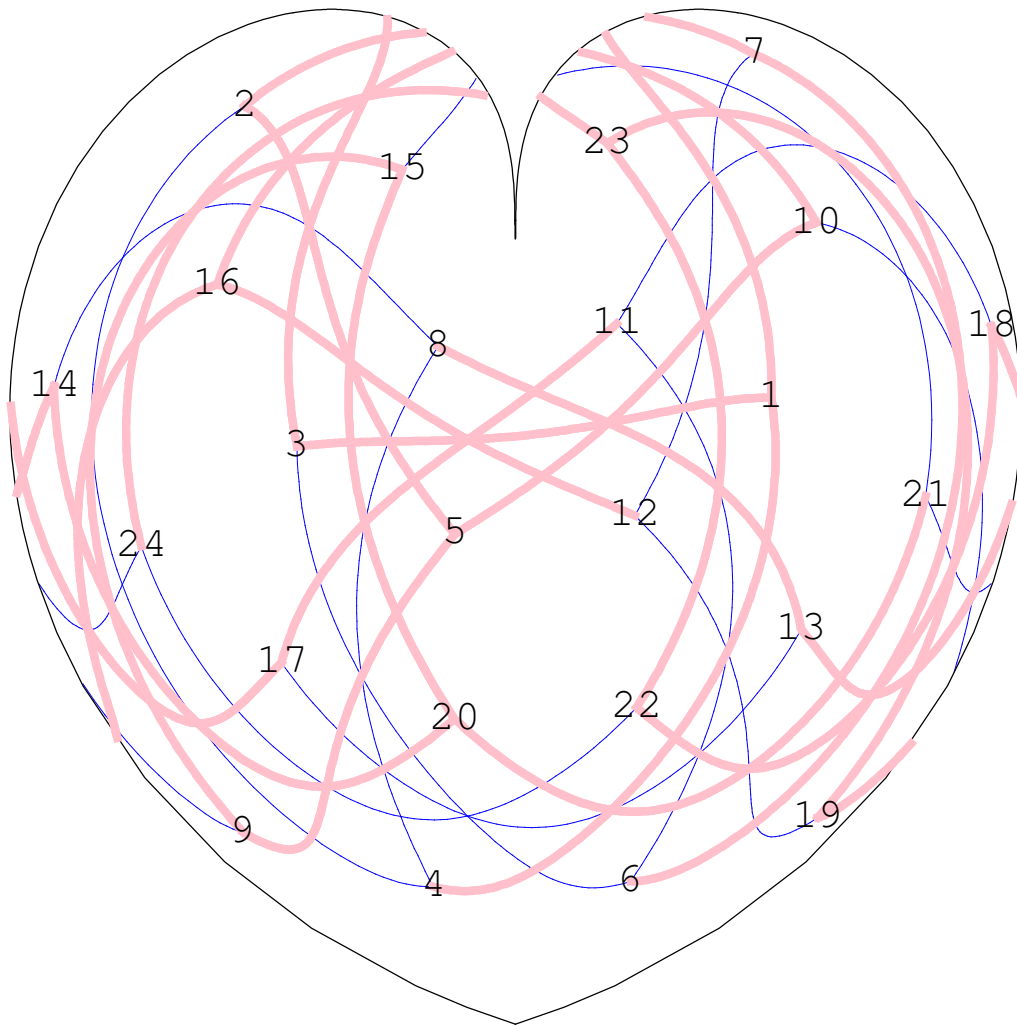


In Mathematica the polyhedron is given by a list of faces and with a list of coordinates of vertices [Roman E. Maeder, The Mathematica Programmer II, Academic Press 1996]. The list of faces consists of a list of lists, where a face is represented by a list of vertices, which is given by a matrix. Let us show the first five faces:

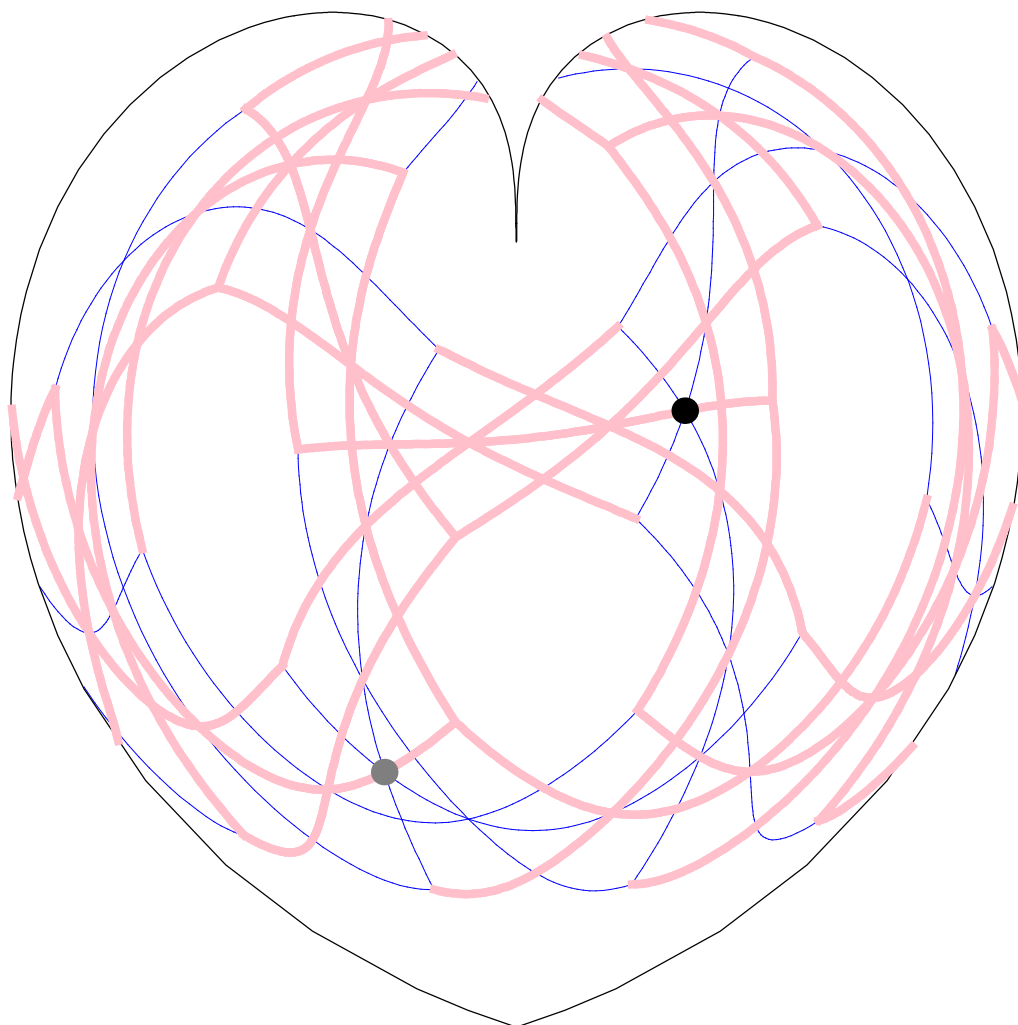
$$\begin{pmatrix} \{1, 2, 5, 10, 16, 12, 7, 3\} \\ \{1, 3, 6, 11, 17, 13, 8, 4\} \\ \{1, 4, 2\} \\ \{2, 4, 8, 14, 20, 15, 9, 5\} \\ \{3, 7, 6\} \end{pmatrix}$$

The next two figures represent faces and vertices. The polyhedron is projected onto a sphere and the sphere is projected by a cartographic projection.

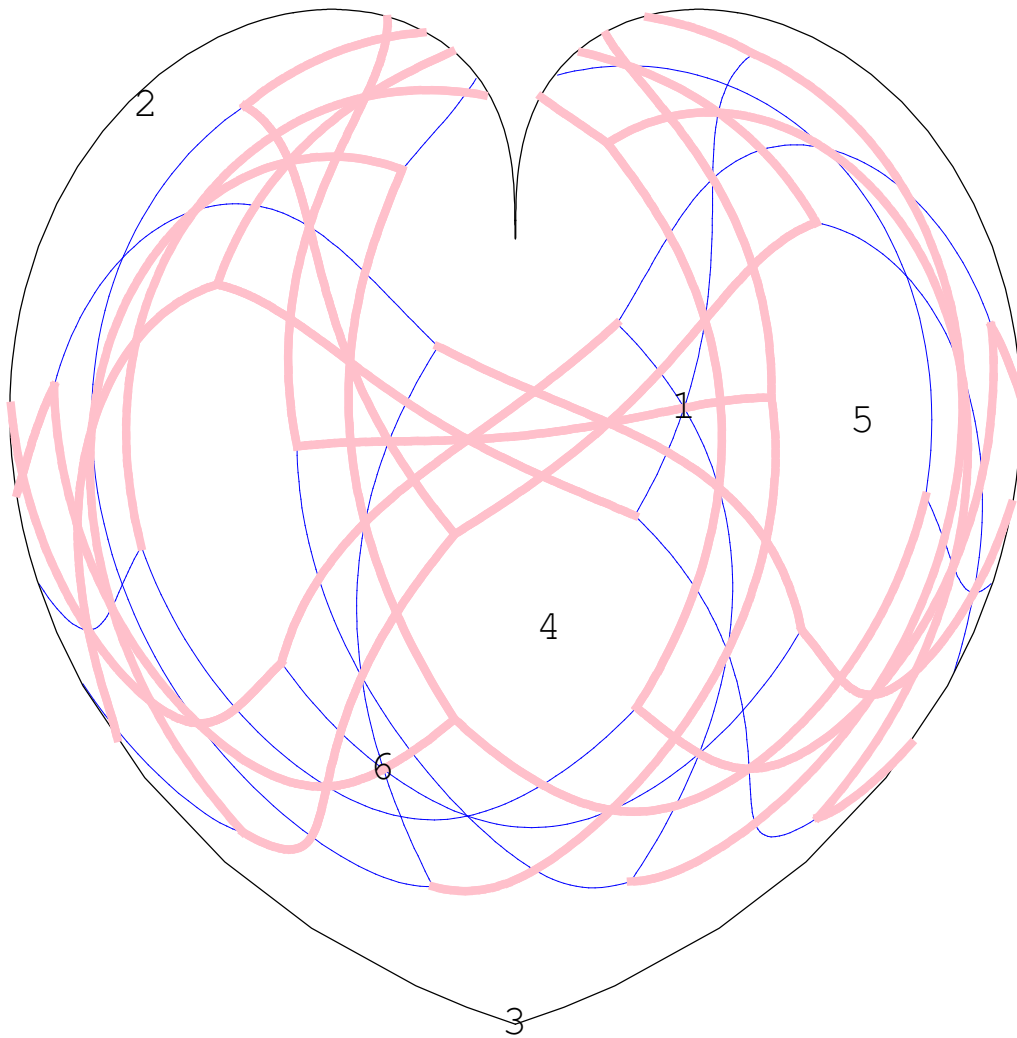




The problem is to find the path from the black dot to gray dot, where thick lines represent walls of a maze.



The solution is given by a list of faces passed from the black to gray dot.

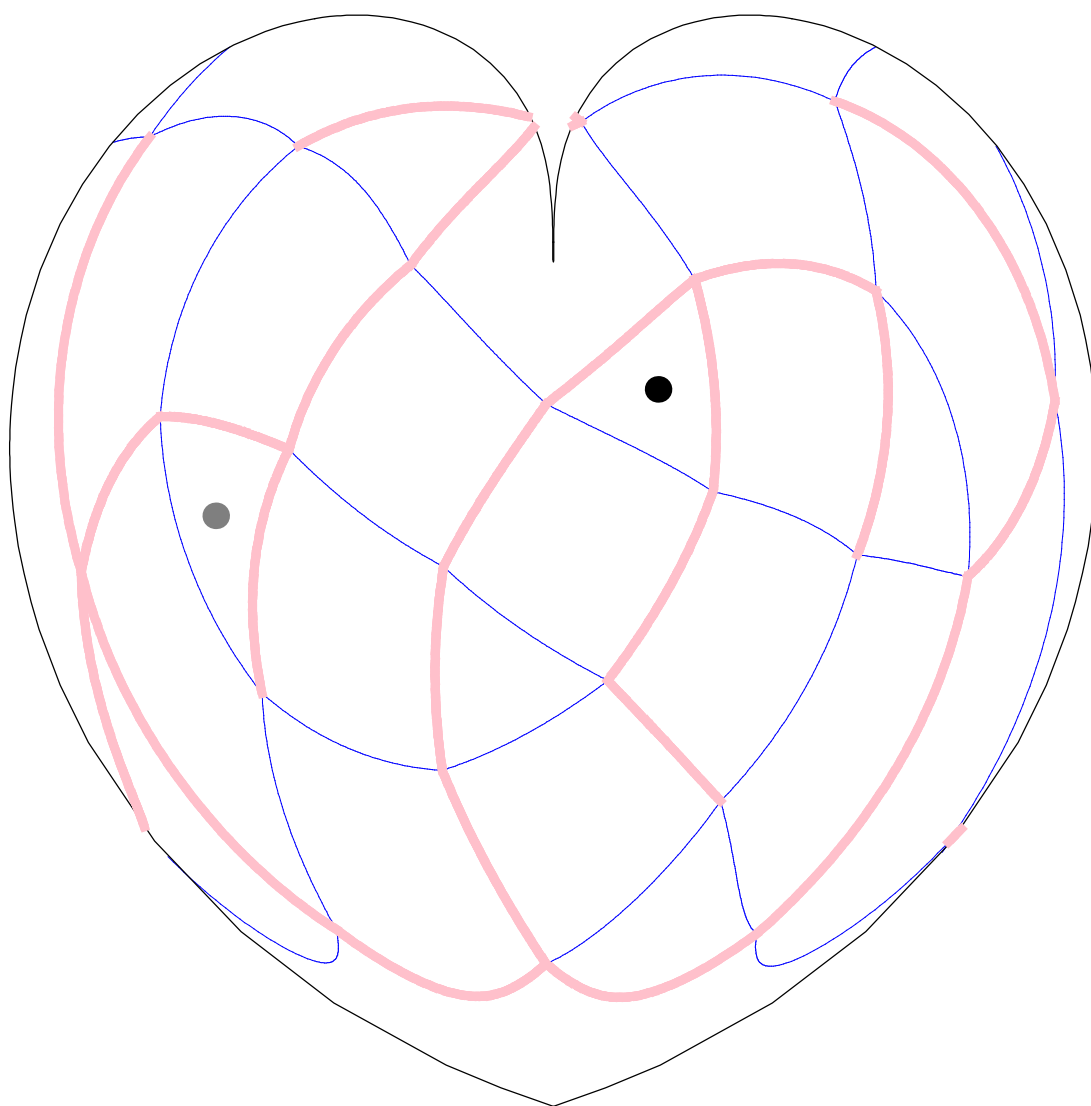
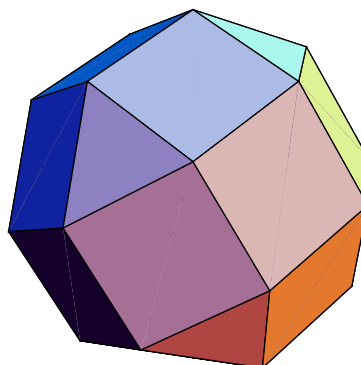
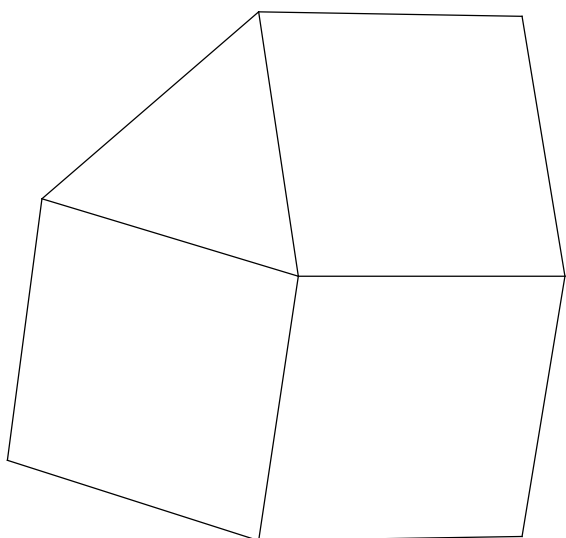


Problems

1.

rhombicuboctahedron

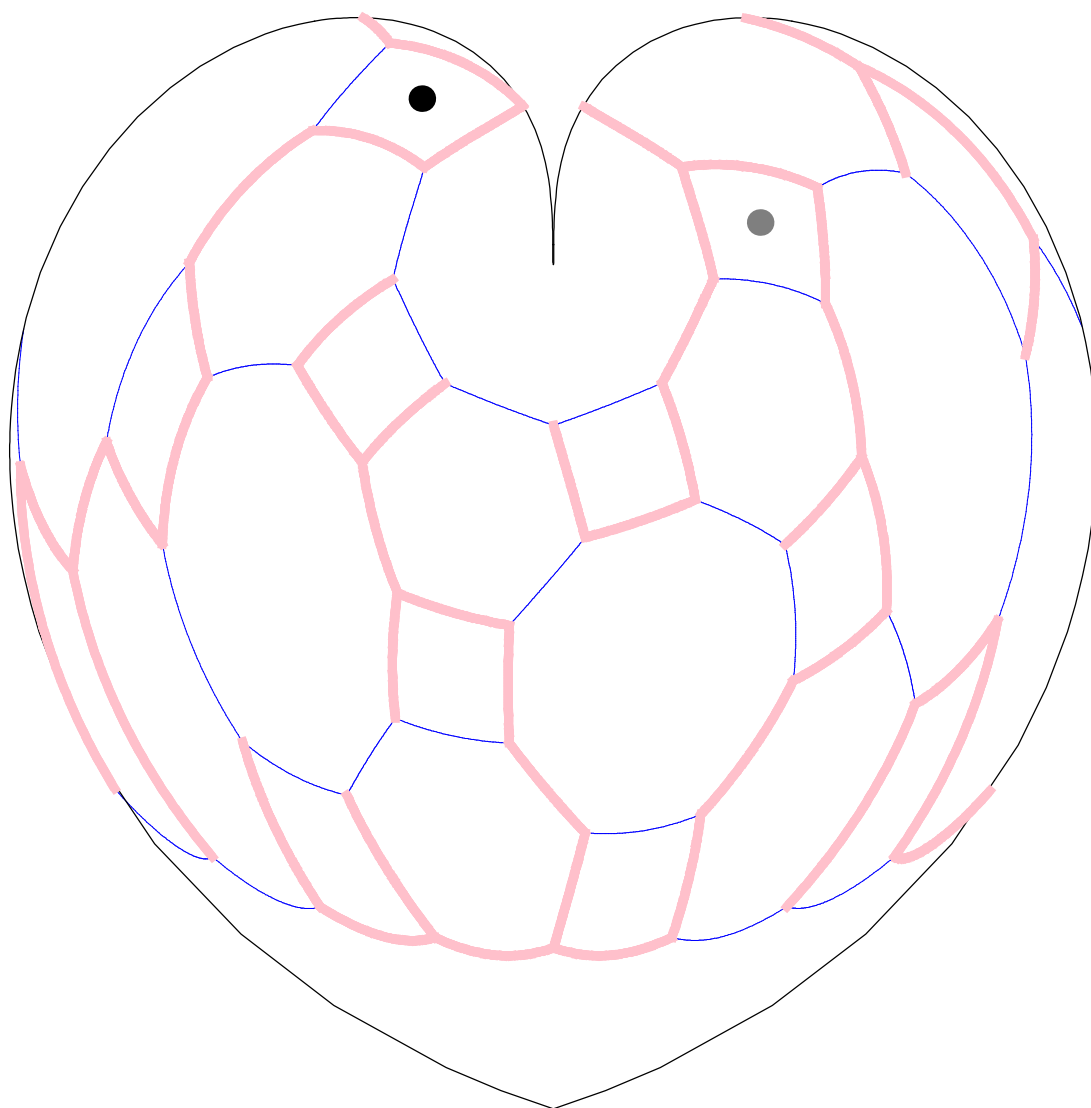
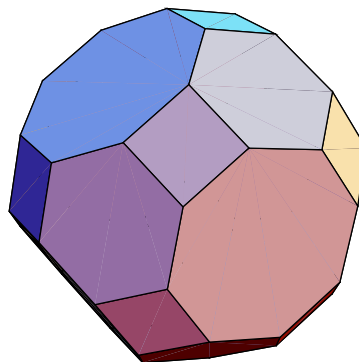
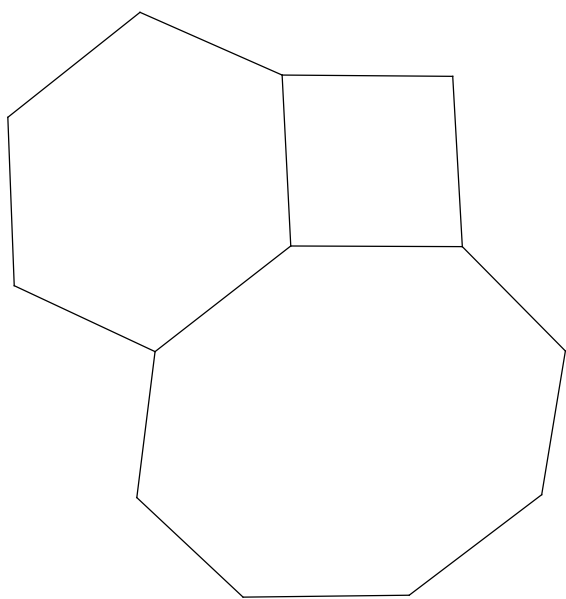
{4, 3, 4, 4}



2.

truncated cuboctahedron

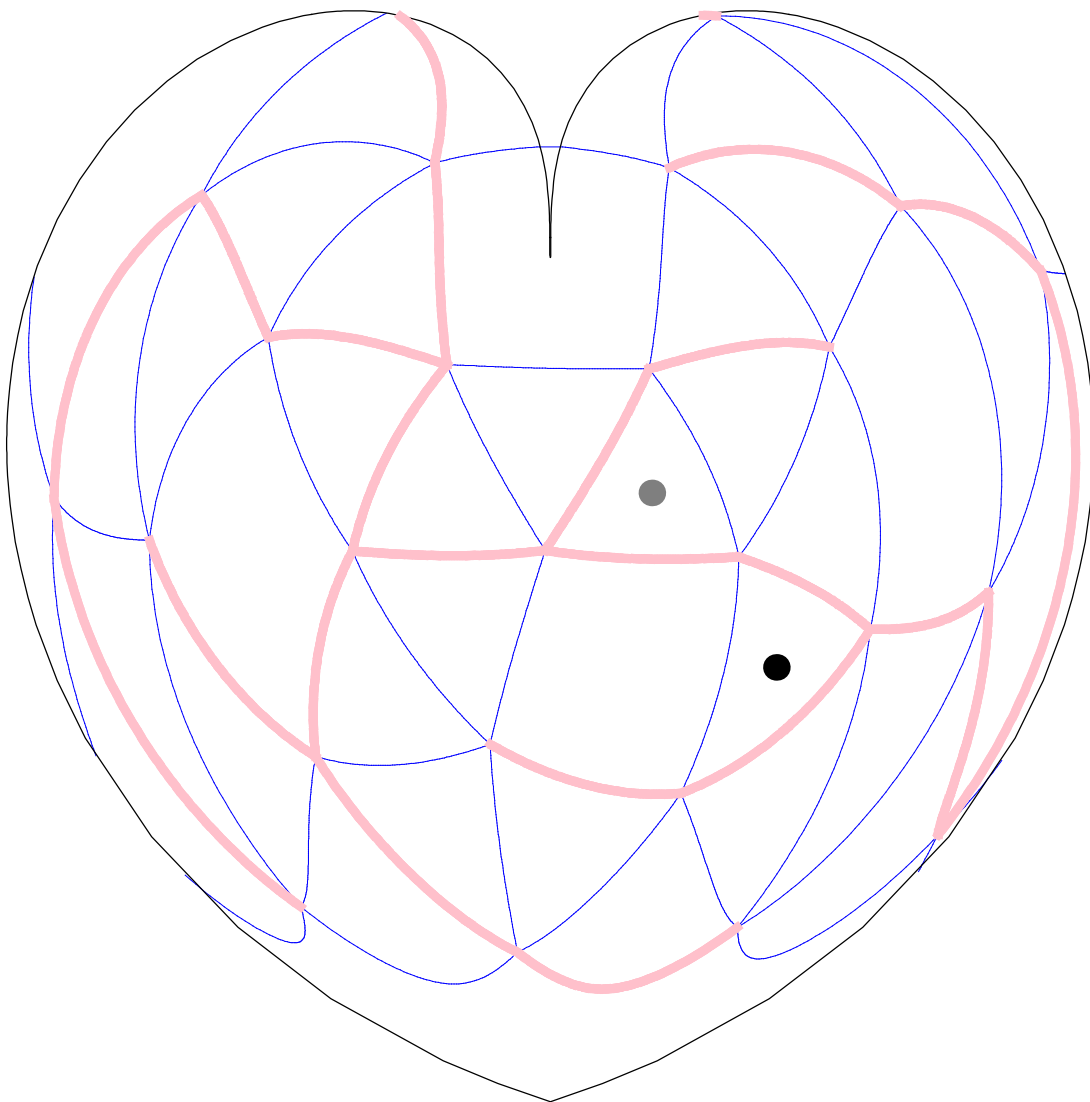
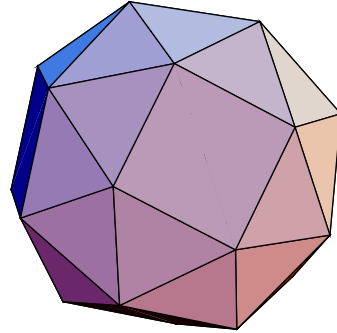
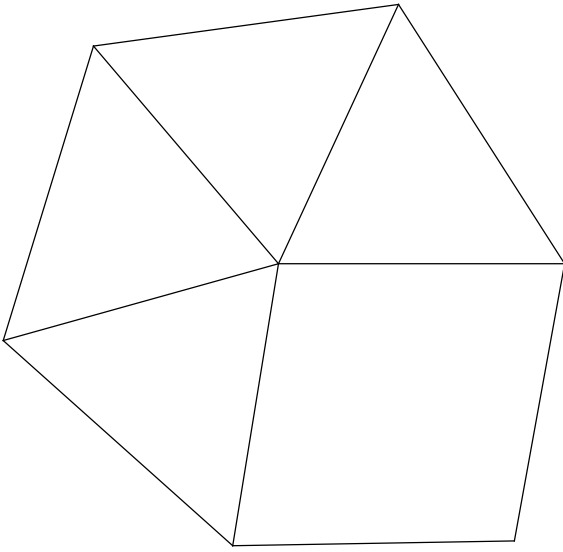
{4, 6, 8}



3.

snub cube

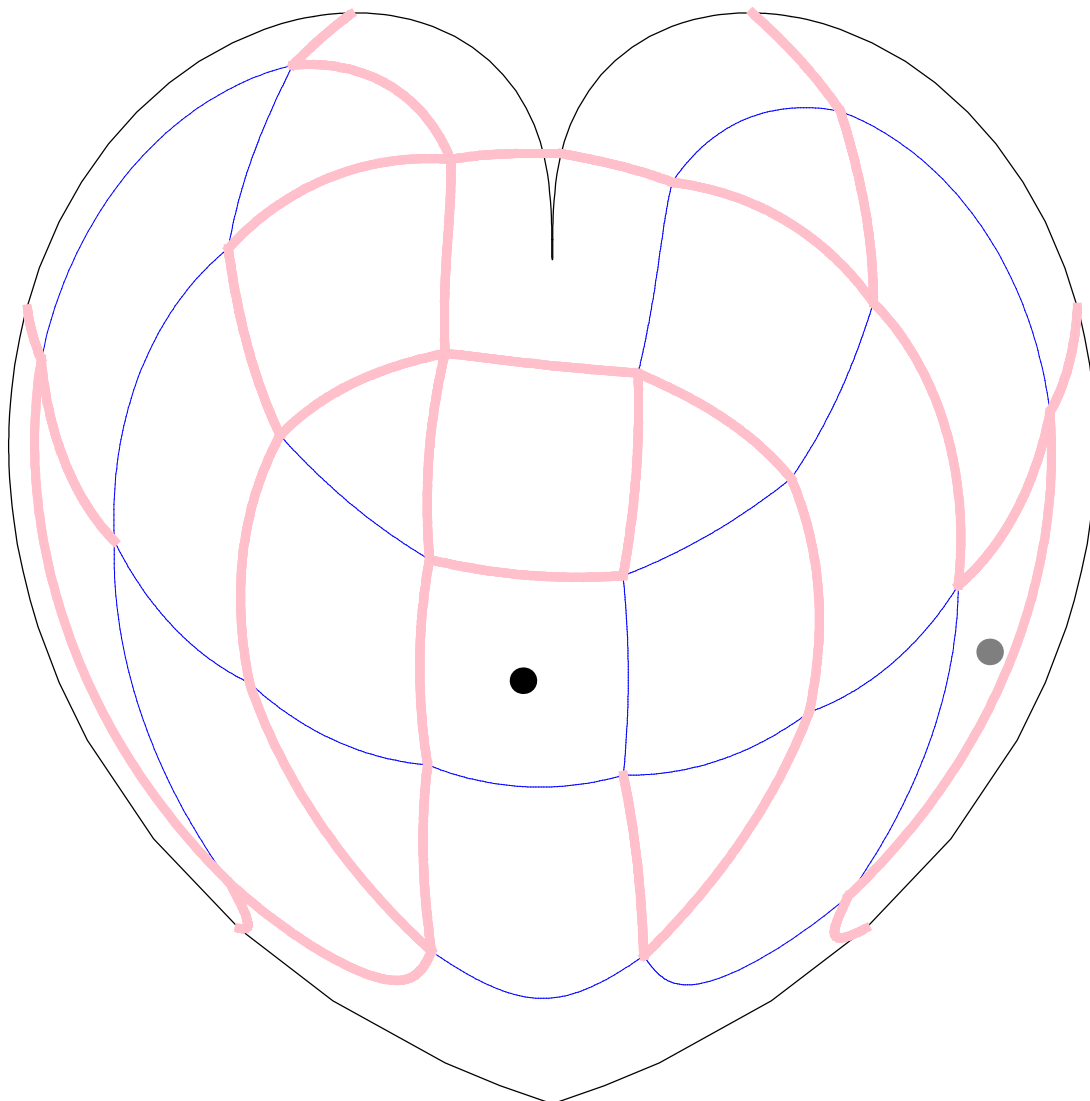
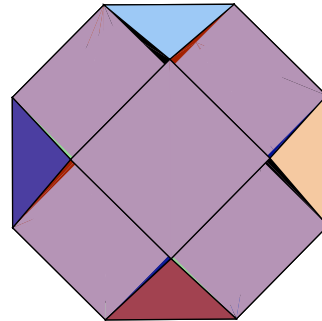
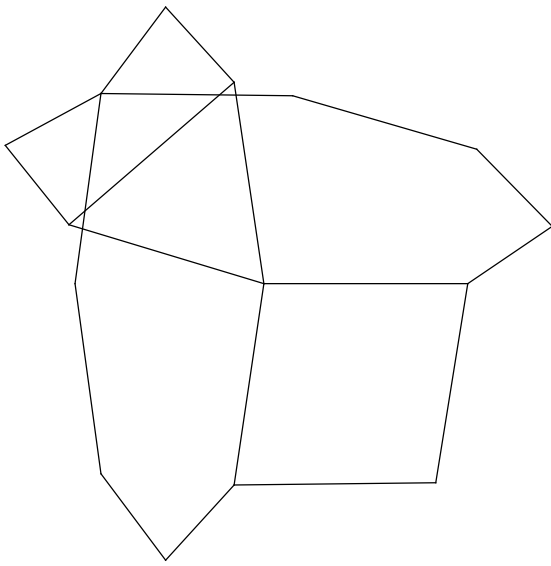
{3, 3, 3, 3, 4}



4.

small cubicuboctahedron

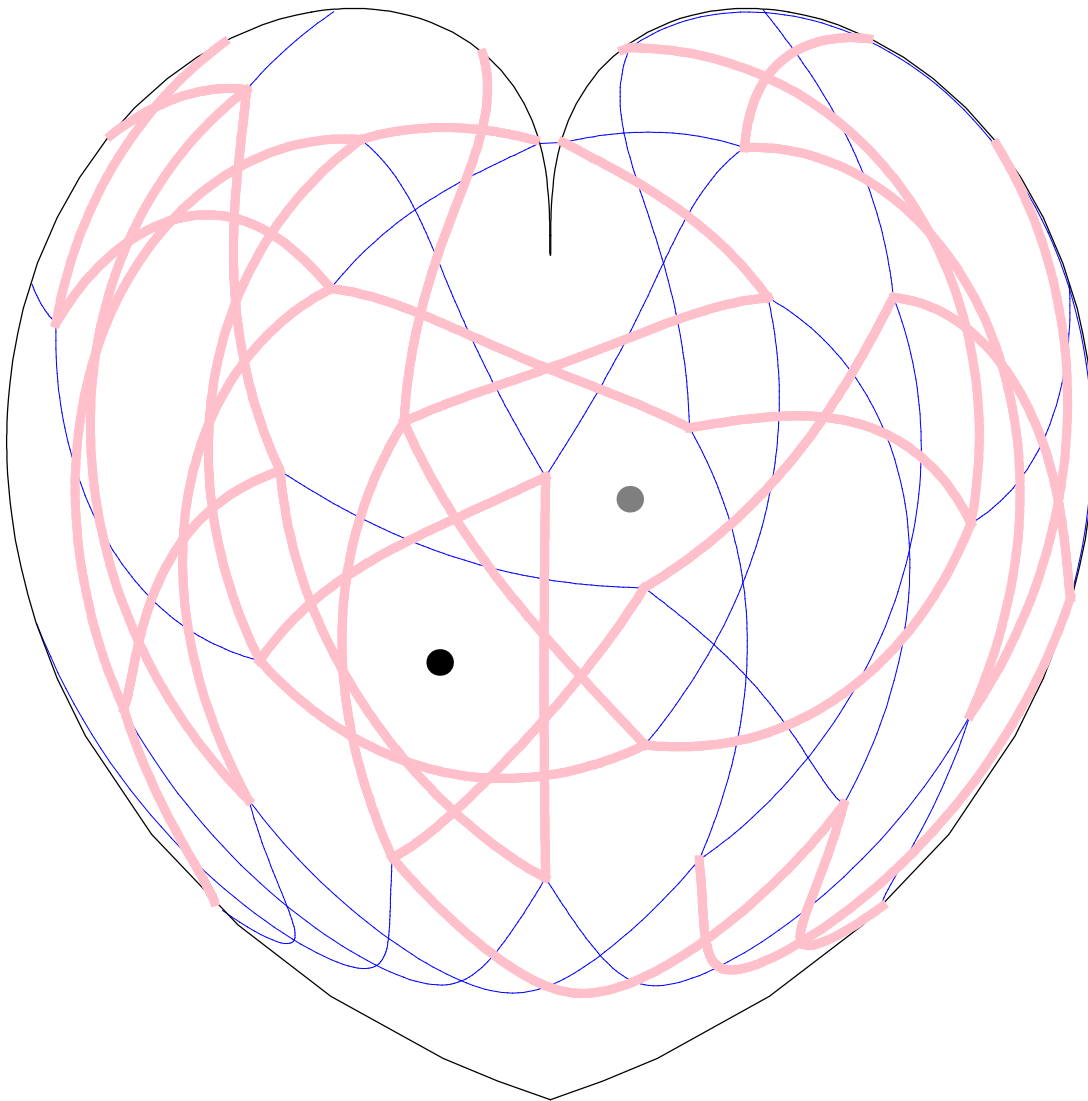
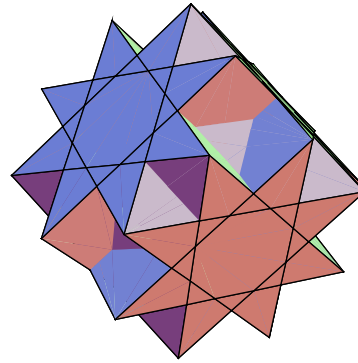
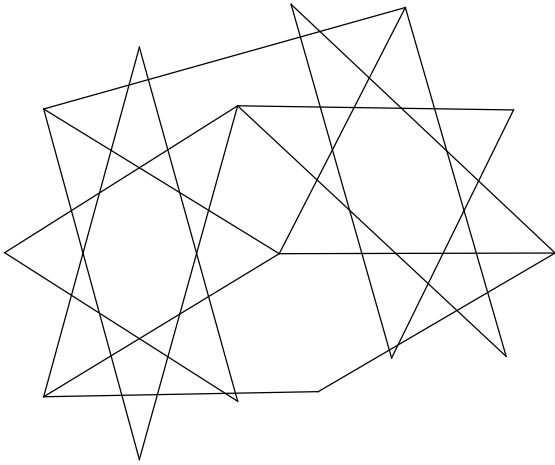
$$\left\{8, \frac{3}{2}, 8, 4\right\}$$



5.

great cubicuboctahedron

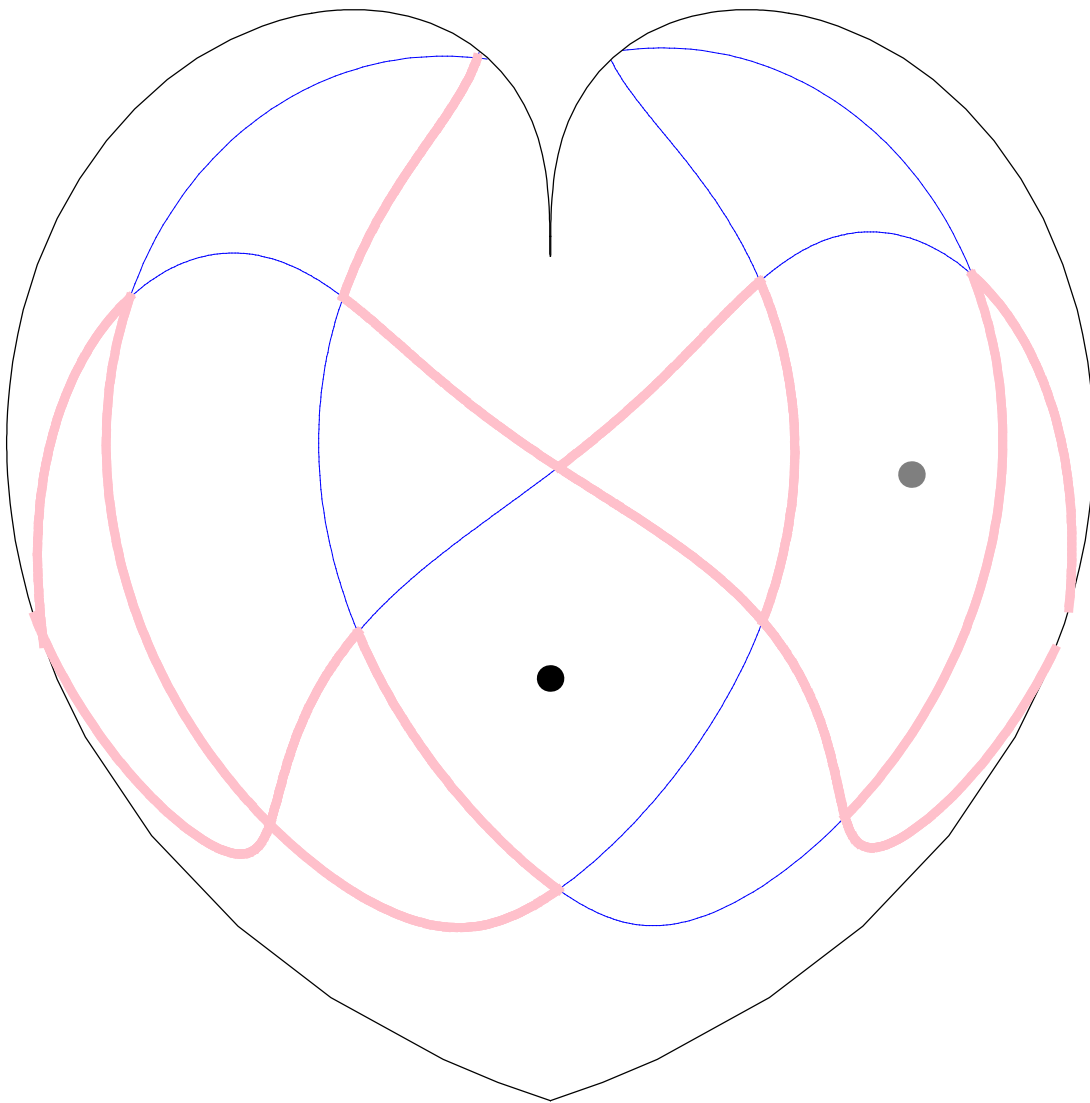
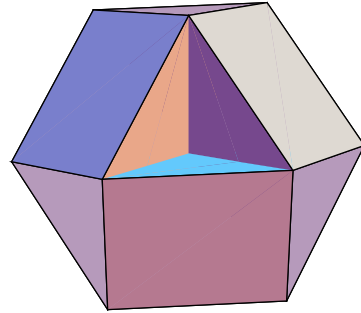
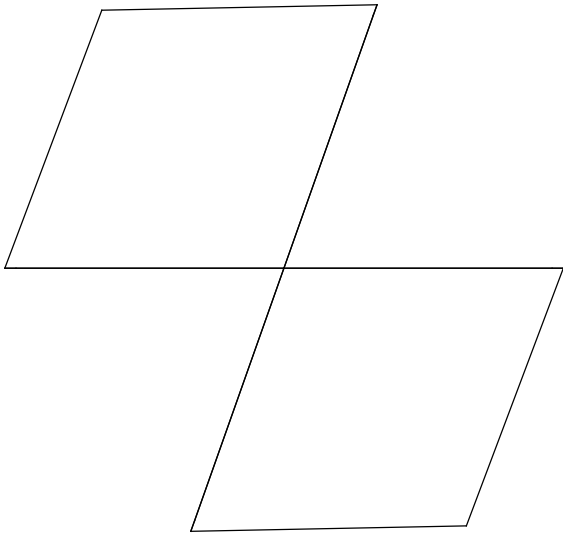
$$\left\{ \frac{8}{3}, 3, \frac{8}{3}, 4 \right\}$$



