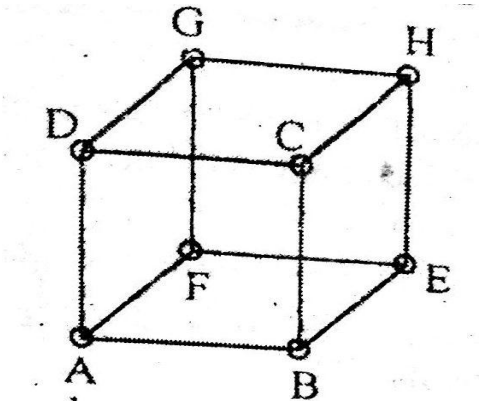
What is Cube?

A cube is three dimensional figure whose length, breath and height are equal and any two adjacent faces are inclined to each other at 90°. It has 6 faces, 8 corners and 12 edges.



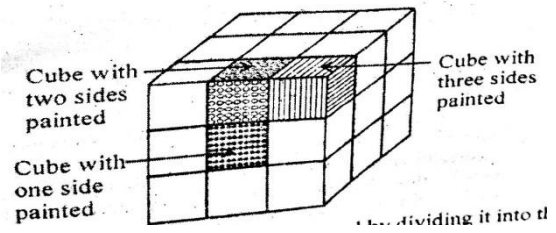
- ❖ Corners of the cube are A, B, C, D, E, F, G and H.
- ❖ Edges of the cube are AB, BE, EF, AF, AD, CD, BC, EH, CH, GH, DG and FG.
- ❖ Faces of the cube are ABCD, EFGH, CDGH, BCHE, ABEF and ADFG.
- ❖ When a cube is painted on all of its faces with any color and further divided into various smaller cubes of equal size, we get following results.

(i) Smaller cubes with no face painted will present inside faces of the undivided cube.

(ii) Smaller cubes with one face painted will present on the faces of the undivided cube.

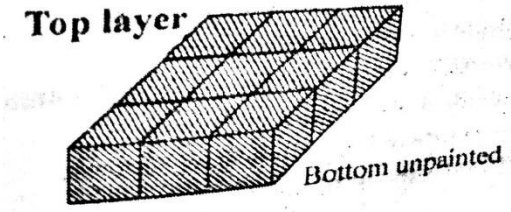
(iii) Smaller cubes with two faces painted will present on the edges of undivided cube.

(iv) Smaller cubes with three faces painted will present on the corners of the undivided cube.

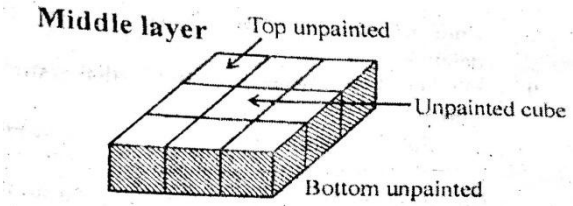


The above figure may be analysed by dividing it into three horizontal layers:

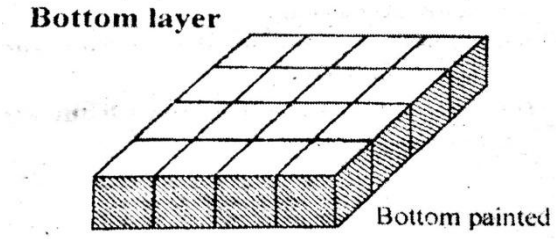
Layer I or top layer: The central cube has only one face coloured, four cubes at the corner have three faces coloured and the remaining 4 cubes have two faces coloured.



Layer II or middle layer: The central cube has no face coloured, the four cubes at the corner have two faces coloured and the remaining 4 cubes have only face coloured.



Layer III or bottom layer: The central cubes has only one face coloured, four cubes at the corner have three faces coloured and the remaining 4 cubes have two faces coloured.



Also, if n, = no. of divisions on the faces of cube

$$= \frac{\text{Length of the edge of undivided cube}}{\text{Length of the edge of one smaller cube}}$$

Then,

(i) Number of smaller cubes with no face painted = $(n-2)^3$

(ii) Number of smaller cubes with one face painted = $(n-2)^2 \times 6$

(iii) Number of smaller cubes with two faces painted = $(n-2) \times 12$

(iv) Number of smaller cubes with three faces painted = 8

EXAMPLE 1.

A cube is painted blue on all faces is cut into 125 cubes of equal size. Now, answer the following questions:

(1) How many cubes are not painted on any face?

(a) 8 (b) 16

(c) 18 (d) 27

(2) How many cubes are painted on one face only?

