Prepp

Practice, Learn and Achieve
Your Goal with Prepp

SSC CGL Exam

Study Material for GI & Reasoning

Simplifying
Government Exams

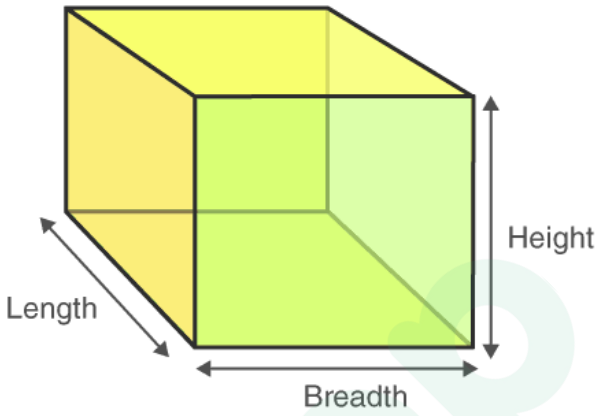
SSC CHSL | IAS EXAM | RRB NTPC | NTSE | CDS
SSC CGL | CBSE UGC NET | IBPS PO | NDA
SBI PO | IBPS CLERK | AFCAT | SSC JE | CTET
CSIR UGC NET | CAPF | IBPS RRB

www.prepp.in

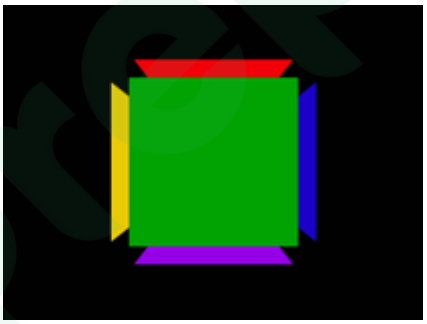
CUBE, CUBOID AND DICE

Basic Structure of a Cube

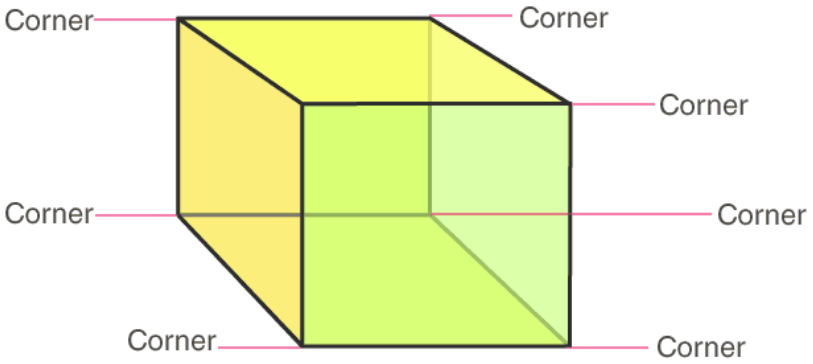
A cube is a 3-dimensional structure with three sides (length, width, and height) where all the sides equal (length = width= height). The word cube is derived from the Arabic word “Kaba” a large cube-shaped structure.



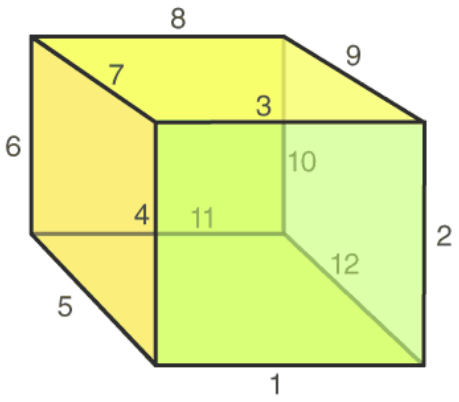
A cube has 6 faces: The faces appear at front, back, right, left, top and bottom.



Cube has 8 vertices: The corner points are called vertices. There are four vertices on the top face and four more at the bottom face.