6.

cubohemioctahedron

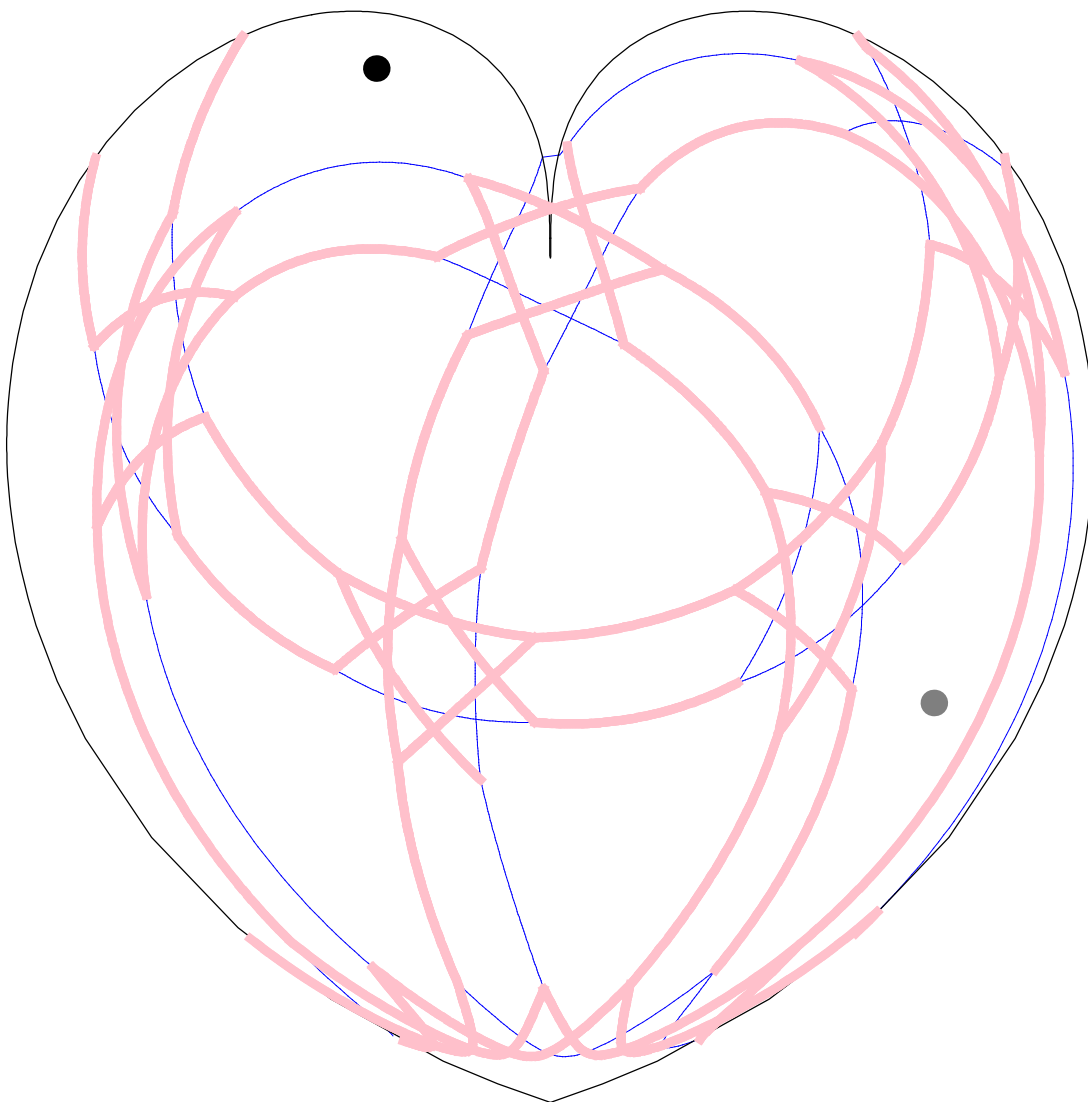
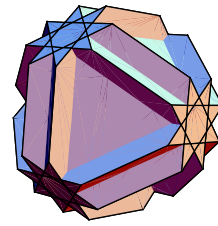
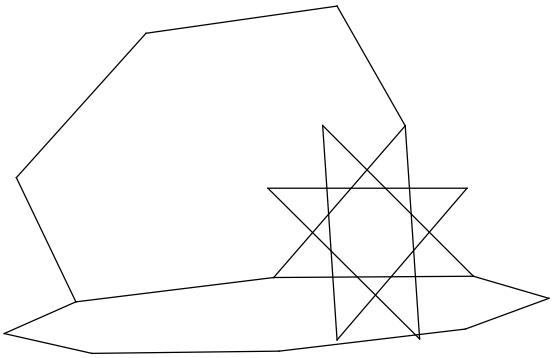
$$\left\{6, \frac{4}{3}, 6, 4\right\}$$



7.

cubitruncated cuboctahedron

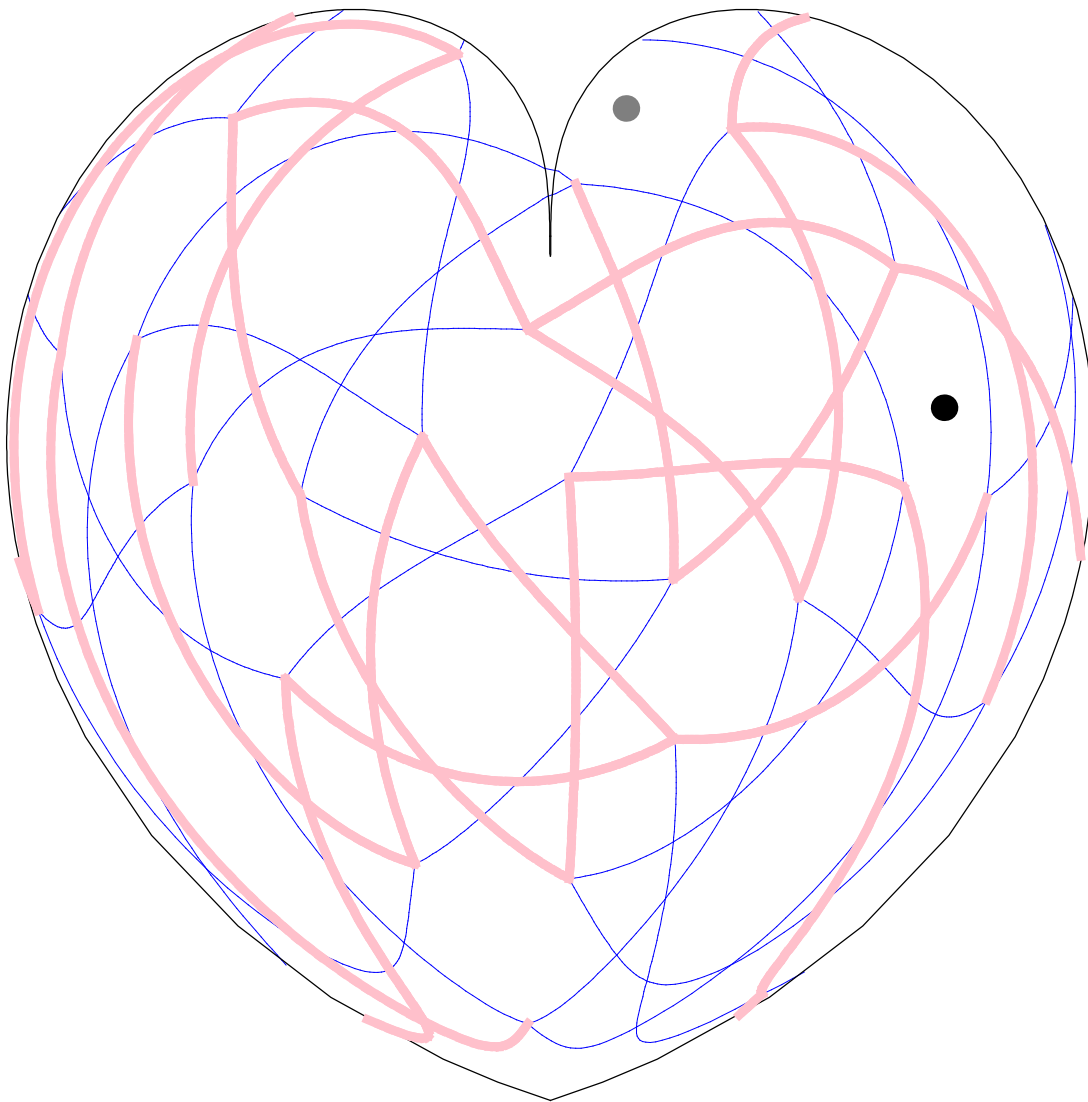
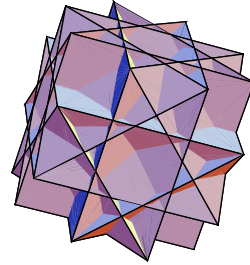
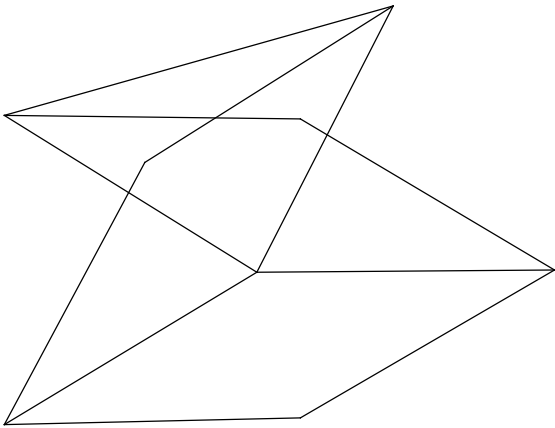
$$\left\{ \frac{8}{3}, 6, 8 \right\}$$



8.

great rhombicuboctahedron

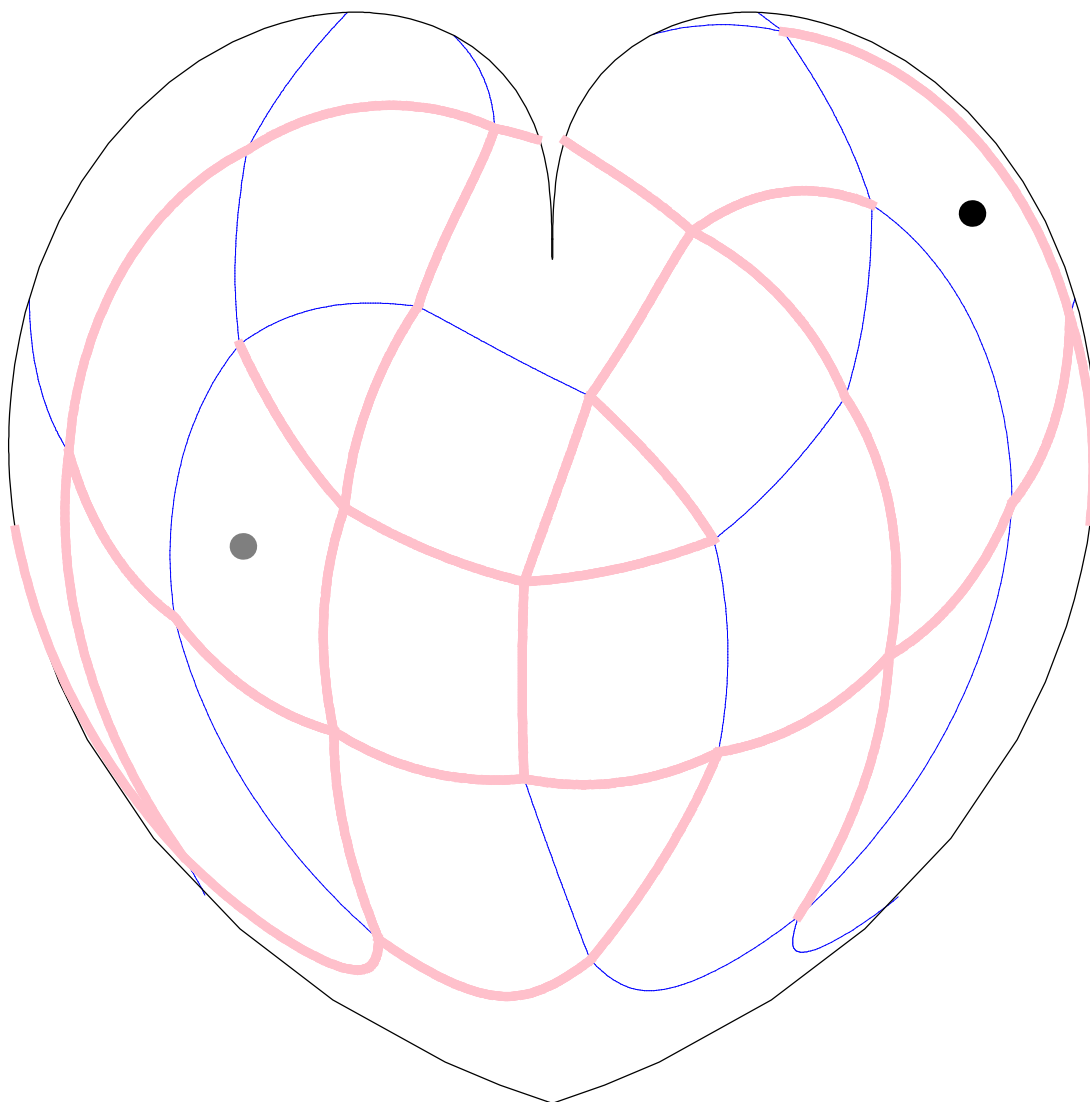
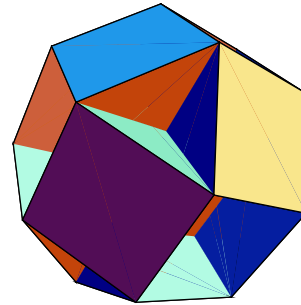
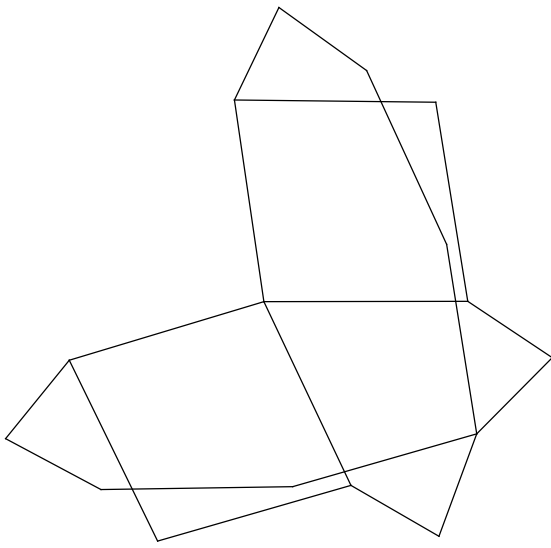
$$\left\{4, \frac{3}{2}, 4, 4\right\}$$



9.

small rhombihexahedron

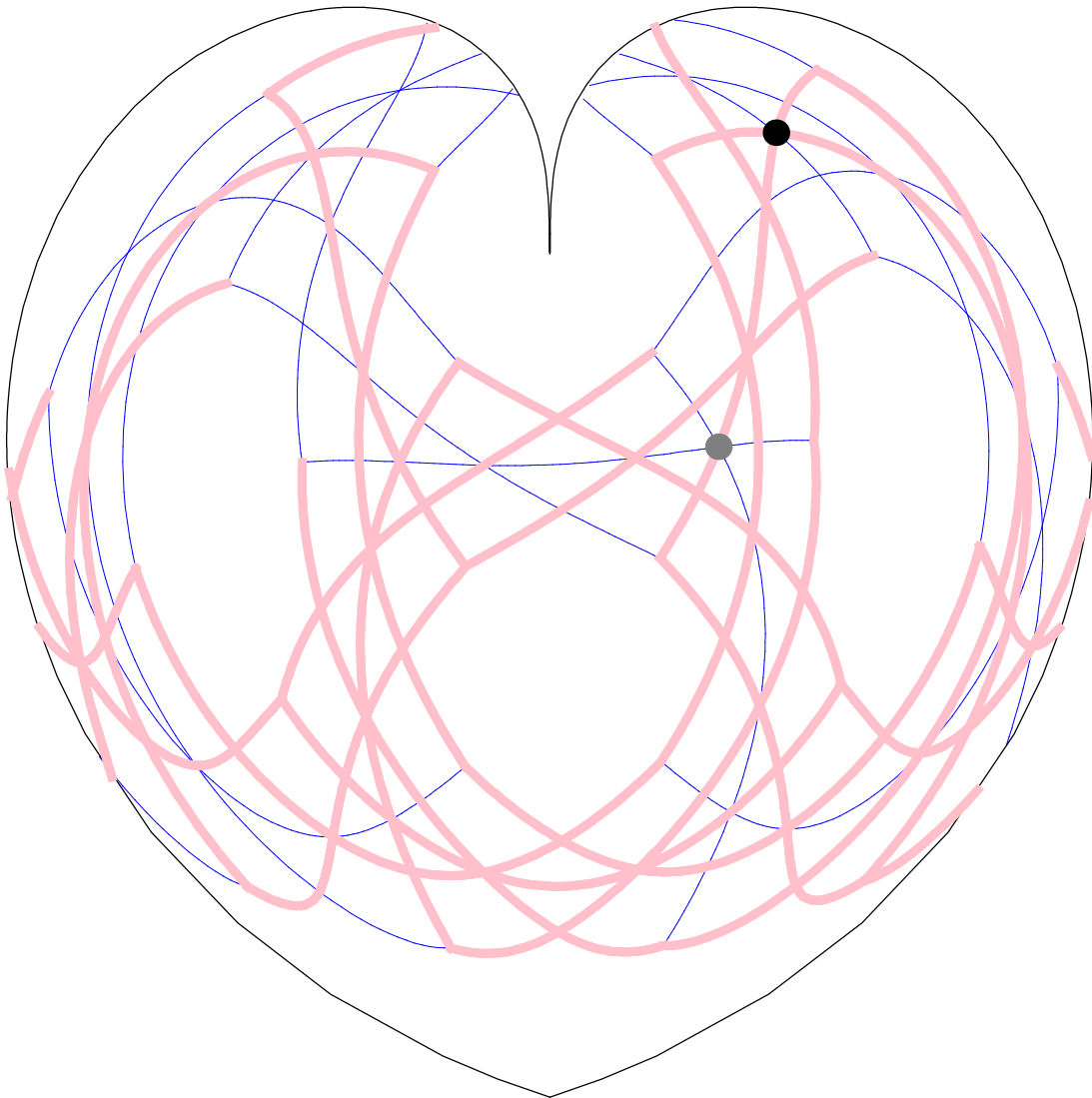
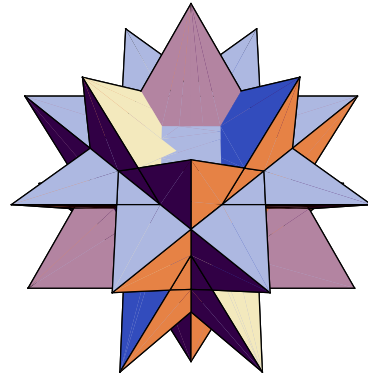
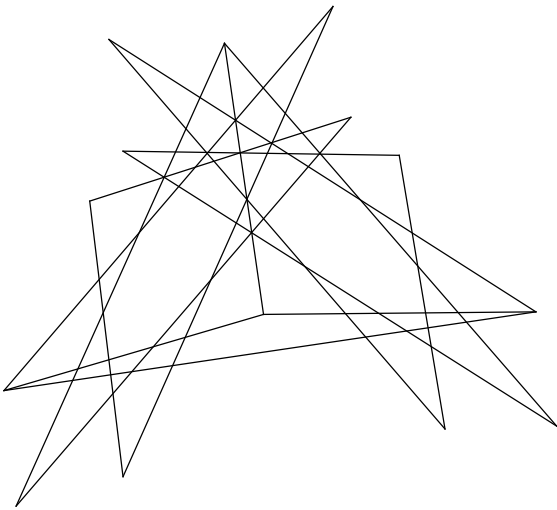
$$\left\{8, 4, \frac{8}{7}, \frac{4}{3}\right\}$$



10.

stellated truncated hexahedron

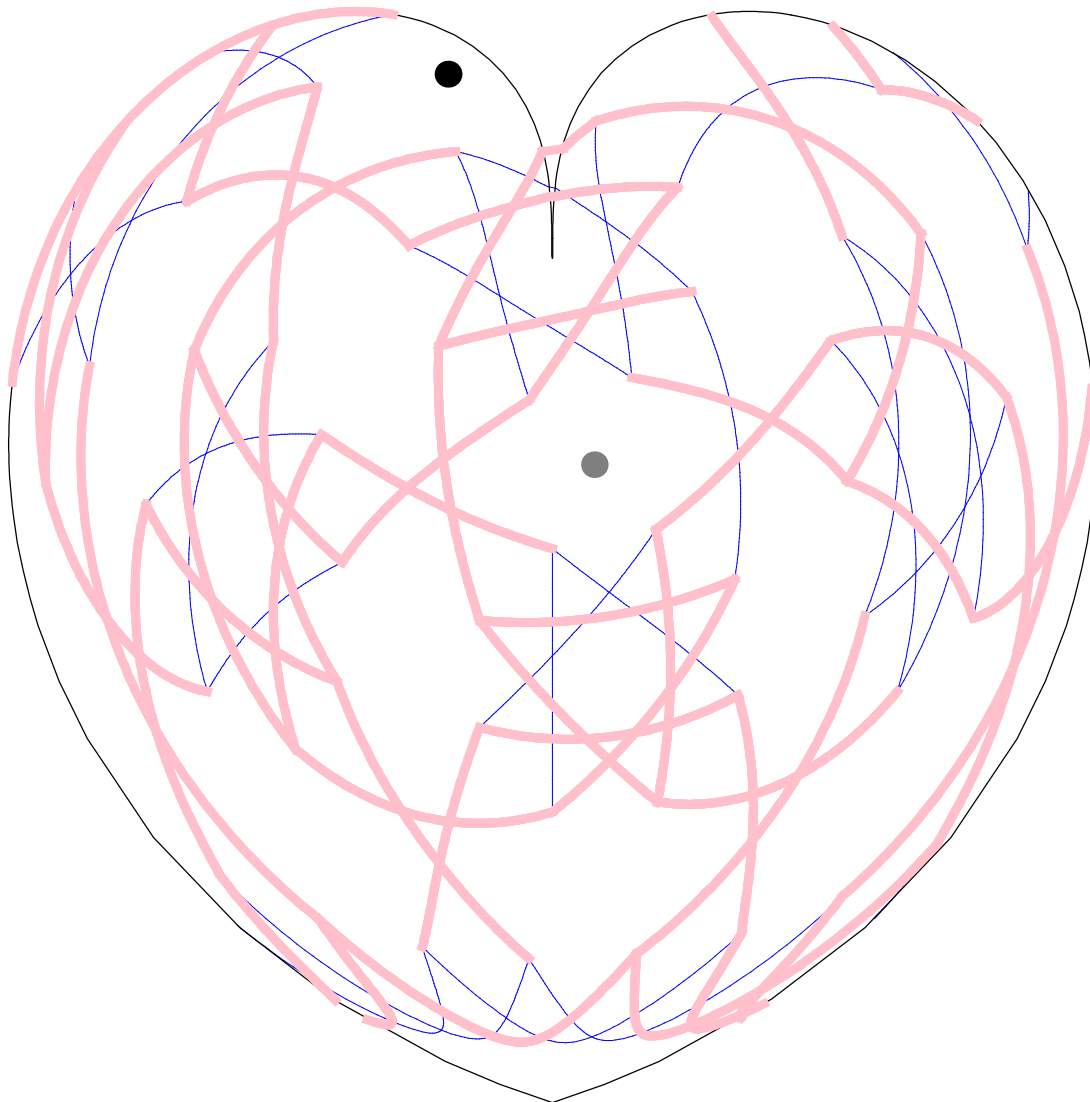
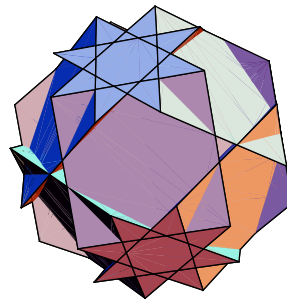
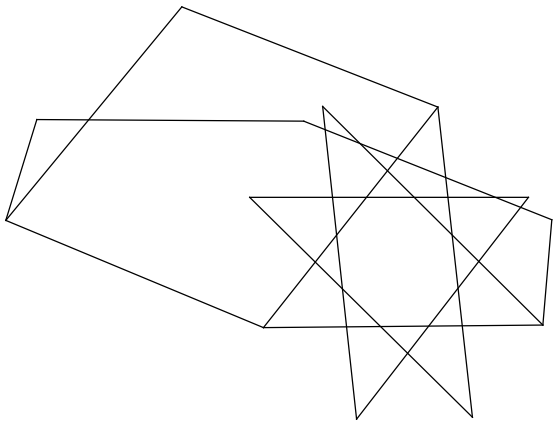
$$\left\{ \frac{8}{3}, \frac{8}{3}, 3 \right\}$$



11.

great truncated cuboctahedron

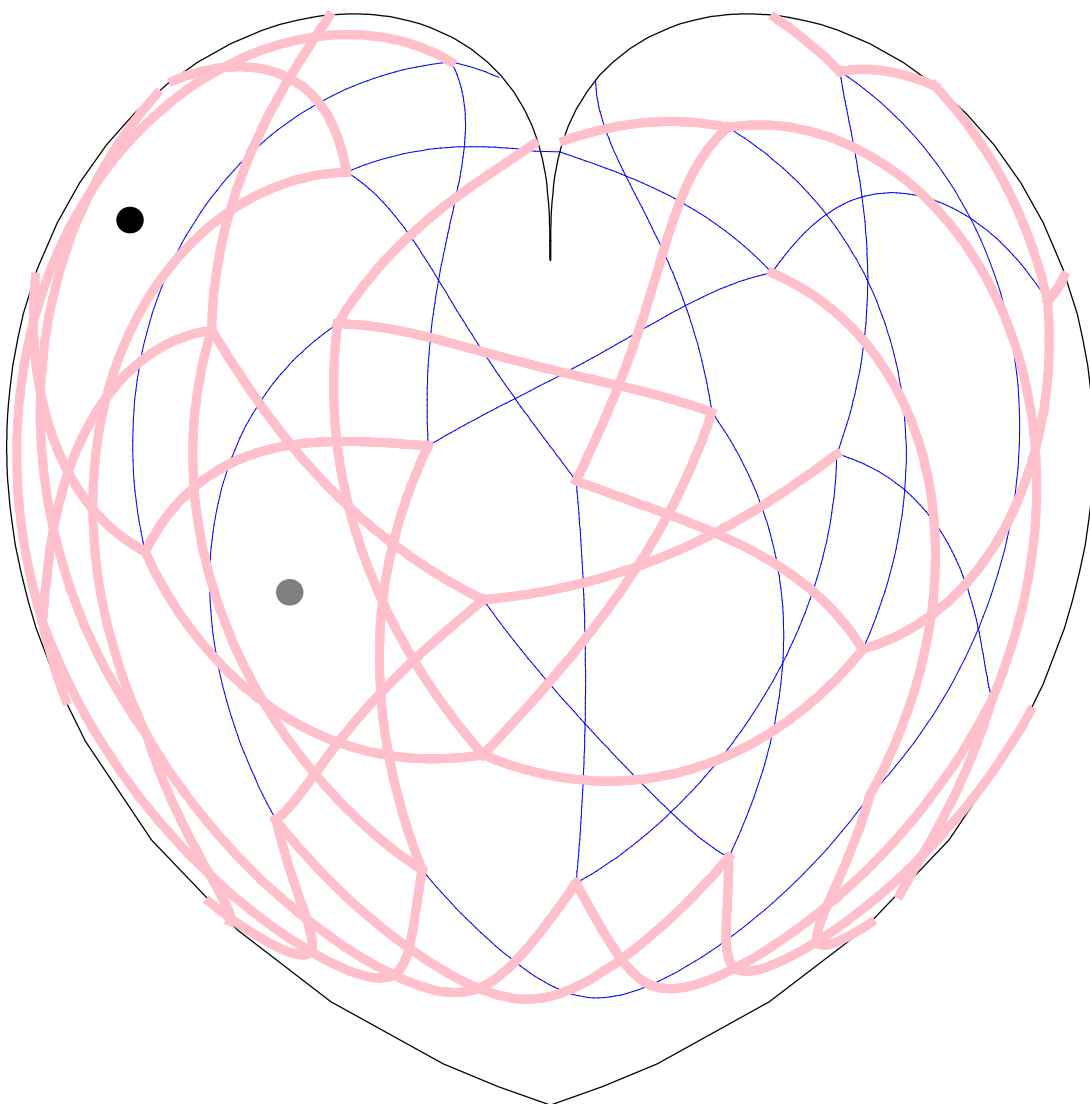
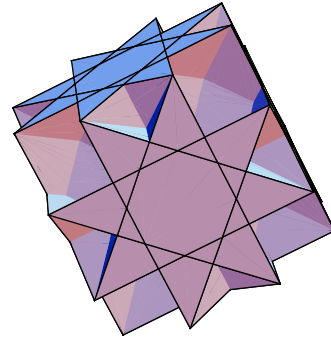
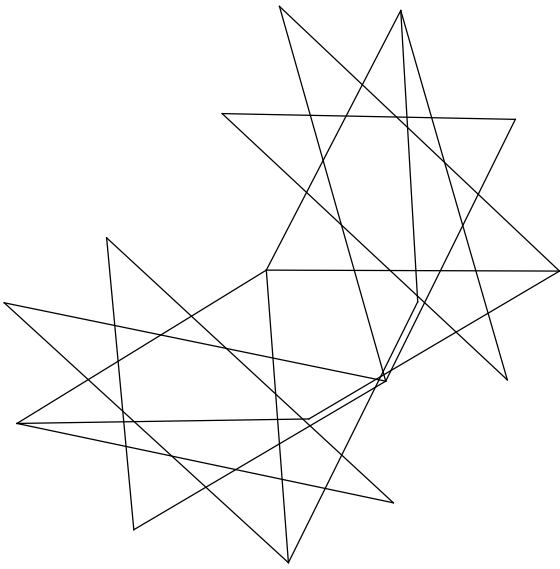
$$\left\{ \frac{8}{3}, 4, 6 \right\}$$



12.

great rhombihexahedron

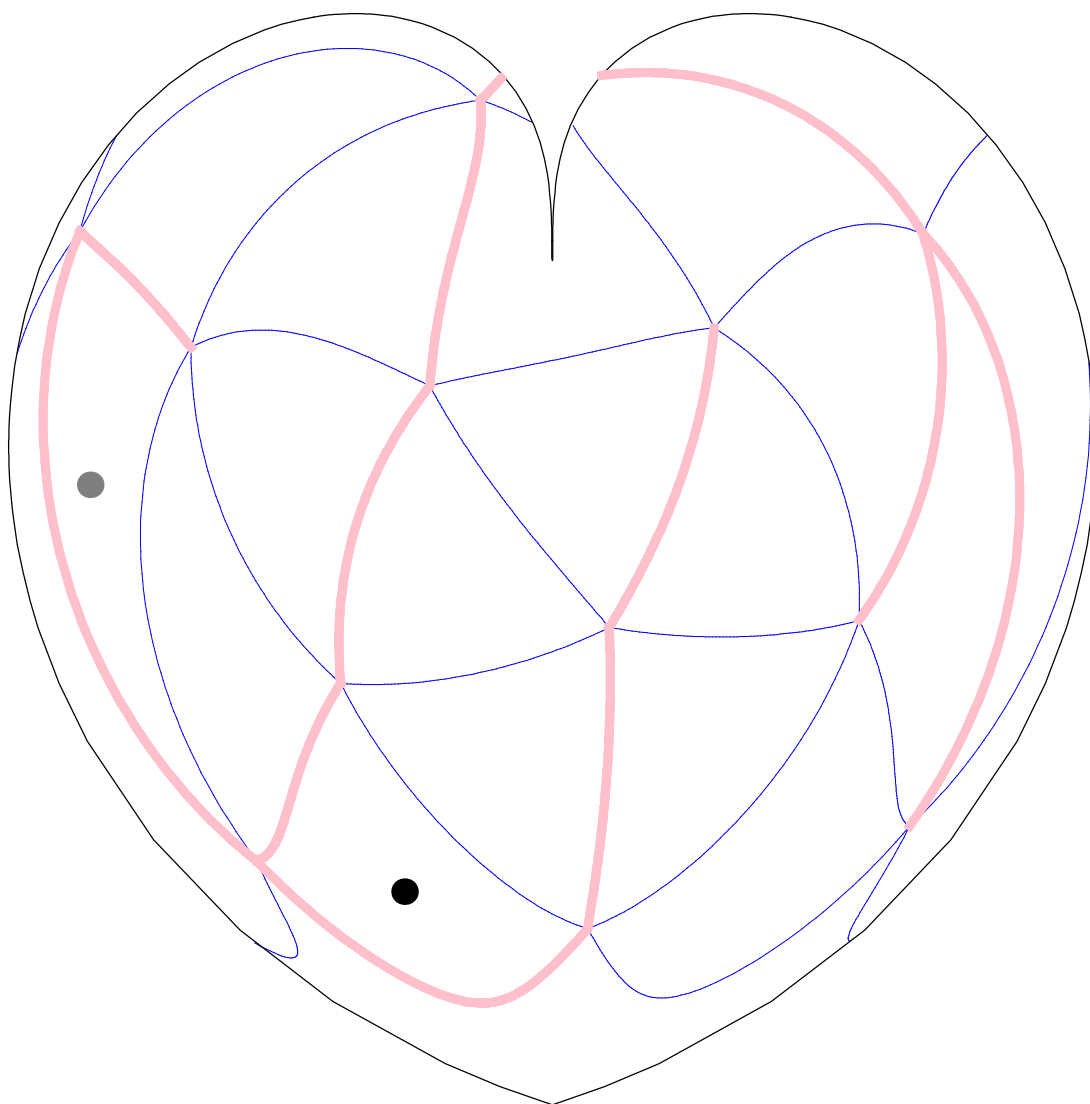
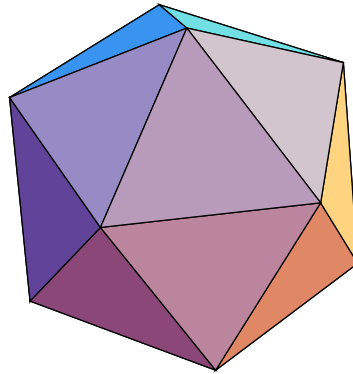
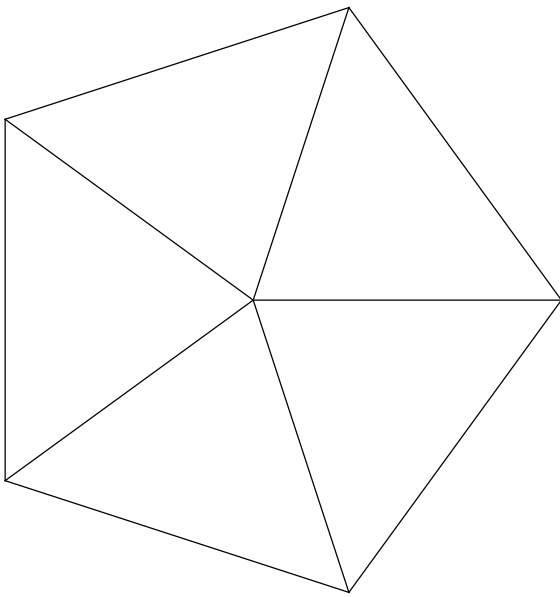
$$\left\{4, \frac{8}{3}, \frac{4}{3}, \frac{8}{5}\right\}$$



13.

