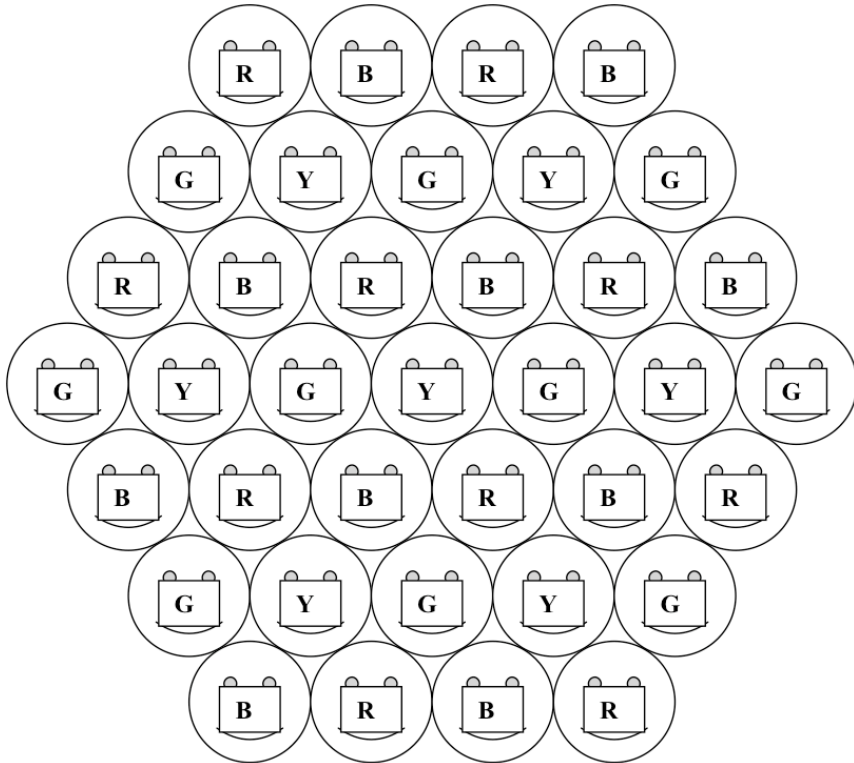


18. INTRODUCING THE TETRAHEDRON

Introducing four colour circle games and the tent games.

1. Problem 1

Put a lot of your circles together as close to each other as you can. If you have enough circles, you could make a “hexagonal” shape like the one below. Your shape does not have to be as big as this one, nor does it have to be the same shape.



2. Problem 2

Then take some red, some blue, some yellow and some green coloured cubes, and put one on each circle but make sure of the following:

On any four circles making the shape of a RHOMBUS, there must be four different colours.

If you don't know what shape a rhombus is, ask your teacher or a friend who knows. Don't look at the above solution if you want to find your own!

3. Problem 3

Take a small toy car, just the right size so that the front wheels can be on one circle and the rear wheels on a circle touching the first circle. There are 12 ways of

placing your car, because you can choose the colour for the rear wheels out of four different colours, leaving three colours to choose from for the front wheels. I shall call these positions red-blue, red-green, red-yellow, blue-red, blue-green, blue-yellow, green-blue, green-red, green-yellow, yellow-blue, yellow-green, yellow-red the first colour being the colour of the circle on which the rear wheels stand, and the second colour is the colour of the circle on which the front wheels stand.

You can move your car in one of the following two ways:

- (i) the rear wheels come to where the front wheels were, and the front wheels turn gently to the right. For example red-blue would become blue-green.
- (ii) the rear wheels come to where the front wheels were and the front wheels turn gently to the left. For example red blue would become blue-yellow.

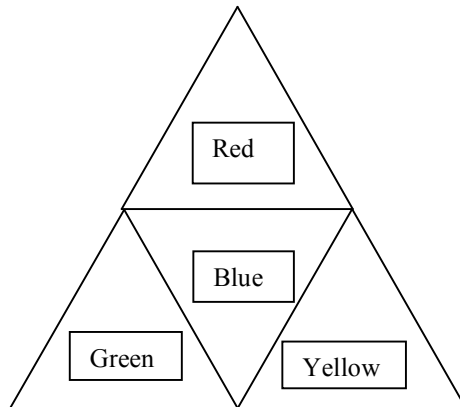
Now place your car in any position and choose another pair of colours where you want the car to end up. You can use moves (i) and/or (ii), as many times as you like, to get your car from the first position to your chosen goal position. Count the number of moves you have needed.

Then let someone else start the car from the same starting position, and see how many moves this person needs to get the car to the goal position. The player who solves the problem in the smallest number of moves, is the winner.

If you need to, you can use a helicopter to move your car from one part of the field to another without counting it as a move, as long as you land in a position in which both the rear and the front wheels are on the same colours as before take-off!

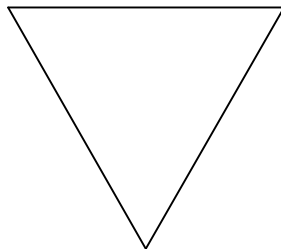
4. Problem 4

Now cut this triangle out and fold it up along the lines separating the colours, so as to make a kind of tent. Such a “tent” is called a TETRAHEDRON in Geometry. Use tape so as to make your “tent” firm, so it does not unfold or fall to pieces.



5. Problem 5

Draw a triangle like the one below and place your “tent” on it. One face of your “tent” will be touching the triangle you have drawn, another will be away from you, and you will see one on your left and one on your right.



You can choose any of the four colours for the face on your left, and any of the three remaining colours for the face on your right. That means you can place your “tent” on your triangle in 12 different ways. These will be called: red-blue, red-green, red-yellow, blue-red, blue-green, blue-yellow, green-blue, green-red, green-yellow, yellow-blue, yellow-green, yellow-red, the first colour being the one on the left and the second colour being the one on the right.

Now you can play the following “game”:

Let us decide that, having placed your “tent” on its triangle, you can move it in two different ways:

- (i) hold the top of the “tent” with your left hand and twist it round slowly until the colour that was on your left, comes to be on your right, with the colour that was behind showing on your left.
- (ii) hold the face that is at the back (the one that you can't see from the front) with your right hand, and twist it until the colour that was on your right comes to be on your left. To do this motion you will have to lift the “tent” off the paper and put it down again as soon as the colour that was underneath is on your right.

Choose any one of the positions of your “tent”. Try to get the “tent” into your chosen position, but only using the “moves” (i) or (ii). You can use these moves as many times as you like. Count the number of moves you have needed to pass from your first position to your chosen position.

Now put the “tent” back into its first position, and let someone else get it to the chosen position, using only the moves (i) and/or (ii) (but of course, several times each, if needed!)

The “player” who does it in the least number of moves is the winner.