Cube has 12 Edges: The line which connects the two vertices is called edges. There are twelve edges in a cube. Four on the top surface and four at the bottom and four more vertical lines connecting the opposite vertices of top and bottom face.



Summary:

A cube has:	Faces	Vertices	Edges
	6	8	12

Surface Area of Cube

A cube is a 3-dimensional representation of a square. Since dimensions of all the three sides i.e., length, breadth, and height of a cube are equal, they are referred to as sides and is indicated by a symbol ‘s’.

The total surface area of a cube is:

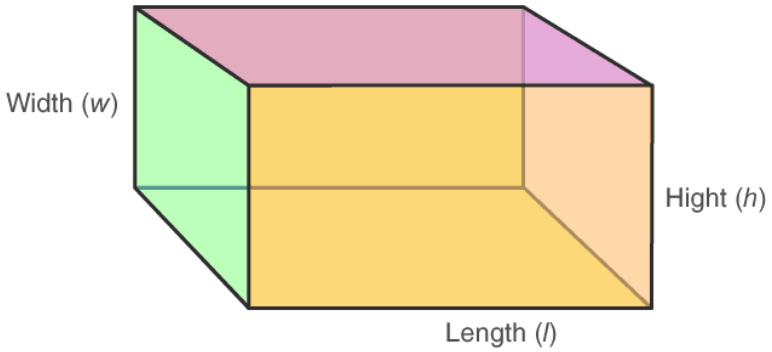
- The surface area of a cube = (area of one square) *6
- The surface area of a cube = (s*s)*6
- The surface area of a cube = 6

The sum of areas of 4 constituting squares (faces) gives the lateral surface area of the cube.

- The lateral surface area of a cube = 4*(area of one square)
- The lateral surface area of a cube = 4*(s*s)
- The lateral surface area of a cube = 4

What is Cuboid?

A cuboid is a 3-dimensional structure with three sides where all the sides are not equal. The three sides are the length, width, and height. All of its faces are rectangles. A cuboid also has 6 faces, 8 vertices, and 12 edges.