(a) 8 (b) 16

(c) 36 (d) 54

Sol. Since there are 125 smaller cubes of equal size, therefore, n = no. of divisions on the face of undivided cube =5

(i) (d) Number of cubes with no face painted = $(n - 2)^3 = (5 - 2)^3 = 27$

(ii) (d) Number of cubes with one face painted = $(n - 2)^2 \times 6 = (5 - 2)^2 \times 6 = 54$

EXAMPLE 2. A cube of side 4 cm is painted black on the pair of one opposite surfaces, blue on the pair of another opposite surfaces and red on remaining pair of opposite surfaces. The cube is now divided into smaller cubes of equal side of 1 cm each. Then,

I. Find the number of smaller cubes with three surfaces painted.

II. Find the number of smaller cubes with two surfaces painted. And out of this '

(i) Find the number of cubes with two surfaces painted with black and blue colour.

(ii) Find the number of cubes with two surfaces painted with blue and red colour.

(iii) Find the number of cubes with two surfaces painted with black and red colour.

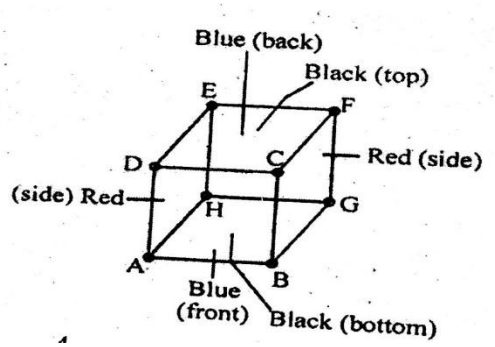
III. Find the number of smaller cubes with one surface painted. And out of this

(i) Find the number of cubes with one surface painted with black colour.

(ii) Find the number of cubes with one surface painted with blue colour.

(iii) Find the number of cubes with one surface painted with red colour.

Sol. (c)



Here, $n = \frac{4}{1} = 4$

I. Number of smaller cubes with three surfaces painted = 8

(All three surfaces painted with different colours black blue and red) '

II. Number of smaller cubes with two surfaces painted = $(4-2) \times 12 = 24$

Now, set faces ABCD and EFGH are painted with Blue Faces BCFG and ADEH are painted with Red. Faces ABGH and CDEF are painted with Black. Therefore,

(i) Number of cubes with two surfaces painted with black and blue colour = 2 (cubes along with edge AB) + 2 (cubes along with edge CD) + 2 (cubes along with edge GH) + 2 (cubes along with edge EF) = 8

(ii) Number of cubes with two surfaces painted with blue and red colour = 2 (cubes along with edge AD) + 2 (cubes along with edge BC) + 2 (cubes along with edge FG) + 2 (cubes along with edge EH) = 8

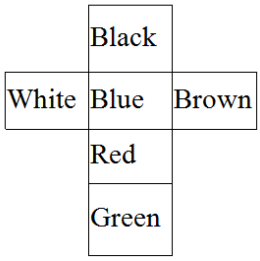
(iii) Number of cubes with two surfaces painted with black and red colour = 2 (cubes along with edge DE) + 2 (cubes along with edge CF) + 2 (cubes along with edge BG) + 2 (cubes along with edge AH) = 8

III. Number of smaller cubes with one surfaces painted $= (4-2)^2 \times 6 = 24$

(i) Number of cubes with one surface painted with black colour - 4(cubes on face ABGH) + 4(cubes on face CDEF) = 8

(ii) Number of cubes with one surface painted with bin, colour = 4(cubes on edge face ABCD) + 4(cubes on face EFGH) – 8

(iii) Number of cubes with one surface painted with red colour = 4(cubes on edge face ADEH) + 4(cubes on face BCFG)=8



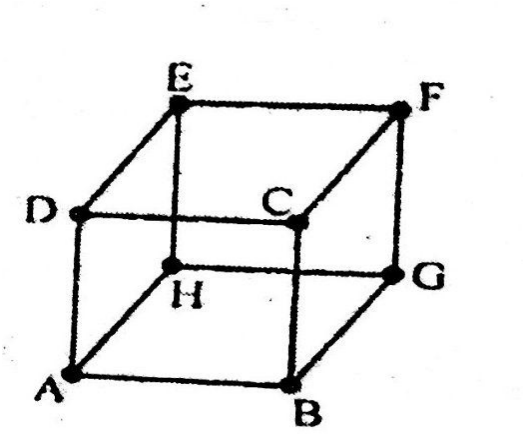
EXAMPLE 3. A cube is painted red on two adjacent faces and on One opposite face, yellow on two opposite faces and green on the remaining face. It is then cut into 64 equal cubes.

How many cubes have only one red colored face?

(a) 4 (b) 8

(c) 12 (d) 16

Sol. (c)



Let faces ABCD, ABGH and CDEF are Painted with red colour.

Faces BCFG and ADEH are Painted with yellow and EFGH is painted with green colour.

Clearly the cubes which have only one red colored face and all other faces uncloured are the four central cubes at each of the three faces ABCD, ABGH and CDEF. Thus, there are 4 × 3 = 12 such cubes.

