

Jaap's Puzzle Page

Ultimate Skewb / Puzzleball



The puzzle is a variant on the Skewb which has a dodecahedral shape. A cube can be embedded in a regular dodecahedron so that its corners coincide with eight of the corners of the dodecahedron. This puzzle can be considered to be a regular Skewb cube which has been extended into a dodecahedron in the same way. It has 8 triangular corner pieces, and 6 square roof-like face pieces. The puzzle usually has only 6 colours, and opposite (parallel) faces have the same colour. When Meffert first made some of these, it was called the Pyraminx Ball.

This puzzle differs from the most other Skewb variants because here the orientation of all the pieces is visible. It is therefore the most difficult Skewb variant. On the regular [Skewb](#) face orientation is not visible, whereas on the [diamond](#) the orientation of the triangular pieces is not visible. Some puzzleball puzzles also have visible orientations on most pieces, and they may be solved in the same manner as the ultimate Skewb.

The number of positions:

There are 4 fixed corners with 3 orientations, 4 free corners with 3 orientations and 6 face pieces with 2 orientations, giving a maximum of $6! \cdot 4! \cdot 3^8 \cdot 2^5$ positions. This limit is not reached because:

- The total twist of the corners is fixed (3)
- The number of flipped faces is even (2)
- The faces must have an even permutation (2)
- The free corners must have an even permutation, and hence form a tetrad (2)
- The orientations of the fixed corners and the position of one of the free corners will determine the positions of the other three (3)

This leaves $6! \cdot 4! \cdot 3^6 \cdot 2^3 = 100,776,960$ positions.

Every position can be solved in at most 14 moves. Thanh Vinh Nguyen has recently calculated God's

Algorithm, i.e. the shortest solution for each position. Many thanks to Thanh and Claude Crépeau for sharing these results. In the table below I have placed the results for all the Skewb variants together for comparison.

Moves	Beachball	Diamond	Pyraminx	Skewb	M-H Pyramid	Ultimate Skewb
0	1	1	1	1	1	1
1	8	8	8	8	8	8
2	48	48	48	48	48	48
3	252	288	288	288	288	288
4	930	1,632	1,728	1,728	1,728	1,728
5	884	8,568	9,896	10,248	10,128	10,248
6	37	36,114	51,808	59,304	57,780	59,976
7		74,799	220,111	315,198	305,483	346,740
8		16,547	480,467	1,225,483	1,239,266	1,958,850
9		220	166,276	1,455,856	1,879,631	10,297,604
10		15	2,457	81,028	237,320	39,466,215
11			32	90	778	46,217,578
12					21	2,417,060
13						615
14						1
Total	2,160	138,240	933,120	3,149,280	3,732,480	100,776,960

The single antipode on the ultimate Skewb is the superflip, the position with all six faces flipped but otherwise correct.

In [Sloane's On-Line Encyclopedia of Integer Sequences](#) these are included as sequences [A079763](#), [A079765](#), [A079744](#), [A079745](#), [A079746](#), and [A079874](#).

Links to other useful pages:



[Uwe Meffert's pages](#). He produces the Pyraminx, the Skewb and many variants of it.

[Meffert's page](#). Contains the solution provided in the booklet for the standard Skewb.

[Meffert's page](#). Contains the solution provided in the Creative Puzzleball booklet.

[Meffert's page](#). Contains the solution provided in the Ultimate Skewb booklet.

[David Joyner's page](#). A catalogue of move sequences.

Notation:

Note that the corners fall in two classes; four left-handed and four right-handed ones. You will only turn one of these classes, so that these will be considered fixed in space while the other 4 free corners move about. Hold the puzzle so that the tetrad of fixed corners point left, right, down and back. Denote clockwise moves at the corners by L, R, D and B. Anti-clockwise turns are denoted L', R', D' and B'. Any face can be specified by two letters, e.g. DR is the face between the down and right fixed corners. The other 4 corners can similarly be specified by 3 letters.



There now follow 2 different solutions. The first solution below closely follows that of the pyraminx.