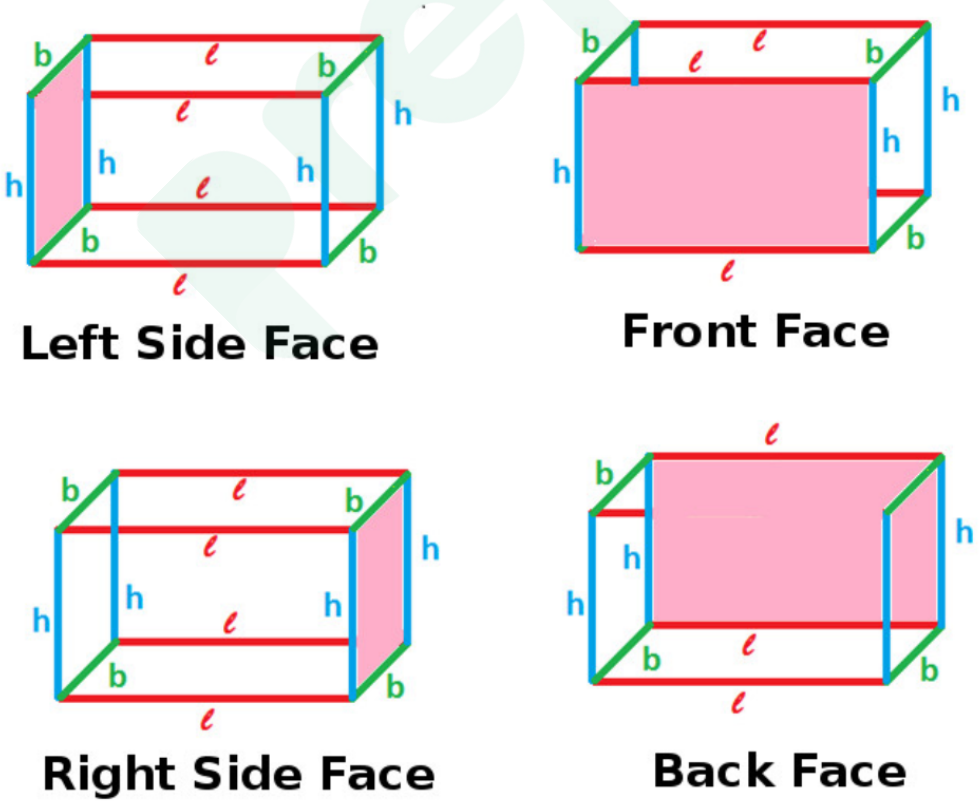


The total surface area (TSA) of a cuboid is the sum of the areas of its 6 faces:

Lateral Surface Area of Cuboid

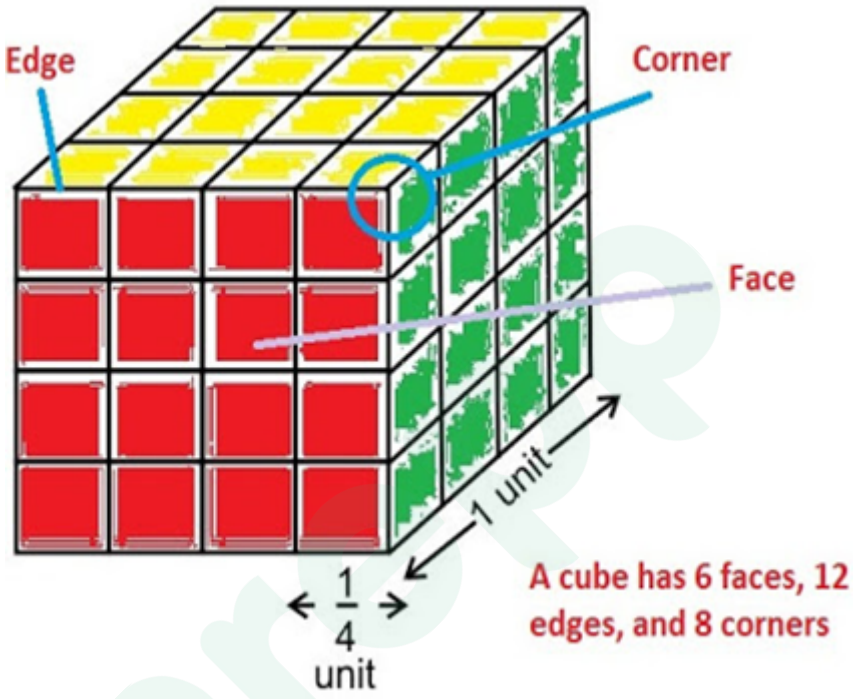
The lateral surface area of a cuboid is the sum of the area of only four rectangles.

Lateral Surface Area of Cuboid = Area of left side face + Area of right side face + Area of front Face + Area of back Face



Creation of Rubik's cube

If we divide a cube into the size part of its side, we get smaller cubes. A cube Shown below, which is painted on all the sides and then cut into 1/4th of its original face. Each small cube is known as "unit cube".



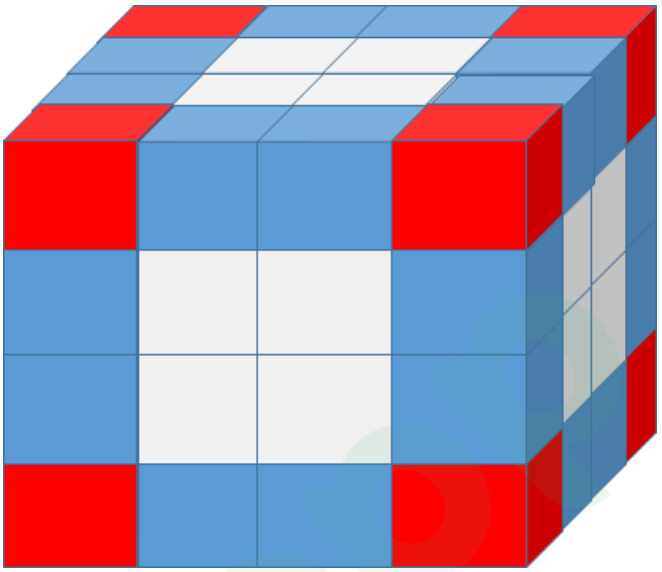
Ex: If we cut a cube to form three rows and three columns on each face then the total number of unit cubes will be = 3*3*3 = 27.