DIRECTIONS (for Examples 4 to 7): Read the information given below to answer the questions that follows.

(i) A cube has six sides, each of which has a different colour: black, blue, brown green, red and white.

(ii) The red side is opposite the black.

(iii) The green side is between the red and the black

(iv) The blue side is adjacent to the white

(v) The brown side is a adjacent to the blue.

(vi) The red side is the bottom face.

EXAMPLE 4. The four colours adjacent to green are:

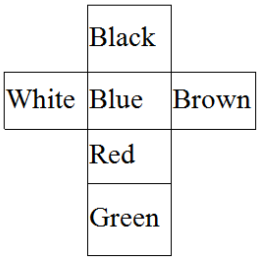
(a) black, blue, brown, red

(b) black, blue, brown, white

(c) black, blue, red, white

(d) black, brown, red, white

Sol. (d) When the cubes is unfolded, it will look like as



The four colours adjacent to green are black, brown, red and white.

EXAMPLE 5. Which of the following can be deduced from the statements I, II and VI?

(a) Black is on the top

(b) Blue is on the top

(c) Brown is on the top

(d) Brown is opposite to black

Sol. (a) The red side is opposite to the black.

Therefore, if red is at the bottom, black will be at the top.

EXAMPLE 6. Which of the following statements given above adds no information ?

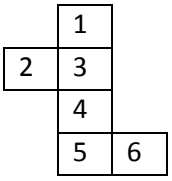
(a) II (b) III

(c) V (d) VI

Sol. (d) VI does not add to the information provided by I – V.

EXAMPLE 7. If the red side is exchanged for the green side and the blue is swapped for black, then which of the following is false?

(a) Red is opposite to black.



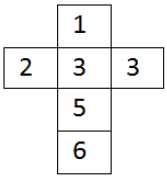
(b) White is adjacent to brown.

(c) Green is opposite to blue.

(d) White is adjacent to blue.

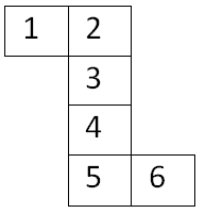
Sol. (b) Adjacent to white, we have brown, A dice is a cube with all of its faces numbered from 1 to 6. When a dice is unfolded, it will look like in any of the following forms:

Form 1:



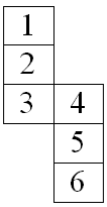
Number 1 is opposite to 5.
Number 2 is opposite to 4.
Number 3 is opposite to 6.

Form 2:



Number 1 is opposite to 6.
Number 2 is opposite to 4.
Number 3 is opposite to 5.

Form 3:

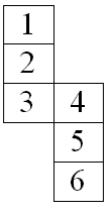


Number 1 is opposite to 3.
Number 2 is opposite to 5.
Number 4 is opposite to 6.

Form 4:

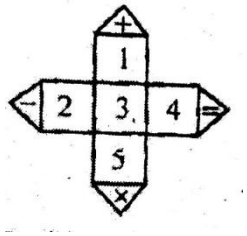
Number 1 is opposite to 4.
Number 2 is opposite to 6.
Number 3 is opposite to 5.

Form 5:

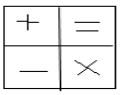


In this case:
1 lies opposite 3;
2 lies opposite 5;
4 lies opposite 6.

Form 6:

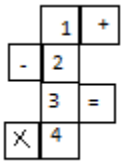


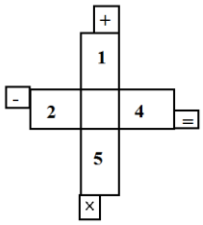
In this case:



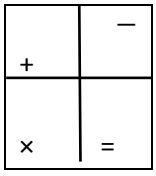
will be the one of the faces of the cube and it lies opposite 3;
2 lies opposite 4;
1 lies opposite 5.

Form 7:



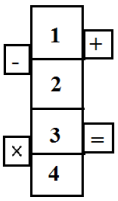


In this case:



will be the, one the faces of the cube and it lies opposite 3;
2 lies opposite 4;
1 lies opposite 5.

Form 8:

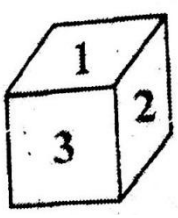


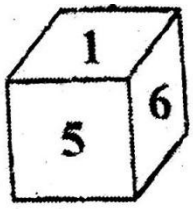
In this case:

-	+
×	=

Will be the one the faces of the cube and it lies opposite 3:
2 lies opposite 4
1 lies opposite 5

EXAMPLE 8. Two positions of a dice are shown, when 4 is at the bottom, what number will be the top?





(a) 1 (b) 2 (c) 5 (d) 6

Sol. (a) From the two figures it is clear that the numbers 2, 3, 5 and 6 cannot appear opposite 1. So, 4 appears opposite 1. Therefore, when 4 is at the bottom, I will be on the top.

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