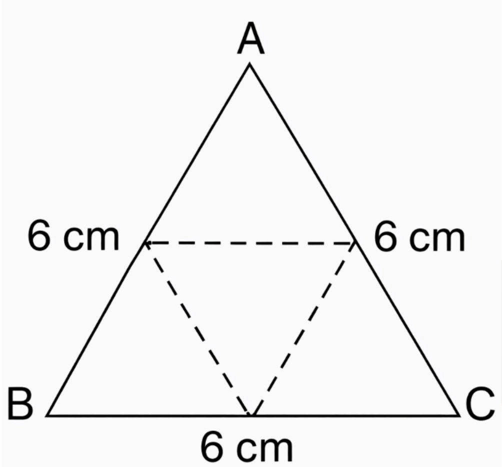
*** Questions With Calculation.[2 Marks Each]** **[48]**

1. Draw the initial few steps (at least till Step 2) of the shape sequence that leads to the Sierpinski Carpet.

Ans. : self

2. Draw a net with appropriate measurements that can be folded into a regular tetrahedron. Verify if it works by making an actual cutout.

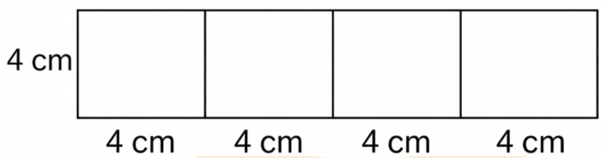
Ans. : Draw an equilateral triangle of side length 6 cm.
Mark the midpoints of the sides of the triangle.
Join the midpoints. Fold along the dotted lines to get the tetrahedron.



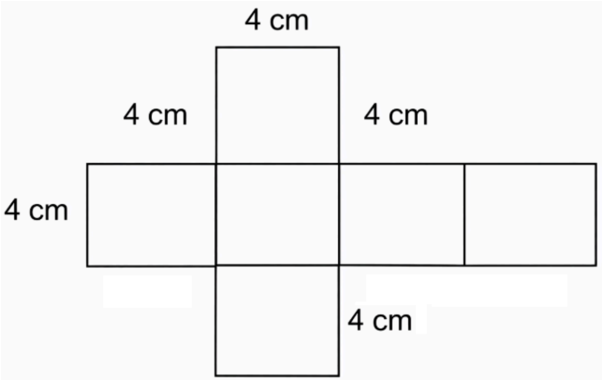
Cut out the triangle to form an actual tetrahedron.

3. Draw a net with appropriate measurements that can be folded into a square pyramid. Verify if it works by making an actual cutout.

Ans. : (a) Draw four squares of side 4 cm in a row.

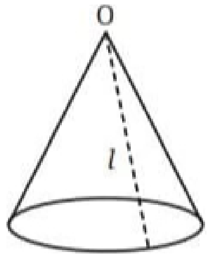


(b) On the opposite edges of any of the middle two squares, draw two more squares of side 4 cm each.



Fold along the common edges to form a cube of edge length 4 cm.
Cut along the outer boundary and fold along the common edge to form a cube.

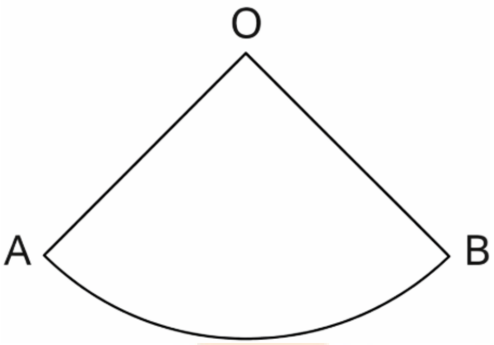
4. How will the net of a cone look?



Ans. : self

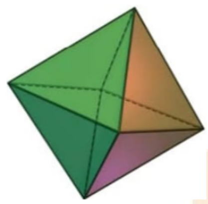
5. What surface do you construct by using the above net, in which O is not the centre of the boundary circle? Make a physical model to help you answer this question!

Ans. : When we join the radii of the sector, we get a cone:



OA and OB are radii of a circle.
Paste OA over OB, we get a cone with slant height = OA.

6. Can you visualise its net (octahedron)?

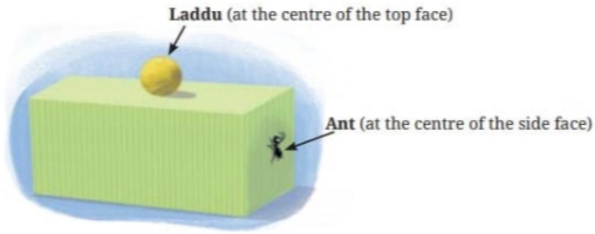


Ans. : self

7. Taking all the triangles in the net to be equilateral, make a cutout of the net and fold it to form an octahedron.

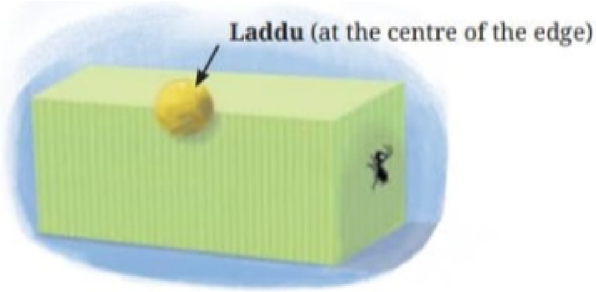
Ans. : self

8. What is the shortest path for the ant to reach the laddu (when laddu is at the centre of the top face and ant is at the centre of the side face)?