Following is the list of unit cube generation based on the division of a bigger cube:

Rows on each side	Columns on each side	Unit cubes
2	2	8
3	3	27
4	4	64
5	5	125
6	6	216
7	7	343

Evaluation of Cube with ‘n’ sides painted

Observe the cube shown. It has been divided into ¼ of its original side length. Hence the total number of smaller or unit cubes formed will be 64.



Q1. How many unit cubes have only three sides painted?

Answer: The cubes with three of their sides painted lie at the vertices of the cubes (The cubes coloured in red). There are eight such cubes. Hence the answer is eight.

Q2. How many cubes have only two sides painted?

Answer: The cubes with two sides painted lie at the edges (the cubes coloured in blue). Evaluate such cubes for one tip and multiply the result by 12 (as there are 12 edges in a cube). From the figure, it is clear that there are two blue cubes at an edge. Hence the total number of such cubes will be 2*12 = 24.

Alternate solution:

The value of n for the given cube 4. Substituting it in the formula we get

12 x (4-2) = 24.

Q3. How many cubes have only one side painted?

Answer: The cubes with only one side painted always lie at the surface. Evaluate the number of such faces at each surface and multiply the result by six. As there are six faces in a cube. From the

figure, it is clear that there are four white cubes at the surface. Hence the total number of such cubes will be 6*4 = 24.

Q4. How many cubes have no side painted?

Answer: The cubes at the inner core part of the cube will not have any side painted. Evaluating it every time for different cubes is a tedious task. The simple and easiest approach is by analyzing the pattern.

In 2*2*2 cube there are zero cubes that have no side painted. Whereas in 3*3*3 cube, there is only one cube at the core part which has no sides painted.

Cube type	Non painted cube
2*2*2	0
3*3*3	1
4*4*4	8
5*5*5	27
6*6*6	64
7*7*7	125

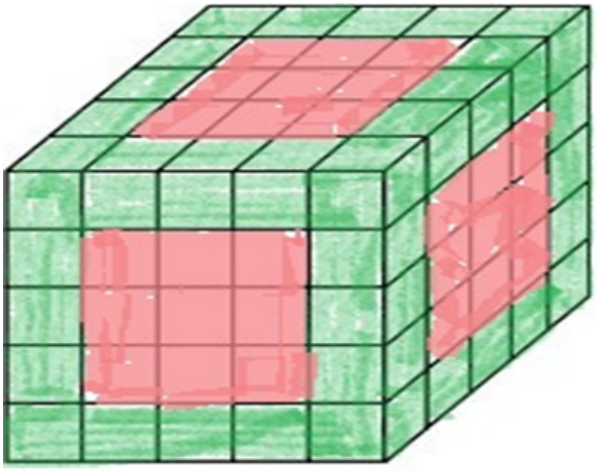
The logical pattern from the table follows that the total number of cubes with no side painted will always be equal to the cube of natural numbers.

Practice Questions:

Direction: A cube of side 10 cm is coloured red with a 2 cm wide green strip along all the sides on all the faces. The cube is divided into 125 smaller cubes of equal size. Answer the following questions based on this statement.

