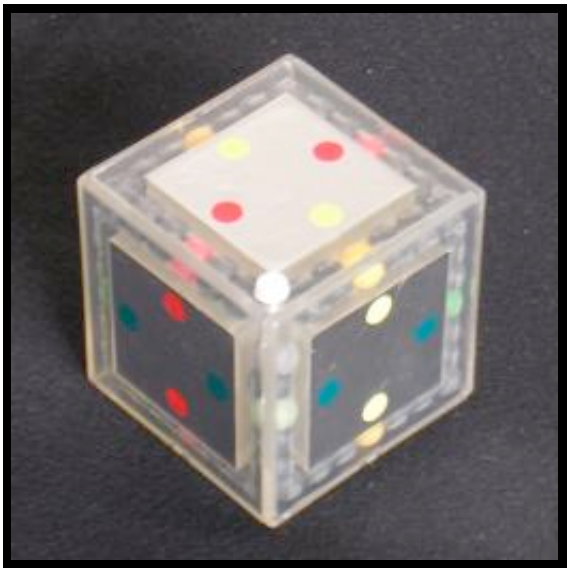
Jaap's Puzzle Page

Pionir Cube



The Pionir Cube is a transparent cube with many small balls which are arranged in tracks inside the cube along its edges. Seven balls lie along each edge, where the balls at either end are of course shared between the three edges that come together at that corner. One ball is missing, giving a gap that allows the balls to be moved around. There are 12·5 + 8 - 1 = 67 balls. Most of them are black. There are however 4 green balls, 4 red ones, and 4 yellow ones. The balls of one colour belong in the middle of a set of parallel edges. The faces of the cube have coloured markings to show exactly where the coloured balls belong.

This puzzle is closely related to the Varikon 3×3×3, except that that puzzle has only 3 pieces along each edge and all its pieces are distinct. Like that puzzle, the Pionir cube has a tiny hole near one corner of the box, into which you can insert a small plastic pin. This prevents the puzzle from getting mixed up accidentally.

The number of positions:

There are 67 loose balls and a space. The balls can be arranged in 67! ways, but balls of the same colour cannot be distinguished, leaving 67!/ (4!^3 55!) arrangements. The space can only really be in one of the corners, giving a total of 8·67!/ (55! 4!^3) = 1,662,357,943,319,673,600 positions.

Notation:

During the solution, the space will generally be at the front top right corner of the cube. Some of the Rubik's cube notation can then be used - letters F, U, and R denote a clockwise shifts of all the balls around the Front, Up, and Right faces respectively. Note that the space will move anti-clockwise once around a face in these cases. Similarly, F', U', R' denote anti-clockwise shifts of the balls (and the space now tours clockwise around the face).

Solution:

Phase 1: Solve the bottom-front edge.

a. Find the little hole in the outer box. This is the location where the space will be when the puzzle is solved. Make sure this hole is in the top half of the cube.
b. Without disturbing the bottom-front edge, place a black ball at the bottom-front-right corner. This is easy, just do R until it is so.
c. Shift the bottom-front edge leftwards, by doing an F move.
d. Repeat b-c for another black ball.
e. See what colour ball belongs in the middle of the bottom-front edge. Do steps b-c with a ball of that colour, not with a black ball.
f. Do b-c two more times with black balls, and the bottom-front edge should be correct.

Phase 2: Solve two more edges.

a. Hold the cube so that the solved edge lies at the bottom-left of the cube.
b. Without disturbing the bottom-front-left corner and its edges, place a black ball at the top-front-left corner. This is easy, just do U until it is so.
c. Shift the front-left edge downwards, by doing an F' move.
d. Repeat b-c for another black ball.
e. See what colour ball belongs in the middle of the bottom-front edge. Do steps b-c with a ball of that colour, not with a black ball.
f. Do c-b five more times with black balls.
g. See what colour ball belongs in the middle of the front-left edge. Do steps b-c with a ball of that colour, not with a black ball.
h. Do b-c twice more times with black balls, and the front-left and bottom-front edges should be correct.

Phase 3: Solve two more edges.

a. Hold the cube so that the solved edges lie at the bottom-back-left of the cube.
b. Without disturbing the solved pieces, use the same method as in phase 2 to put the correct balls in the bottom-front and front-left edges. This involves moving two black balls, a coloured ball (for the bottom-front edge), 5 black balls, a coloured ball (for the front-left edge) and finally 2 black balls downwards from the top-front-left corner.

Phase 4: Solve the last three edges not in the top face.

a. Hold the cube so that the remaining unsolved edges lie in the front and top faces of the cube.
b. Find three coloured balls that belong in the front-left, front-bottom and front-right edges. If you cannot find these balls in the top face only, then do any F (and U) moves necessary to bring them to the top face.
c. Without disturbing the solved pieces, use essentially the same method again as in phase 2 to put the correct balls in the front-right, bottom-front and front-left edges. This involves moving downwards from the top-front-left corner two black balls, a coloured ball (for the front-right edge), 5 black balls, a coloured ball (for the bottom-front edge), 5 black balls, a coloured ball (for the front-left edge) and finally 2 black balls.

Phase 5: Solve the top face.

a. Hold the cube so that the little hole is at the top-front-right corner of the cube. The space should also be moved to that corner.
b. Look at where the 4 coloured balls are in the top face. In the solved position they will be alternating in colour, and have 4 or 5 black balls between them. Work out which way you would want the coloured balls to move to create that situation.
c. You can move a coloured ball by swapping it with one of the balls adjacent to it as follows:

1. Rotate U until the coloured ball and the ball you want to swap it with lie on both sides of the front-top-right corner, with the gap between them.
2. Do F R' F' R to swap the two balls.
3. If necessary, rotate U back to where it was.

d. Repeatedly use step c to put the coloured balls of the top face in their correct relative positions.

Note: It may take quite a lot of move to solve the top face using the method of phase 5. This is especially the case when the four coloured balls are near each other instead of more spread out, because then you would have to make many swaps. There is however an easy way to move a coloured ball a longer distance:
1. Rotate U until the coloured ball that you want to move lies at the top-front-left corner.
2. Do F' to drop the ball out of the top face.
3. Rotate U to bring the place you want to insert the ball as near as you can to the top-front-left corner, while also ensuring that there is no coloured ball just to the left of the space at the top-front-right corner.
4. Do F to insert the ball.
5. Rotate U back to approximately where you started.
This method is fine for spacing out the coloured balls, though you probably need to use a couple of swaps from phase 5 to place them more precisely.

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