icosahedron

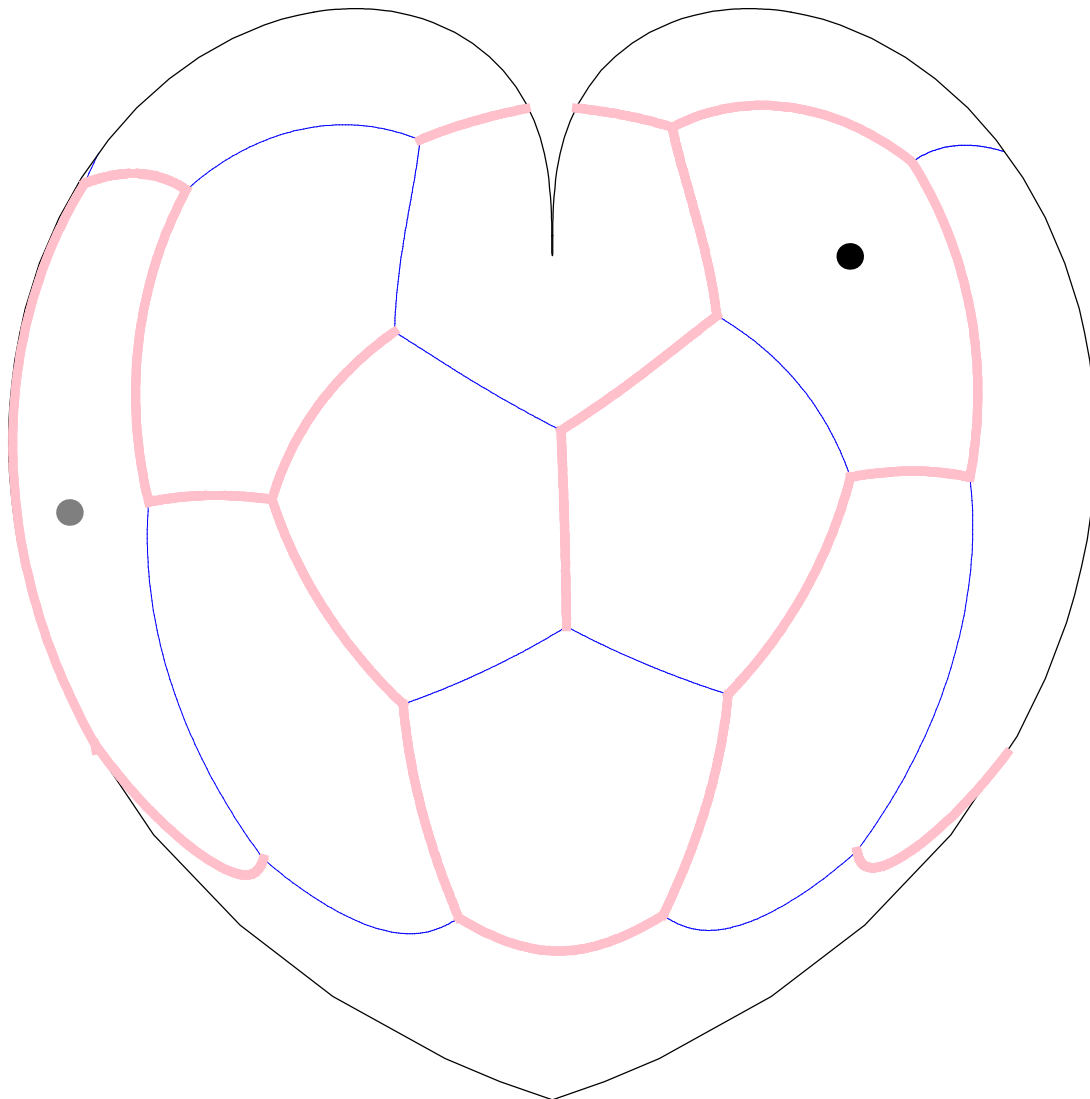
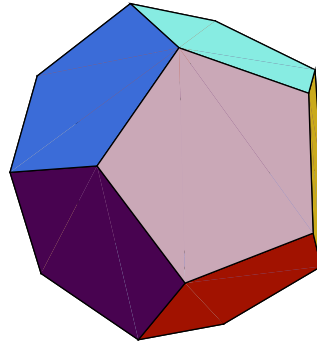
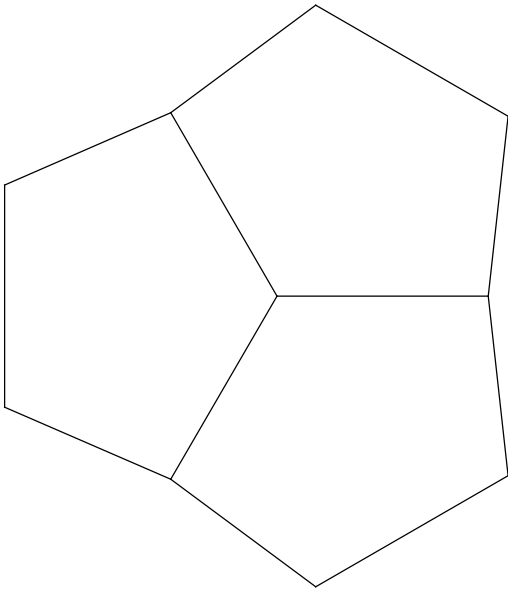
{3, 3, 3, 3, 3}



14.

dodecahedron

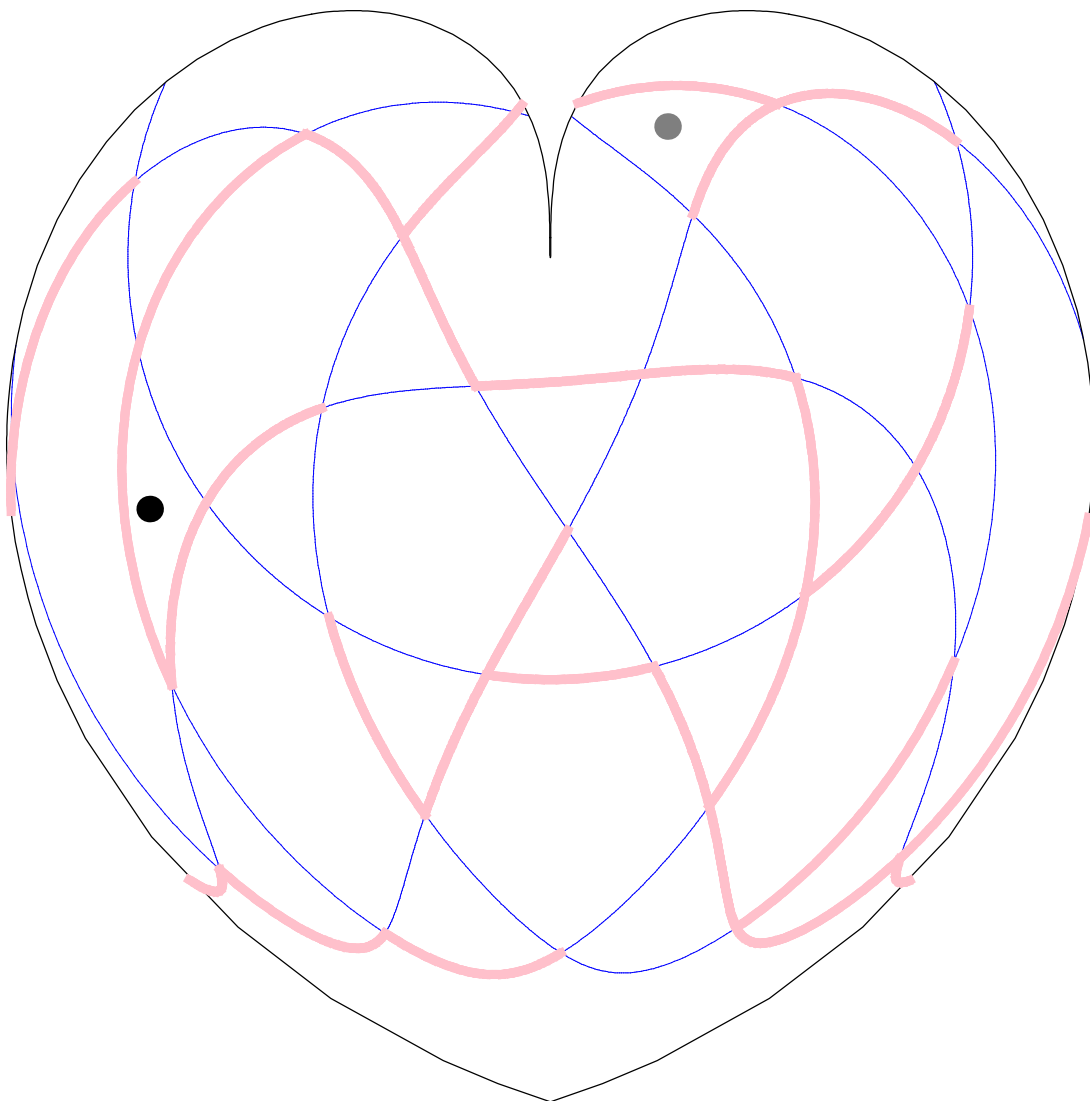
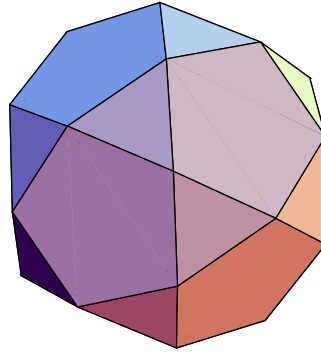
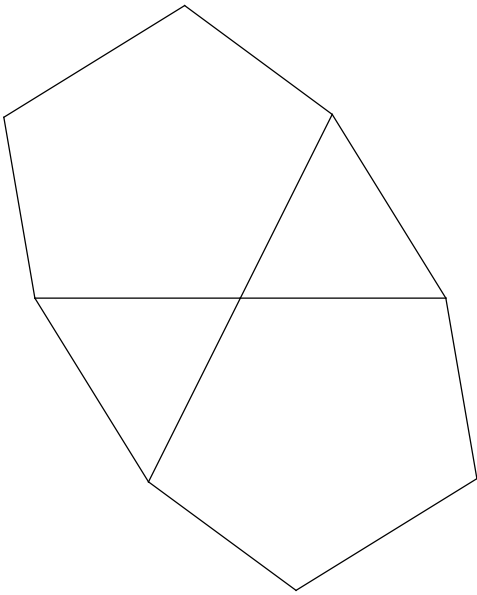
{5, 5, 5}



15.

icosidodecahedron

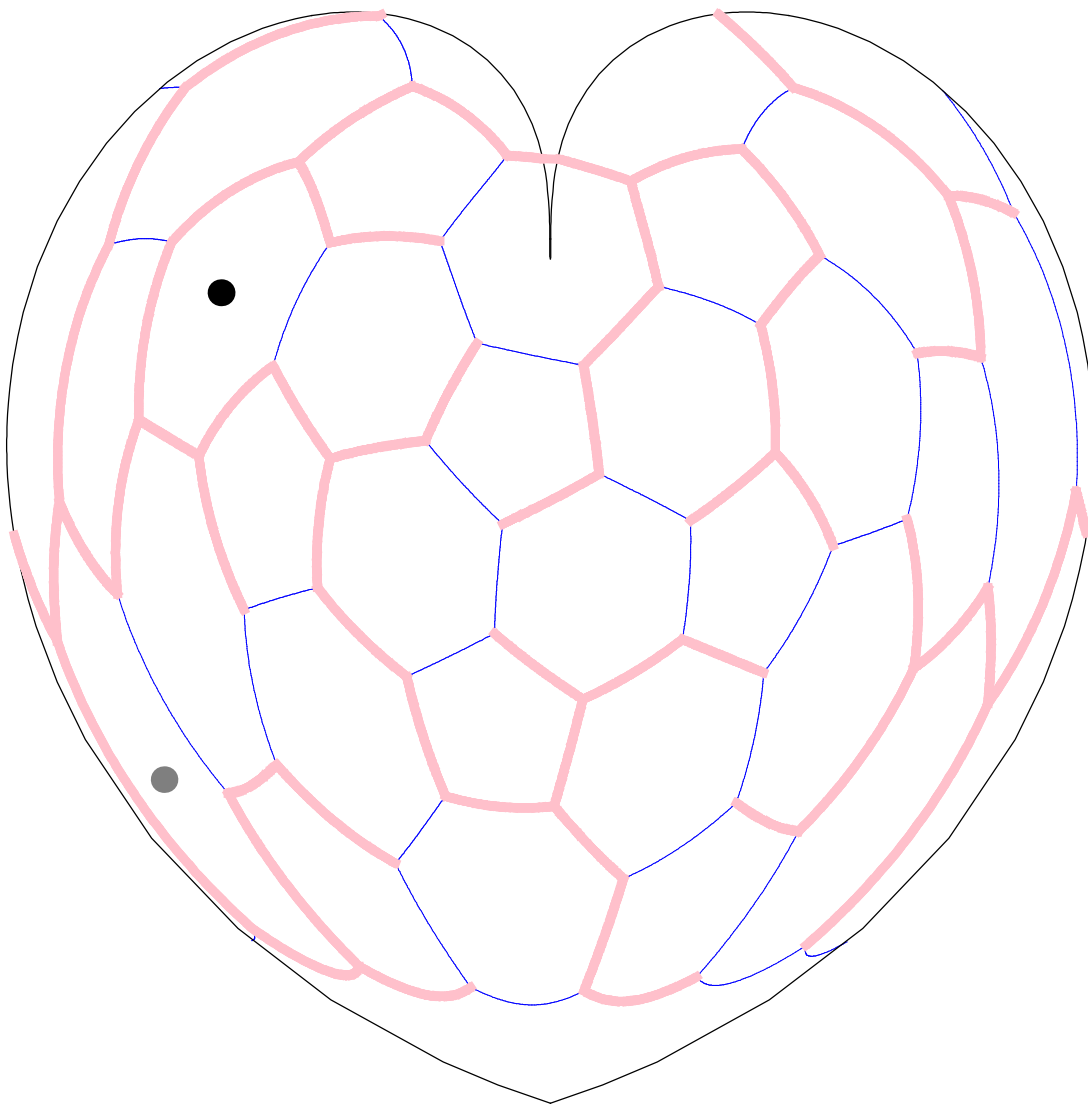
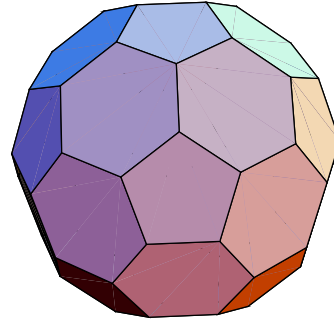
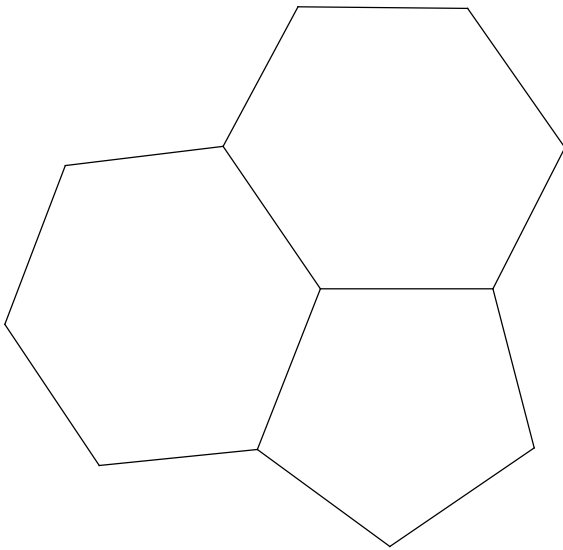
{3, 5, 3, 5}



16.

truncated icosahedron

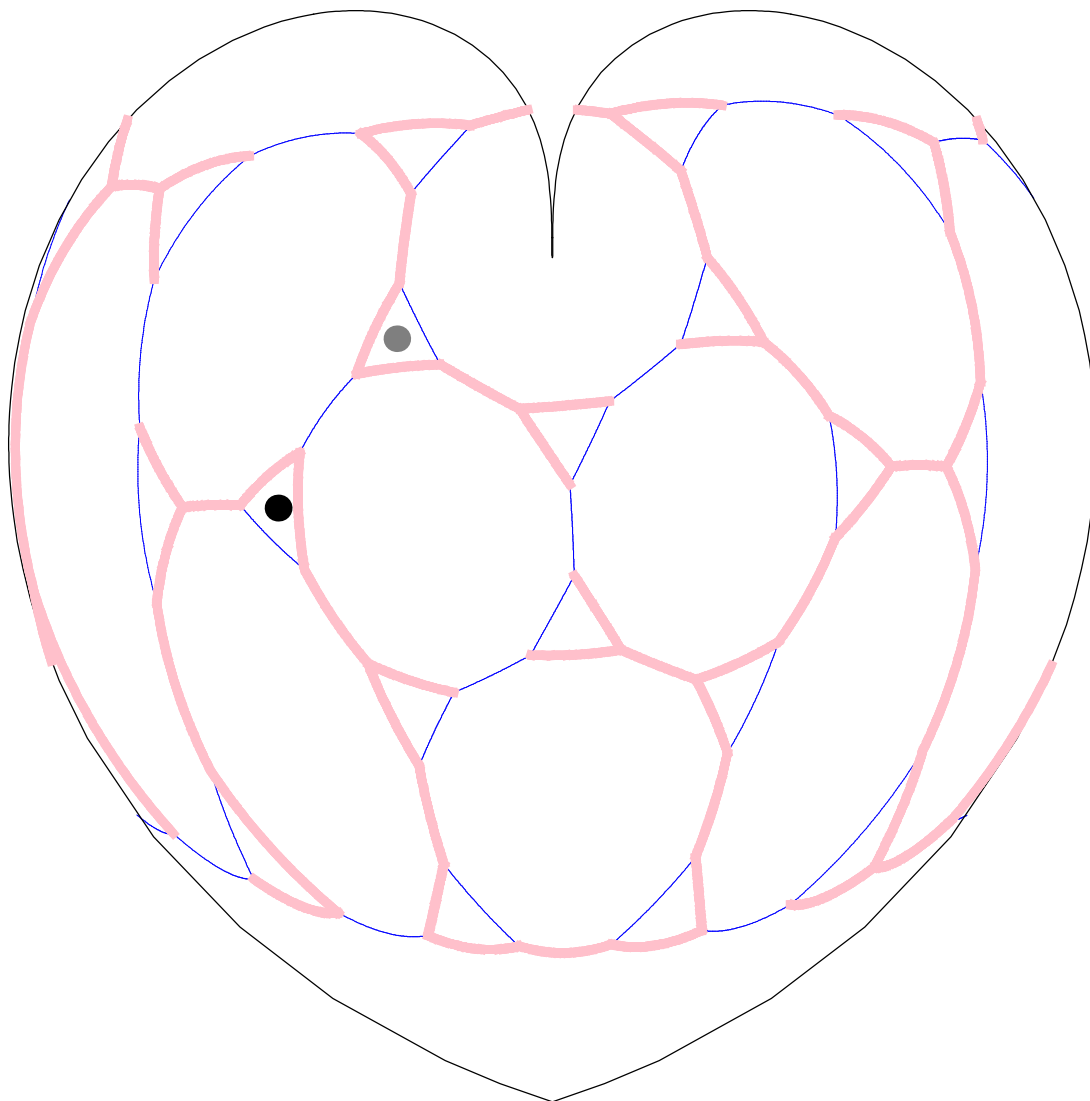
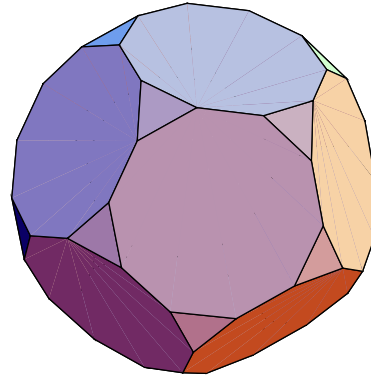
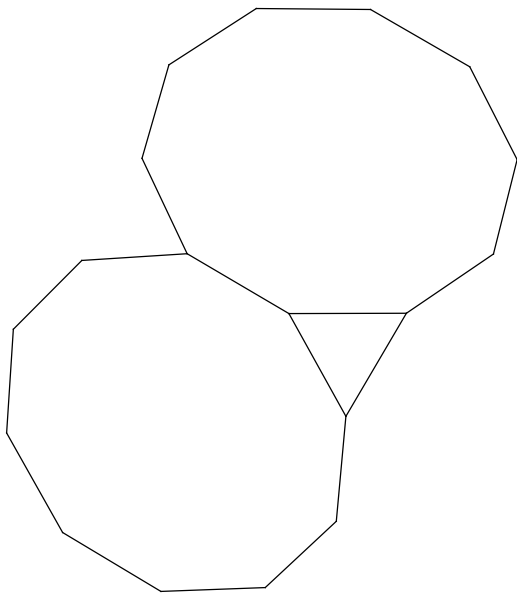
{6, 6, 5}



17.

truncated dodecahedron

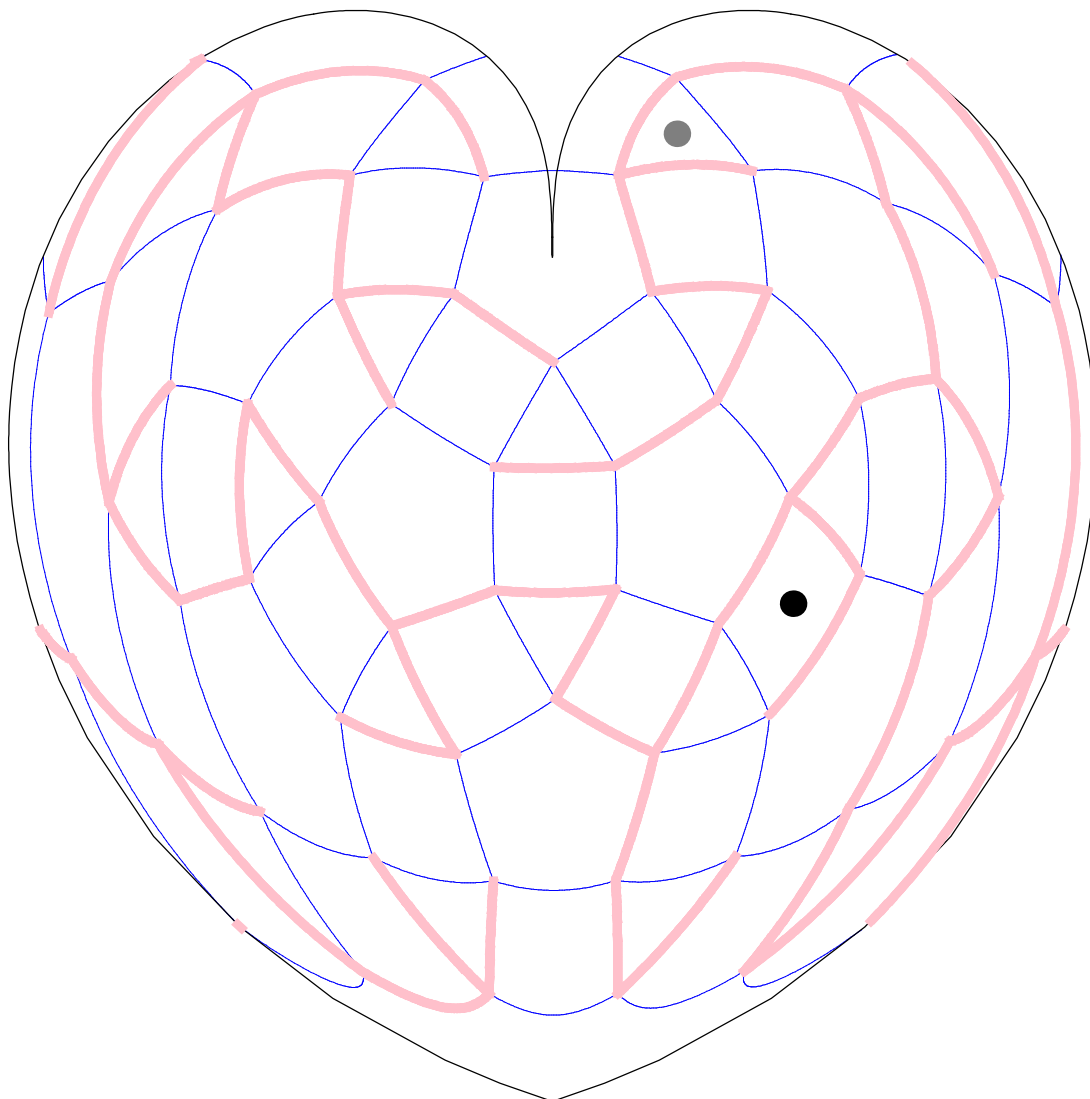
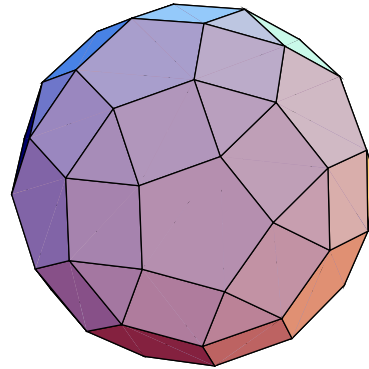
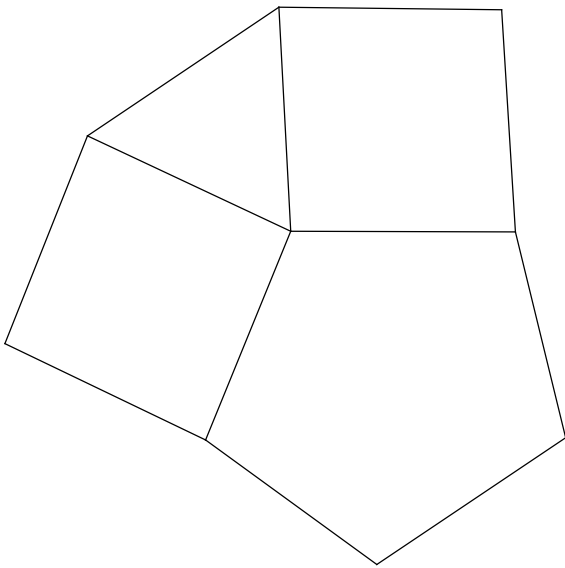
{10, 10, 3}



18.

rhombicosidodecahedron

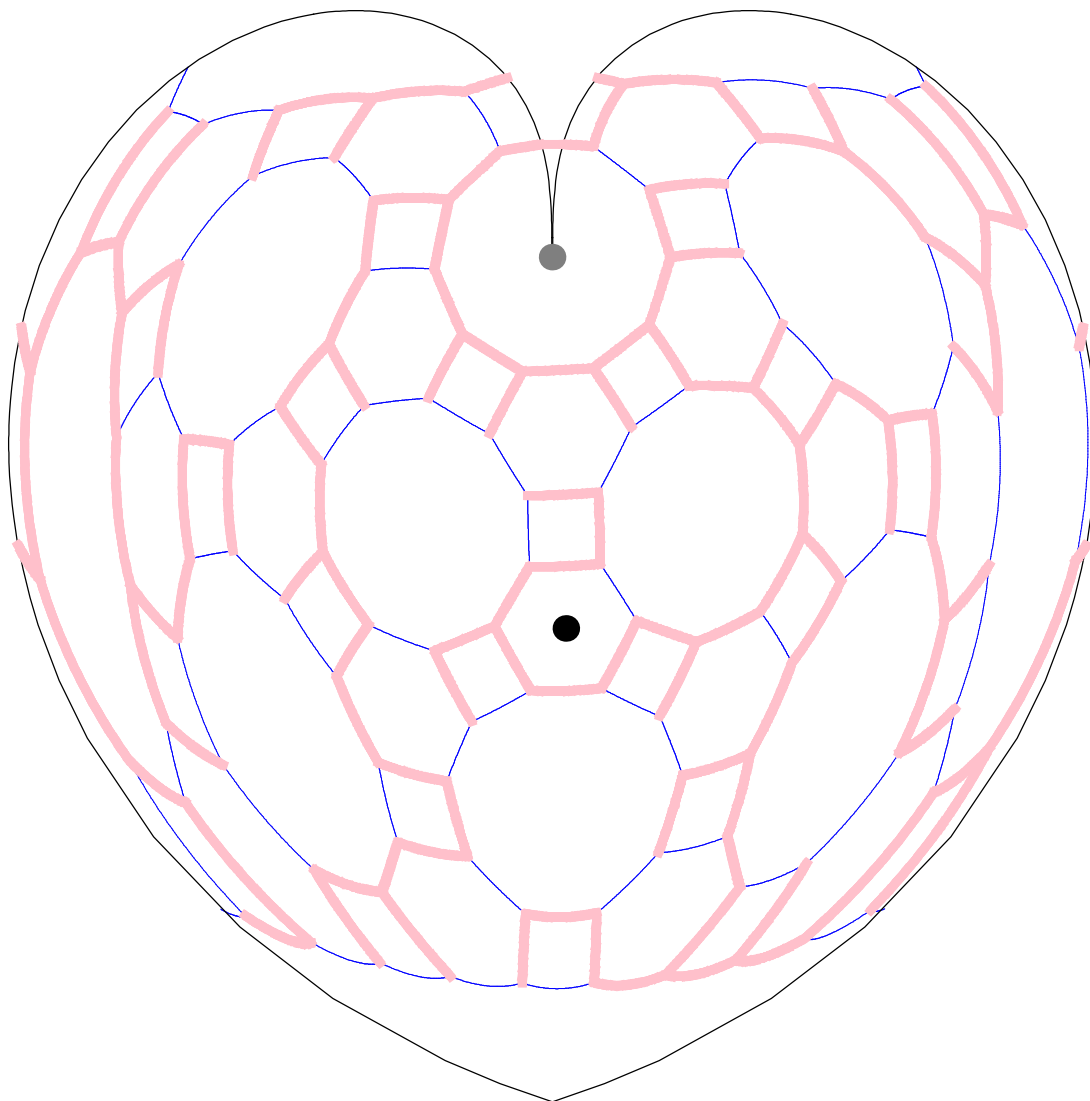
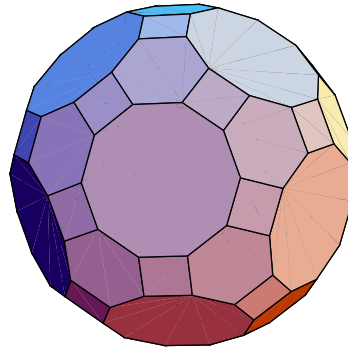
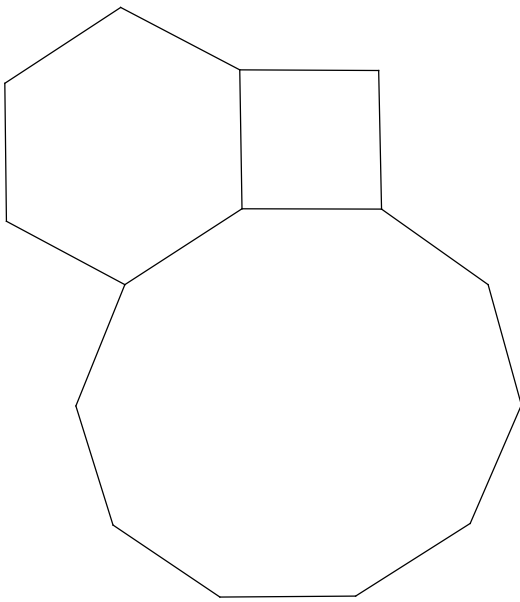
{4, 3, 4, 5}



19.

truncated icosidodecahedron

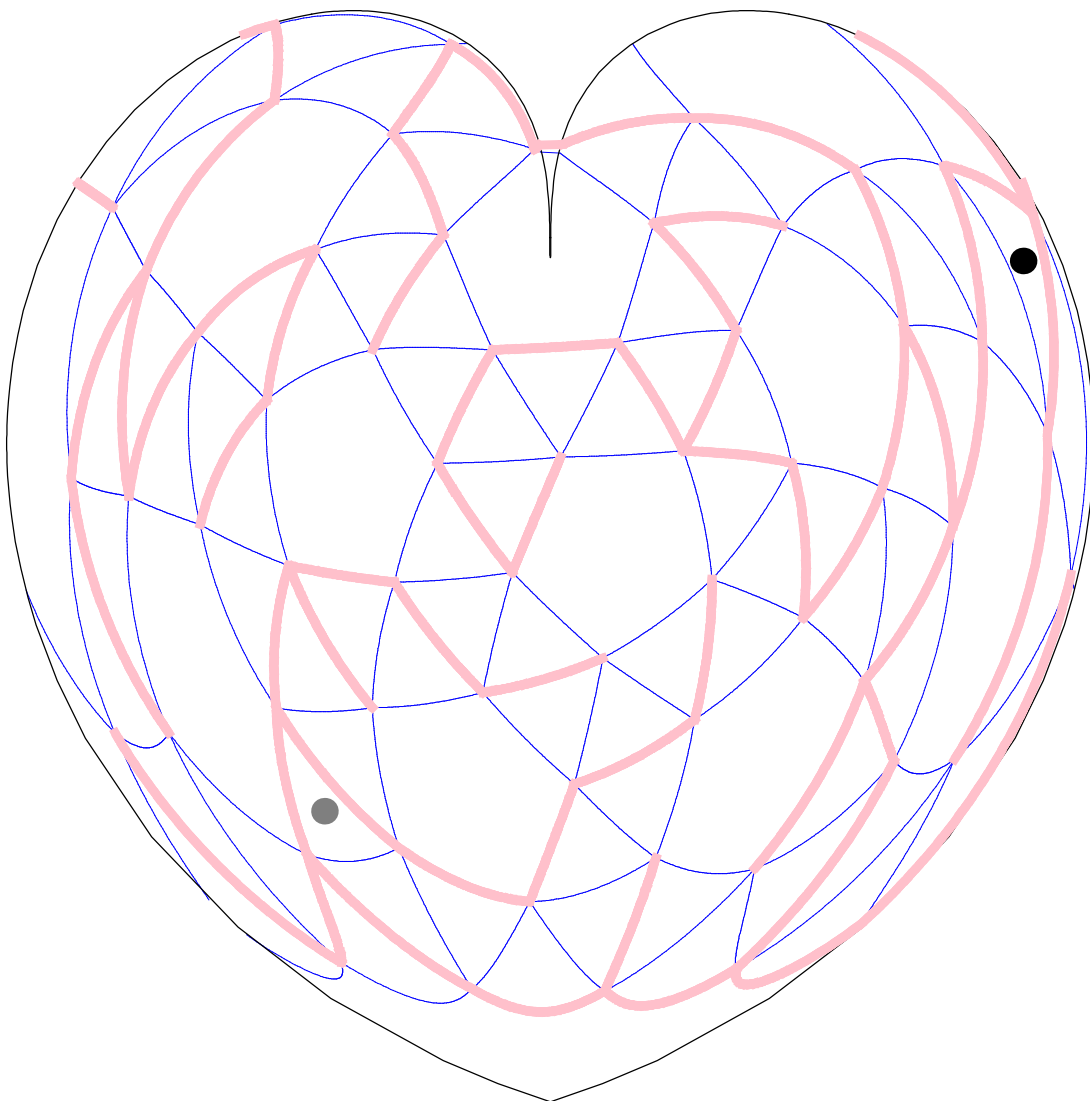
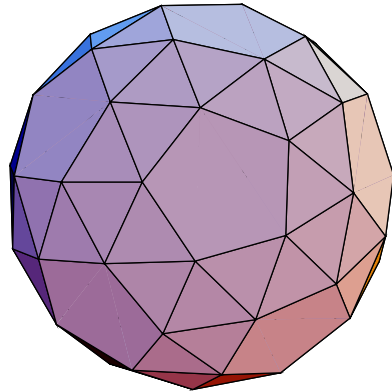
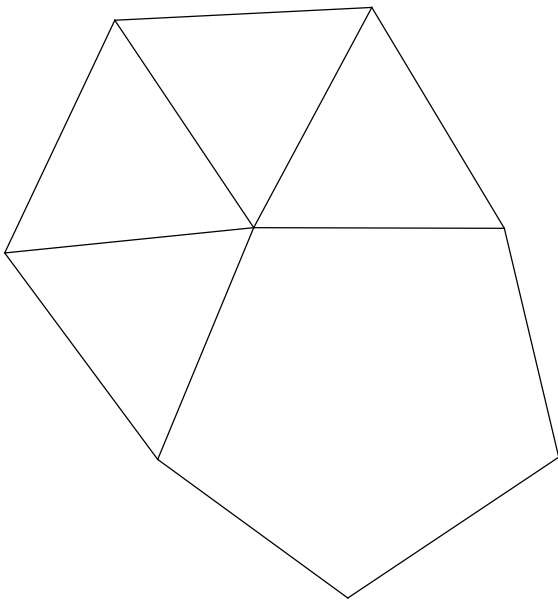
{4, 6, 10}



20.

snub dodecahedron

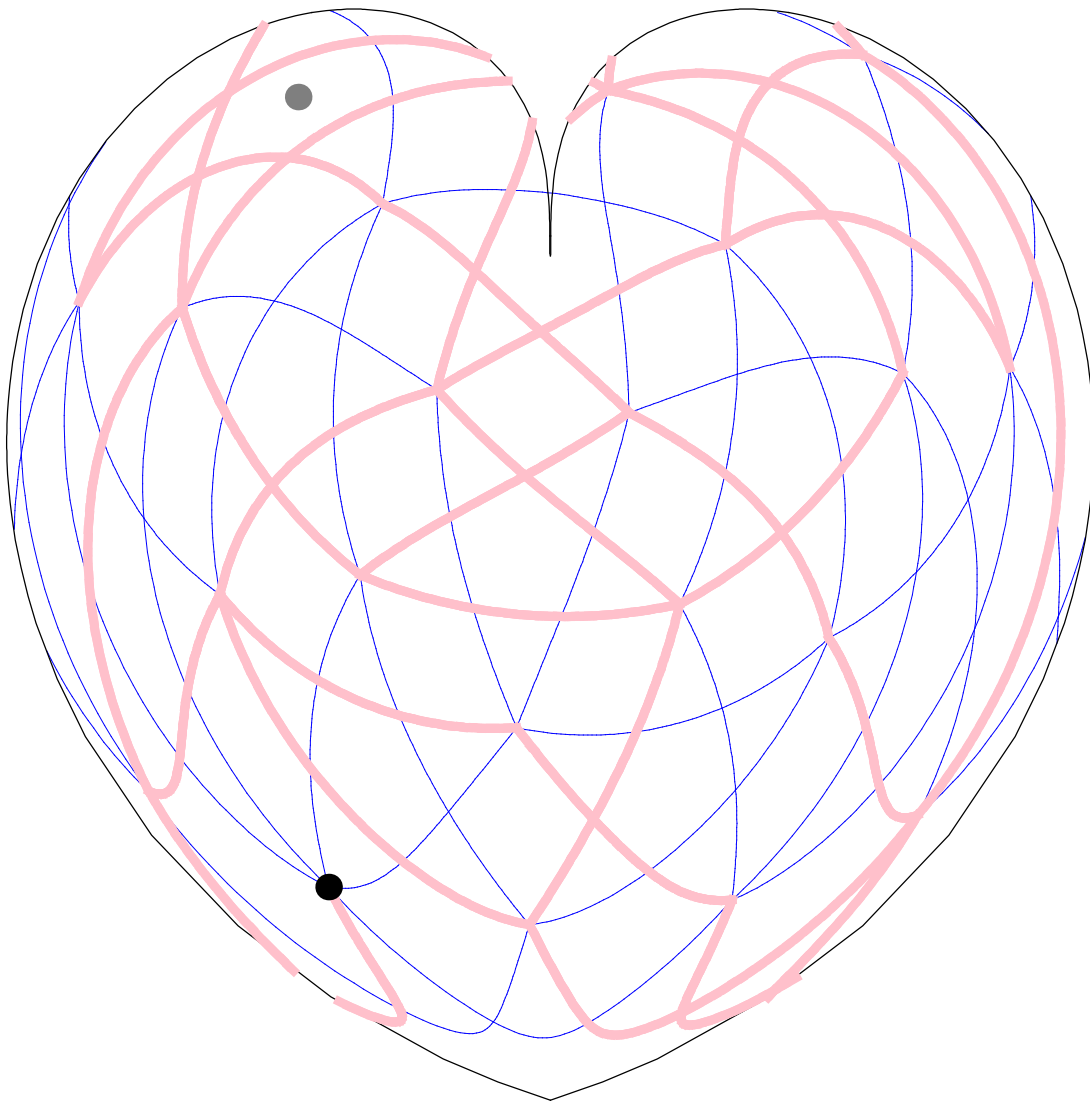
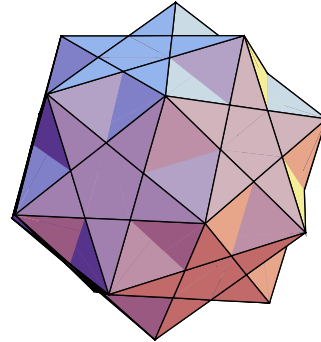
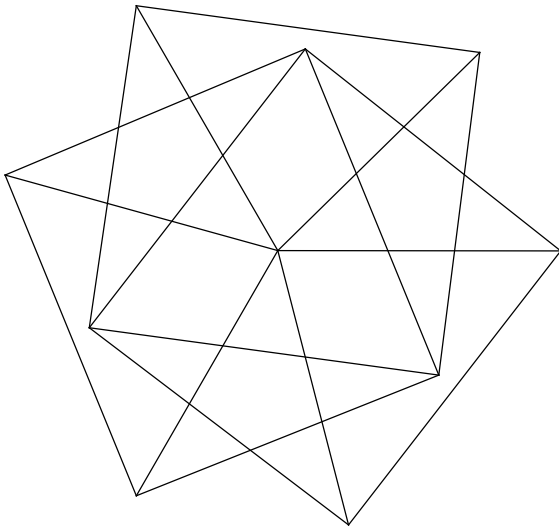
{3, 3, 3, 3, 5}



