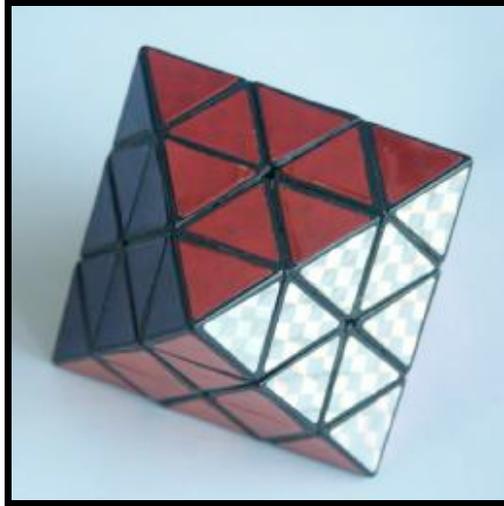


# Octahedron



This is a regular octahedron, of which each triangular face is divided into 9 identical smaller triangles, three to a side. A move consist of rotating a vertex; either just a tip (one triangle to a side) or a larger part (two triangles to a side). Christoph's Jewel is essentially the same puzzle except that the tips are missing, much like the Tetraminx is a Pyraminx without tips.

It is equivalent to a Rubik's cube puzzle without corners, but with the face centres marked to show their orientations. If you understand the solution for the [Pyraminx](#), then you can probably solve much of this puzzle too, because it acts very similar.

## The number of positions:

There are 6 vertex pieces with 4 orientations, 12 edge pieces with 2 orientations giving a maximum of  $12! \cdot 2^{12} \cdot 4^6$  positions. This limit is not reached because:

- Only half the vertex orientations are possible given a certain edge position because a quarter turn is an odd permutation (2)
- Only an even number of flipped pieces are possible (2)

This leaves  $12! \cdot 2^{10} \cdot 4^6 = 2,009,078,326,888,000$  or  $2.0 \cdot 10^{15}$  positions.

If you include the trivial vertex tips then this has to be multiplied by a further  $4^6$ .

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## Links to other useful pages:

['Simplest Solutions' page](#) A text based solution.

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## Notation:

The vertices are denoted by the letters L, R, F, B, U, D (Left, Right, Front, Back, Up and Down). Clockwise quarter turns are denoted by the appropriate letter, anti-clockwise turns by the letter followed by an apostrophe (e.g. L' means turn the Left vertex 90 degrees anti-clockwise), and half turns by the letter followed by a 2 (e.g.. F2 means turn Front 180 degrees). Since the vertex tips are solved independently from the rest of the puzzle (see phase 1 below) this notation is not applied to tip moves but only to the larger moves.

## Solution:

**Phase 1:** Solve tips.

- a. Rotate the tips on each vertex to match the adjacent vertex pieces.

**Phase 2:** Solve vertex pieces.

- a. Rotate the F, B, L, R and U vertices so that their vertex pieces match, and only the edge pieces have the wrong colour. The D vertex will be done later.

**Phase 3:** Place the U edges correctly.

- a. First find any edge that belongs next to the U vertex.
- b. If the edge is not at the D vertex, then put it there by using this sequence:  
Move FR->DF: Do R'D'R.  
This moves the edge between the F and R vertices to a position between the D and F vertices.
- c. Hold the puzzle so that the edge belongs at the front, i.e. at FU.
- d. Rotate D to place the piece at the front, i.e. at DF.
- e. Use one of the following sequences to place the edge in its correct position:  
To move FD->FU do D F2 D' F2.  
To move DF->FU do D F' L D2 L' F.
- f. Repeat the above until all U edges are at the U vertex. Note that if all U edges are at the U vertex but they are not all correctly positioned, then you can bring one down to the D vertex by using one of the above sequences to displace a U edge.

**Phase 4:** Place middle edges correctly.

- a. Find a middle layer edge that lies at the D vertex.
- b. Hold the puzzle so that the edge belongs at FR.
- c. Rotate D to bring the edge to the DF position.
- d. Place the edge piece by using one of the following:  
To move FD->FR, do R' D R.  
To move DF->FR, do D L D' L'.
- e. Repeat the above until all middle edges are correct. Note that if a middle edge is incorrectly positioned, it can be brought down to the D vertex by using one of the above sequences to displace it.

**Phase 5:** Solve D vertex piece.

- a. Rotate D until the vertex piece matches the others. Now only the four D edge pieces remain unsolved.

**Phase 6:** Place D edges in position.

- a. Hold the puzzle so that one of the following sequences will place the remaining edges in the correct position:
  1. To move DR->DF->DL->DR, do R' D R D R' D2 R
  2. To move DR->DL->DF->DR, do R' D2 R D' R' D' R.
  3. To move DR-DL, DF-DB, do R' D2 R D2 R' D R D2 R' D2 R D'
  4. To move DR-DF, DL-DB, do R' D R D' R' D2 R D R' D' R D2

**Phase 7:** Orient the D edges.

- a. Hold the puzzle so that one of the following sequences will solve the puzzle completely:
  1. To flip DR, DF, do R D' F D F' D R' D'
  2. To flip DR, DL, do R D' F D2 F' D R' D2
  3. To flip DR, DL, DF, DB, use b or c to flip them two at a time.

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