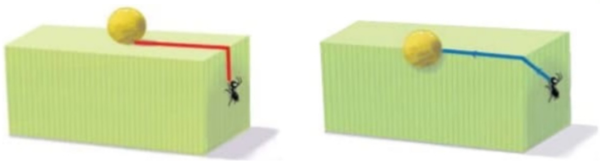
Ans. : self

9. What about in the following case (when laddu is at the centre of the edge)?



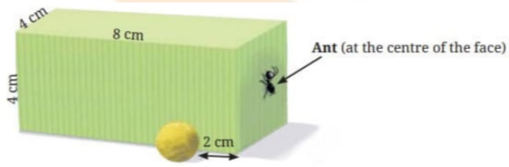
Ans. : self

10. Are either of these the shortest path?



Ans. : self

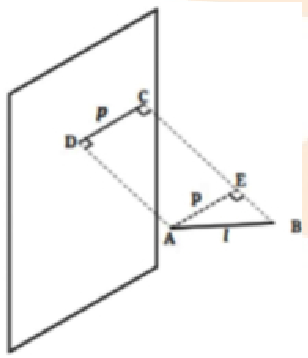
11. Find the shortest path between the ant and the laddu in the following case:



- Dimensions: 8 cm × 4 cm × 2 cm

Ans. : self

12. What happens to the length of a line in its projection?



Ans. : self

13. When is the length of the projected line equal to its actual length?

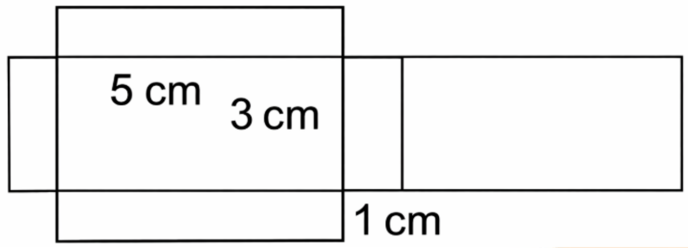
Ans. : self

14. What do you think are the different possible projections of a square that we get based on its orientation?

    Ans. : self

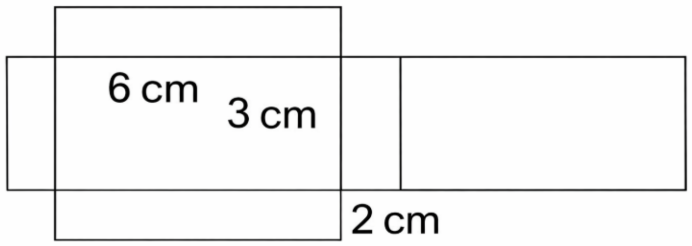
15. Draw a net of a cuboid having sidelengths 5 cm, 3 cm, and 1 cm.

    Ans. :



16. Draw a net of a cuboid having sidelengths 6 cm, 3 cm, and 2 cm.

    Ans. :



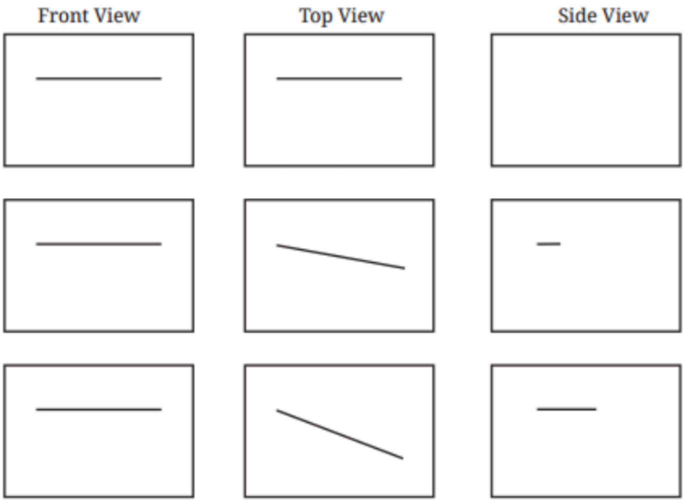
17. Net of a sphere? Experiment and see if you can make a paper cutout that can perfectly wrap around a ball without leaving any wrinkles, gaps or overlaps.