1. How many cubes have three green faces each?
2. How many cubes have one face red and an adjacent face green?
3. How many cubes have at least one face coloured?
4. How many cubes have at least two green faces each**?**

Answer:

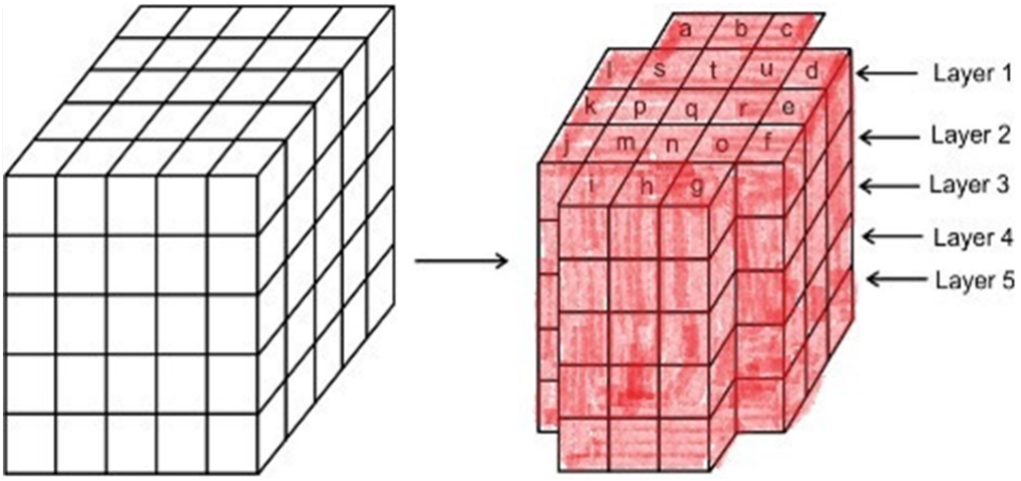


1. All the corner cubes are painted green. So, there are 8 cubes with 3 sides painted with green.
2. There is no cube having one face red and an adjacent face green as all the green painted cubes got paint on at least 2 faces.
3. Let us calculate the number of cubes with no painting. By formula, which is 27.
   Therefore, there are 125 – 27 = 98 cubes having at least one face coloured.
4. From the total cubes, let us subtract the cubes with red painting and cubes with no painting.
   125 – (9 x 6) – 27 = 44

Directions: **One hundred and twenty-five cubes of the same size are arranged in the form of a cube on a table. Then a column of five cubes is removed from each of the four corners. All the exposed faces of the rest of the solid (except the face touching the table) are coloured red. Now, answer these questions based on the above statement:**

1. How many small cubes are there in the solid after the removal of the columns?
2. How many cubes do not have any coloured face?
3. How many cubes have only one red face each?
4. How many cubes have two coloured faces each?
5. How many cubes have more than 3 coloured faces each?

Answer:



1. Since out of 125 total number of cubes, we removed 4 columns of 5 cubes each, the remaining number of cubes = 125 – (4 x 5) = 125 – 20 = 105.
2. Cubes with no paintings lie in the middle. So, cubes which are below the cubes named as s, t, u, p, q, r, m, n, o got no painting. Since there are 4 rows below the top layer, total cubes with no painting are (9 x 4) = 36.
3. There are 9 cubes named as m, n, o, p, q, r, s, t and u in layer 1, and 4 cubes (in columns b, e, h, and k) in each of the layers 2, 3, 4 and 5 got one red face. Thus, there are 9 + (4 x 4) = 25 cubes.
4. The columns (a, c, d, f, g, i, j, l) each got 4 cubes in the layers 2, 3, 4, 5. Also in layer 1, h, k, b, e cubes got 2 faces coloured. so total cubes are 32 + 4 = 36
5. There is no cube in the block having more than three coloured faces. There are 8 cubes (in the columns a, c, d, f, g, i, j and l) in layer 1 which have 3 coloured faces. Thus, there are 8 such cubes.

What is a dice?