21.

small ditrigonal icosidodecahedron

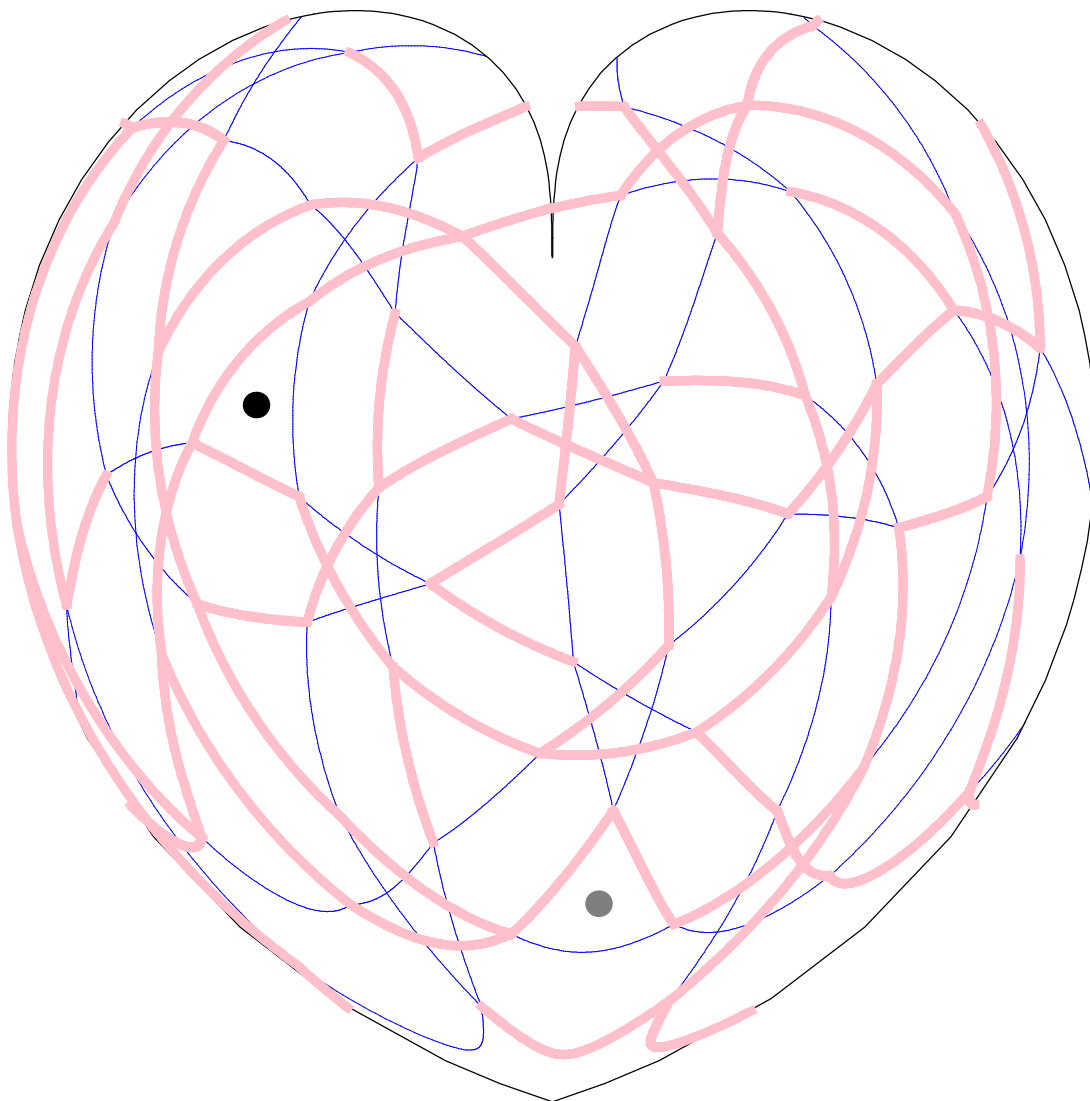
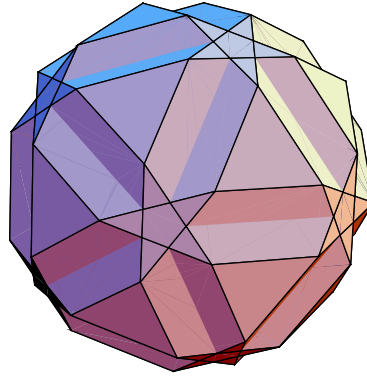
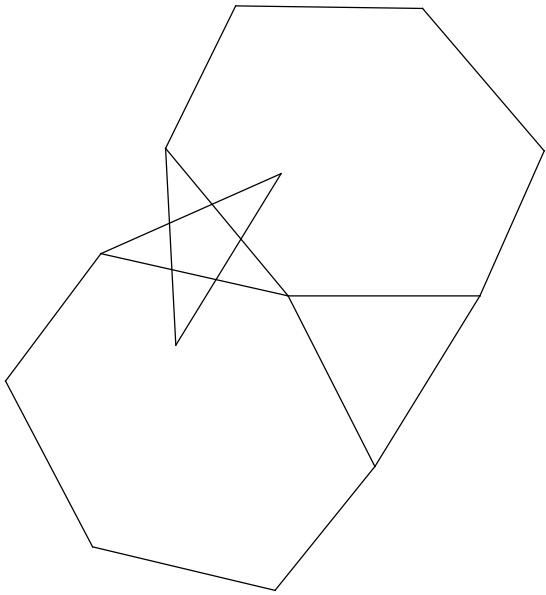
$$\left\{ \frac{5}{2}, 3, \frac{5}{2}, 3, \frac{5}{2}, 3 \right\}$$



22.

small icosicosidodecahedron

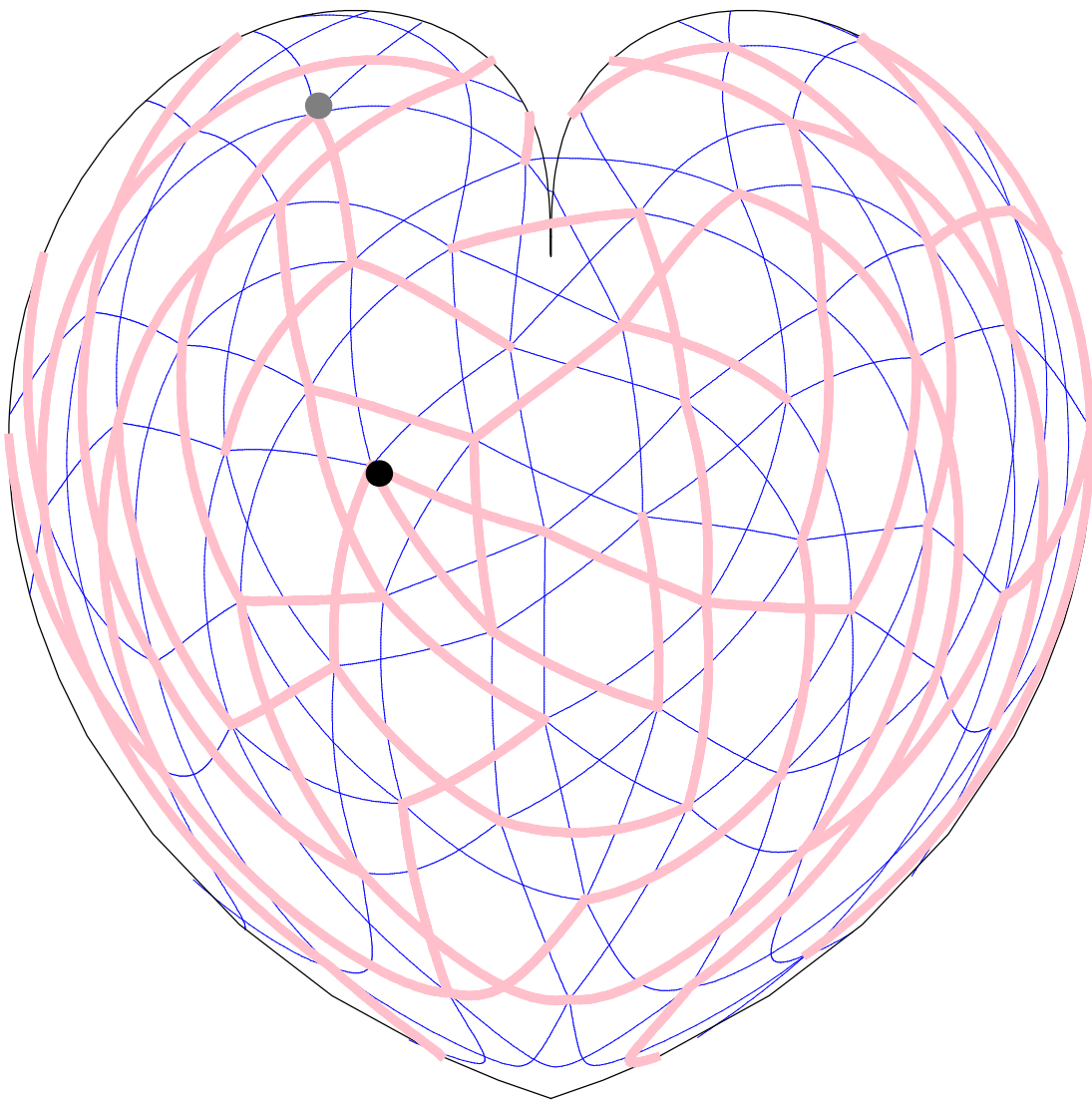
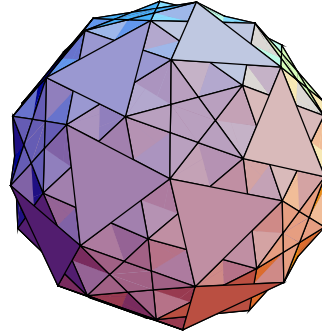
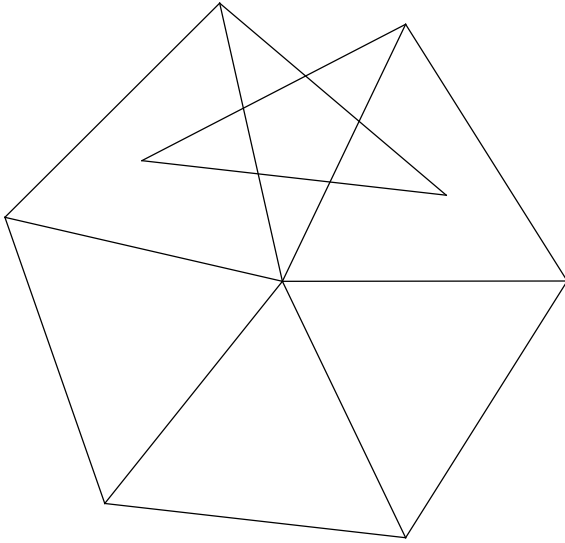
$$\left\{6, \frac{5}{2}, 6, 3\right\}$$



23.

small snub icosicosidodecahedron

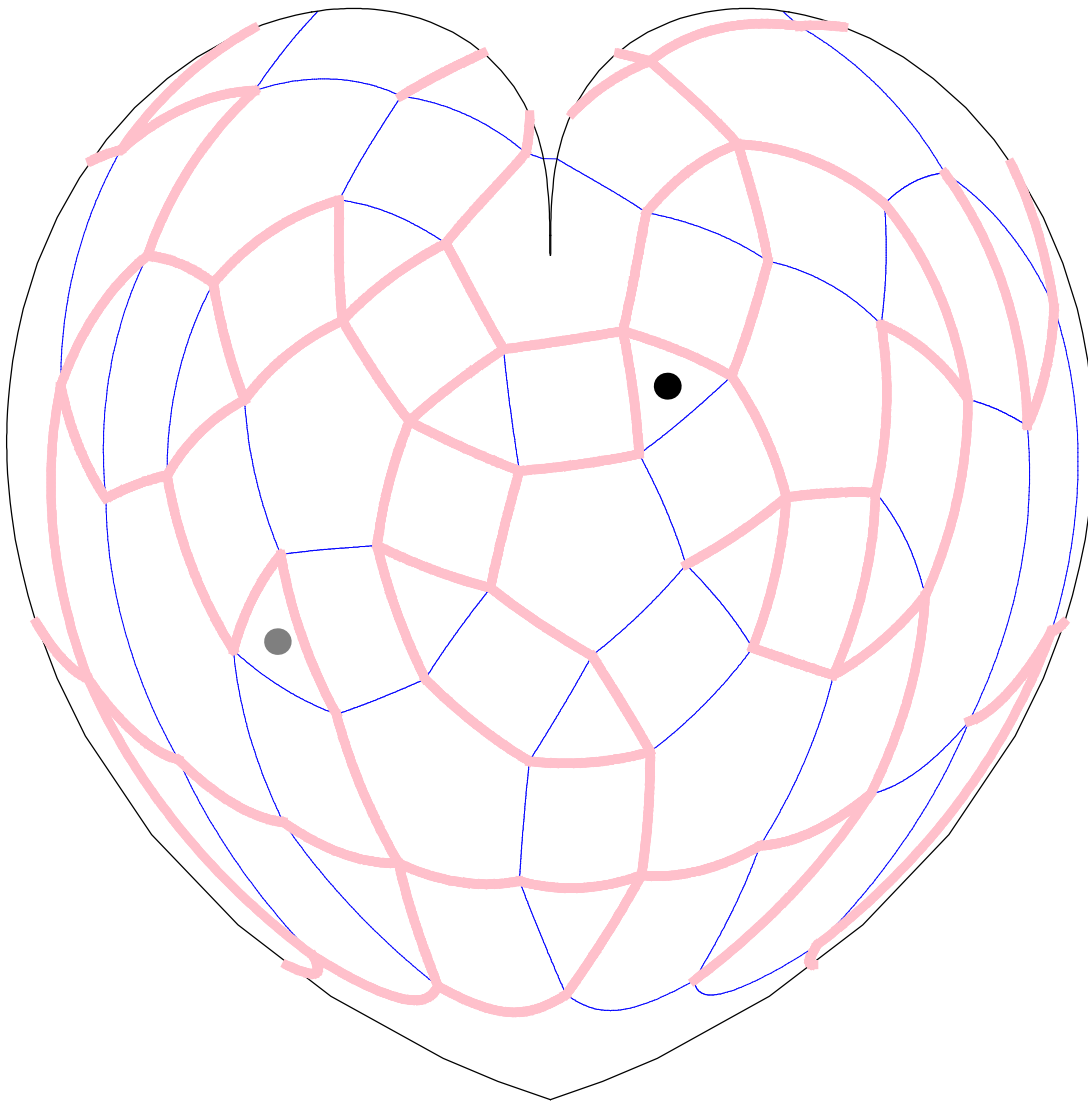
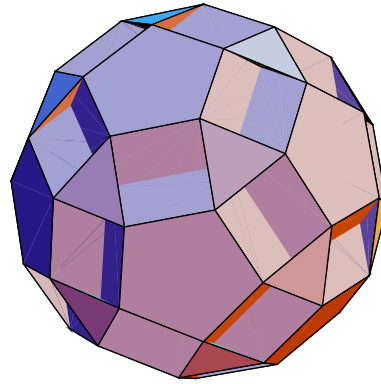
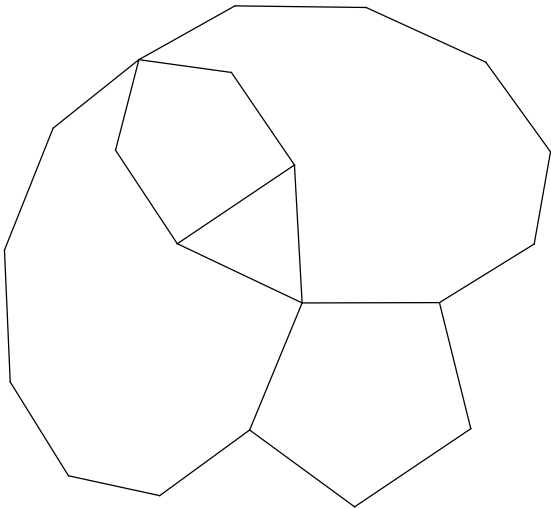
$$\left\{3, \frac{5}{2}, 3, 3, 3, 3\right\}$$



24.

small dodecicosidodecahedron

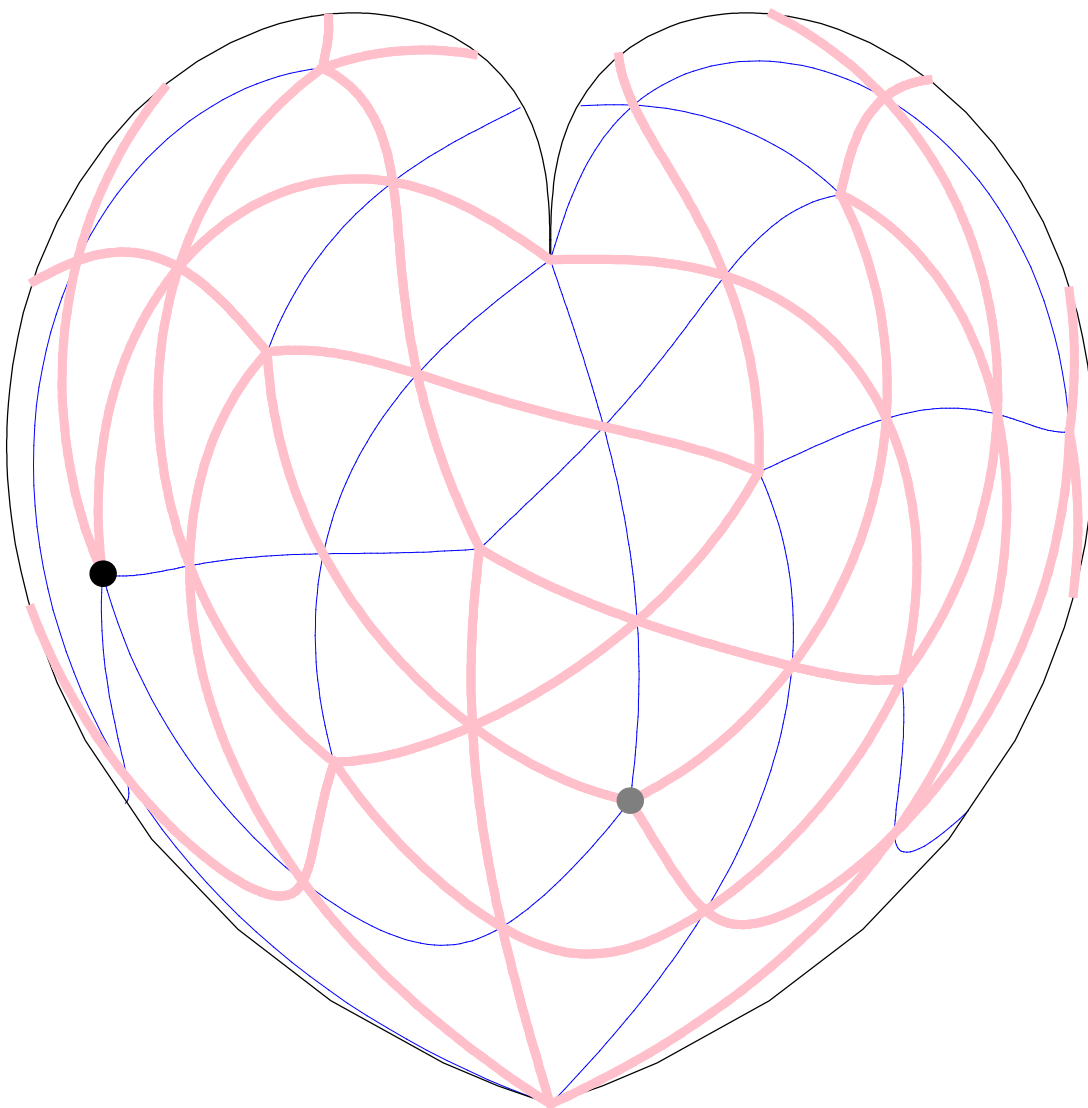
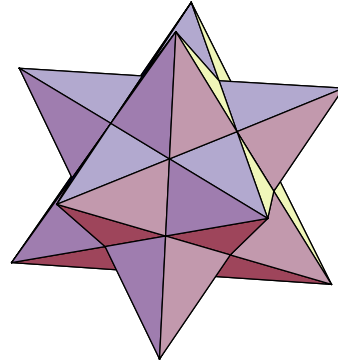
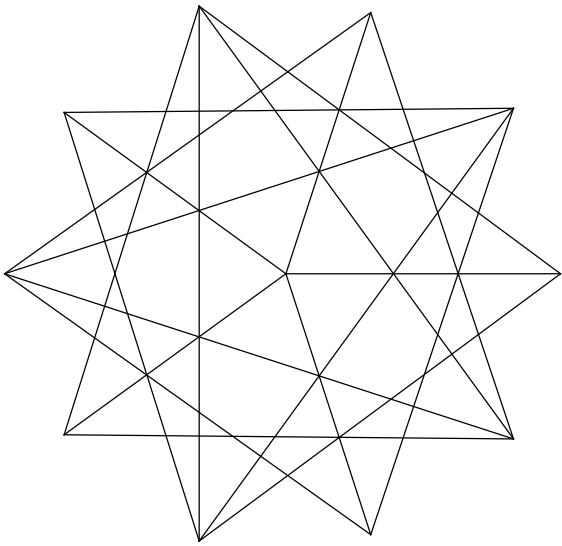
$$\left\{10, \frac{3}{2}, 10, 5\right\}$$



25.

small stellated dodecahedron

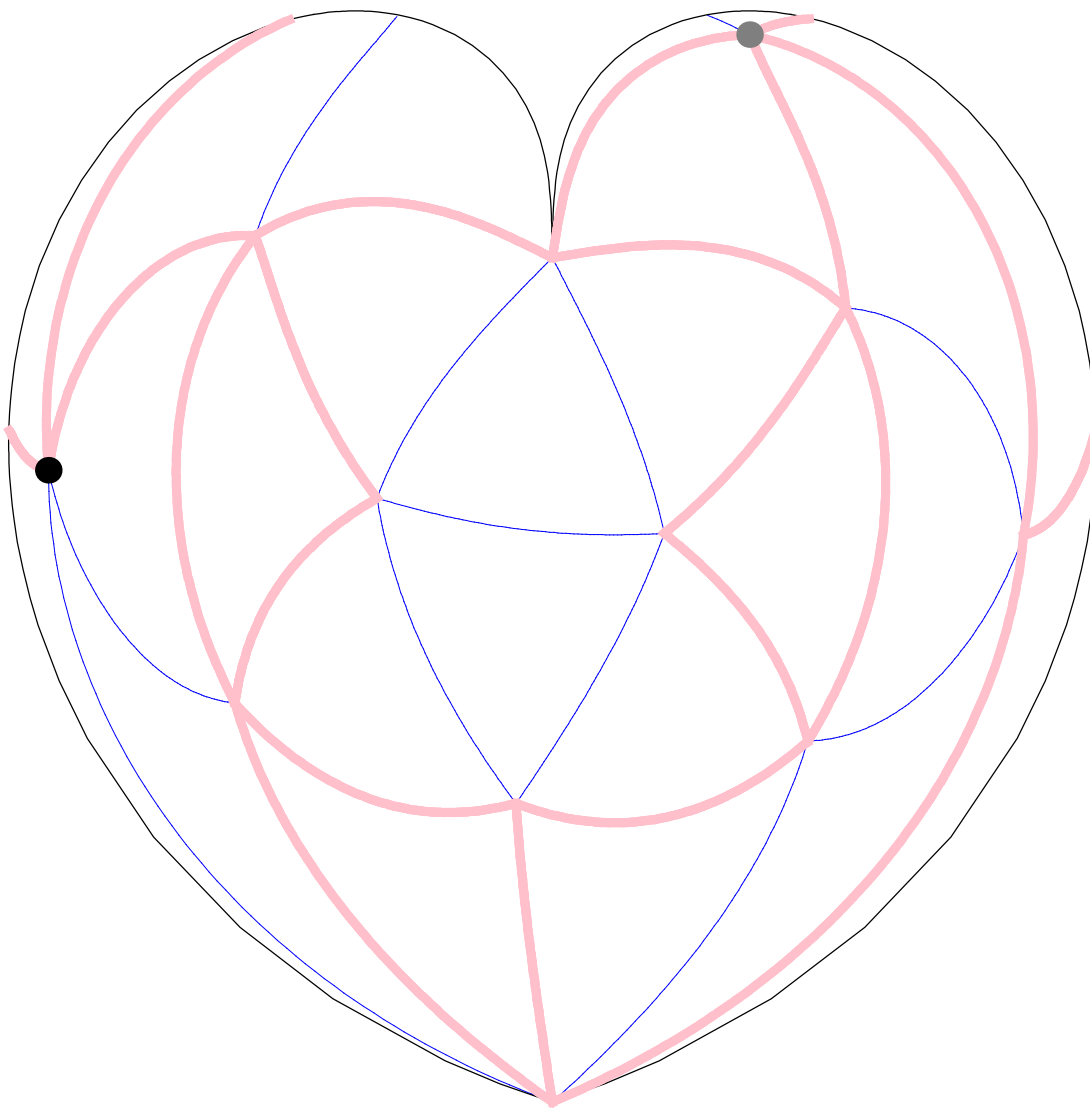
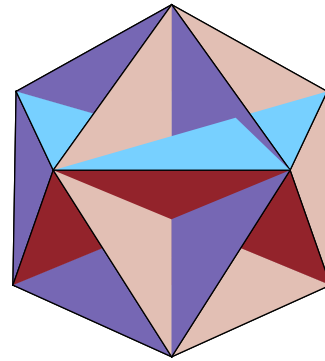
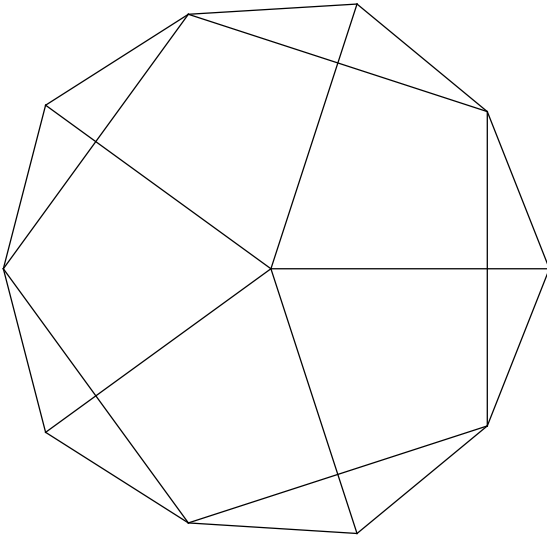
$$\left\{ \frac{5}{2}, \frac{5}{2}, \frac{5}{2}, \frac{5}{2}, \frac{5}{2} \right\}$$



26.

great dodecahedron

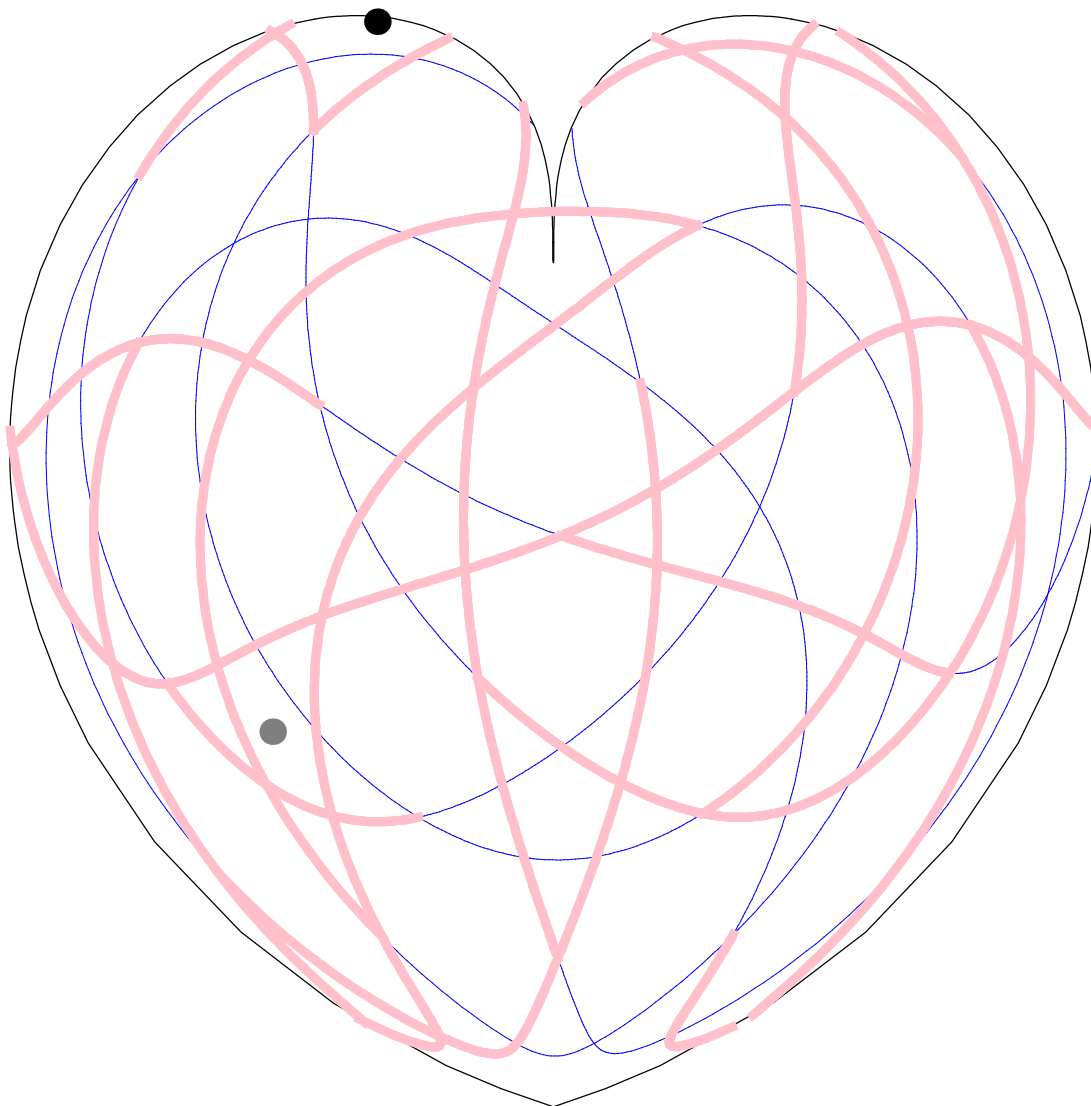
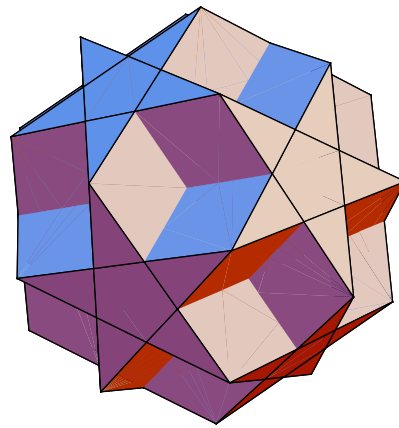
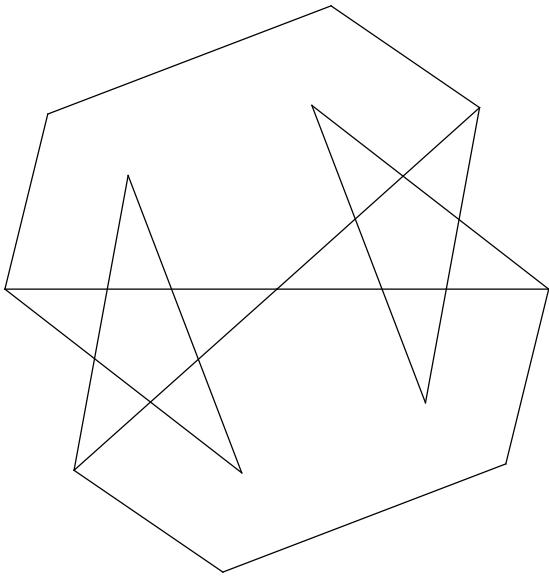
$$\frac{1}{2} \{5, 5, 5, 5\}$$



27.

dodecadodecahedron

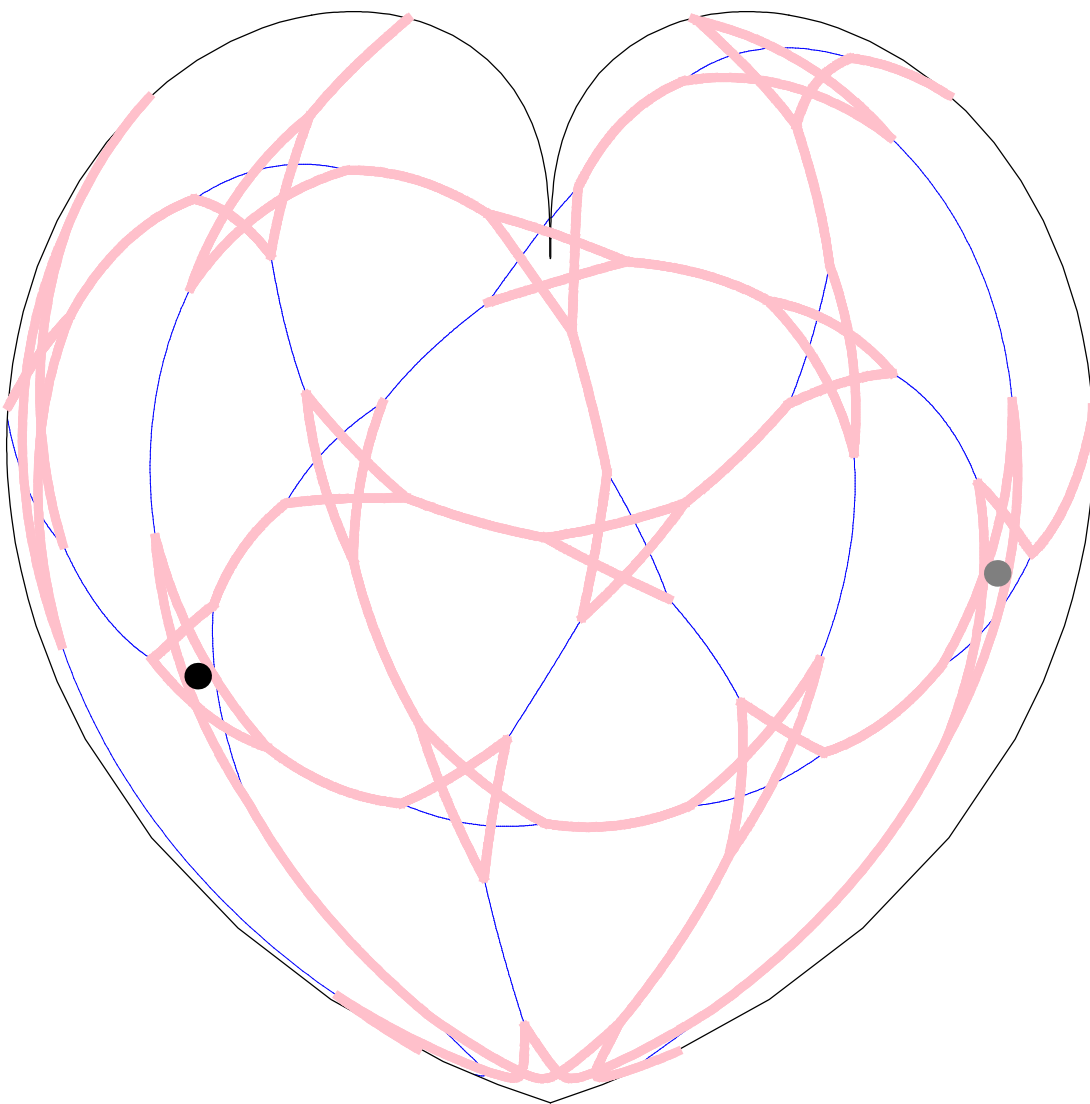
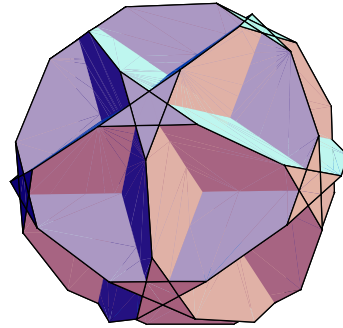
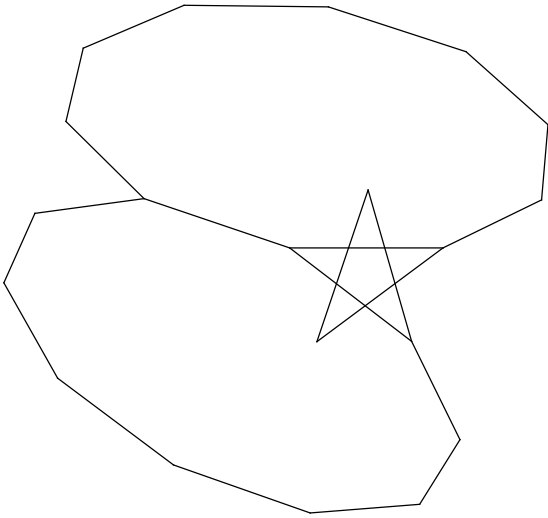
$$\left\{ \frac{5}{2}, 5, \frac{5}{2}, 5 \right\}$$



28.