    Ans. : self

18. Have we now completely analysed the problem of finding the shortest path between two points on a cuboid?

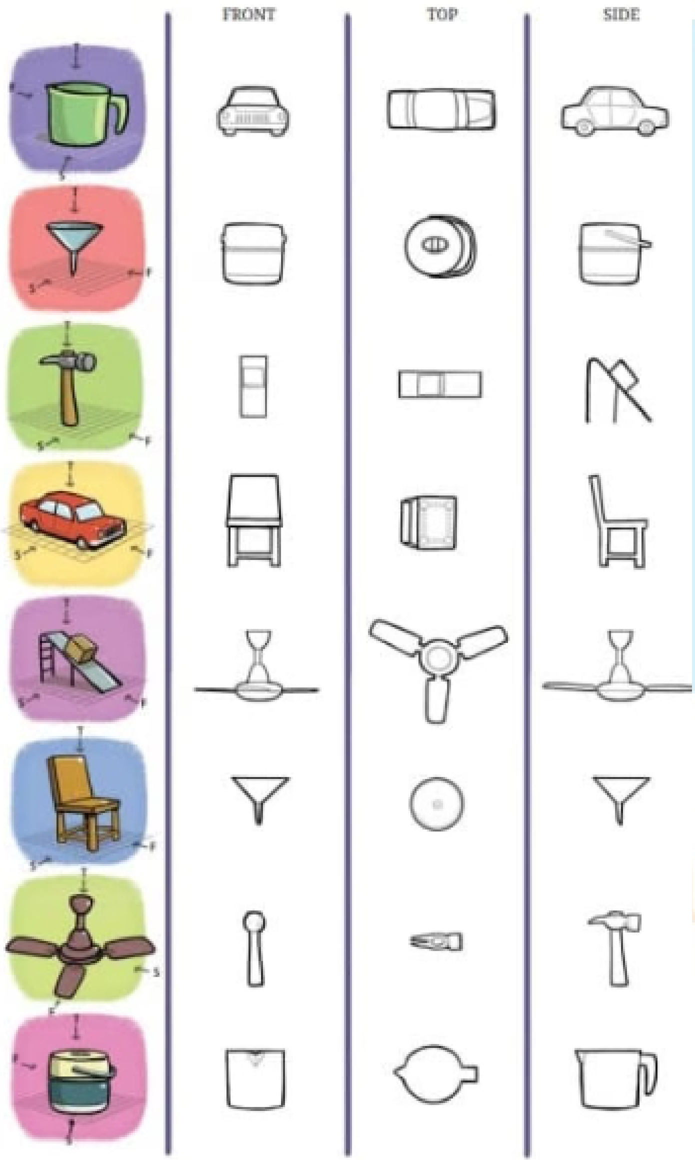
    Ans. : self

19. Observe the front view, top view and side view of the different lines in Fig. 4.6. Is there any relation between their lengths?



Ans. : (a) Horizontal Line
(b) oblique (slanting) line
(c) oblique (slanting) line, More tilted than line (b)
Top views show that (a) is the shortest, and (c) is the longest.

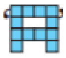
20. Match each of the following objects with its projections.

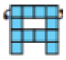


Ans. : (a) – (viii) (b) – (vi) (c) – (vii) (d) – (i) (e) – (iii) (f) – (iv) (g) – (v) (h) – (ii)

21. Imagine eight identical cubes, glued together along faces to form the letter .

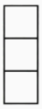
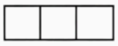
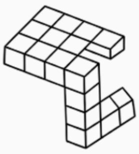
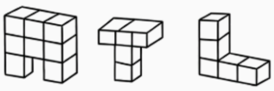
i. This looks like a  from the front. What does it look like from the side? From the top?

ii. Glue additional cubes to make a shape that looks like  from the front and  from the top.

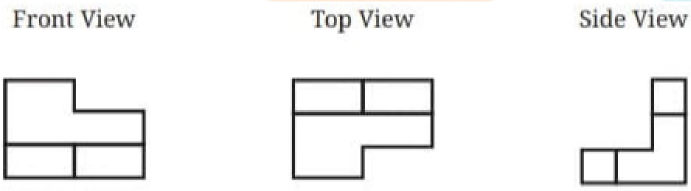
iii. Now, can you glue even more cubes to make it look like  from the front,  from the top, and  from the side?

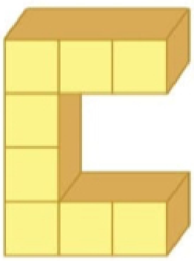
iv. Can you think of other letter combinations to make with a single combination of cubes in this manner?

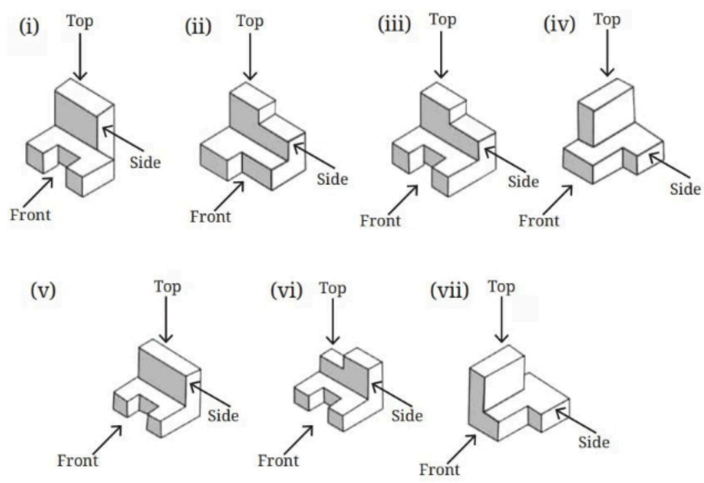
Ans. :