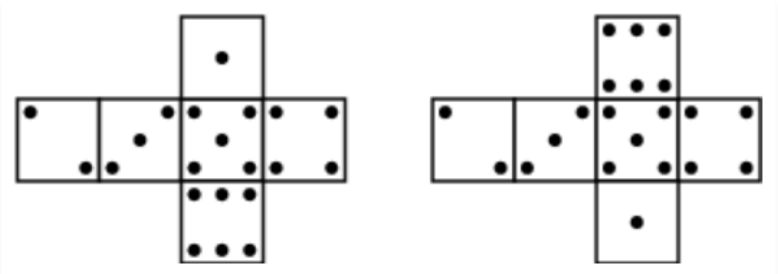
Dice is a cube having different numbers on all its faces. The numbers are usually a single digit, from 1 to 6.

Numbers on a Die

The scheme of numbering on a die is specific. The sum of the number on the opposite faces will be equal to ‘7’ always. The number 1 will be opposite to number 6. The number 2 is opposite to 5 and 3 is opposite to 4. Such that:

- 1 + 6 = 7

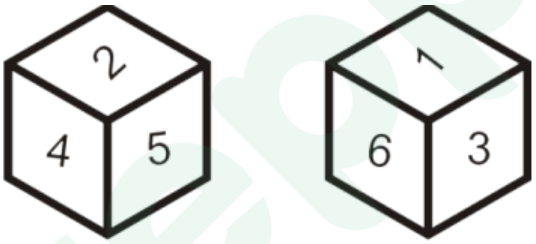
- 2 + 5 = 7
- 3 + 4 =7.



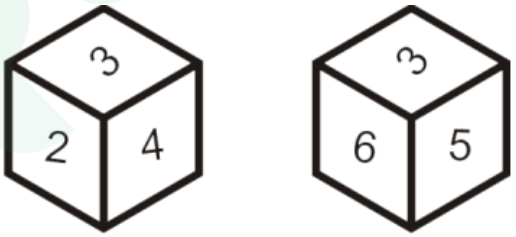
Classification of Dice

Base dice: The base dice is further classified into two types.

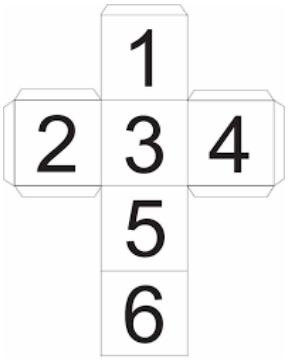
- **Standard dice** - When the dice are rolled, if the number on the faces of the two dice do not match each other, they are called as standard dice.



- **Ordinary dice** - If one or more than one number matches between two dice than it is called as an ordinary dice.

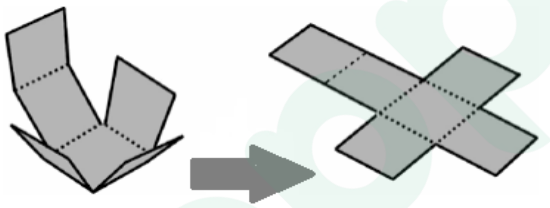


Open dice: In an open dice all the six faces of the dice are shown. The dices show the opposite position of rows and columns.

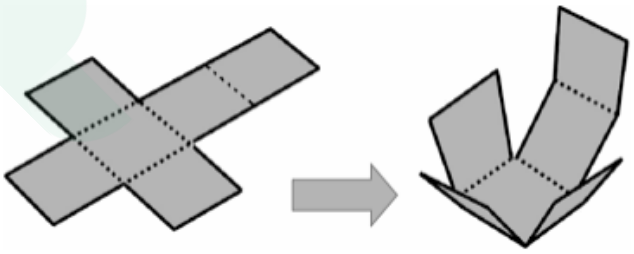


Constructed and Deconstructed Dice

- **Constructed dice:** This section of dice gives the constructed version of dice, the questions will be based on the visualization of the flattened-out version of dice.



- **Deconstructed Dice:** This section of dice gives the flattened-out version of dice, the questions will be based on the visualization of what is at the other end of the constructed dice.