truncated great dodecahedron

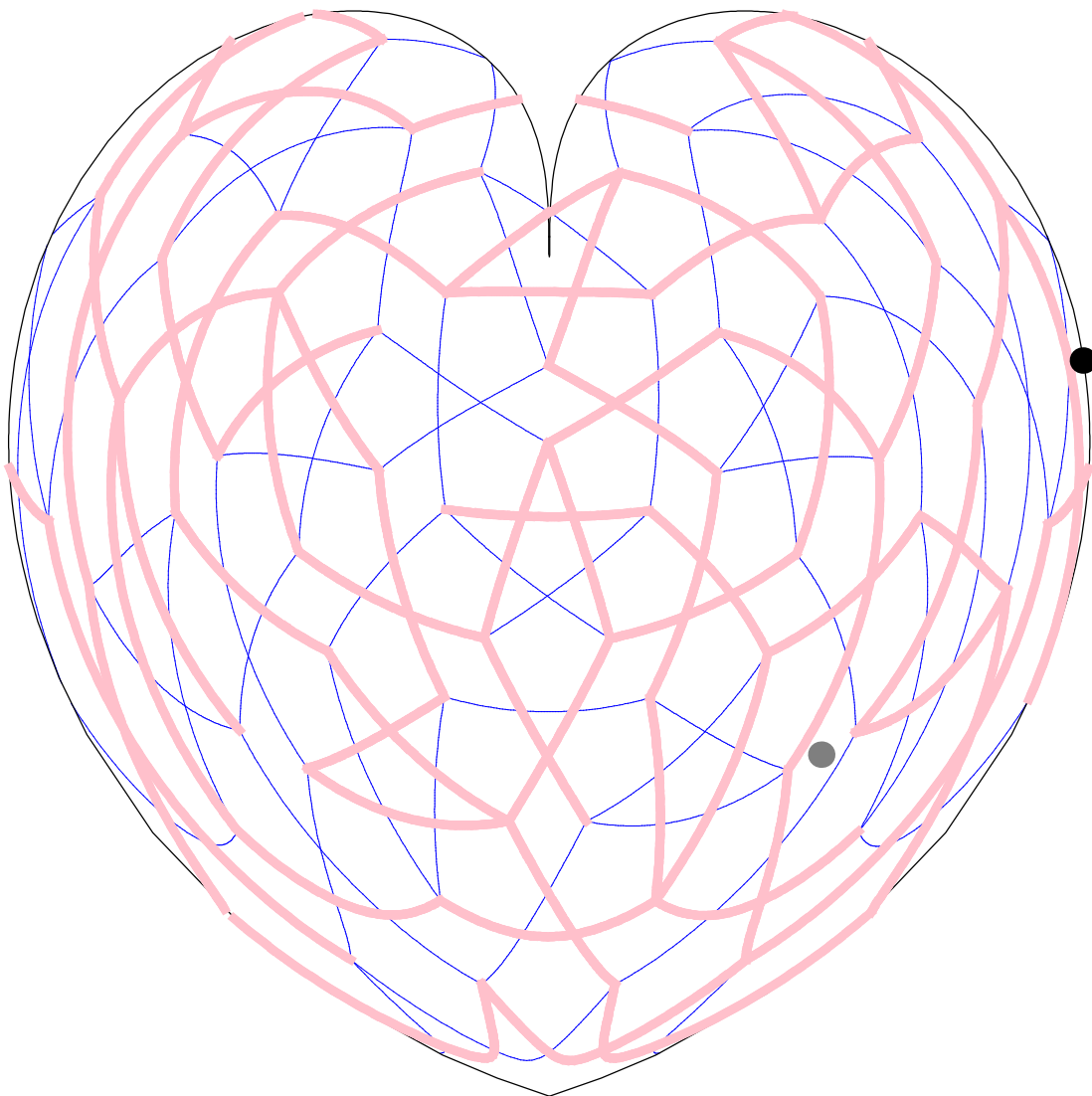
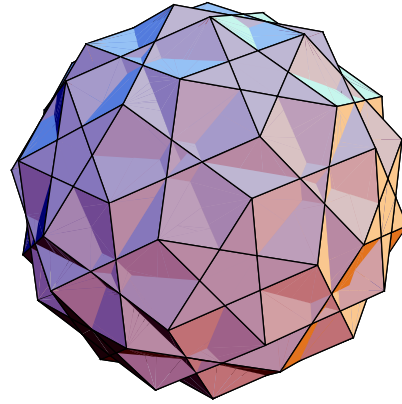
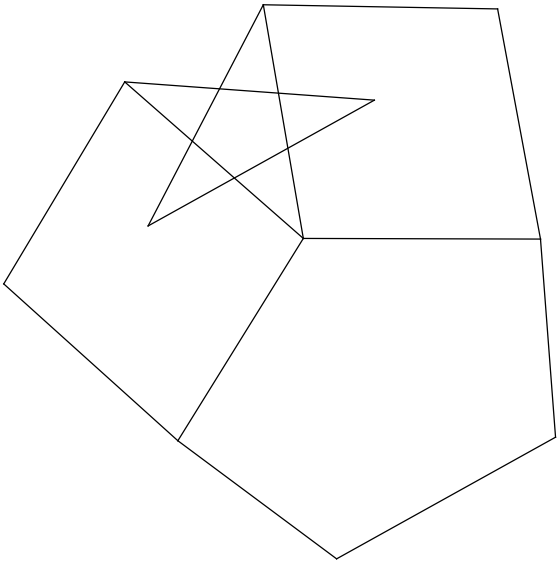
$$\{10, 10, \frac{5}{2}\}$$



29.

rhombidodecadodecahedron

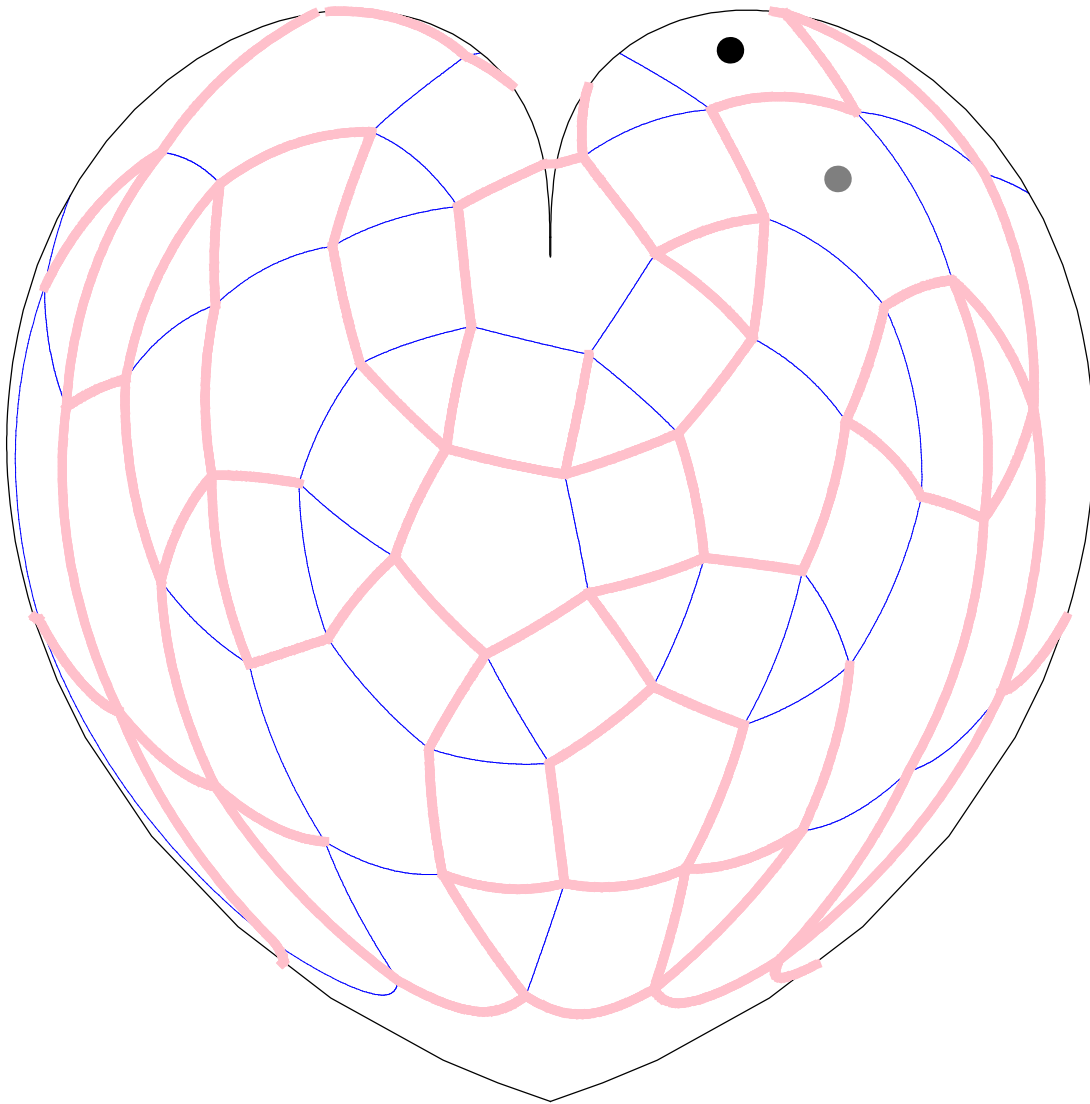
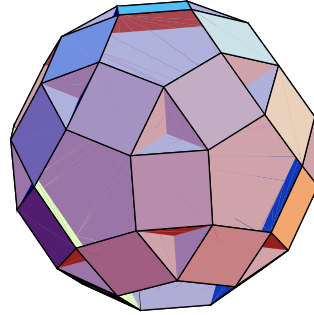
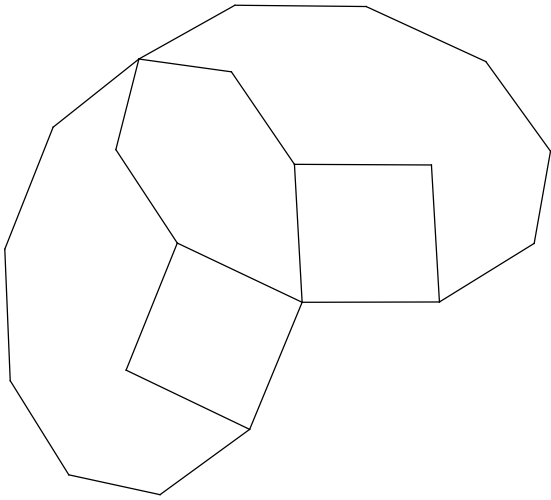
$$\{4, \frac{5}{2}, 4, 5\}$$



30.

small rhombidodecahedron

$$\left\{10, 4, \frac{10}{9}, \frac{4}{3}\right\}$$

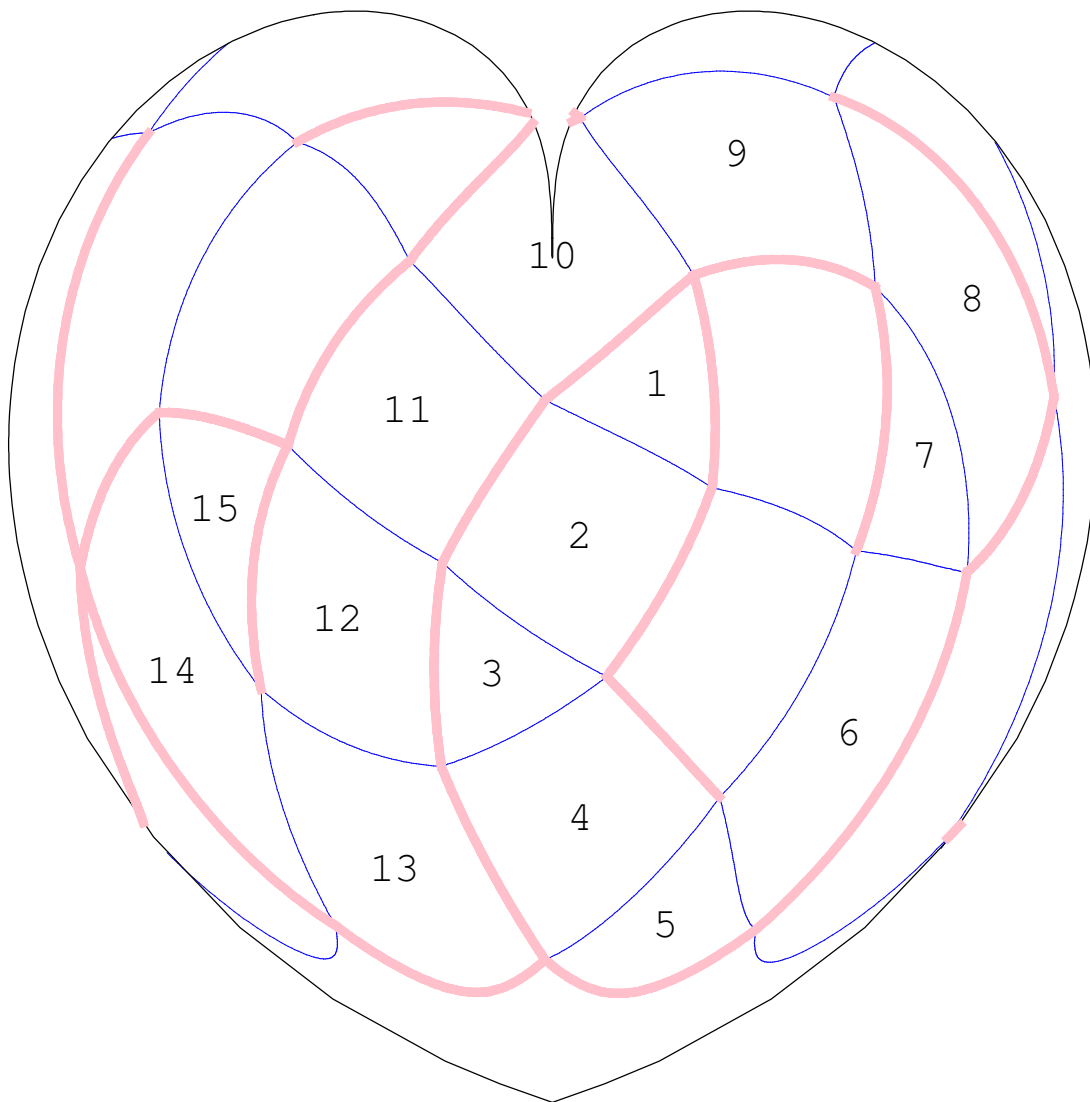
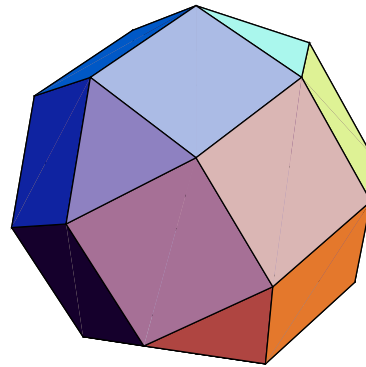
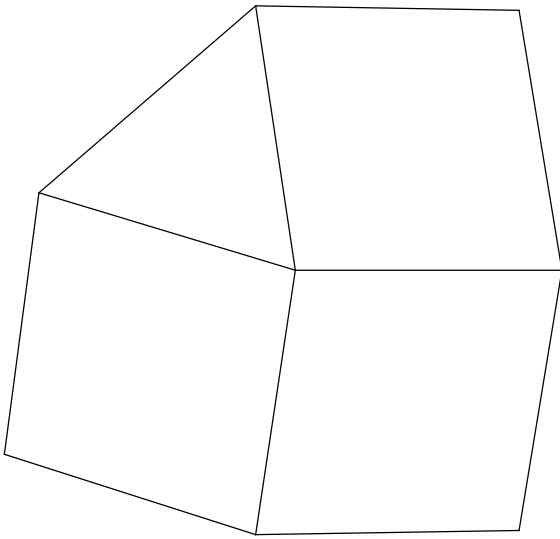


Solutions

1.

rhombicuboctahedron

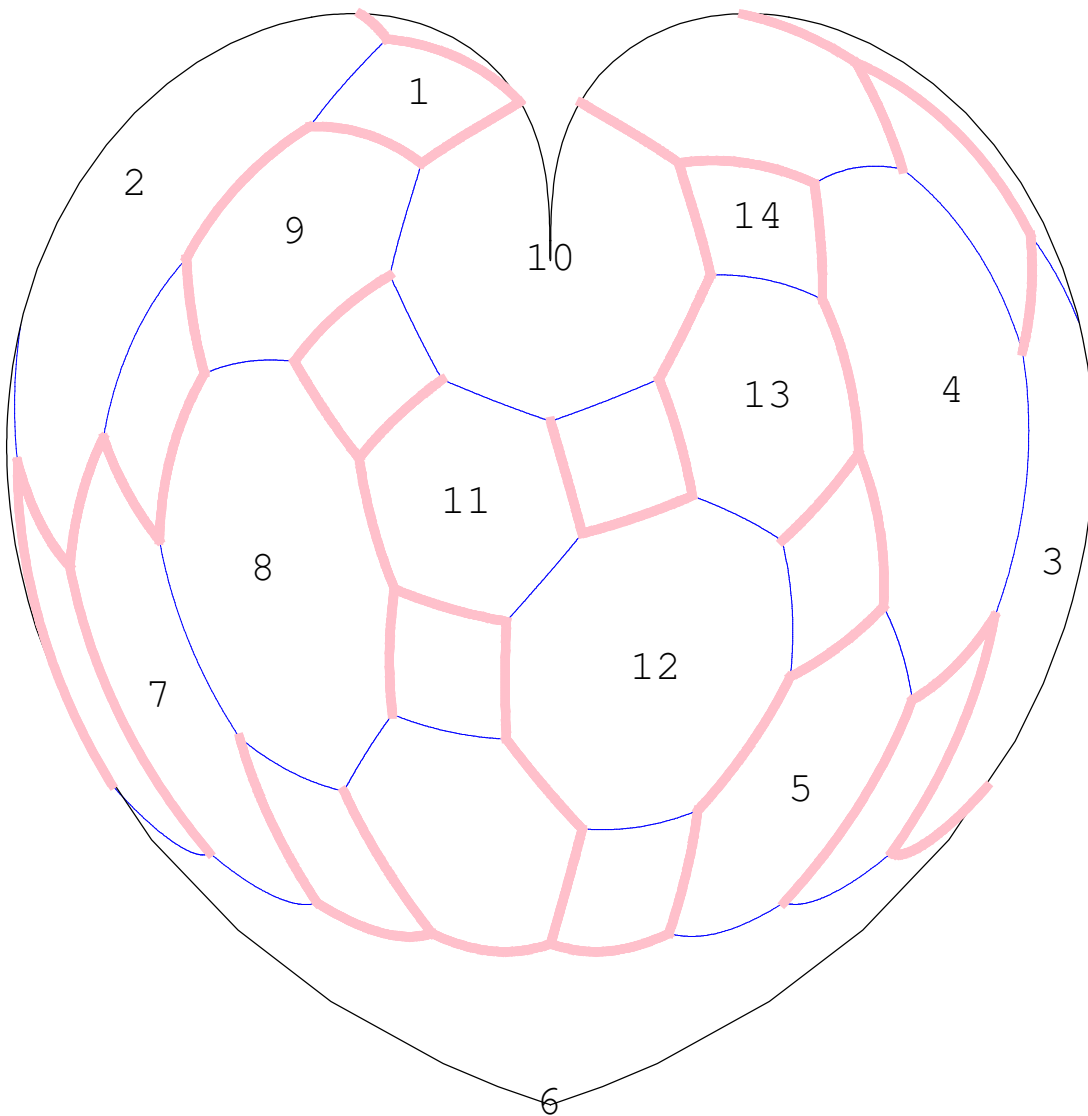
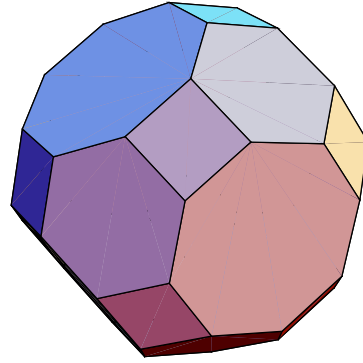
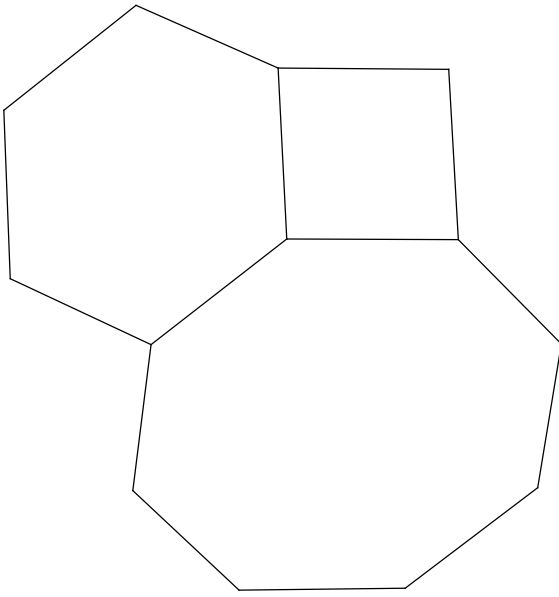
{4, 3, 4, 4}



2.

truncated cuboctahedron

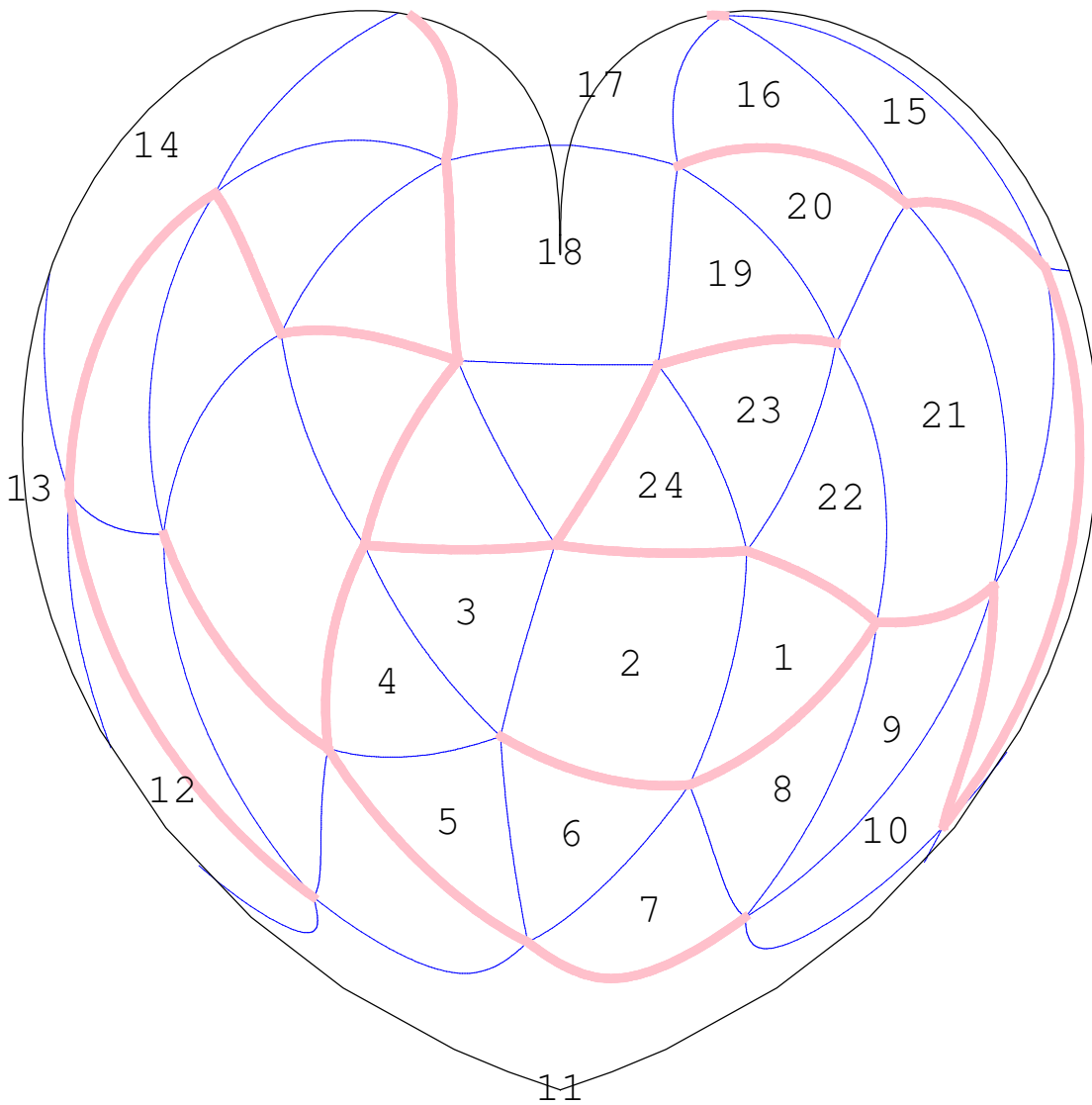
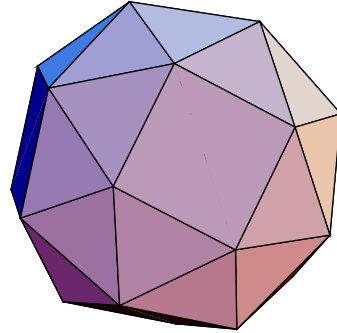
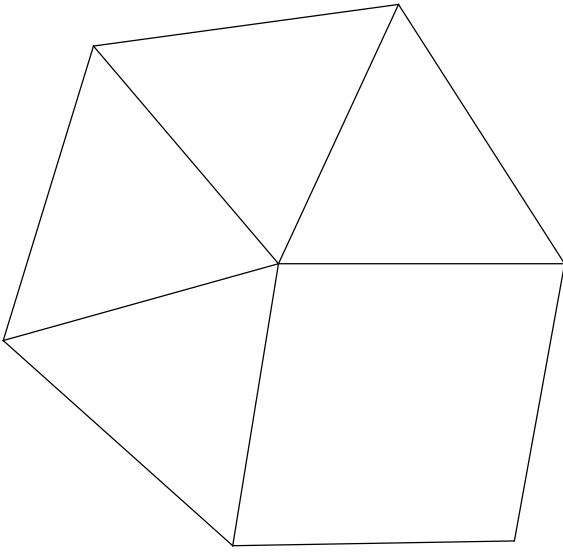
{4, 6, 8}



3.

snub cube

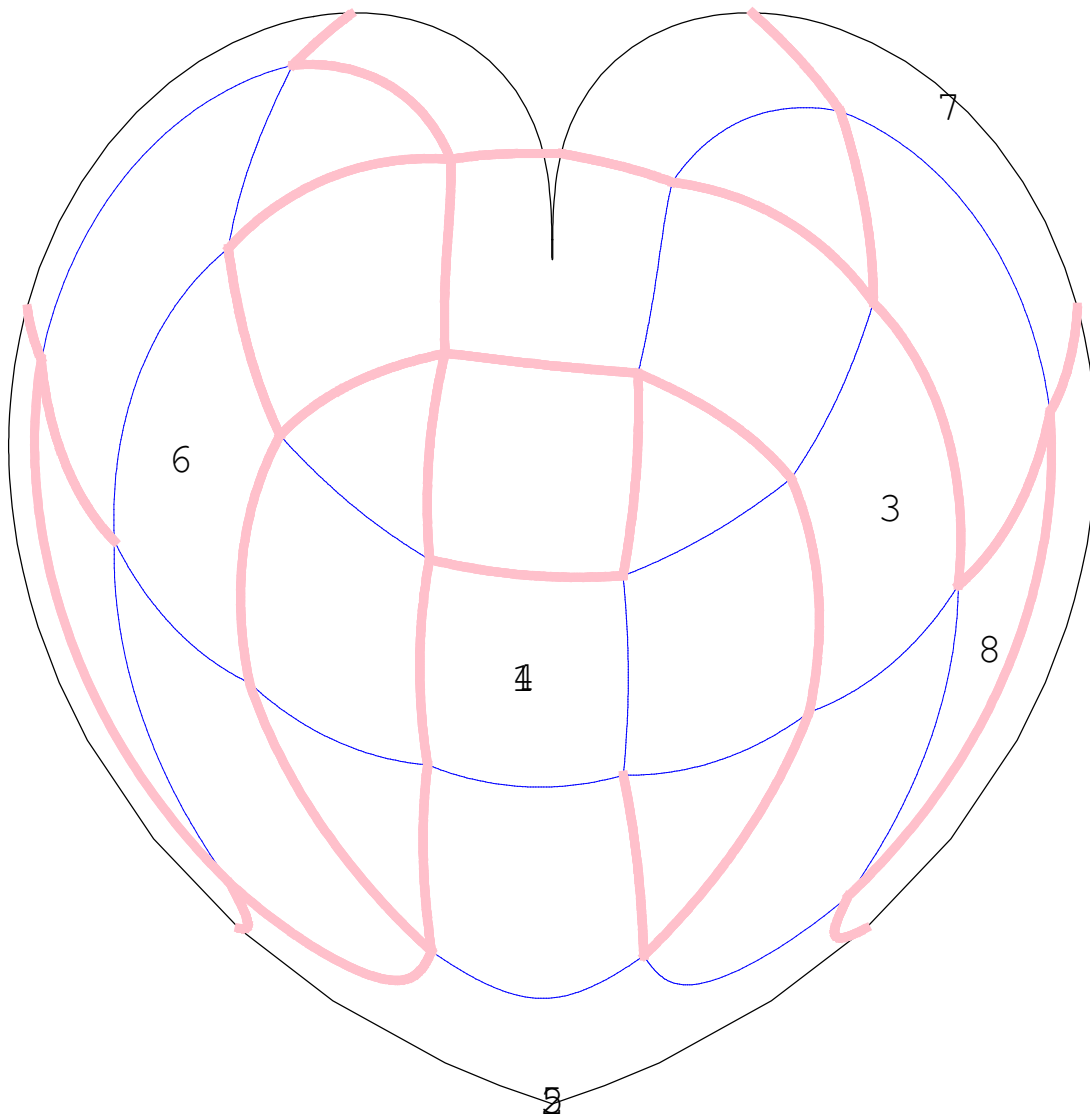
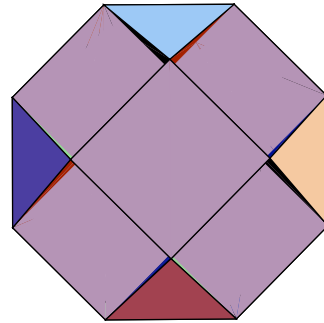
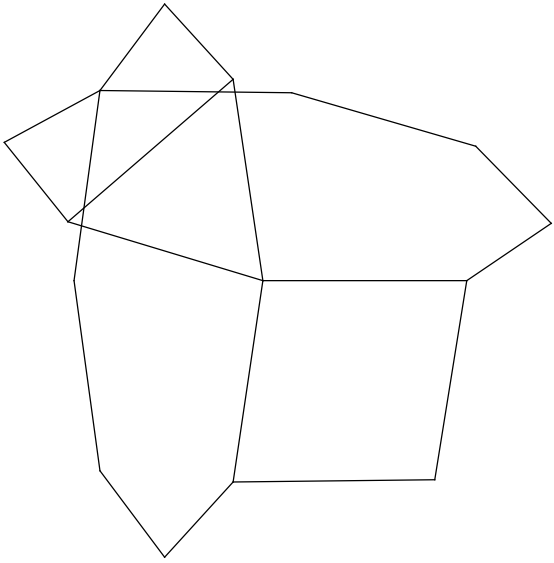
{3, 3, 3, 3, 4}



4.

small cubicuboctahedron

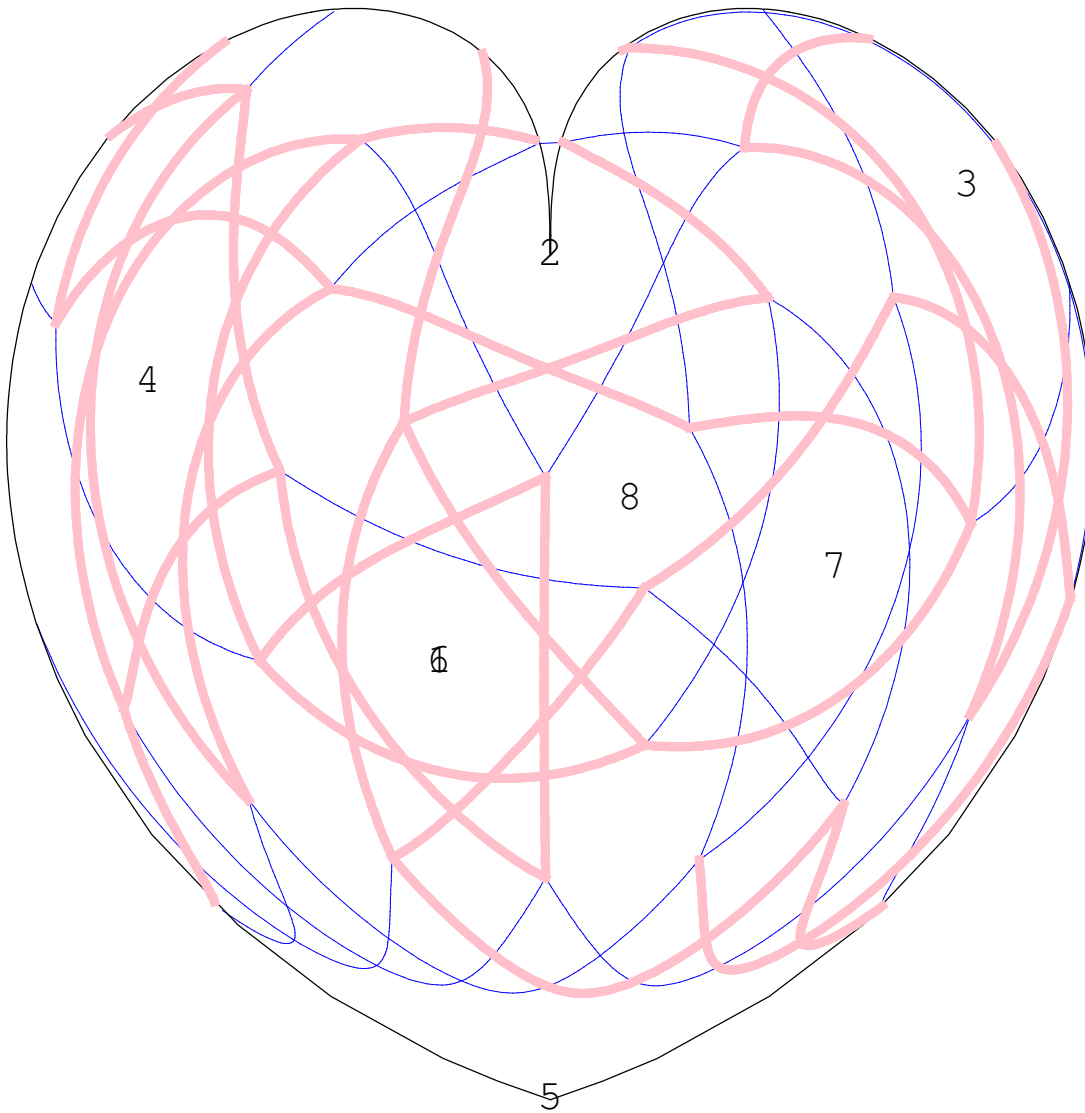
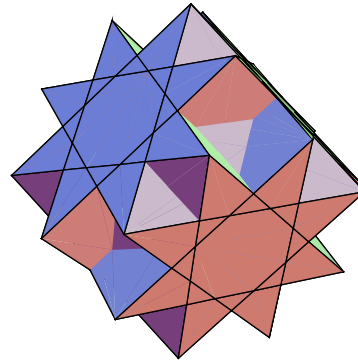
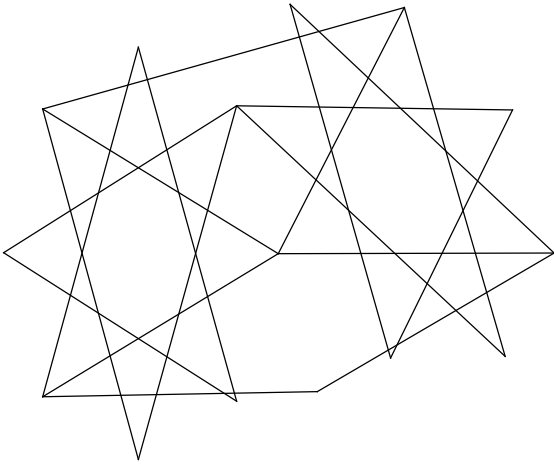
$$\left\{8, \frac{3}{2}, 8, 4\right\}$$



5.

great cubicuboctahedron

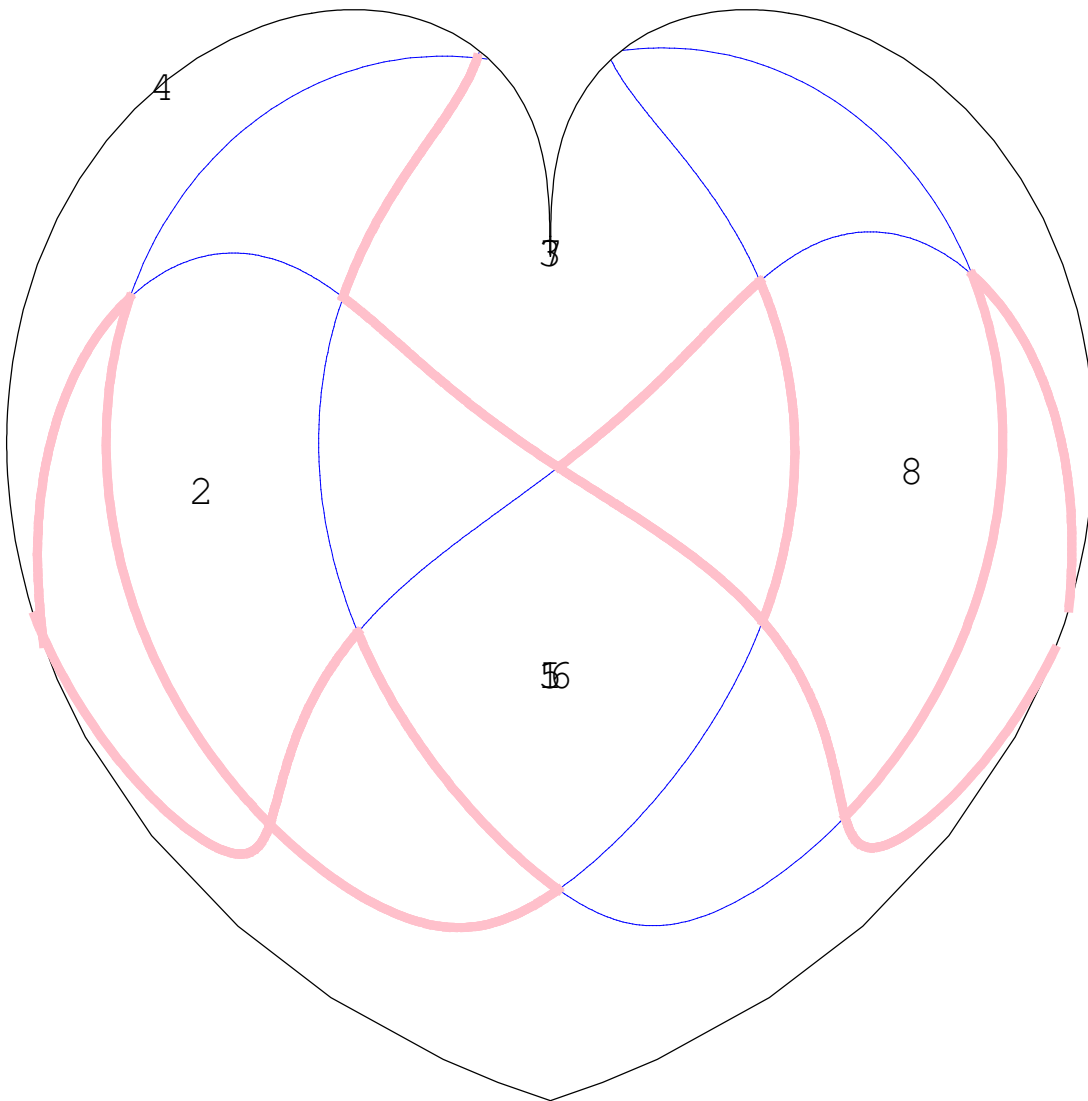
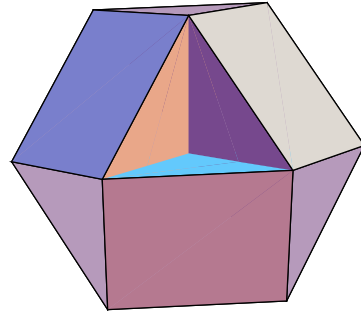
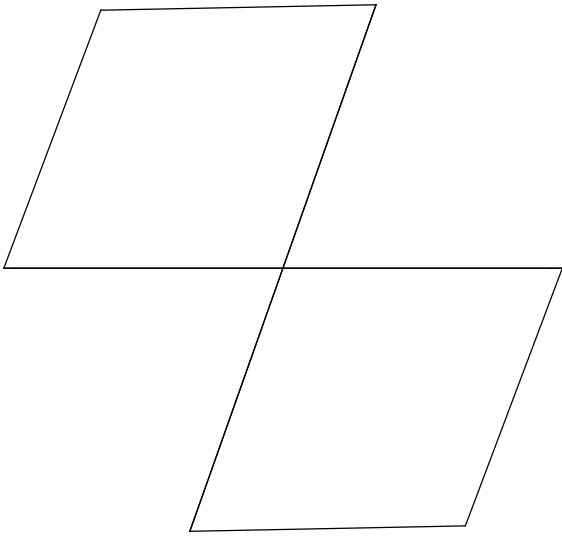
$$\left\{ \frac{8}{3}, 3, \frac{8}{3}, 4 \right\}$$



6.

