23GET276 - VQAR-II

UNIT IV - NON - VERBAL REASONING

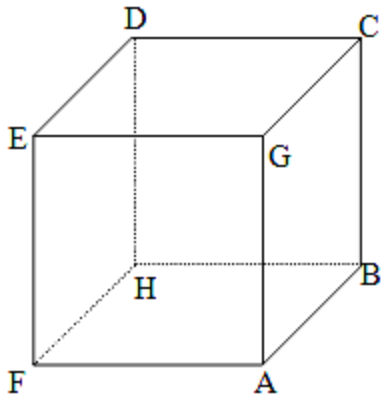
Cubes and Dices

Basic Concepts:

What is a Dice?

A Dice is a cube. In a cube, there are six faces. Let us study some basic facts about Cube using the given figure.

The six faces in the cube are– ABCG, GCDE, DEFH, BCDH, AGEF and ABHF.



1. Four faces are adjacent to one face
2. There are pairs of opposite faces e.g. Opposite of DEFH is ABCG and so on
3. CDEG is the upper face of the cube
4. ABHF is the bottom face of the cube

Important Facts:

1. A cube has 6 square faces or sides
2. A cube has 8 points (vertices)
3. A cube has 12 edges
4. Only 3 sides of a cube are visible at a time (known as “Joint Sides”) and these sides can never be on the opposite side of each other
5. Things that are shaped like a cube are often referred to as ‘cubic’
6. Most dice are cube shaped, with the numbers 1 to 6 on the different faces.

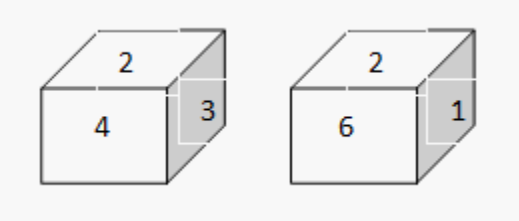
Certain Basic Rules:

There are certain dice rules in reasoning which can be sued to solve dice-based questions:

Rule No. 1:

Two opposite faces of the dice cannot be adjacent to each other.

E.g. Two positions of a dice are shown below.



Here, faces with number 4, 3, 6 and 1 are adjacent to the face number 2.

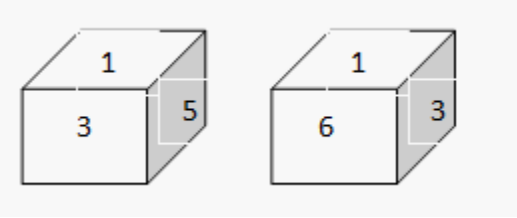
Therefore, the 4,3,6,1 can't be opposite to the face number 2.

Therefore, face number 5 is opposite to the face number 2.

Rule No. 2:

If two dice are shown as below, and one of the two common faces (Face number 4) is in the same position, then the remaining faces will be opposite to each other.

E.g.: Two dice are shown below.



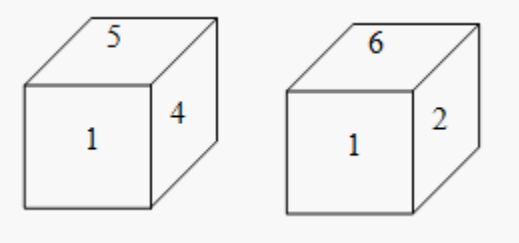
In both the diagrams, two faces numbered 1 & 3 are common.

Also, 5 & 6 are remaining faces. Hence, face which is number 5 is opposite to the face number 6.

Rule No. 3:

If in 2 different positions of the dice, the positions (different), the position of the face that's common is the same, and then the opposite faces of the faces that remain will be in the same positions.

E.g.:



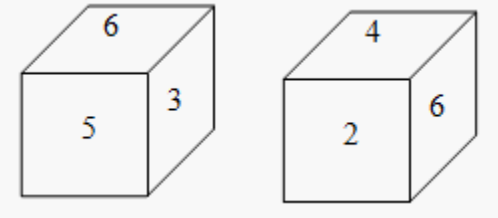
In both the positions, face number 1 is common for both dice is same.

Therefore, the opposite of 4 is 2 and the opposite of 5 is 6.

Rule No. 4:

If 2 positions of a die are given (Different) and it is also stated that common face is different then the face opposite to the given common face would be that which is not shown on any given face in the 2 given positions. It is also to be noted that the opposite face of the faces that are left cannot be the same.

E.g.:



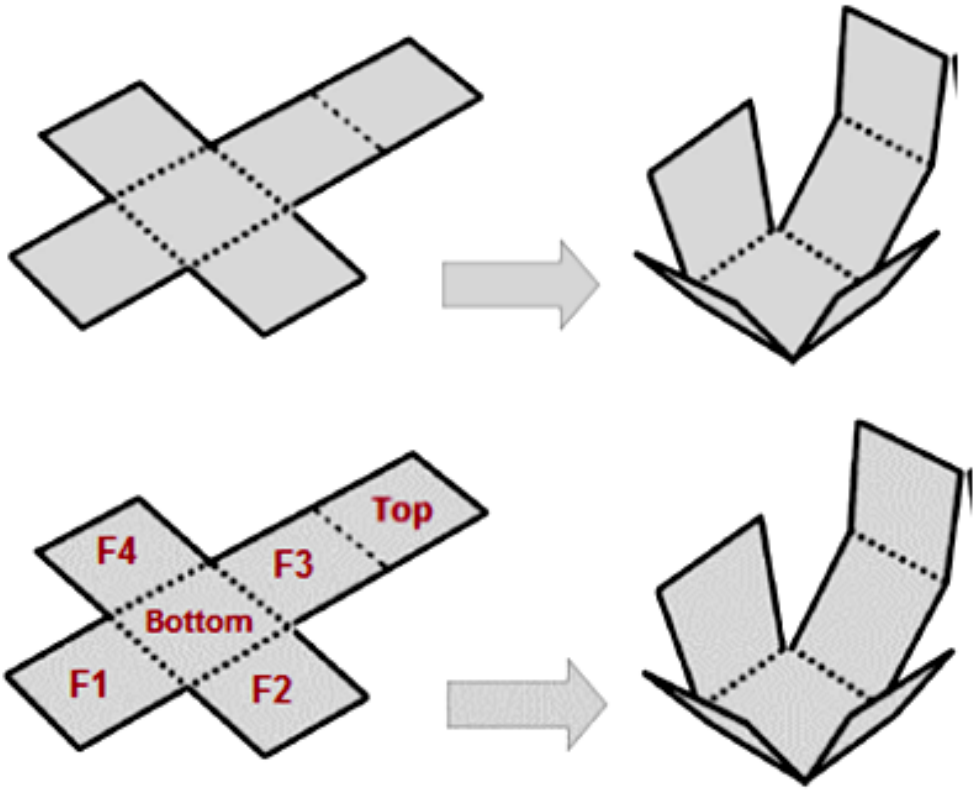
Note, in the above shown dice, the face having value 6 is not in the similar position.

The face numbered 1 is not shown.

So, the face opposite to the face with number 6 is 1.

Also, the opposite face of 3 is the face with number 2 and the opposite to face numbered 5 is the face with number 1.

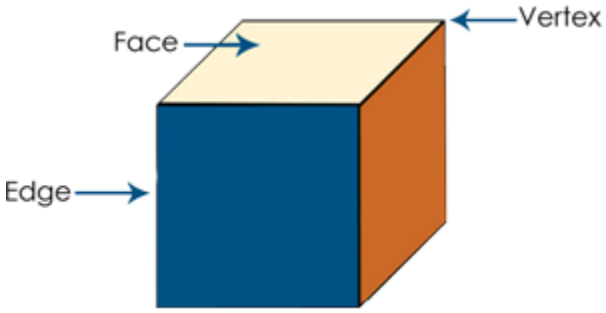
When we are given a dice it is somewhat difficult to visualize it in 3-D so what we do is that we flatten the cube. We can form a cube that has been flattened where we can visualize, the square at the farthest end will give the top of the cube and the square that is the middle will form the base of the given dice. The given figures below can help you understand the theory stated above.

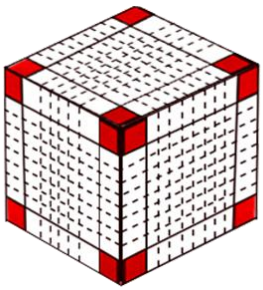


The rest of the square will give the adjacent sides of the dice. Note that we have to clearly visualize the adjacent sides and we have to figure out what exactly the question is asking. The flattening of dice is the easiest way that we can use to solve the dice problems.

Cube

Let's first learn some basic terminologies i.e. **face**, **vertex** and **edge** of a cube.
In a cube, there are 6 faces, 8 vertices & 12 edges. Vertex means corners & edge means side.





Generally, questions from this topic are of the type wherein, a cube with side measuring unit 'x' is painted on all faces and is cut into smaller cubes with sides measuring unit 'y'. You are then required to find the number of cubes having 'n' faces painted.

The first thing that you need to figure out is the number of smaller cubes. For this, you look at one particular edge of the big cube and figure out how many smaller cubes can fit into this. It will be x/y. So, the number of smaller cubes will be $(x/y)^3$.

Since all the smaller cubes will have at least one face facing inside i.e. not on the surface of the original cube, hence, none of the smaller cubes will have all faces painted. Further, since the maximum number of faces of the larger cube that intersect at a point are 3(at the corners), hence, the smaller cubes can have a maximum of 3 faces painted.

So, the number of smaller cubes with 3 faces painted = No of corners of larger cube = 8 (always), provided none of the faces of the larger cube is left unpainted.

Example 1: A cube having a side of 6 cm is painted red on all the faces and then cut into smaller cubes of 1 cm each. Find the total number of smaller cubes so obtained.

Solution:

As explained above, the number of smaller cubes = $(6/1)^3$ = 216 smaller cubes. (Here x=6 and y=1)

Example 2: In the above example, how many cubes will have three faces painted?

Solution:

As explained above, only the corner cubes i.e. the 8 cubes at the corners of the original cube will have three faces painted. Hence the answer will be 8 only.

To find the number of smaller cubes with only 2 faces painted, you need to consider the cubes where 2 faces of the bigger cube meet, i.e. the edges. Remember, this includes the cubes present at the corners as well, so you need to remove those 2 cubes from the number of cubes on each edge.

Example 3: In the above example, how many cubes will have only two faces painted?

Solution:

As discussed above, only the cubes at the edge of the bigger cube can have two faces painted. The larger cube has 6 cm edge and smaller cube is 1 cm edge. Hence, there are 6 cubes on each edge. However, you need to consider 4 middle cubes only, as the 2 cubes on each corner will have 3 painted faces.

Hence, there are 4 such cubes on each edge. As there are 12 edges, there will be 4*12 = 48 cubes