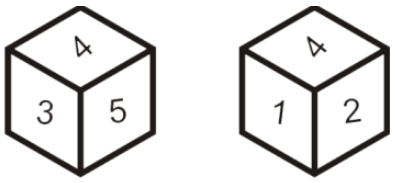


Rules to remember

Rule #1

If one of the numbers is common in both the dice when two dice have the same surface, then the remaining surfaces of both dice are opposite to each other.

Example:

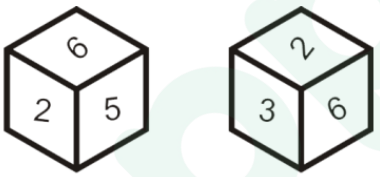


In the above two dice, the number 4 is common and the numbers 3 and 5 on one die and 1 and 2 on the surface of the other die are opposite to each other respectively i.e., the number 3 is opposite 1 and 5 is opposite to 2.

Rule #2

If any two numbers are the same in two dices irrespective of their position on the dice then the remaining third number in both the dice are opposite to each other.

Example:

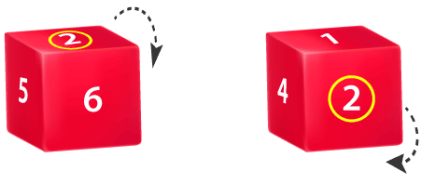


In the above scenario, irrespective of their place or position the two numbers 6 and 2 are common in both the dice. Then the third number 5 on one first die and 3 on the second die are opposite to each other.

Rule #3

If there is one element common on both the dice at the different position, then rotate the dice in a clockwise direction to get the opposite surface.

Example:

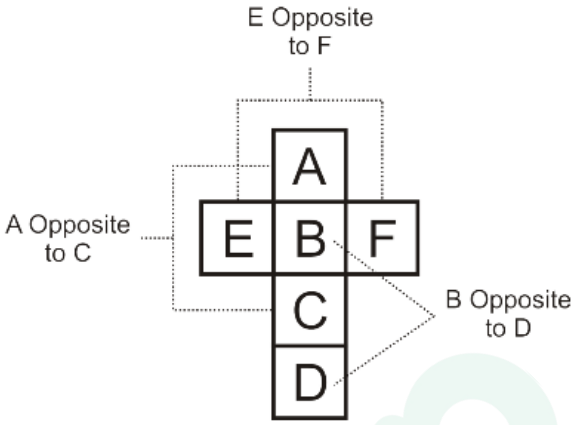


The number ‘2’ is common in both the dice, but it is occurring at a different position. In order to find out, the number appearing on the opposite face, rotate the die in a clockwise direction with the common number as the reference.

The rotation of the first die in the clockwise direction gives ‘6’ at the front face. Now the rotation of the second die in the clockwise direction gives ‘4’ in the front face. Hence the number ‘6’ is

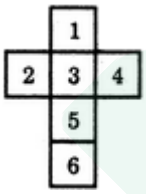
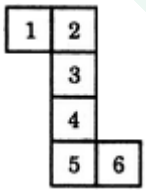
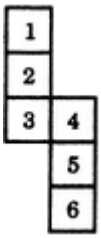
opposite to ‘4’. A similar operation gives the result that the number ‘5’ is opposite to ‘1’. This also indicates that the number ‘3’ is opposite to ‘2’.