cubohemioctahedron

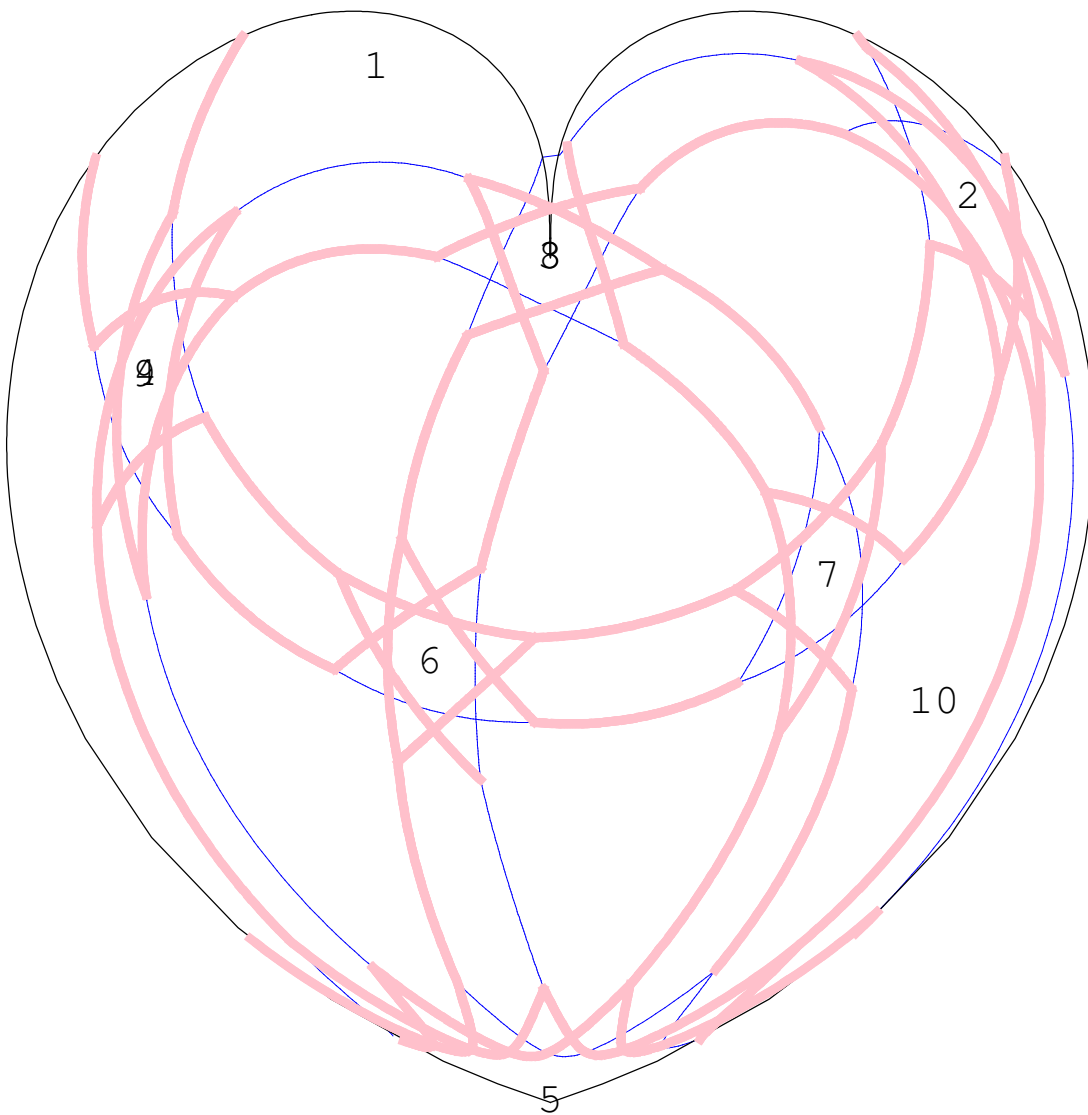
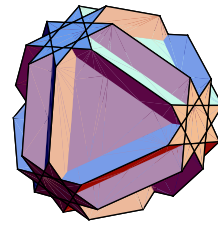
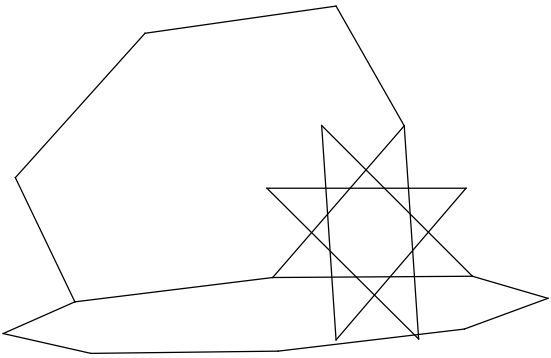
$$\{6, \frac{4}{3}, 6, 4\}$$



7.

cubitruncated cuboctahedron

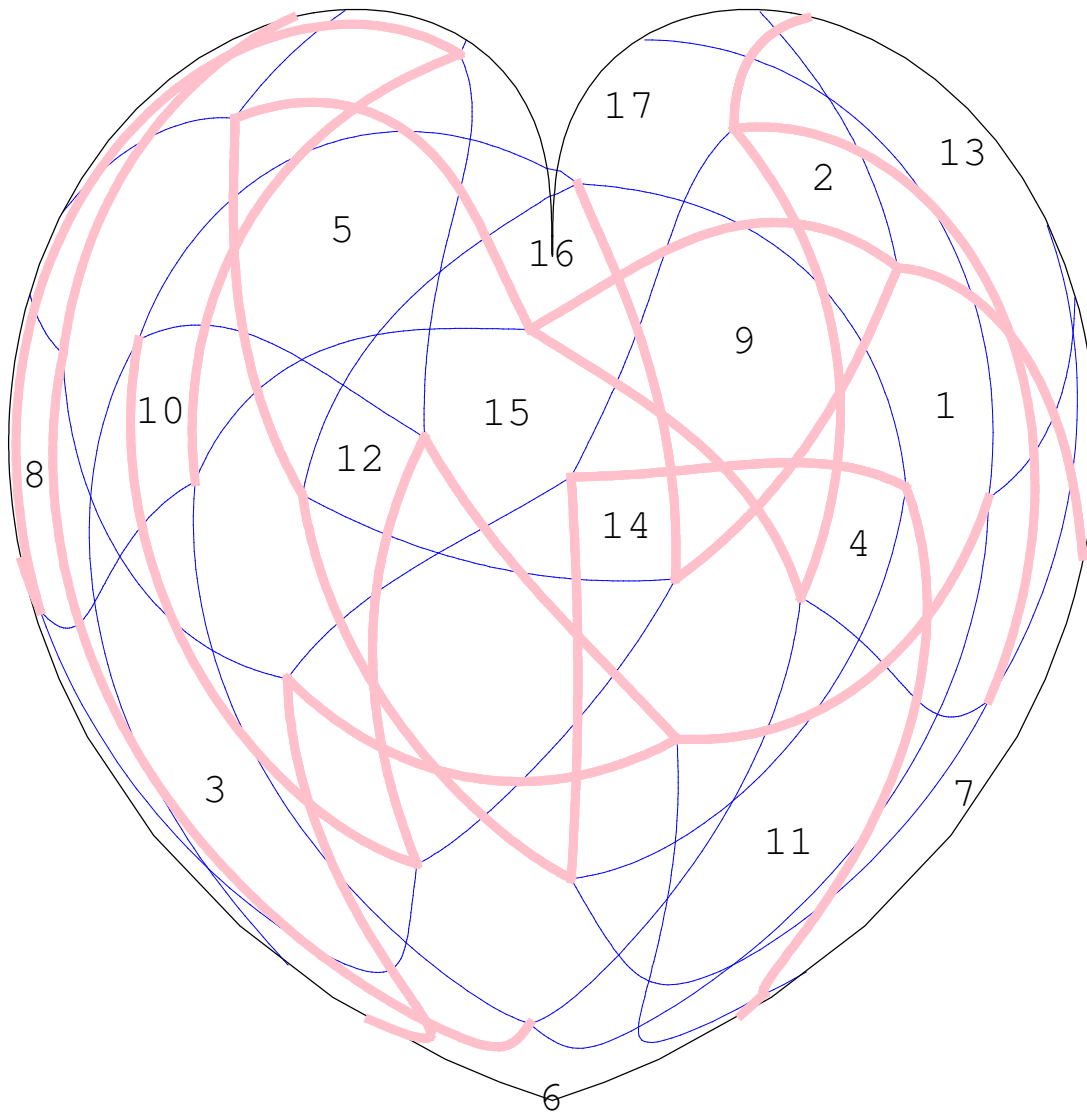
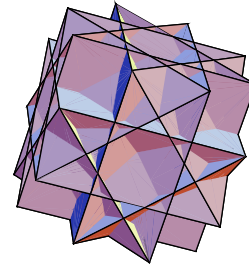
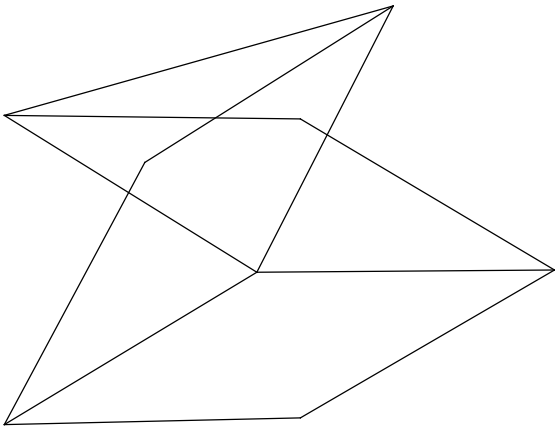
$$\left\{ \frac{8}{3}, 6, 8 \right\}$$



8.

great rhombicuboctahedron

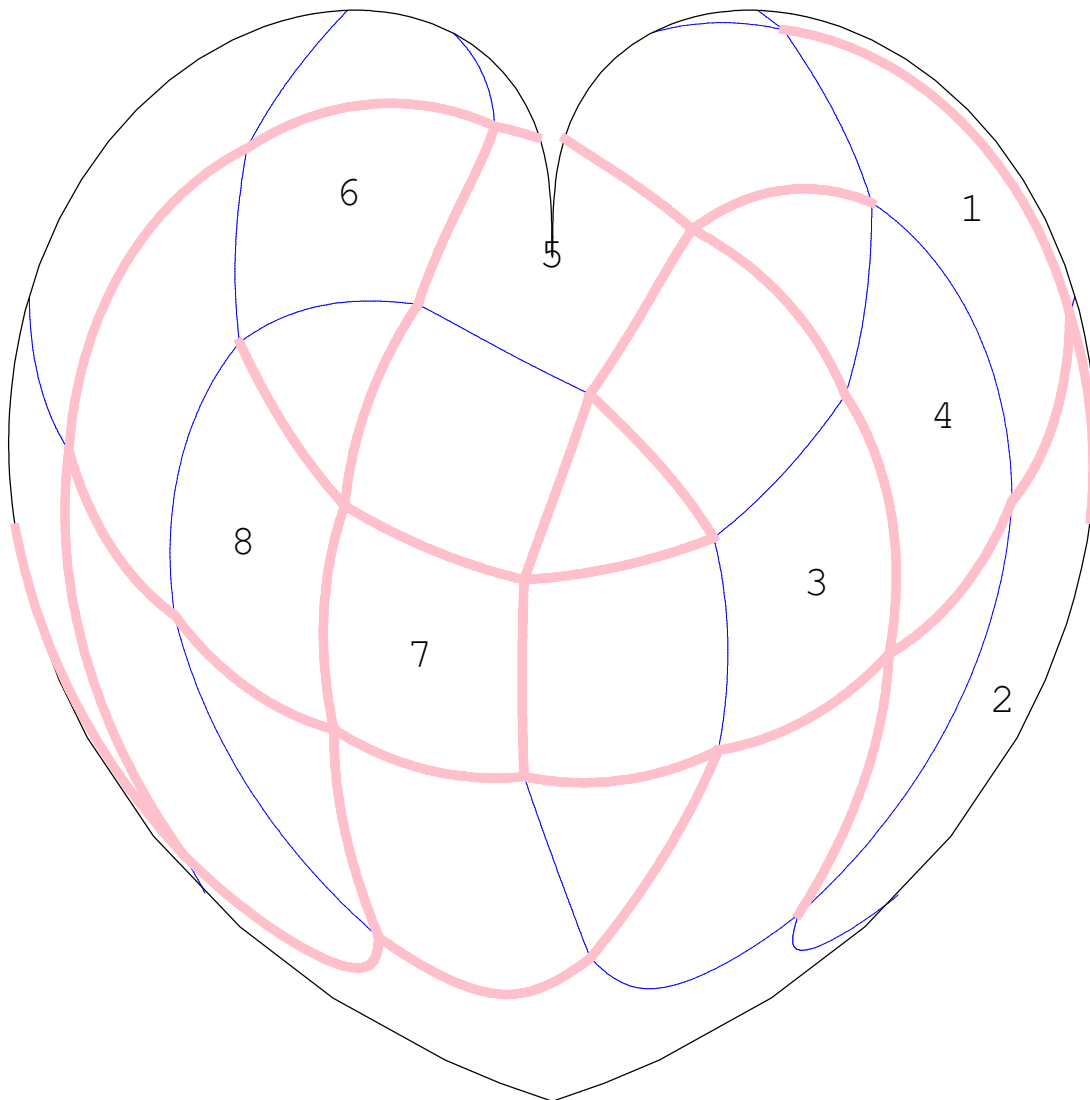
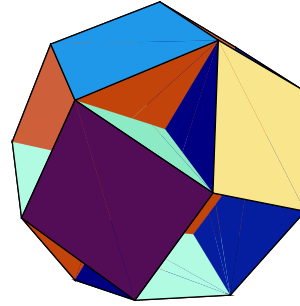
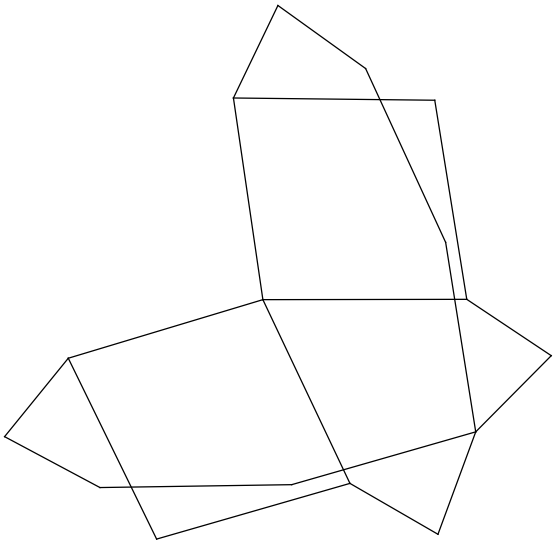
$$\{4, \frac{3}{2}, 4, 4\}$$



9.

small rhombihexahedron

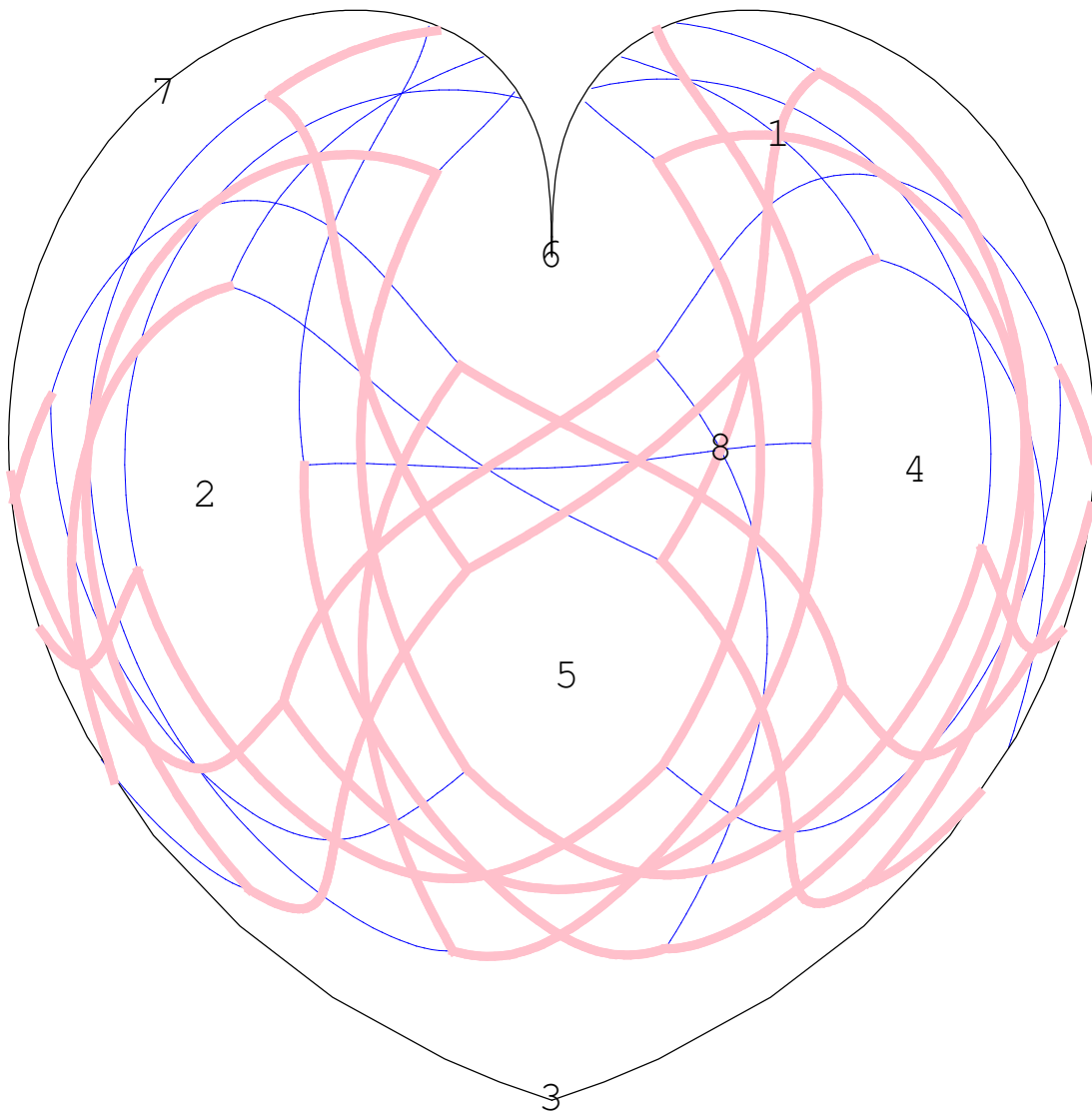
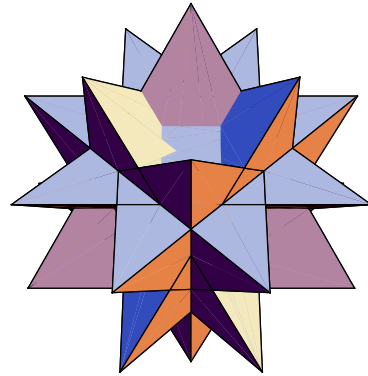
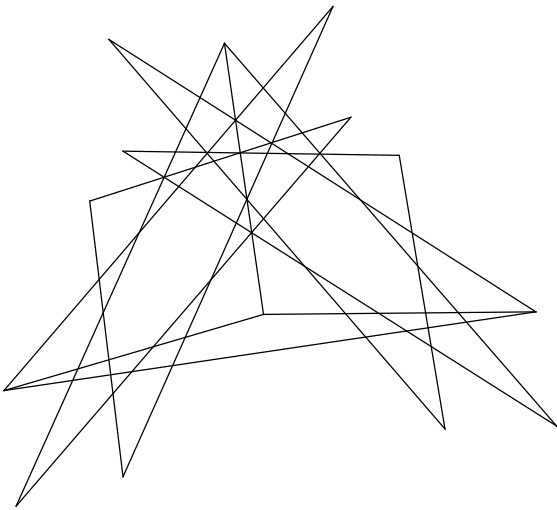
$$\{8, 4, \frac{8}{7}, \frac{4}{3}\}$$



10.

stellated truncated hexahedron

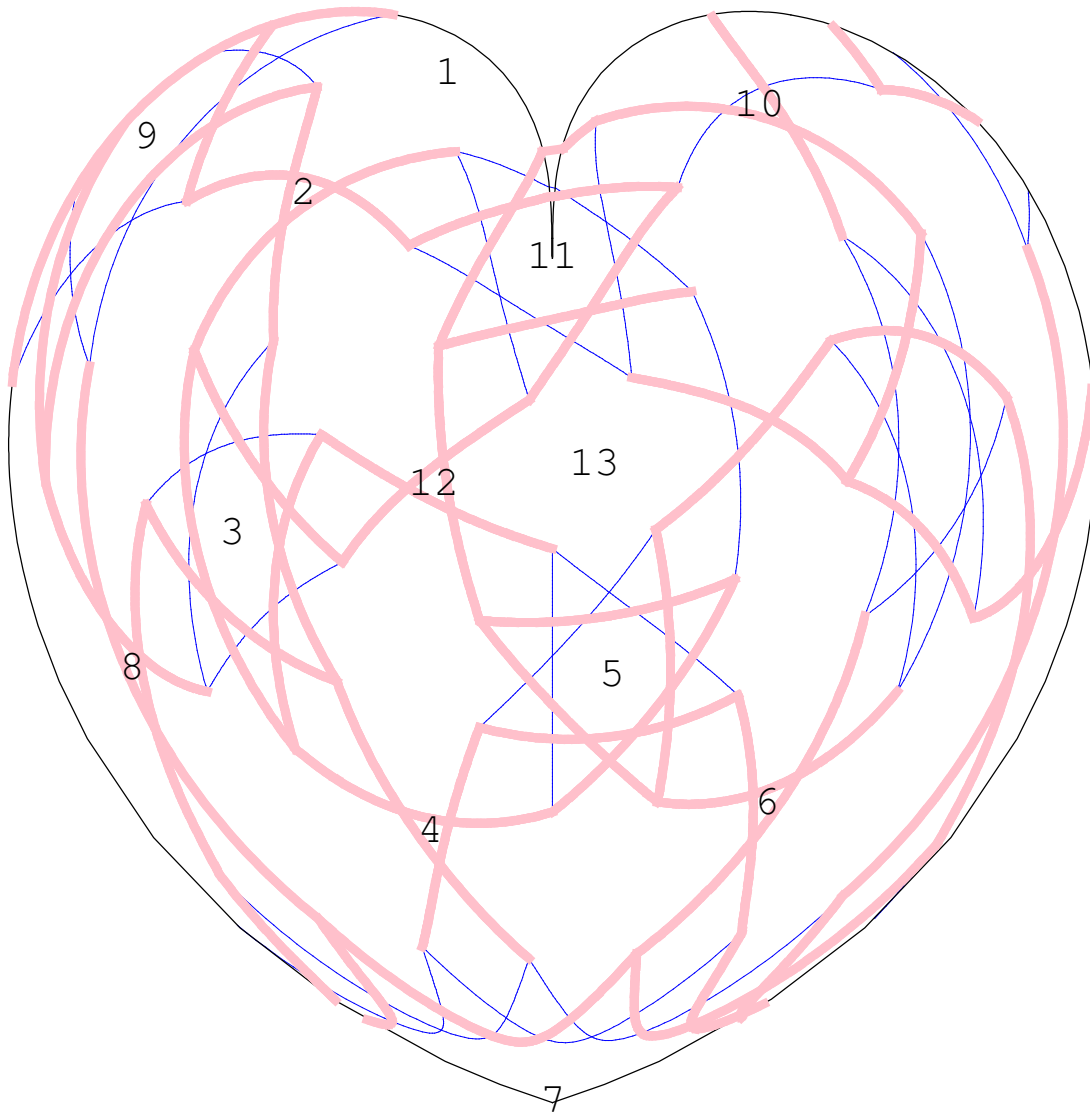
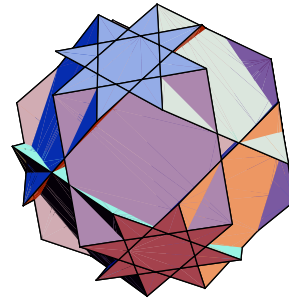
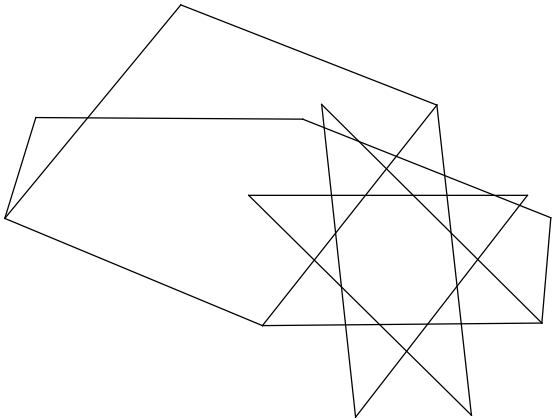
$$\left\{ \frac{8}{3}, \frac{8}{3}, 3 \right\}$$



11.

great truncated cuboctahedron

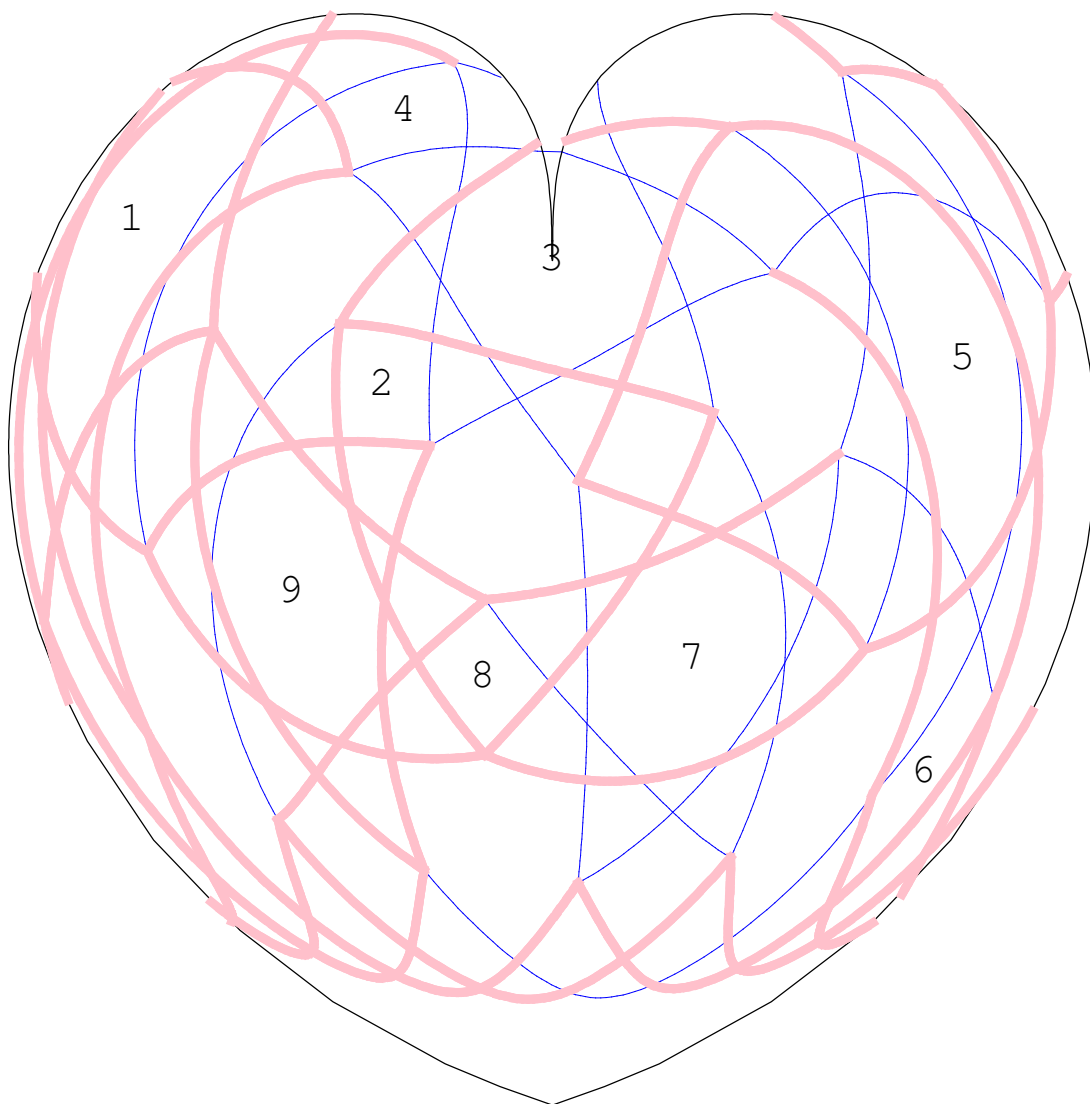
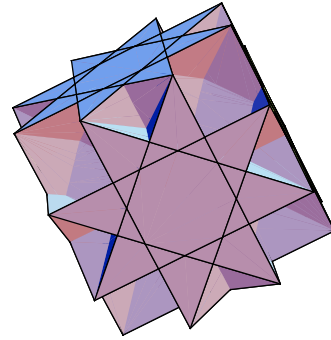
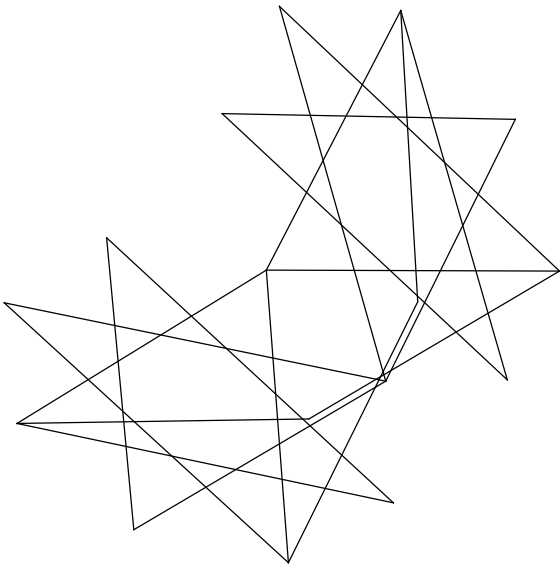
$$\left\{ \frac{8}{3}, 4, 6 \right\}$$



12.

great rhombihexahedron

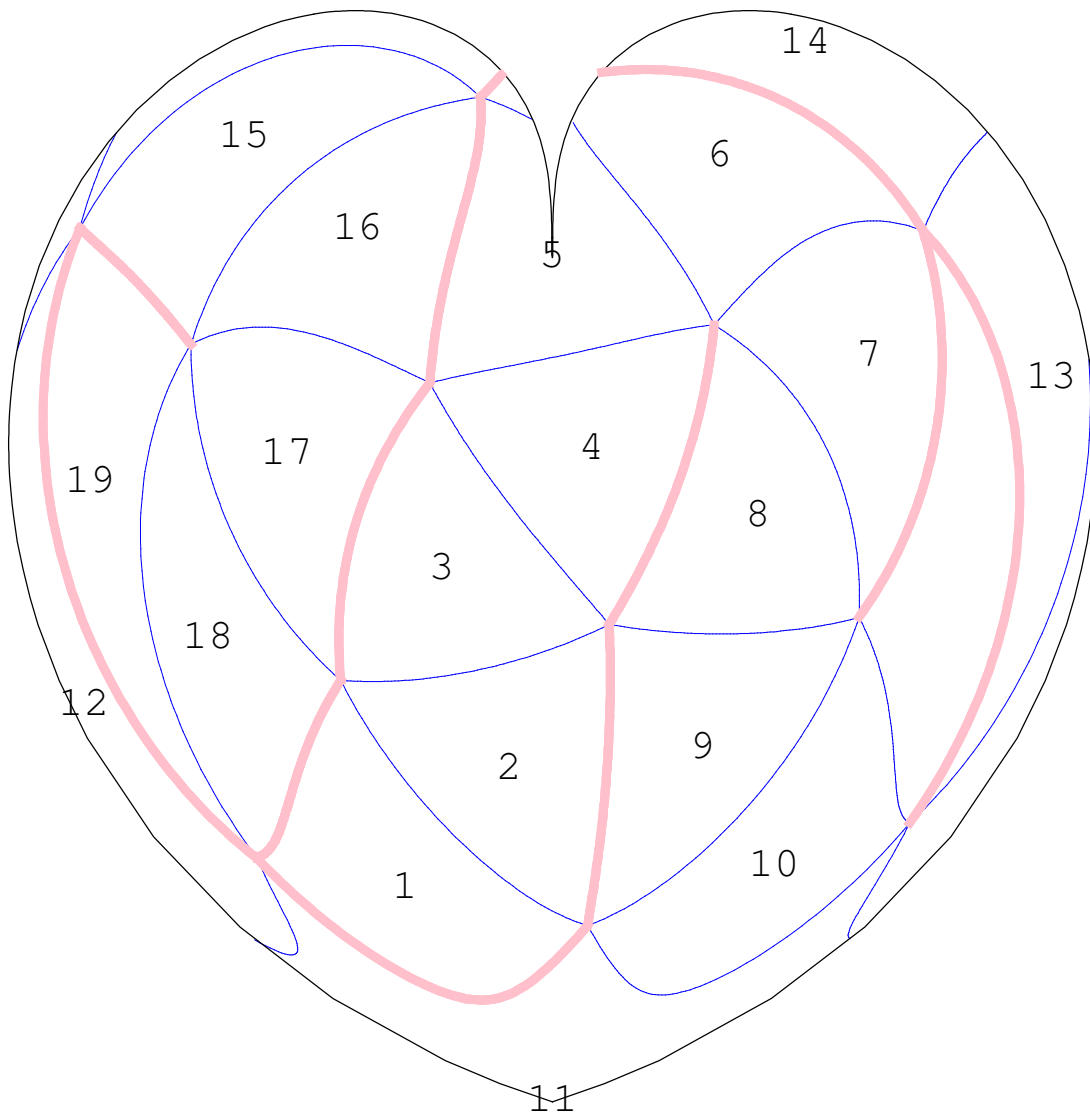
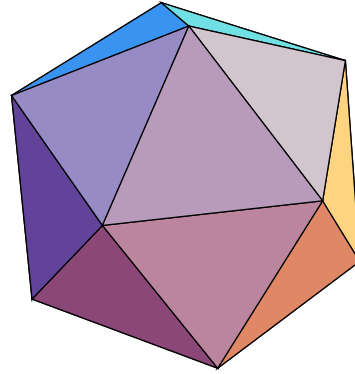
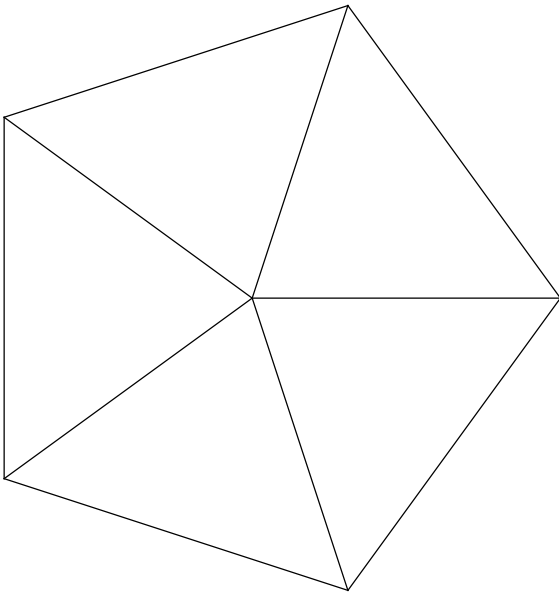
$$\left\{4, \frac{8}{3}, \frac{4}{3}, \frac{8}{5}\right\}$$



13.

icosahedron

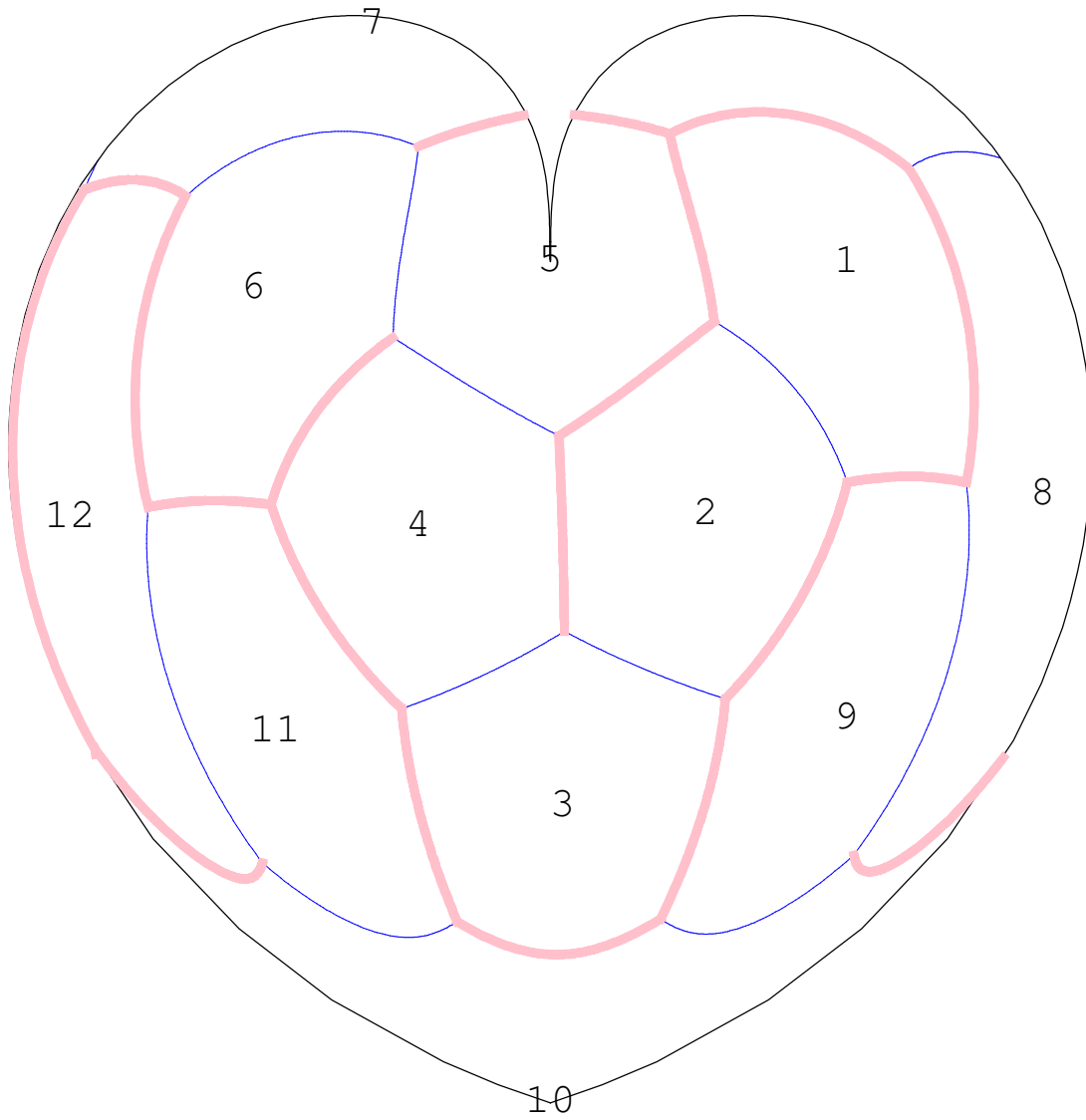
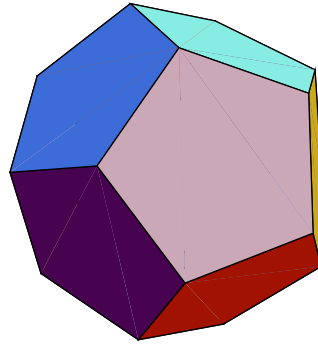
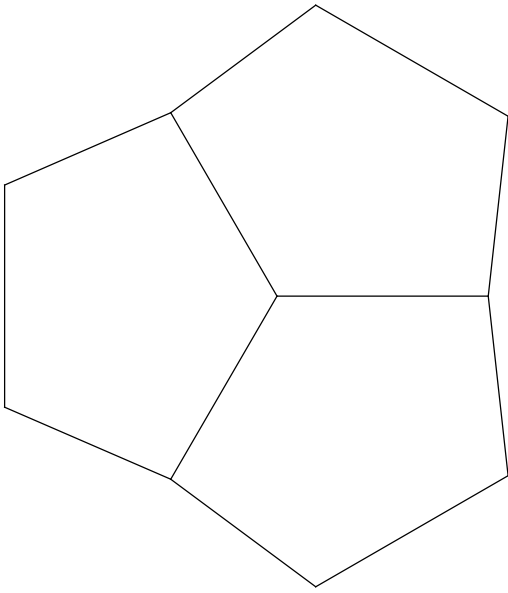
{3, 3, 3, 3, 3}