	Side	Top
(i)		
(ii)		
(iii)	Not possible	
(iv)		

22. Which solid corresponds to the given top view, front view, and side view?

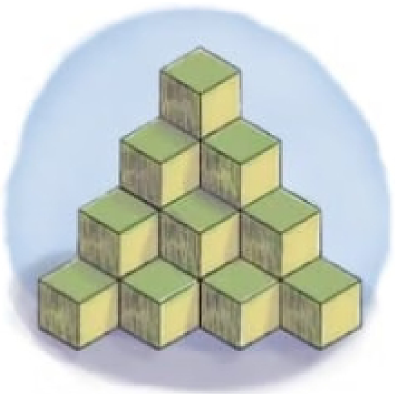






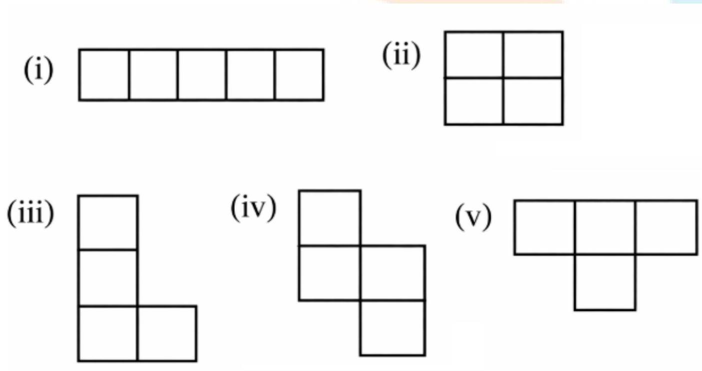
Ans. : Solid (ii)

23. Find the number of cubes in this stack of identical cubes.

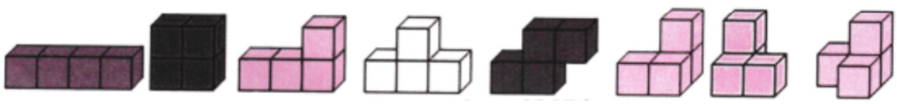


Ans. : Counting from the top layer to the bottom layer:
1 + 3 + 6 + 10 = 20 cubes

24. In addition to the 5 ways shown in Fig.4.8, are there any additional ways of gluing four cubes together along faces? Can you visualise and draw these as well?



Ans. :



*** Questions With Calculation.[3 Marks Each]** [69]

25. Do you see any pattern in the number of holes and squares that remain at each step?

Ans. : self

26. Show that by joining the midpoints of an equilateral triangle, we divide it into 4 identical equilateral triangles.

Ans. : self

27. Find the number of holes, and the triangles that remain at each step of the shape sequence that leads to the Sierpinski Triangle.

Ans. : Number of holes in
Step 0: 0 hole
Step 1: 1 hole
Step 2: 1 + 3 = 4 holes
Step 3: 1 + 3 + 9 = 13 holes
Step 4: 1 + 3 + 9 + 27 = 40 holes
.
.
.
Step n: $3^{1-1} + 3^{2-1} + 3^{3-1} + \ldots + 3^{n-1}$ holes
$3^0 + 3^1 + 3^2 + \ldots + 3^{n-1}$ holes

28. Find the area of the region remaining at the nth step in each of the shape sequences that lead to the Sierpinski fractals. Take the area of the starting square/triangle to be 1 sq. unit.

Ans. : (a) Let the side of the square of Sierpinski's Carpet be 1 square unit.
As one-ninth of the square is removed, and one-eighth remains in each step.
Step 0: Area of whole square $= (1)^2 = 1$
Step 1: Area of remaining region $= \frac{8}{9}(1)^2 = \frac{8}{9}$
Step 2: Area of remaining region $= \frac{8}{9} \times \frac{8}{9} = \frac{64}{81}$
Step 3: Area of remaining region $= \frac{8}{9} \times \frac{64}{81} = \frac{8^3}{9^3} = \frac{512}{729}$
Area of remaining region after nth step $= \left(\frac{8}{9}\right)^n$ sq. units
(b) Let the area of the triangle of Sierpinski's Gasket be 1 square unit.
One-fourth of the triangle is removed in each step, and three-fourth remains.
Step 0: Area of the whole triangle $= 1$ sq. unit.
Step 1: Area of remaining region $= \frac{3}{4}$ sq. units
Step 2: Area of remaining region $= \frac{3}{4} \times \frac{3}{4}$ square units $= \frac{9}{16} sq.$ units
Area of remaining region after n th step $= \left(\frac{3}{4}\right)^n$ sq. units

29. Draw the initial few steps (at least till Step 2) of the shape sequence that leads to the Koch Snowflake.

Ans. : self

30. Find the number of sides in the nth step of the shape sequence that leads to the Koch Snowflake.

Ans. : Number of sides:

Step 0: 3

Step 1: 3 × 4 = 12

Step 2: $3 \times 4^2 = 48$

Step 3: $3 \times 4^3 = 192$

.