Solution 1:

3 top corners 3
 3 top faces 14
 bottom corner 1
 3 bottom faces 8

4 free corners 13
total: 39 moves

Phase 1: Solve 3 top corners

Rotate L, R, and B so that their orientation is correct. On the Ultimate Skewb these corners do not have any sides in common, but as opposite faces of the solved puzzle usually have the same colour, then the three corners can be turned so that their matching colours are on opposite faces.

Phase 2: Solve 3 top faces

- Find a face piece at the D corner which does not belong there.
- Hold the puzzle so that the belongs at the LR position.
- Rotate D to bring the piece to the back so that it is in the RD or BD position.
- Use one of the following sequences to place the piece correctly:
 - Move BD->LR: Do LDL'.
 - Move DB->LR: Do R'DR.
- Repeat the above until all three top faces are correct. If necessary, you can use one of the above sequences to displace incorrectly placed faces from the top layer.

Phase 3: Solve the D corner.

Simply rotate D to orient its corner correctly. See the remarks in Phase 1. If you are solving a puzzle ball and the D triangle has no visible orientation, then rotate D so that either all 4 free moving corners are correctly positioned, or such that none of them are (If there are identical free corners then keep in mind that they may be considered to be swapped).

Phase 4: Solve the D faces.

There are now only a few possibilities for the last 3 faces left:

- To cycle RD->LD->BD->RD: Do: R'DRDR'DR.
- To cycle RD->BD->LD->RD: Do: R'D'RD'R'D'R.
- To flip RD->DR, LD->DL: DRD'LD'L'DR'.
- To cycle RD->DL->DB->RD: RLDL'D'R'
- To cycle RD->DB->DL->RD: RDL'D'L'R'

Phase 5: Solve the final 4 corners.

- If the corners are positioned correctly, but only need to be oriented properly, then the following sequences can be used. You will probably need to rotate the whole puzzle to get into one of these positions:
 - LRD->DLR, RBD->DRB, BLD->DBL: B' RD'R'D BD' L'R'L'RL' D
 - LRD->RDL, RBD->BDR, BLD->LDB: D' LR'LRL DB' D'RDR' B
 - BLD->DBL, RBD->BDR: LDL'D' R B'D'BD R'
 - LRD->DLR, RBD->BDR, BLD->LDB, LRB->RBL: D' LR'LRL DB' D'RDR' B
- If the corners are not in the correct position, then one of the following sequences will do:
 - DLR->BRL->DLR, LDB->RBD->LDB: DR'D' L'D'LD R D'L'DL
 - DLR->LBR->RDL, LDB->DRB->DBL: DL' D'RDR' L RD'R'
 - DLR->RLB->LRD, LDB->BDR->BLD: B'LD'L'D B D'LDL'
 - DLR->BRL->DLR, LDB->DRB->LDB: DR'L'B'LRDLBL'D
 - DLR->LBR->RDL, LDB->RBD->DBL: R D R'LRL' D' LR'L'
 - DLR->LBR->RDL, LDB->BDR->DBL: L'R'L B' L'RLR' B R
 - DLR->LBR->LRD, LDB->BDR->BLD: L RD'R'D L' D'RDR'
 - DLR->LBR->RDL, LDB->DRB->LDB: L'R'DRL BRD'R'B'
 - DLR->LBR->RDL, LDB->BDR->LDB: LDBL R' L'B'D'L' R

Solution 2:**Phase 1:**

Do any standard Skewb solution. This solves everything except the face orientations.

Phase 2: Orient the faces.

Do one of the following sequences to flip the faces correctly:

1. Flip DL, DR: B'LB D'R'DR BL'B' RDR'D'
2. Flip DB, LR: DBL B'R'BR D'L'B' LRL'R'
3. Flip DL, DR, DB, LR: B' D'RD' L'B'R DB'D LR
4. Flip DL, DR, BL, BR: DRD B' RD'LD'R'D B' DR'DB'L'
5. Flip DL, DR, DB, LR, BL, BR: DRD' L'B DRD' L DB'DL'RDL

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