14.

dodecahedron

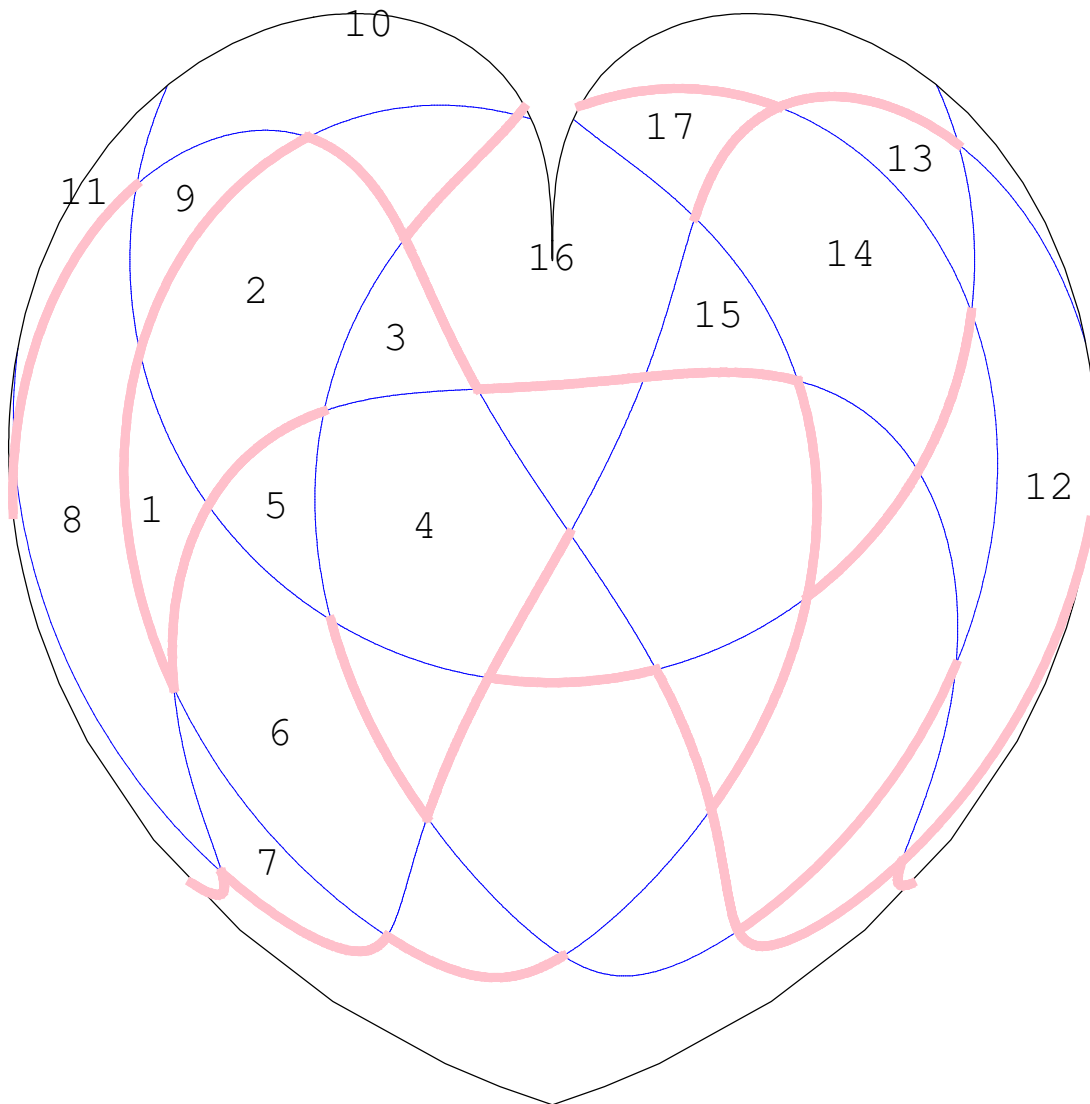
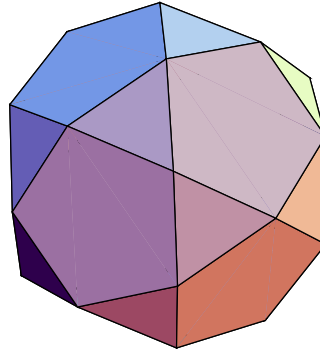
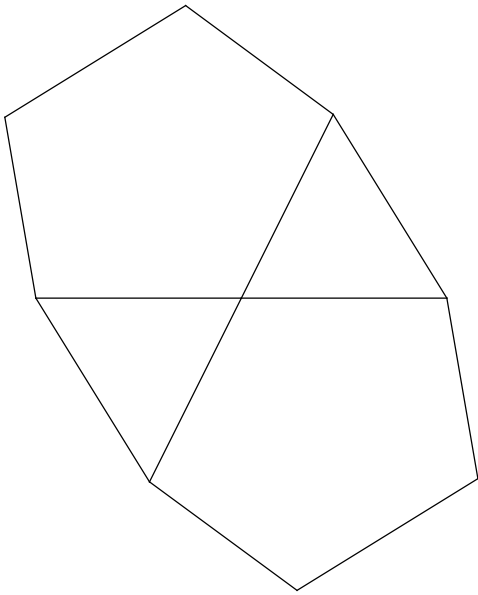
{5, 5, 5}



15.

icosidodecahedron

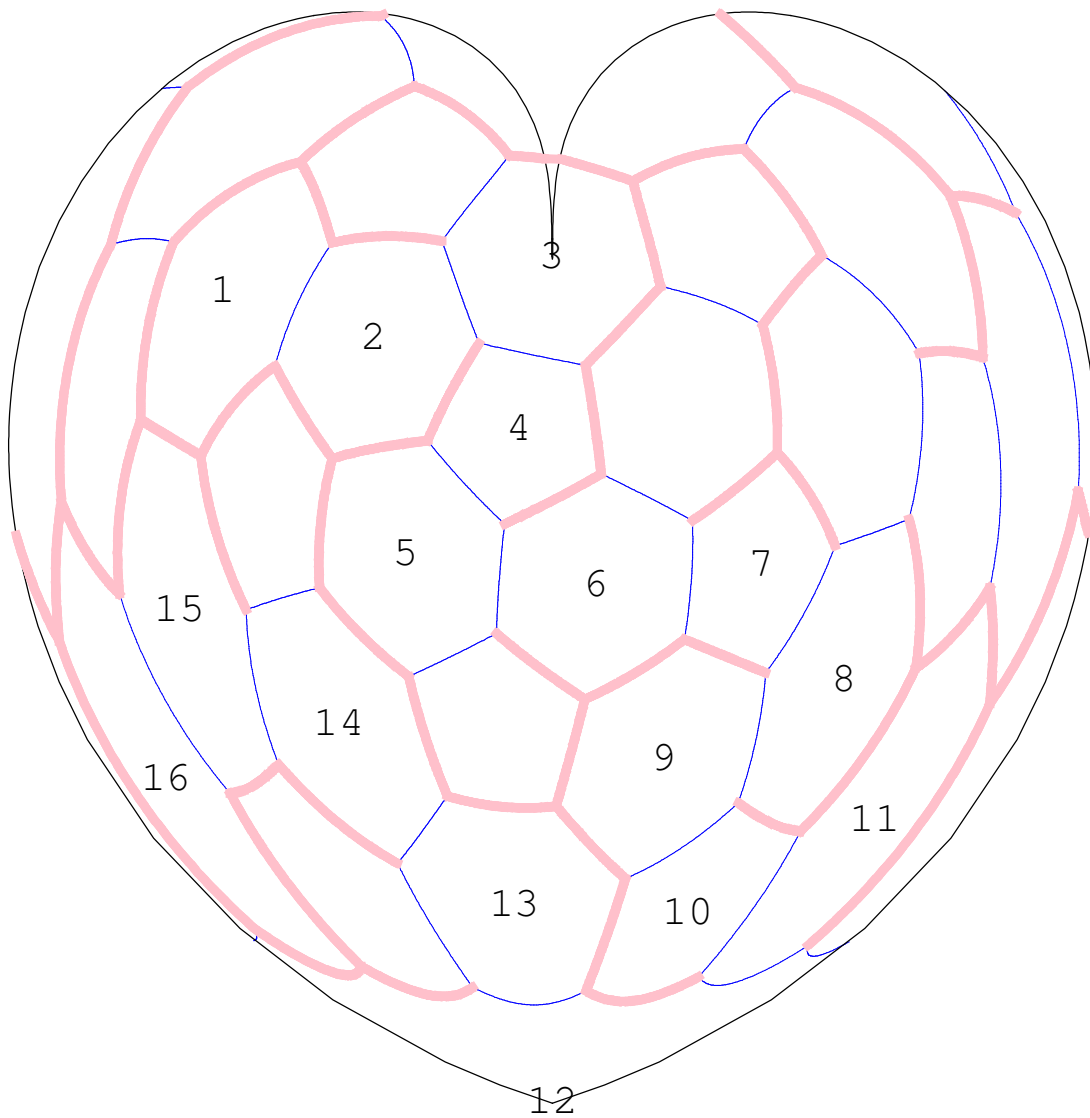
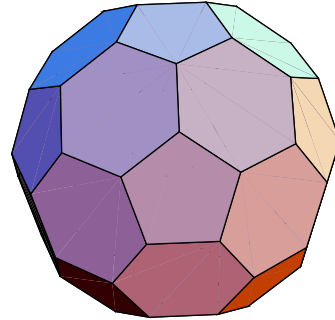
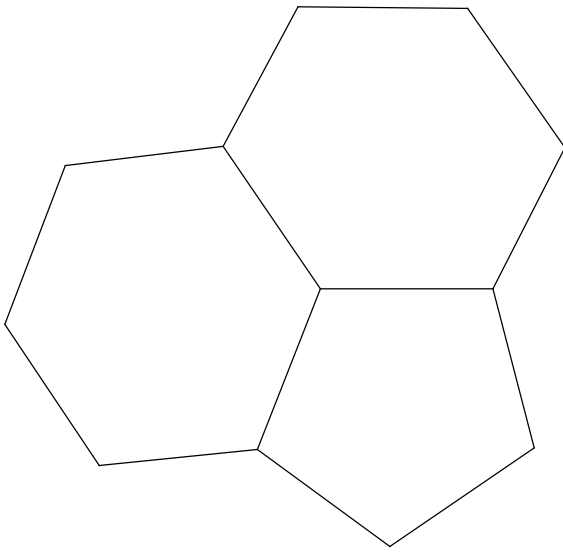
{3, 5, 3, 5}



16.

truncated icosahedron

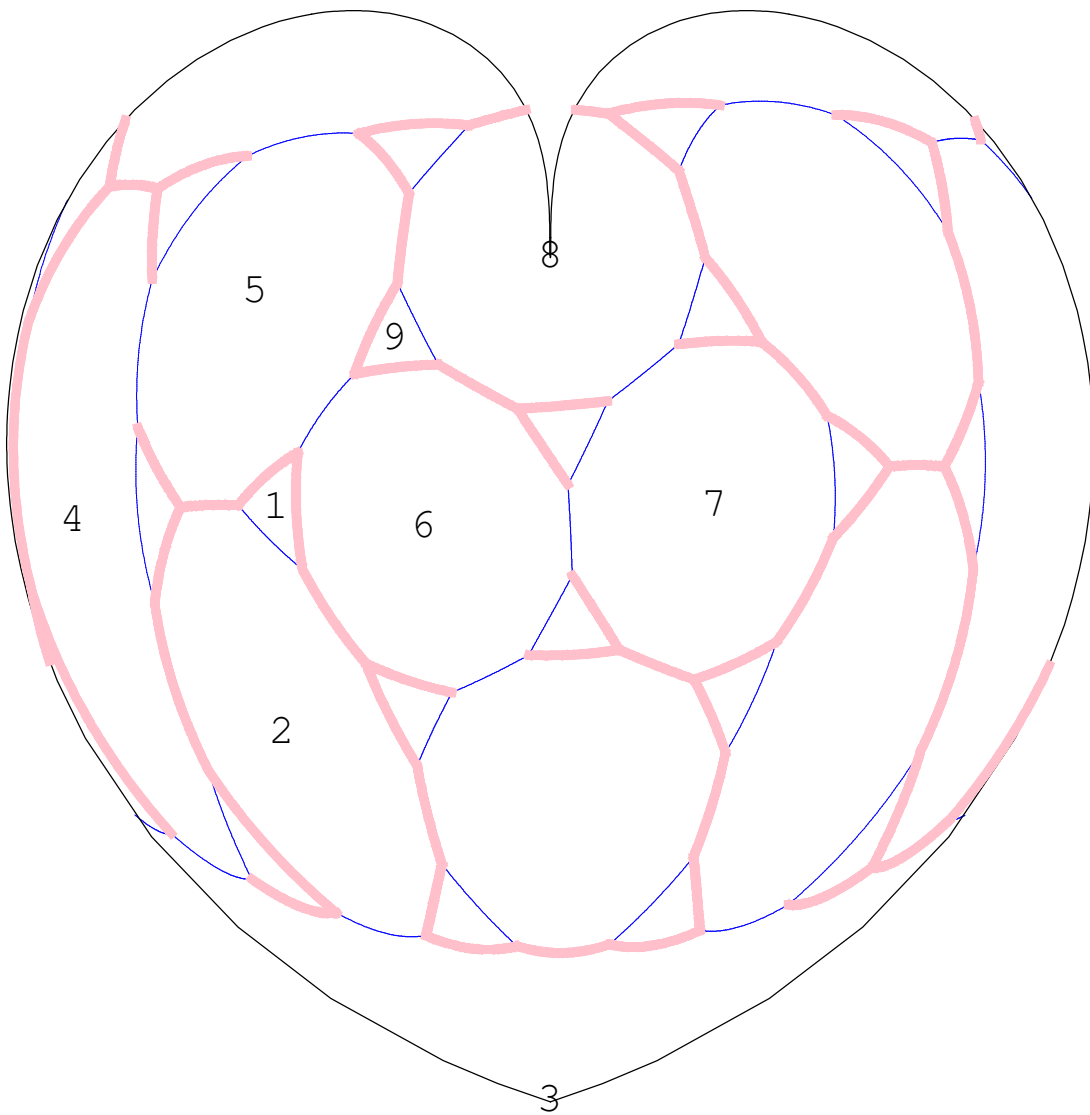
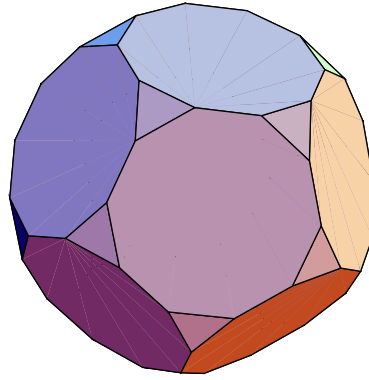
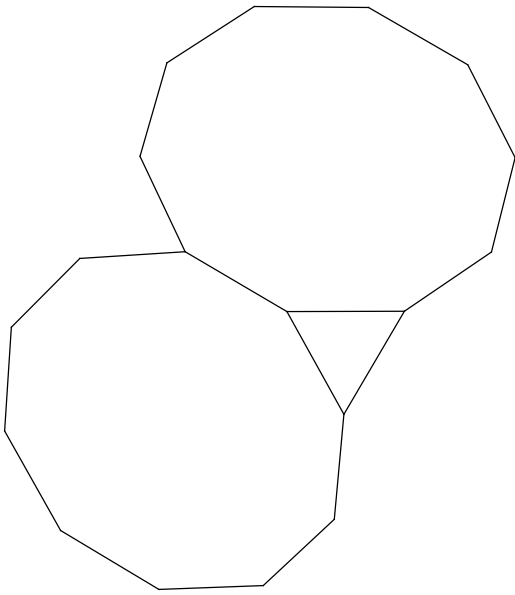
{6, 6, 5}



17.

truncated dodecahedron

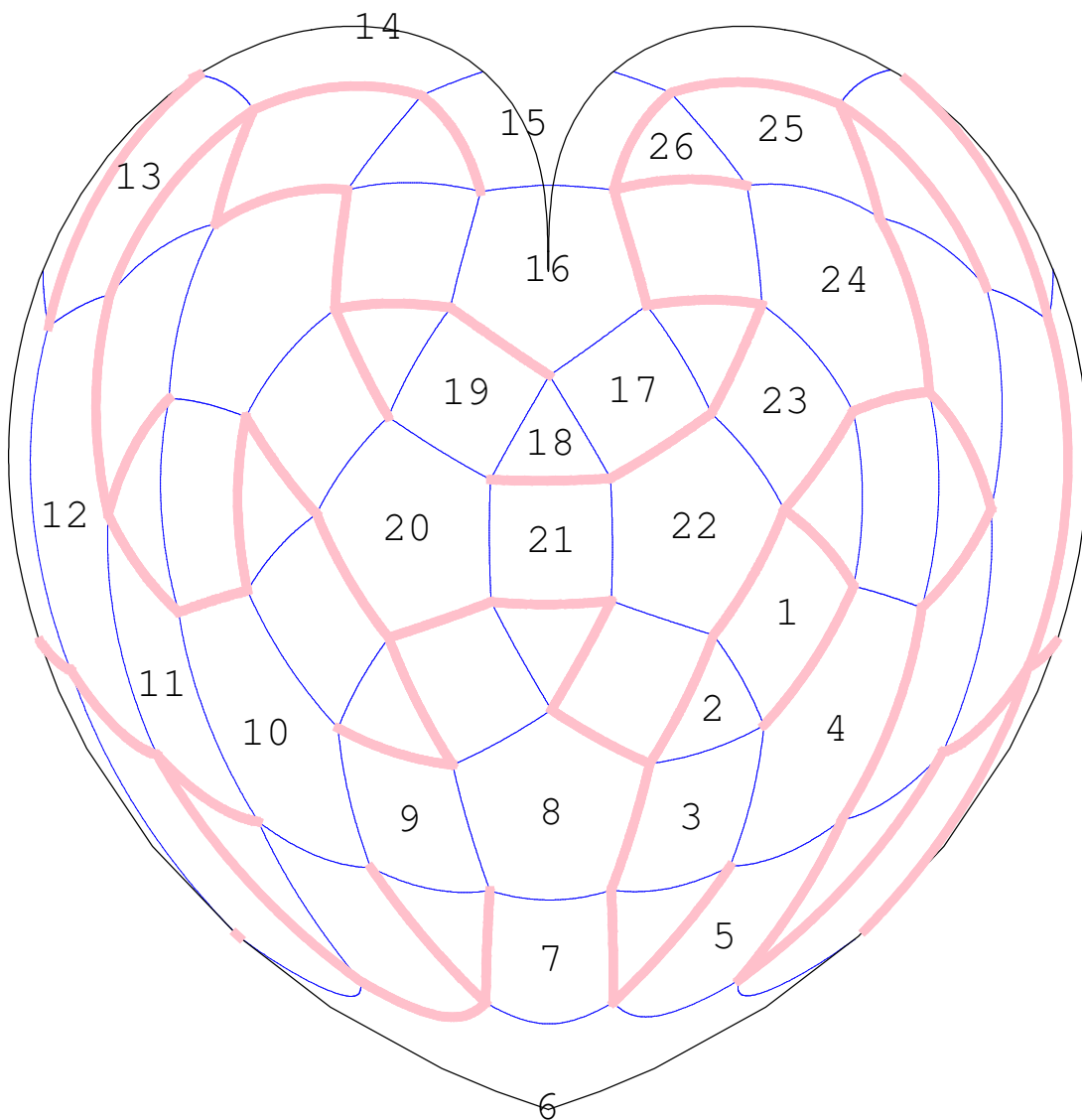
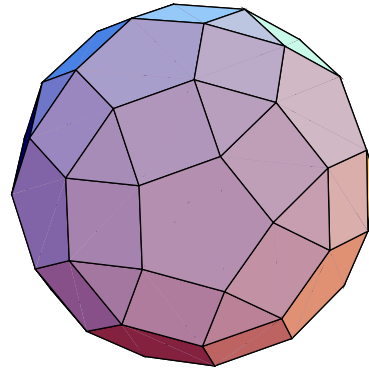
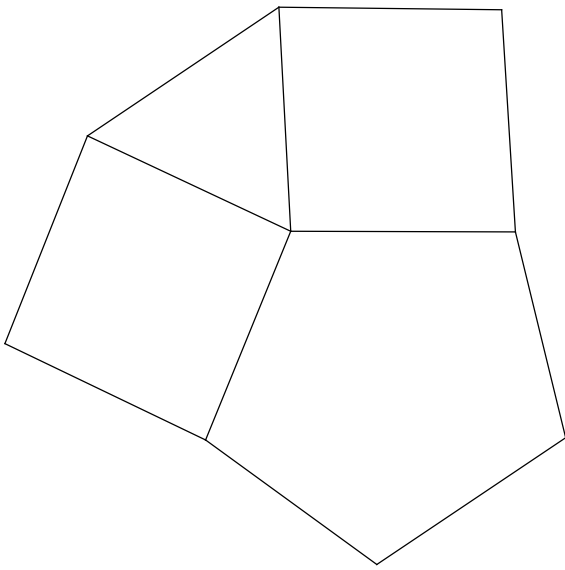
{10, 10, 3}



18.

rhombicosidodecahedron

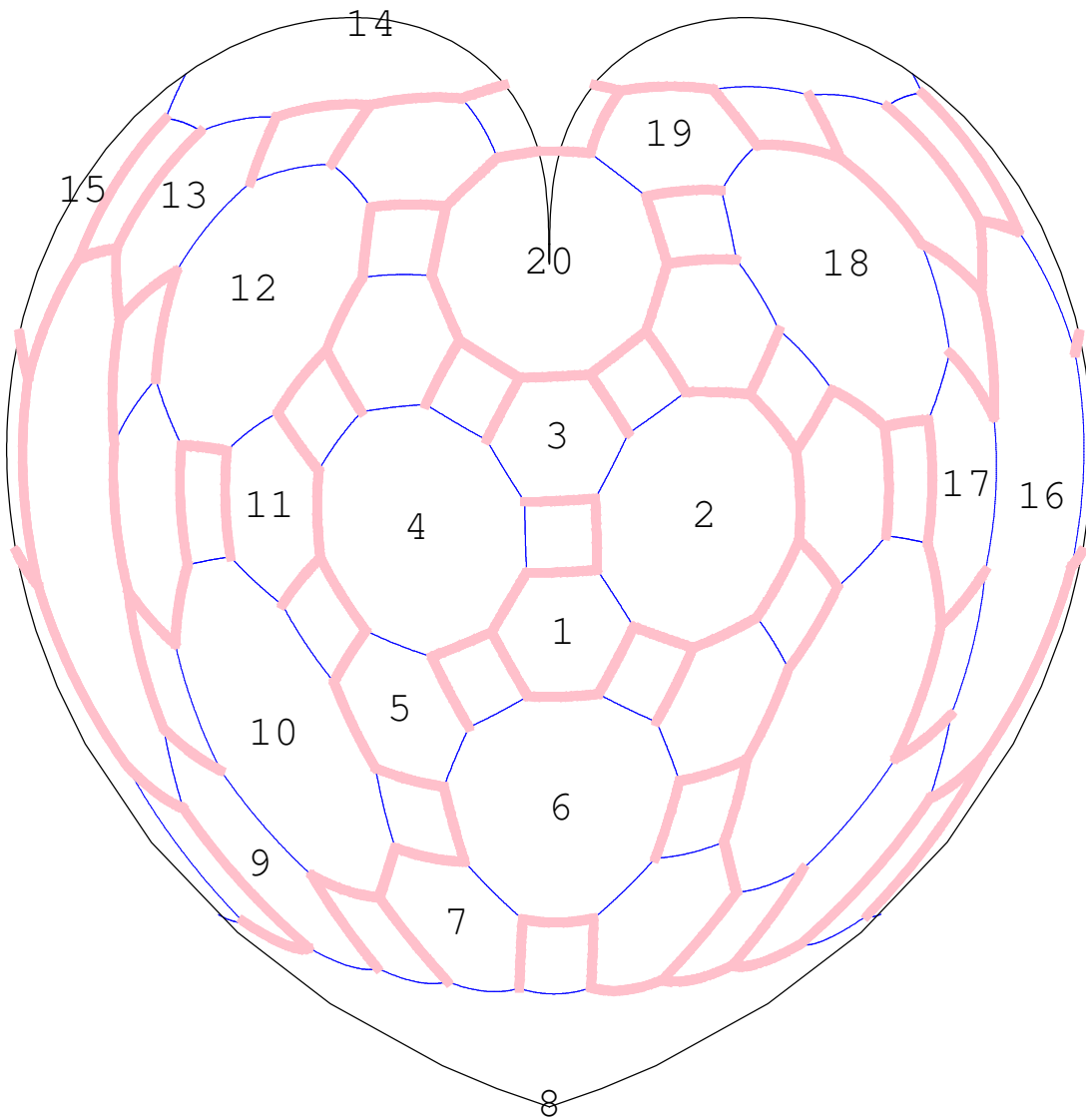
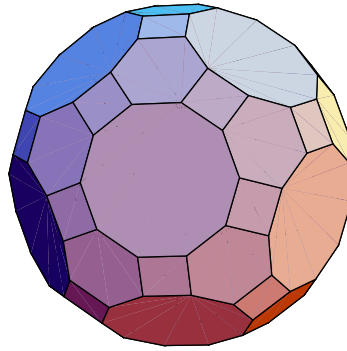
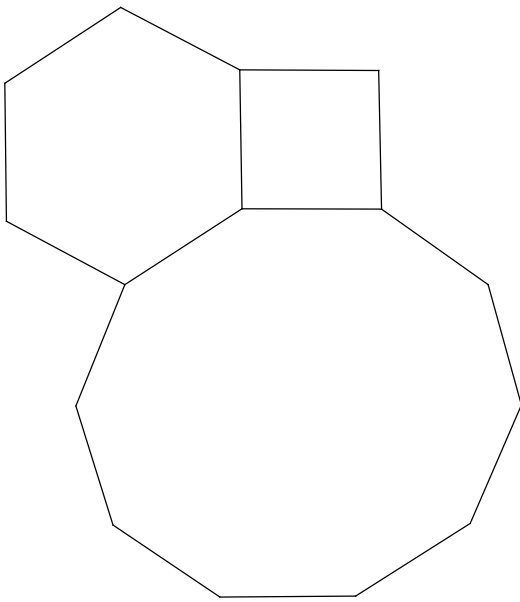
{4, 3, 4, 5}



19.

truncated icosidodecahedron

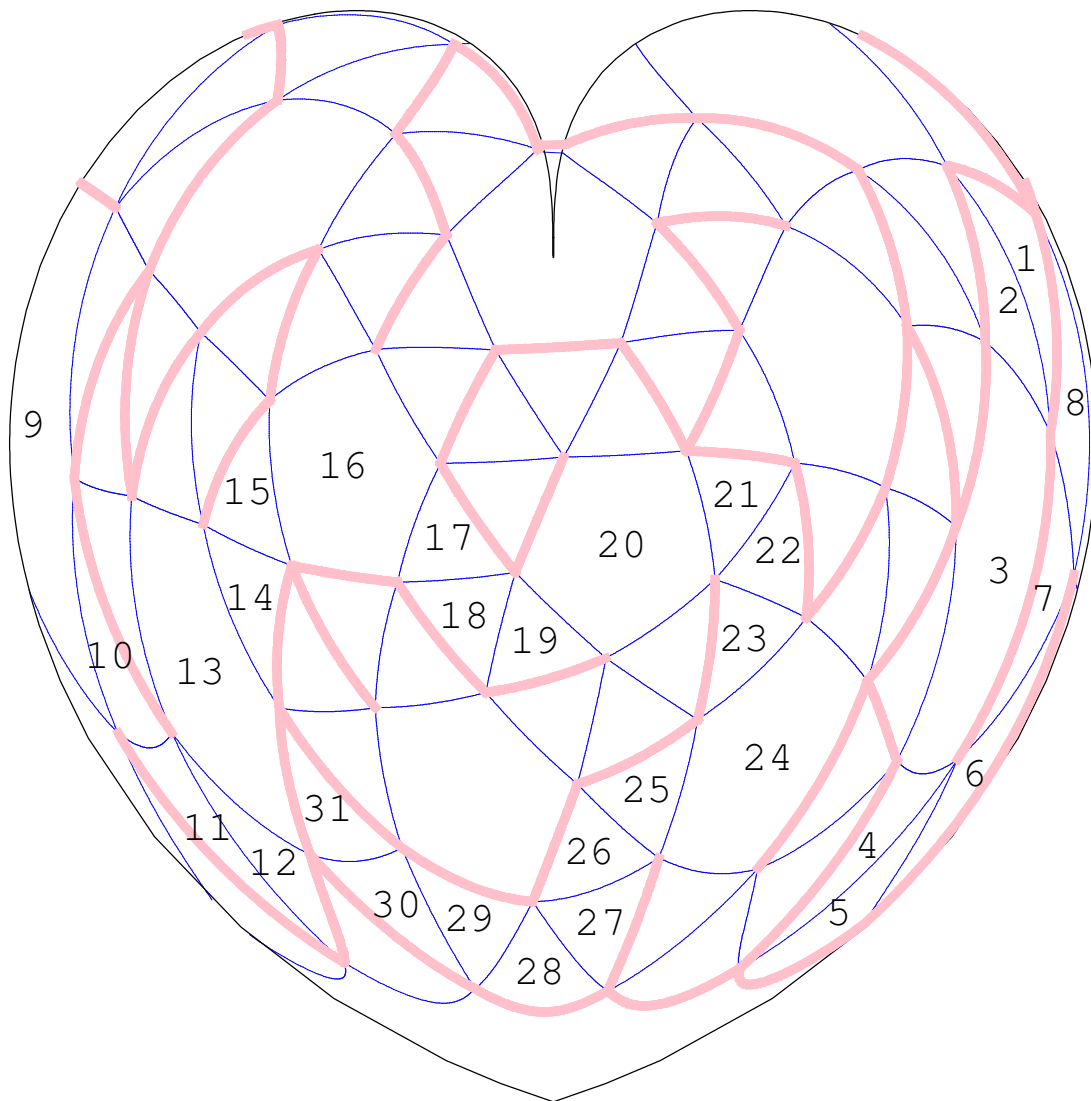
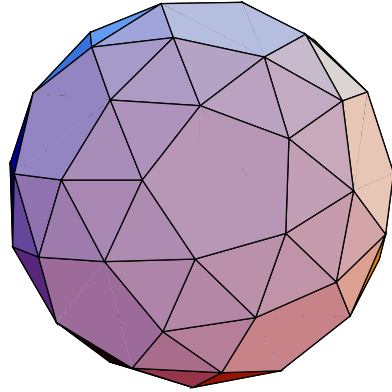
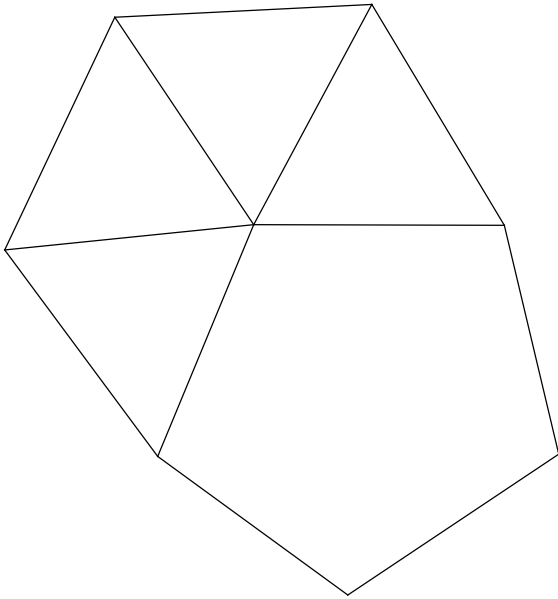
{4, 6, 10}



20.

snub dodecahedron

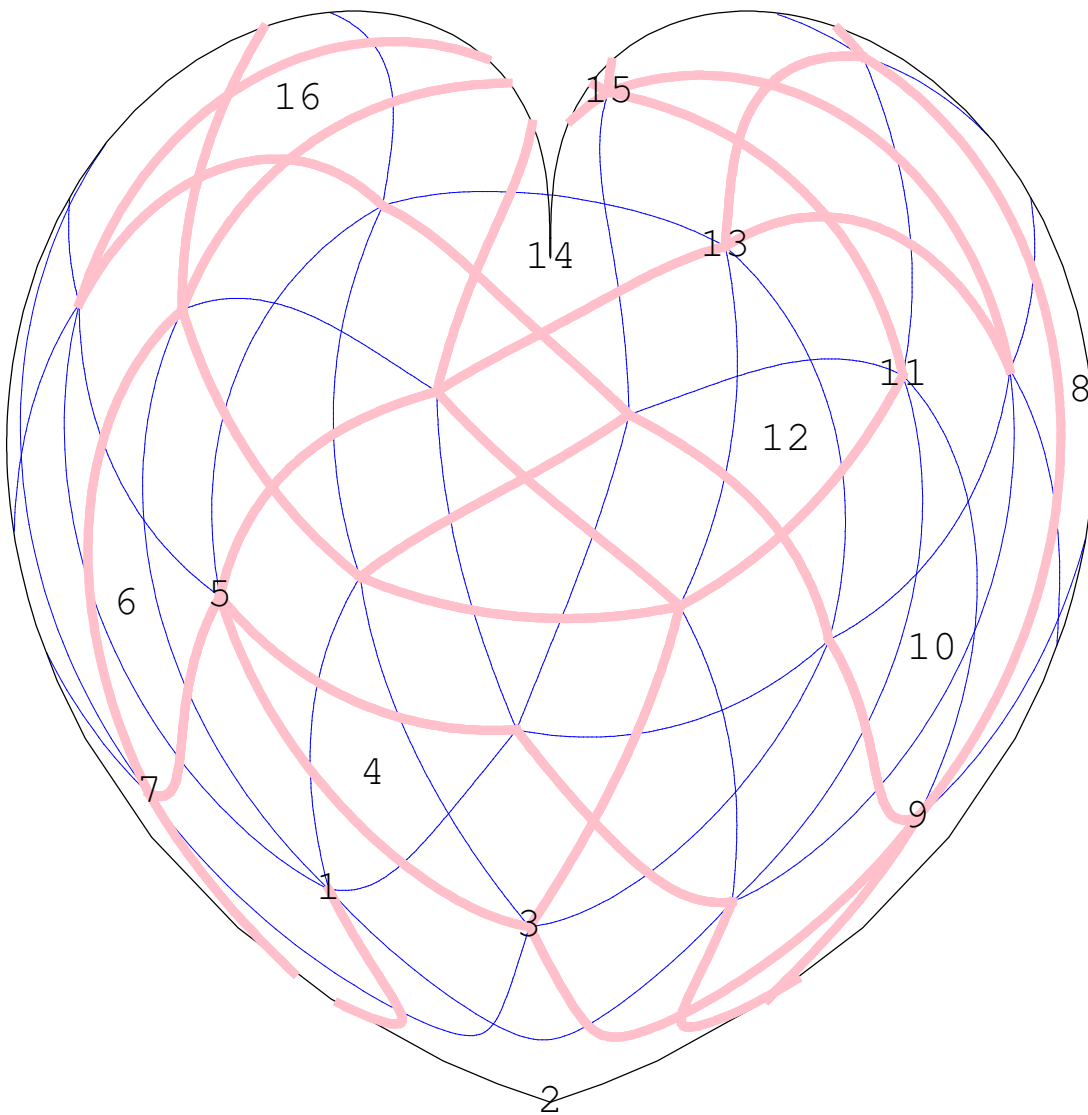
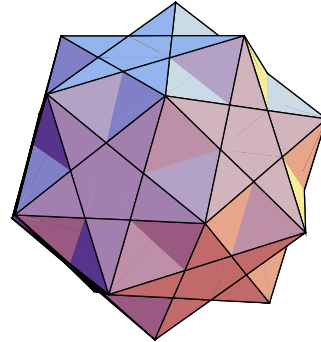
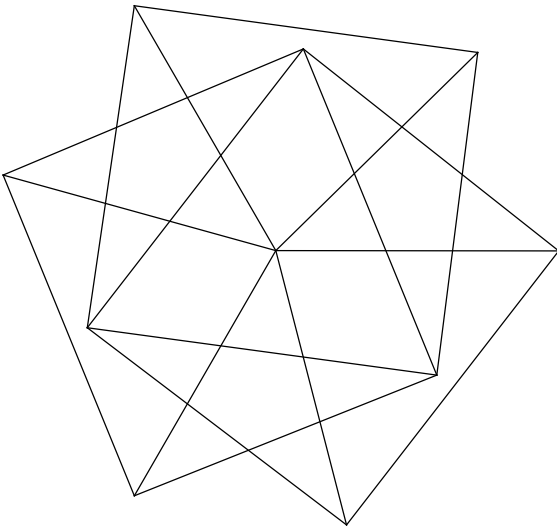
{3, 3, 3, 3, 5}



21.

small ditrigonal icosidodecahedron

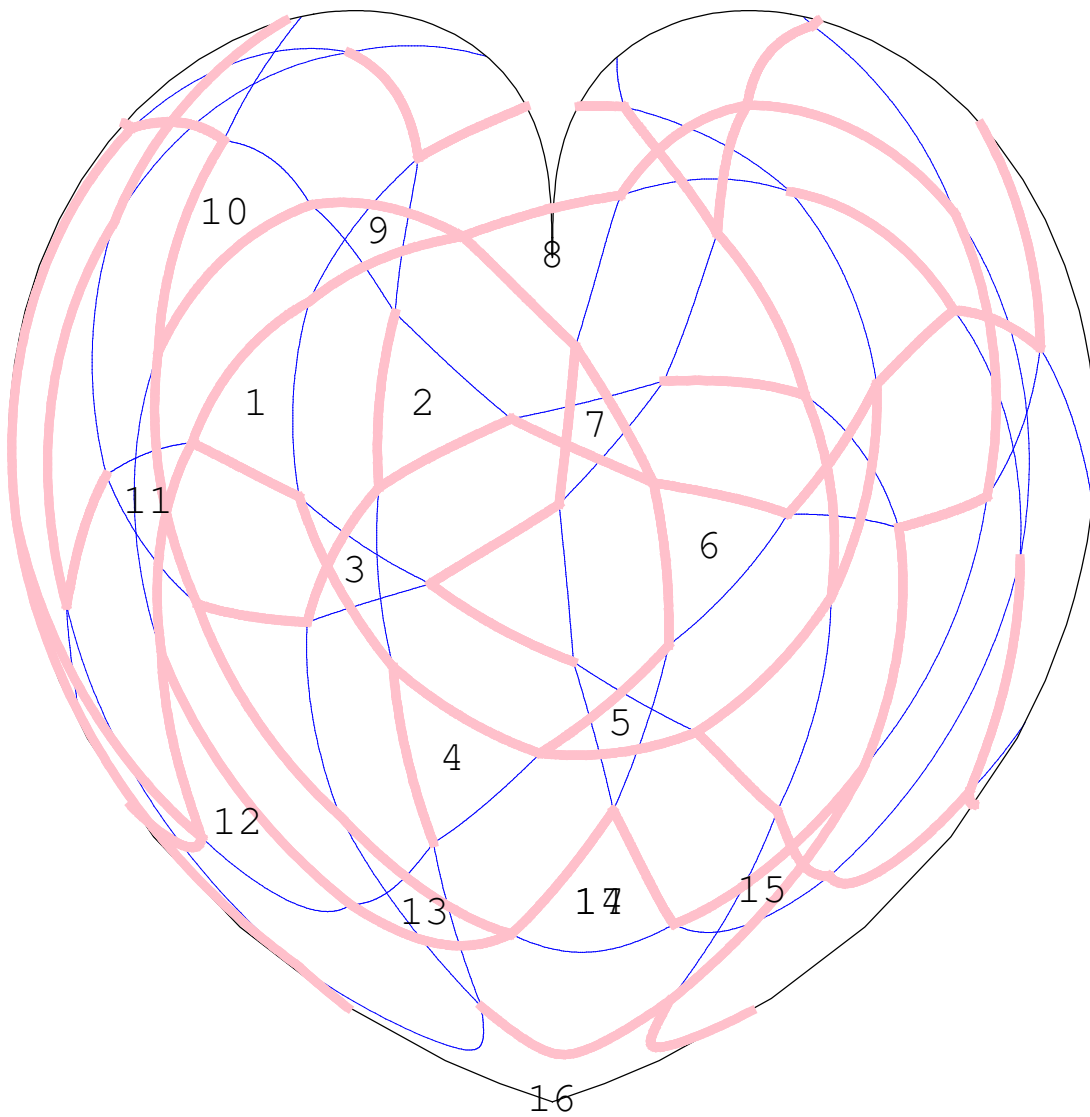
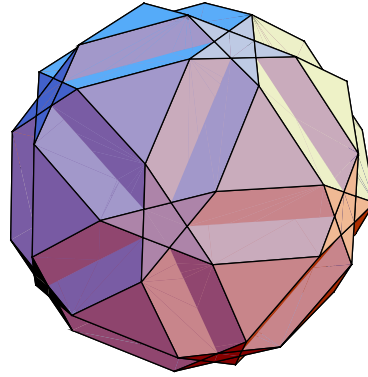
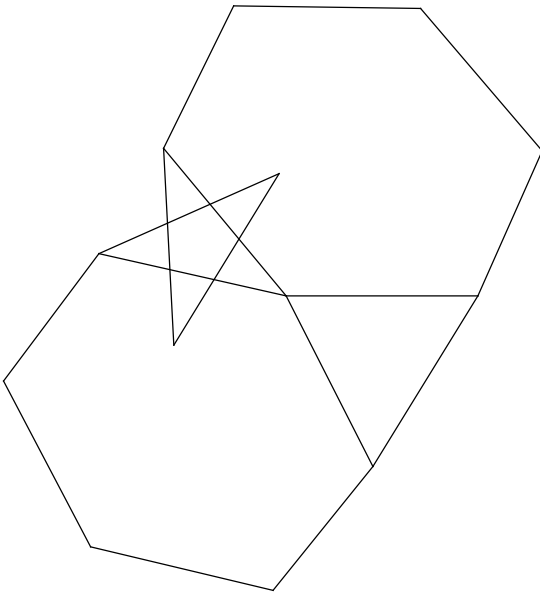
$$\left\{ \frac{5}{2}, 3, \frac{5}{2}, 3, \frac{5}{2}, 3 \right\}$$