.

.

Step n: 3×4^n

31. Find the perimeter of the shape at the nth step of the sequence. Take the starting equilateral triangle to have a sidelength of 1 unit.

Ans. : Perimeter of Koch Snowflake

Step 0: 3 units

Step $1 : 3 \times \left(\frac{4}{3}\right)^1$ units

Step 2: $3 \times \left(\frac{4}{3}\right)^2$ units

Step 3: $3 \times \left(\frac{4}{3}\right)^3$ units

Step 4: $3 \times \left(\frac{4}{3}\right)^4$ units

.

.

.

Step $n : 3 \times \left(\frac{4}{3}\right)^n$ units.

Perimeter of step $n = 3\left(\frac{4}{3}\right)^n$ units.

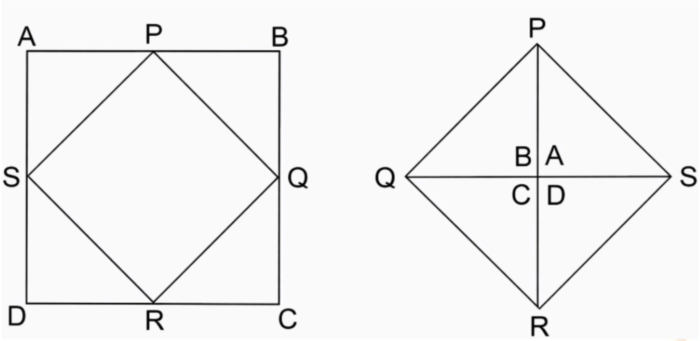
32. Picture your name, then read off the letters backwards. Make sure to do this by sight, not by sound - really see your name! Now try with your friend's name.

Ans. : self

33. Cut off the four corners of an imaginary square, with each cut going between midpoints of adjacent edges. What shape is left over? How can you reassemble the four corners to make another square?

Ans. : ABCD is a square.

P, Q, R, and S are midpoints of AB, BC, CD, and AD, respectively.



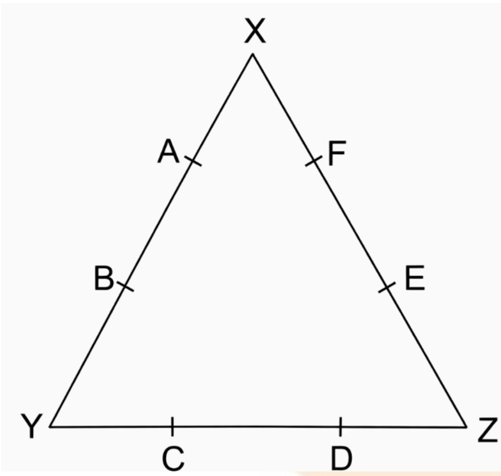
When we cut along PQ, QR, RS, and PS, we again get a square.

If we join the shaded portions again, we get a square of the same size as that of PQRS.

34. Mark the sides of an equilateral triangle into thirds. Cut off each corner of the triangle, as far as the marks. What shape do you get?

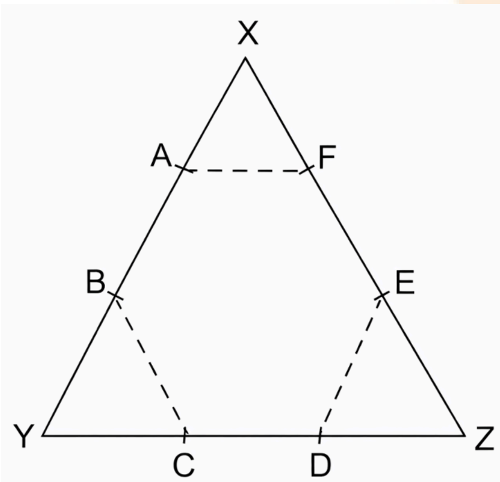
Ans. : XYZ is an equilateral triangle with AY = YZ = ZX.

Divide each side into 3 equal parts as shown.



We note XA = AB = BY = YC = CD = DZ = ZE = EF = FX

Join AF, BC, ED.



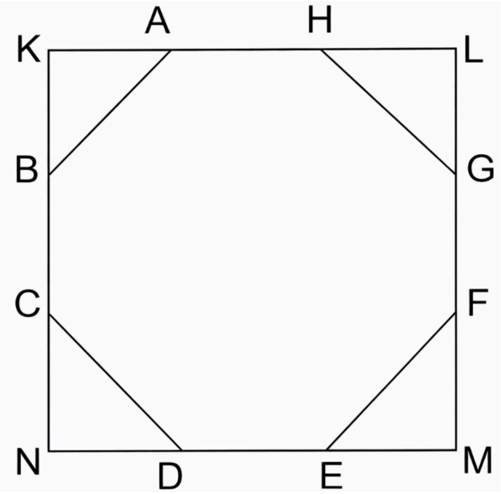
Shape ABCDEF is a hexagon.