An Open die (A flat end version of a die)



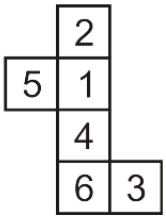
Observations of an open die:

- The faces E & F, A & C, B & D are opposite to each other and their surfaces never touch each other.
- Variations of open dice:

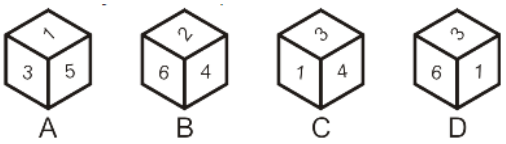
Open die	Opposite faces
	1 is opposite to 5. 2 is opposite to 4. 3 is opposite to 6.
	1 is opposite to 6 2 is opposite to 4 3 is opposite to 5
	1 is opposite to 3 2 is opposite to 5 4 is opposite to 6

Practice Questions:

1. Possible combination of dice. Observe the open die:



The number of a possible combination is:

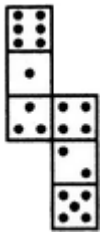


1) Only A
2) Only B
3) Only C
4) Only D

Answer:

Option 1 is not possible as 3 is not opposed to 5. The second option is also wrong as 2 is not adjacent to 4. Option 3 is possible. And option 4 is not possible as 1 is not adjacent to 6. **Hence the correct answer is option 3.**

2. Finding the opposite side. Observe the die:



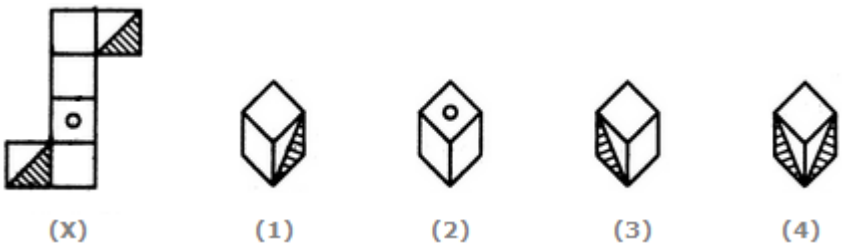
If the surfaces of the above die are reconstructed to form a perfect die. How many dots lie opposite to the face having three dots?

1) 2
2) 4
3) 5
4) 6

Answer:

Since 4, 5 and 2 are adjacent to 3, six is the only possibility. **Hence the correct answer is option 4.**

3. Choose the die that is similar to the die, formed from the open die.

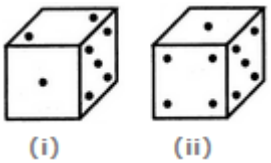


1) Only 1
2) Only 2
3) 1 and 3
4) 1, 2 and 3

Answer:

The figure number 1 is possible as the top face is shaded and adjacent faces are blank. Figure 2 is not possible as the surface with a dot should lie between shaded one, but here it is blank. Figure 3 is possible but the 4th one is impossible as the two shaded faces cannot be adjacent to each other. **Hence, the correct answer is option 3.**

4. Observe the dice. How many dots are contained on the face opposite to that containing four dots?

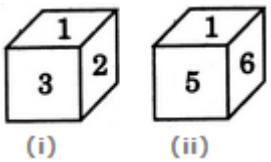


1) 1
2) 2
3) 3
4) 6

Answer:

From the second figure, it can be observed that the face with 4 dots is adjacent to the one with 1 and 5 dots. Hence, then comparing this with the first die it can see that the only place possible the face with 4 dots is opposite it to the face having 2 dots. **Hence the correct answer is option 2.**

5. Observe the dice. Two positions of a dice are shown. When 4 is at the bottom, what number will be on the top?



1) 1
2) 2
3) 5
4) 6

Answer:

It can be observed from both the dice, if 2,3,5 and 6 adjacent to 1. Then the number opposite 1 should be 4. **Hence the correct answer is option 1.**

6. A dice is numbered from 1 to 6 in different ways. If 1 is adjacent to 2, 3 and 5, then which of the following statements is necessarily true?

1) 1 is adjacent to 4

2) 2 is adjacent to 5

3) 1 is adjacent to 6

4) 4 is adjacent to 6

Answer:

If 1 is adjacent to 2,3 and 4 then there is a possibility that numbers 6 or 4 has to be opposite to 1. Hence options A and C are definitely not possible. The number 2 need not necessarily be adjacent to 5. But 4 will definitely be adjacent to 6. **Hence, the correct is option 4.**