22.

small icosicosidodecahedron

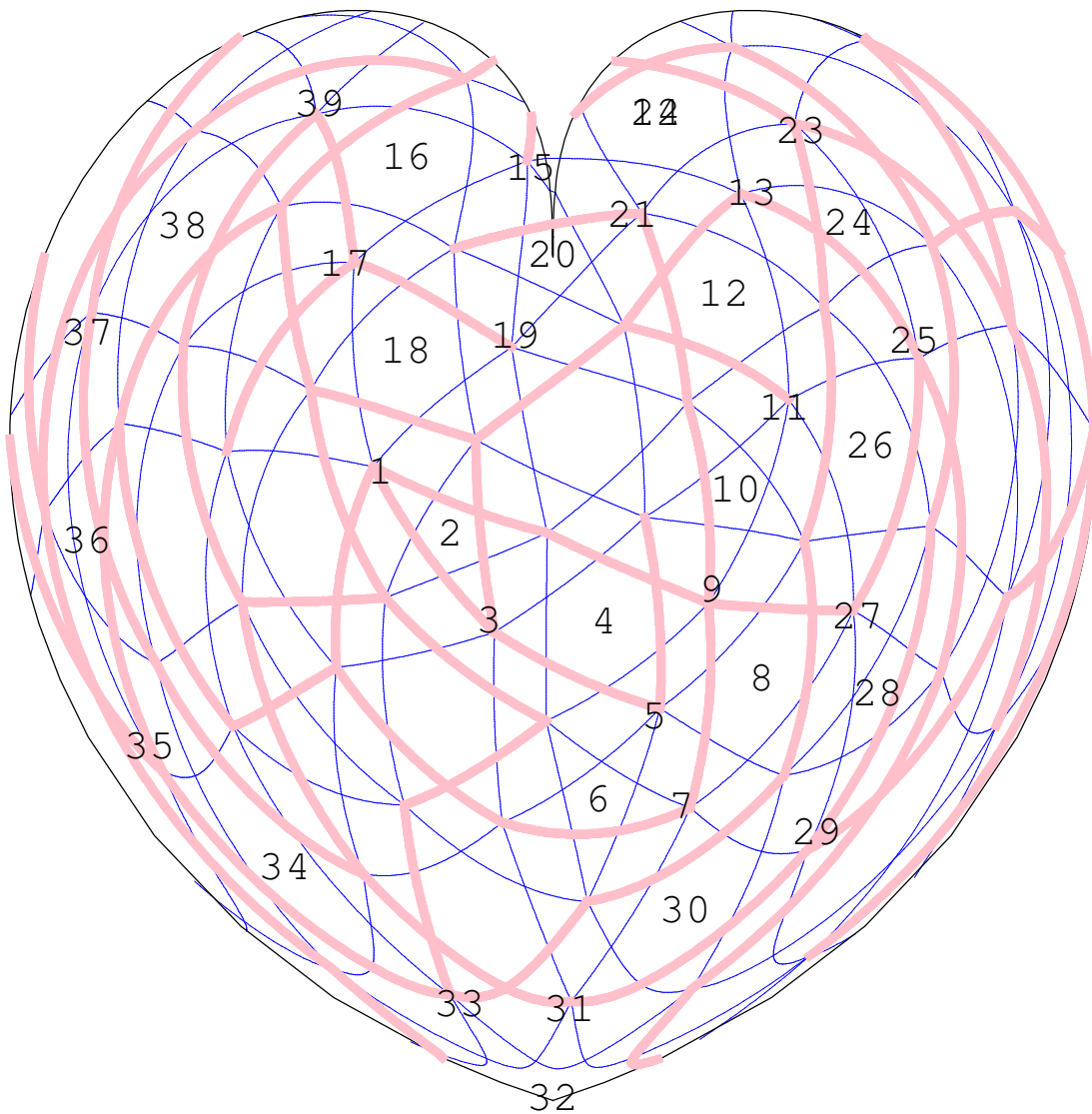
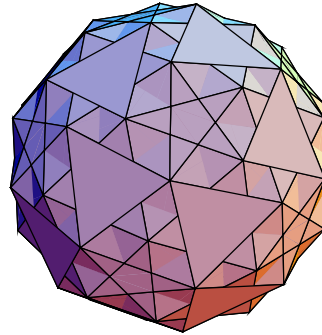
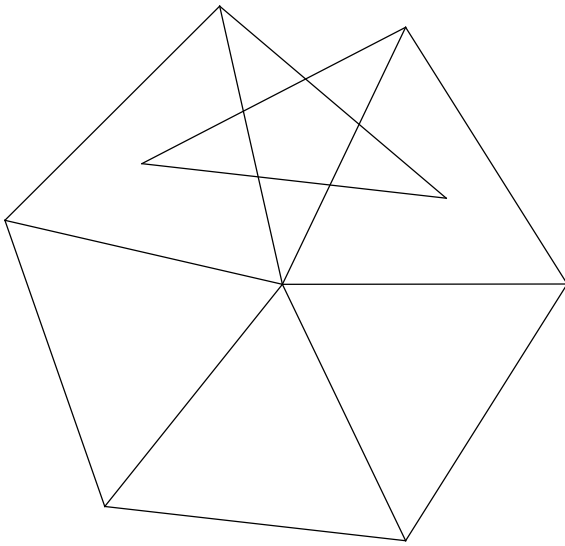
$$\{6, \frac{5}{2}, 6, 3\}$$



23.

small snub icosicosidodecahedron

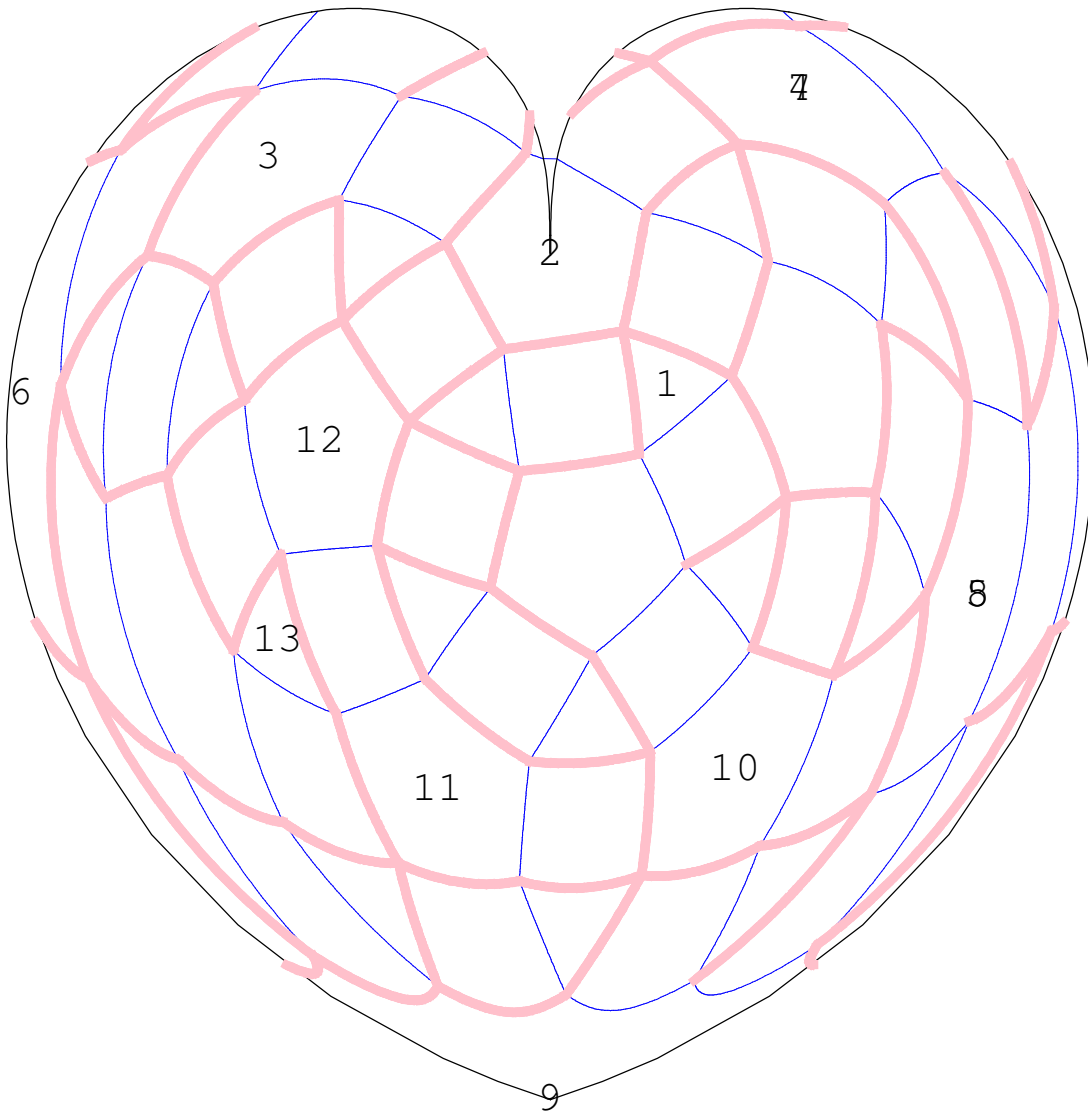
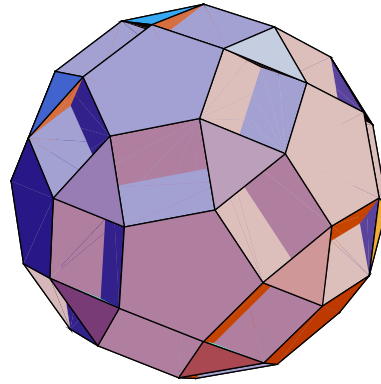
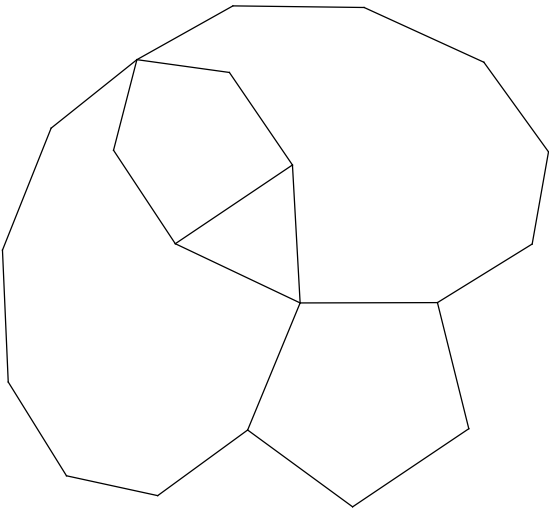
$$\left\{3, \frac{5}{2}, 3, 3, 3, 3\right\}$$



24.

small dodecicosidodecahedron

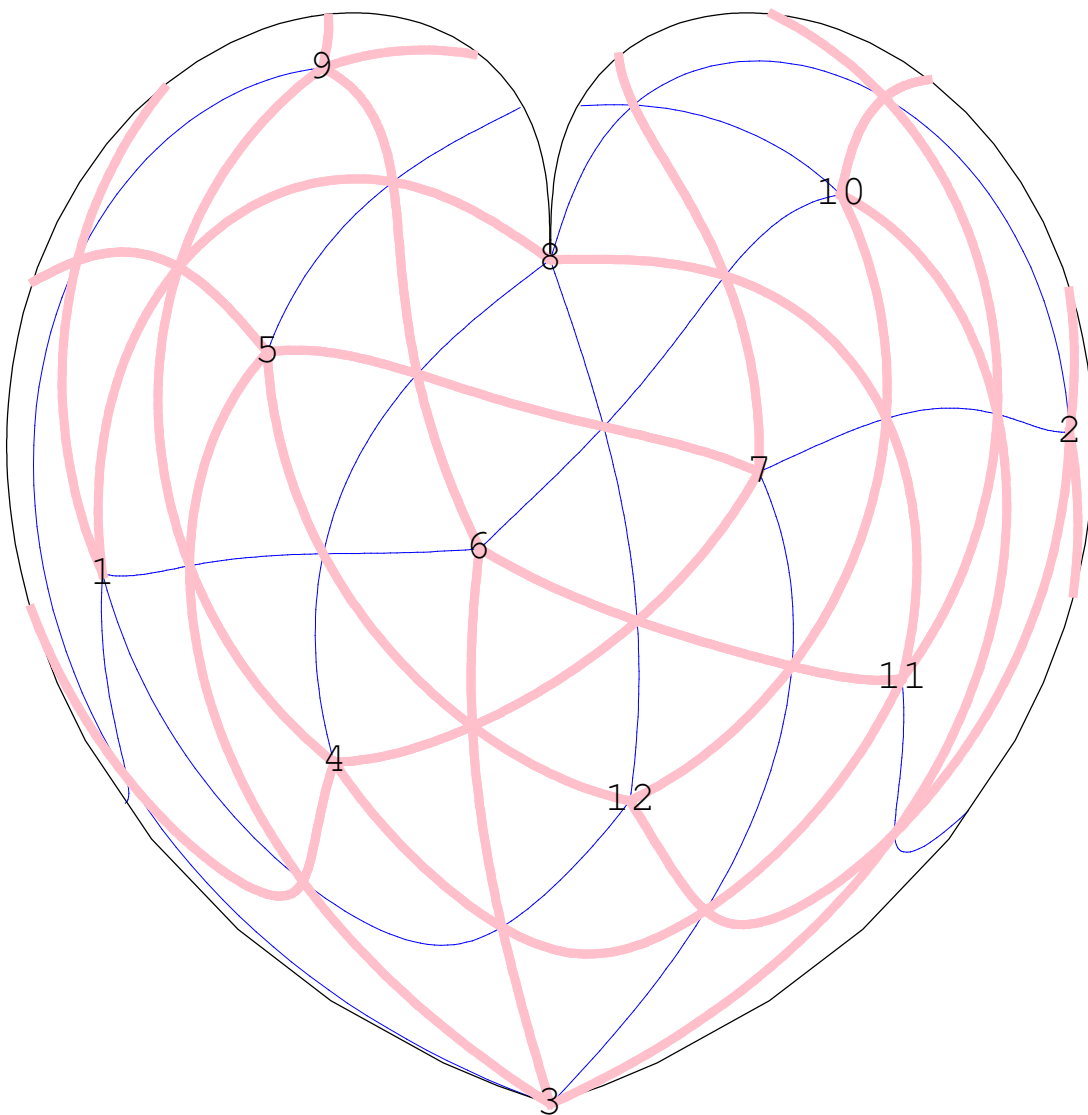
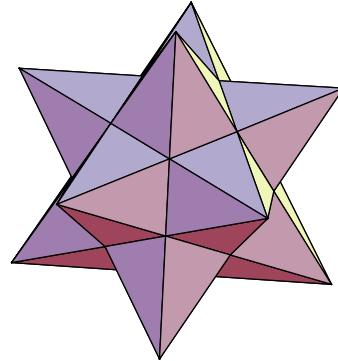
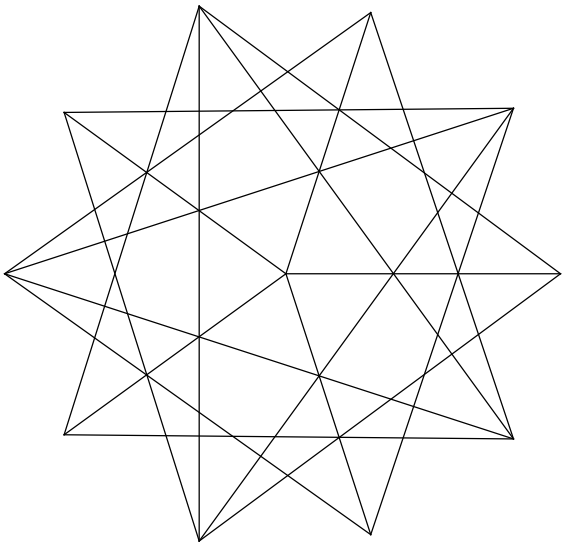
$$\left\{10, \frac{3}{2}, 10, 5\right\}$$



25.

small stellated dodecahedron

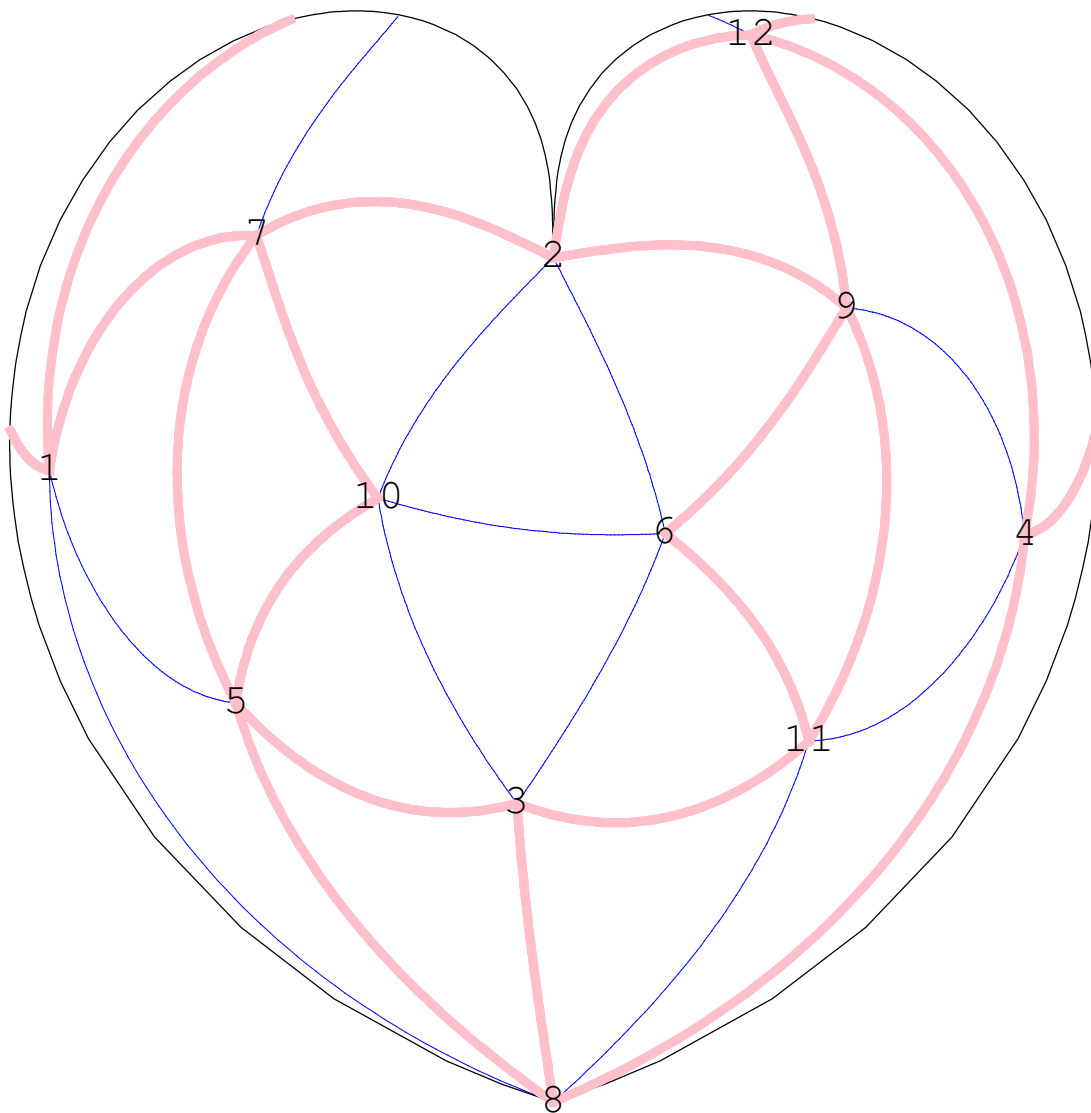
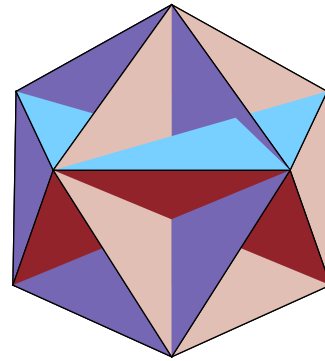
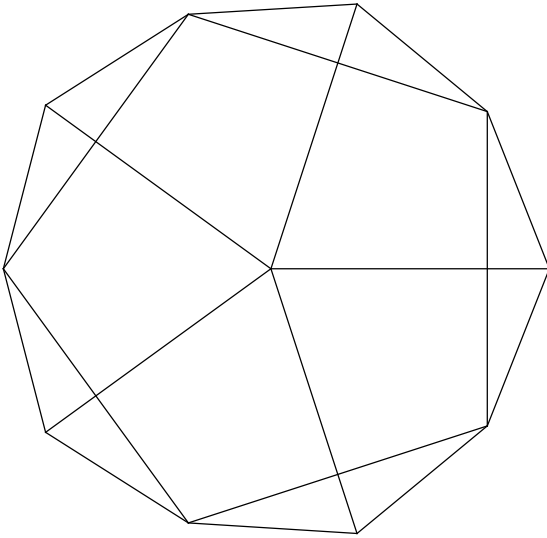
$$\left\{ \frac{5}{2}, \frac{5}{2}, \frac{5}{2}, \frac{5}{2}, \frac{5}{2} \right\}$$



26.

great dodecahedron

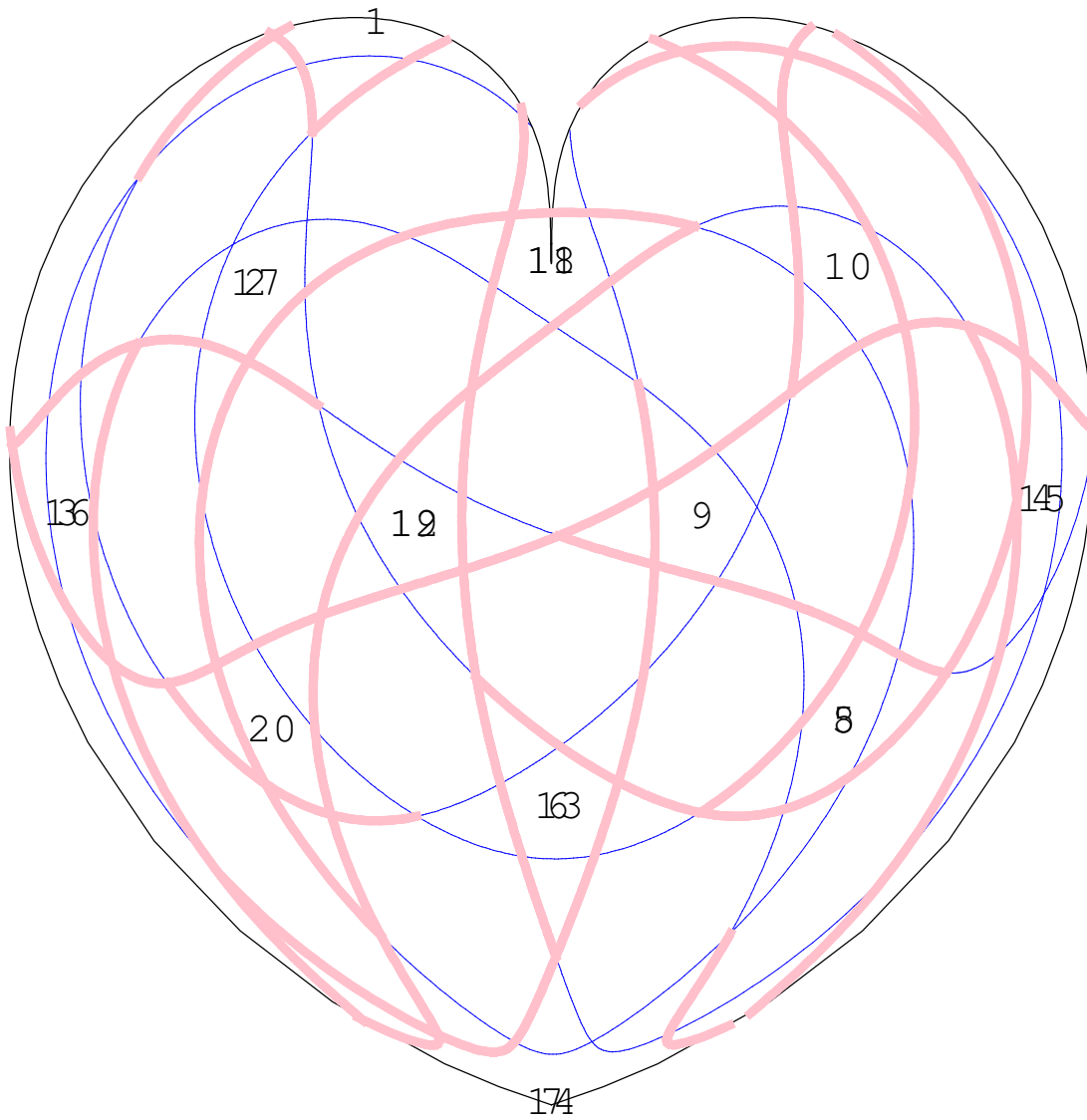
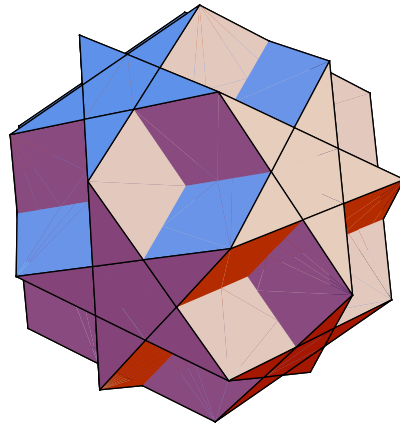
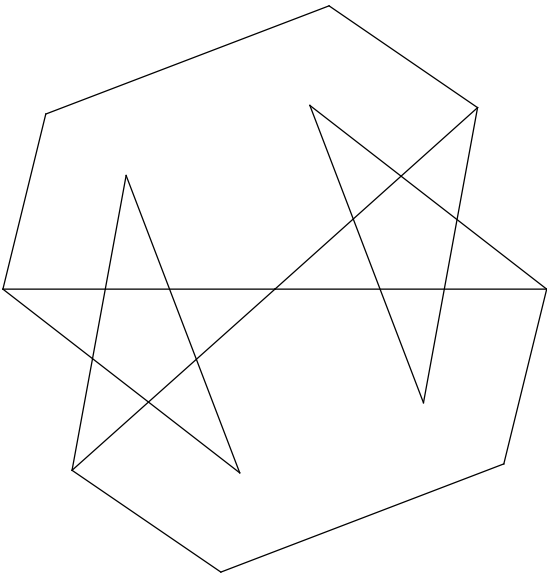
$$\frac{1}{2} \{5, 5, 5, 5, 5\}$$



27.

dodecadodecahedron

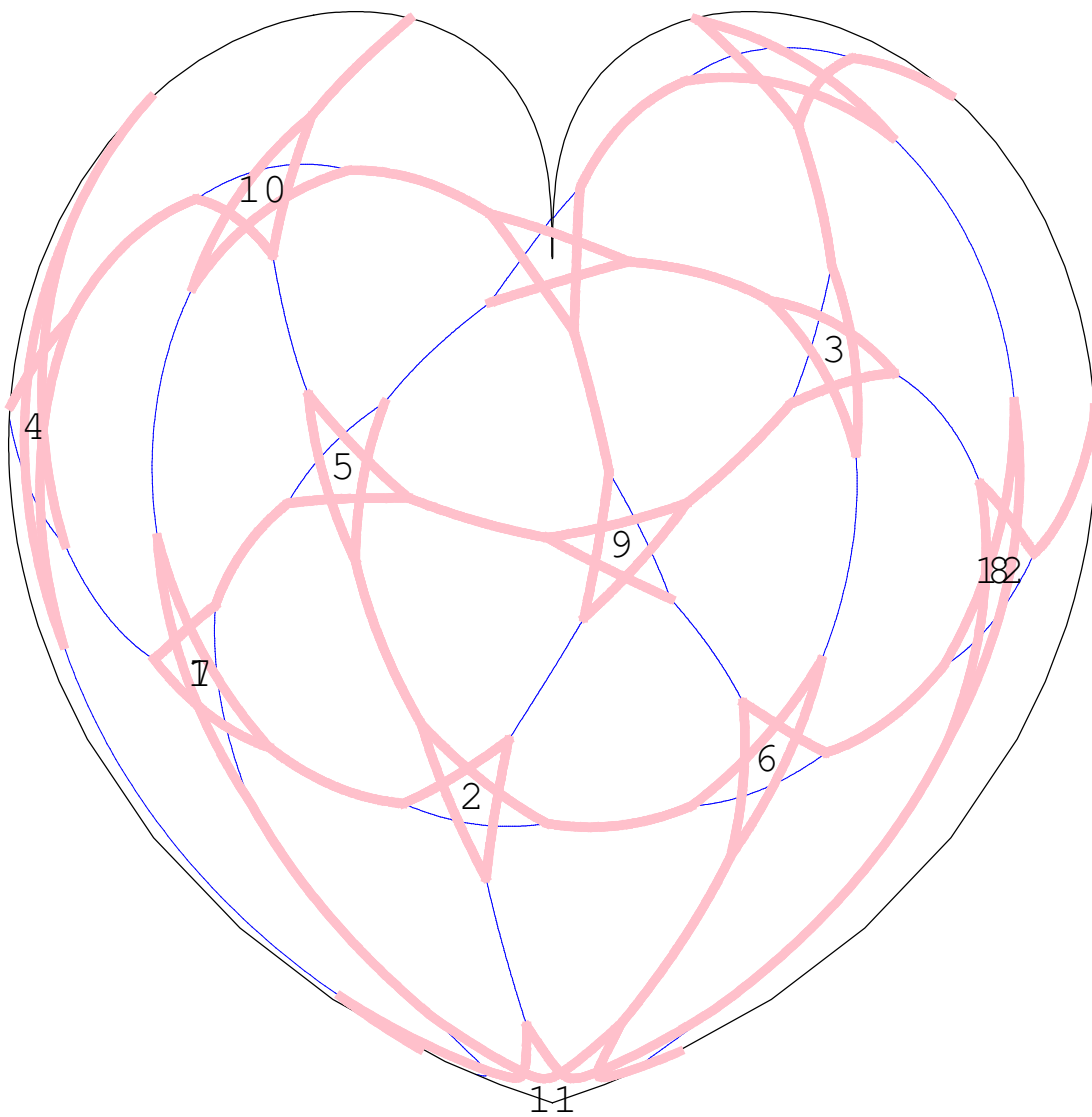
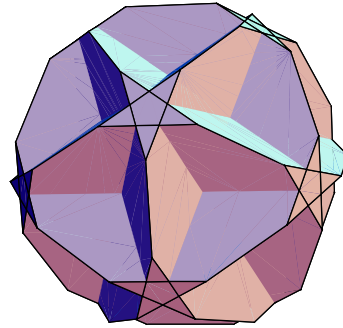
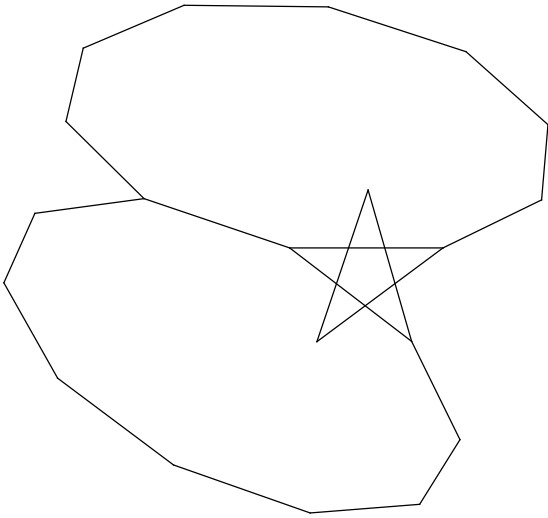
$$\left\{ \frac{5}{2}, 5, \frac{5}{2}, 5 \right\}$$



28.

truncated great dodecahedron

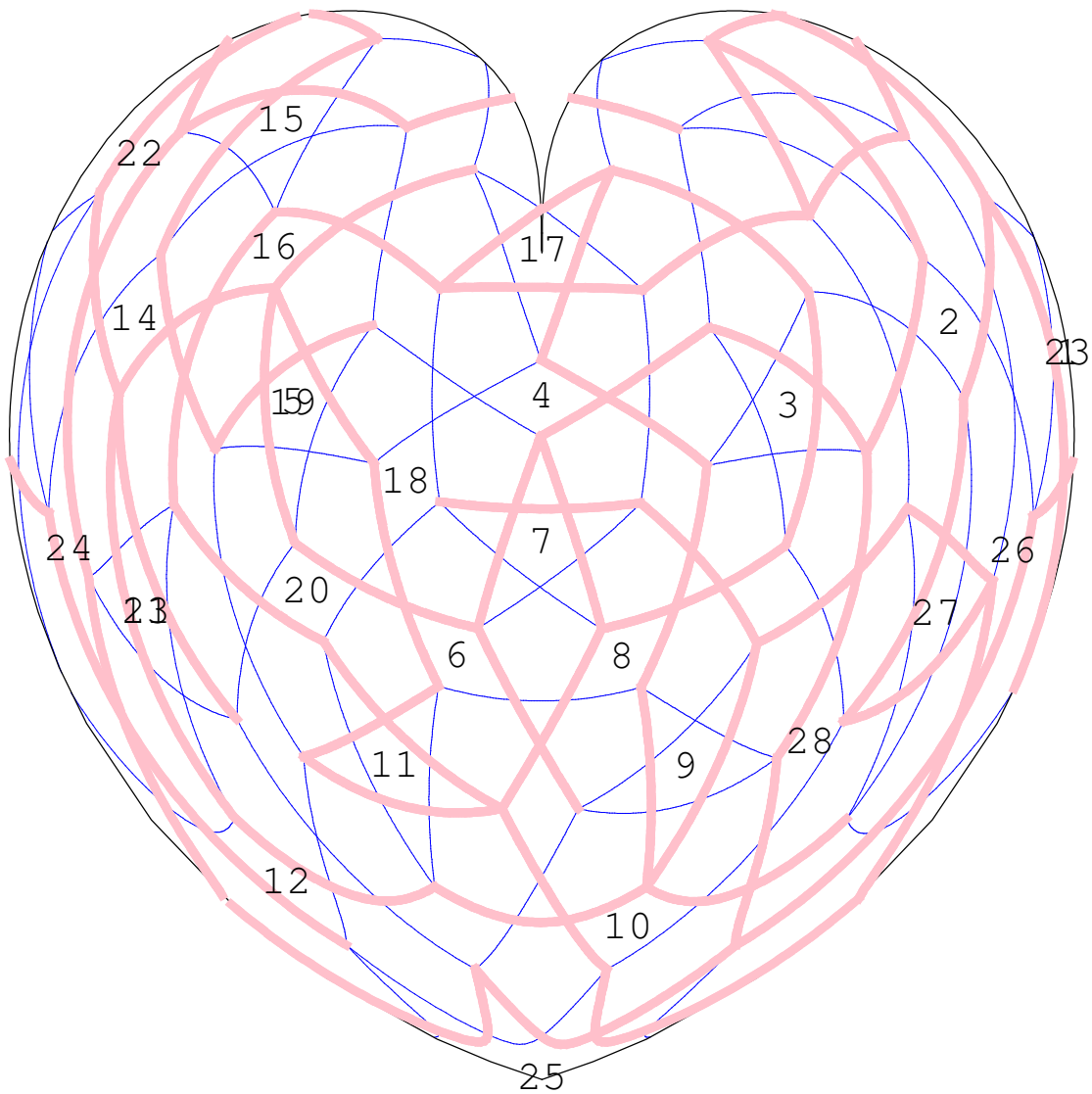
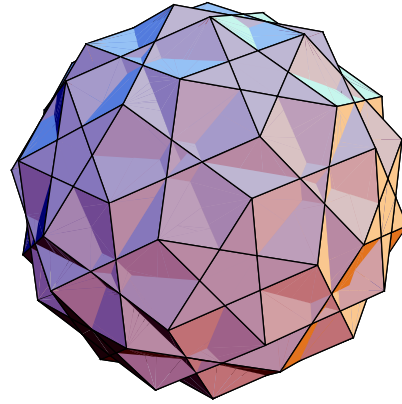
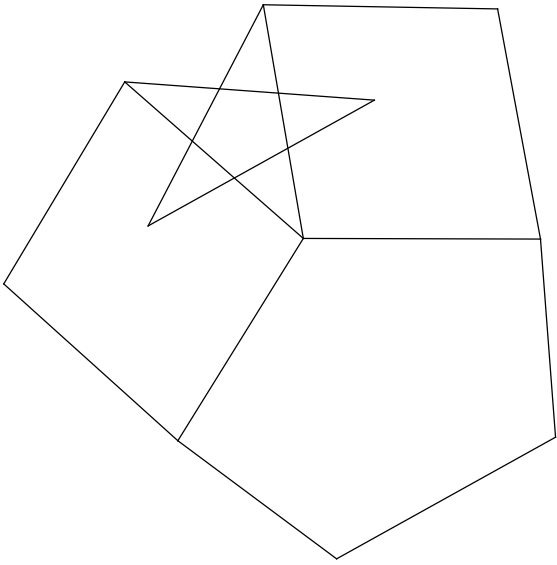
$$\{10, 10, \frac{5}{2}\}$$



29.

rhombidodecadodecahedron

$$\{4, \frac{5}{2}, 4, 5\}$$



30.

small rhombidodecahedron

$$\left\{10, 4, \frac{10}{9}, \frac{4}{3}\right\}$$