As all sides of the hexagon are equal, it is called regular hexagon.

35. Mark the sides of a square into thirds and cut off each of its corners as far as the marks. What shape is left?

Ans. : KLMN is a square.

Each side of the square is divided into three equal parts.



When the four corners of the square are cut off, we get an octagon.

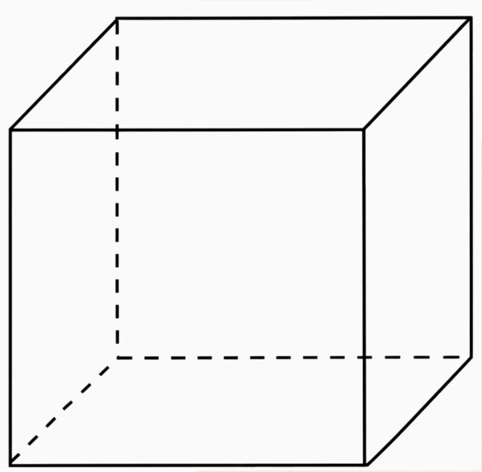
36. Can you describe a solid and a viewpoint that would result in each of the following cases? If it helps, you can imagine the solid passing through a wall like Tom did, and leaving a hole of the appropriate shape.

i. A solid whose profile has a square outline

ii. A solid whose profile has a circular outline

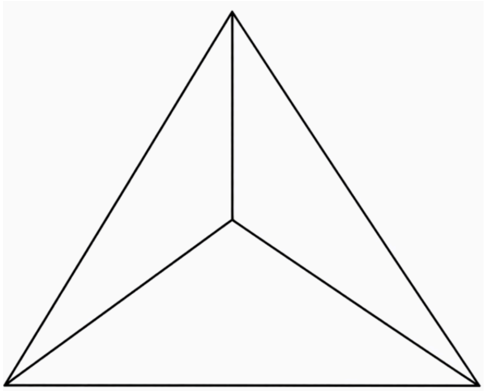
iii. A solid whose profile has a triangular outline

Ans. : i. A solid with a profile that has a square outline is a CUBE.



ii. A solid whose profile has a circular outline is a sphere.

iii. A solid whose profile has a triangular outline is a triangular pyramid.



37. If the congruent polygons of a prism have 10 sides, how many faces, edges and vertices does the prism have? What if the polygons have n sides?

Ans. : Number of sides of a congruent polygon of a prism = 10

Number of faces = n + 2

= 10 + 2

= 12

Number of edges = 3 × n

= 3 × 10

= 30

Number of vertices = 2 × n

= 2 × 10

= 20

A polygon with n sides will have

Number of faces = n + 2

Number of edges = 3n

Number of vertices = 2n

38. If the base of a pyramid has 10 sides, how many faces, edges and vertices does the pyramid have? What if the base is an n-sided polygon?

Ans. : Number of sides of the base of the pyramid = 10

Number of faces = n + 1

= 10 + 1

= 11

Number of edges = 2n

= 2 × 10

= 20

Number of vertices = n + 1

= 10 + 1

= 11

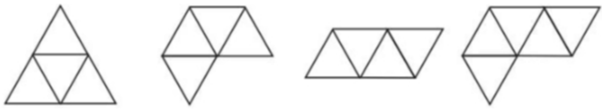
If the base is an n-sided polygon, then

No. of faces = n + 1

No. of edges = 2n

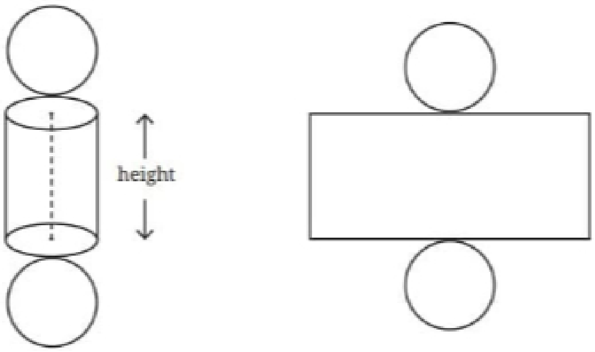
No. of vertices = n + 1

39. What is a net of a regular tetrahedron? Which of the following are nets of a regular tetrahedron? Are there any other possible nets?



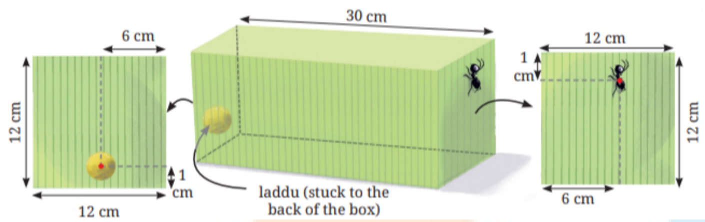
Ans. : (ii) and (iv) are not a net of a tetrahedron.

40. What are the sidelengths of the rectangle obtained (from unfolding a cylinder)?



Ans. : self

41. What is the length of the shortest path between the ant and the laddu?



Ans. : self

42. What do you think is the projection of a parallelogram under different orientations? Can this ever be a quadrilateral that is not a parallelogram?

Ans. : self

43. What can you say about the projection of an n-sided regular polygon?

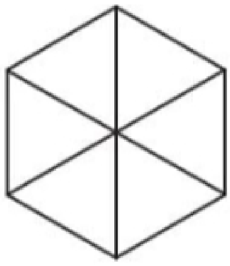
Ans. : self

44. Find another object that makes the same projection as that of a given cone.

Ans. : self

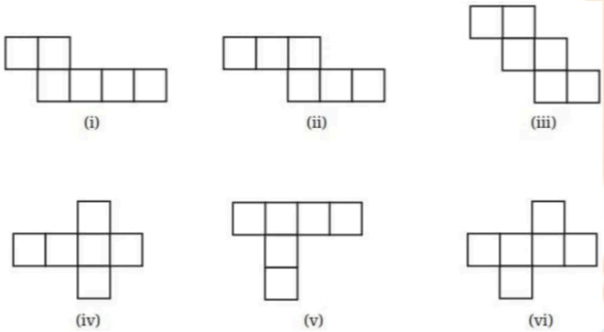
45. Construct a model of a cube and use your hands to keep it balanced on one corner vertex. Can you try to understand why all the projected edges have equal

length?



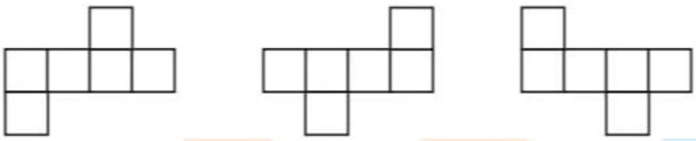
Ans. : self

46. Which of the following are the nets of a cube? First, try to answer by visualisation. Then, you may use cutouts and try.



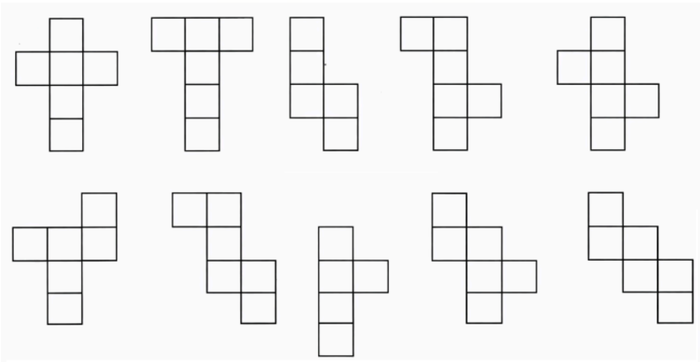
Ans. : (i) No
(ii) Yes
(iii) Yes
(iv) Yes
(v) No
(vi) Yes

47. A cube has 11 possible net structures in total. In this count, two nets are considered the same if one can be obtained from the other by a rotation or a flip. For example, the following nets are all considered the same -



Find all the 11 nets of a cube.

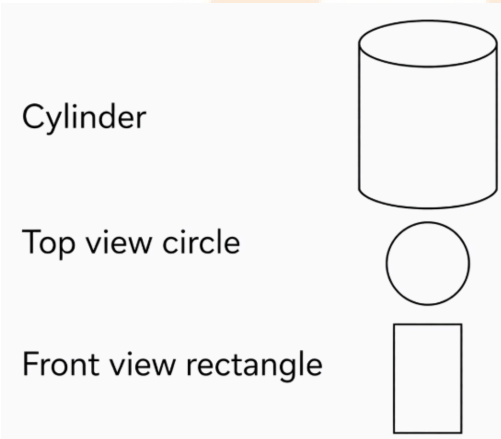
Ans. :



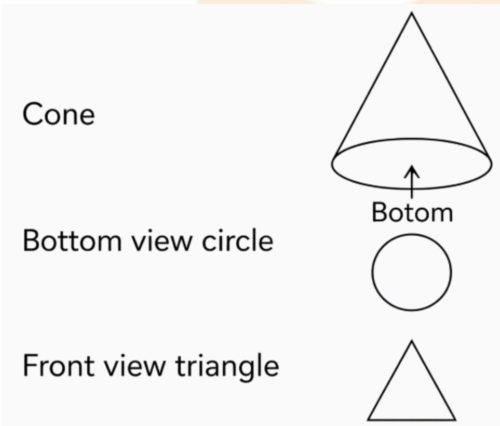
*** Questions With Calculation.[5 Marks Each]** **[40]**

48. As we saw with the elephant, a given solid might have very different profiles from different viewpoints. Can you visualise solids that have the following contrasting profiles?
Spend some time on this, and if you are finding it difficult to visualise, you may look around and use objects that are around you, or that you will make in the next section. Feel free to consider viewpoints from any direction, including directly above the object.
i. A solid with a rectangular profile from one viewpoint and a circular profile from another viewpoint
ii. A solid with a circular profile from one viewpoint and a triangular one from another viewpoint
iii. A solid with a rectangular profile from one viewpoint and a triangular one from another viewpoint
iv. A solid with a trapezium shaped profile from one viewpoint and a circular one from another viewpoint
v. A solid with a pentagonal profile from one viewpoint and a rectangular one from another viewpoint

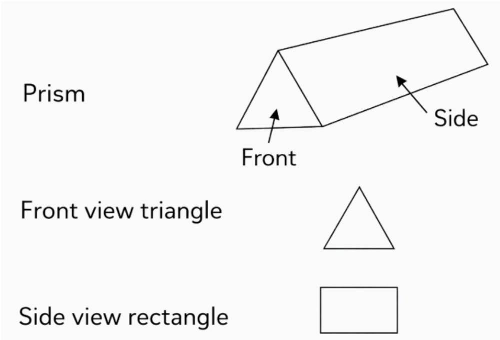
Ans. : i.



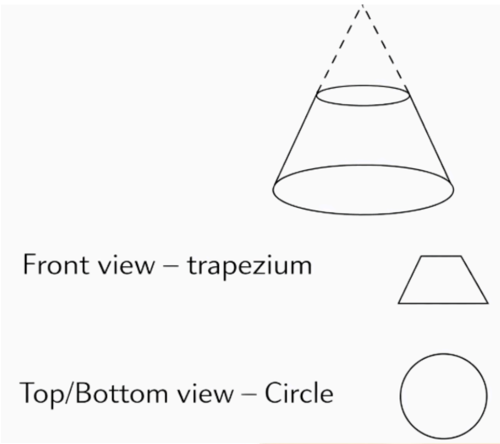
ii



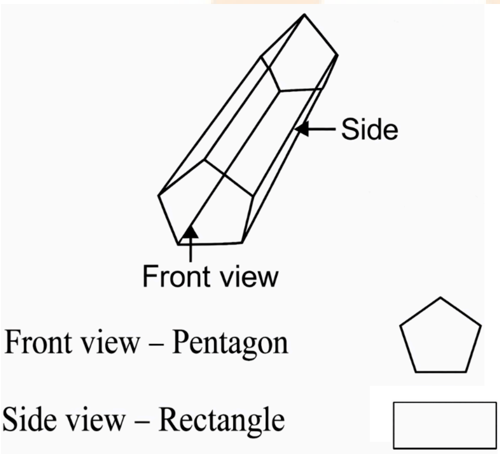
iii.



iv. A truncated cone or a cone cut off from a larger cone.
This shape is called a frustum.



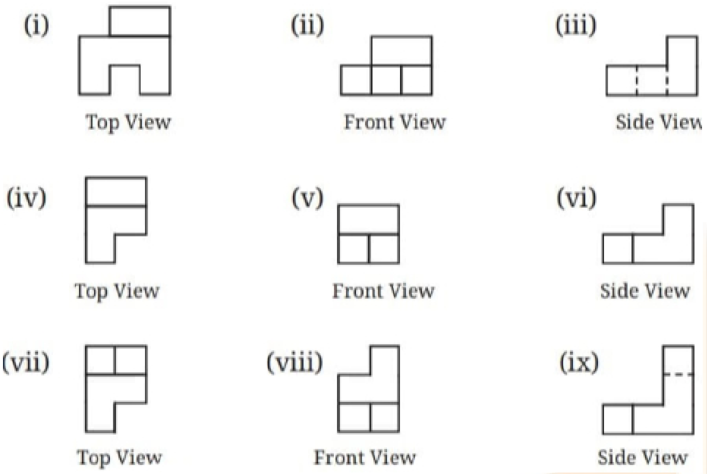
v. Pentagon base prism.



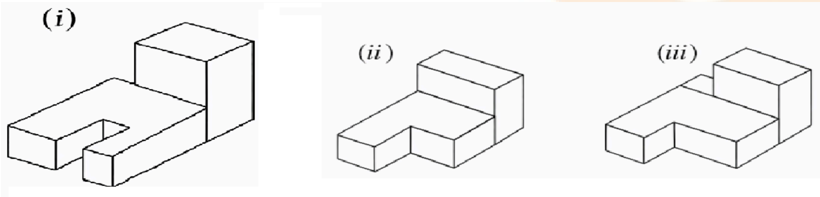
49. Why is this correspondence between directions on isometric paper and axes of the solid so effective for communicating the shape of the solid?

Ans. : self

50. Using identical cubes, make a solid that gives the following projections.



Ans. :



51. What are the different shapes the projection of a cube can make under different orientations?

Ans. : Five different shapes can be observed.

(a) Square

Orientation: One face of the cube is parallel to the projection plane.

(b) Rectangle

Orientation: Two faces are visible, but one set of edges is parallel to the plane.

(c) Parallelogram

Orientation: A face is tilted relative to the plane.

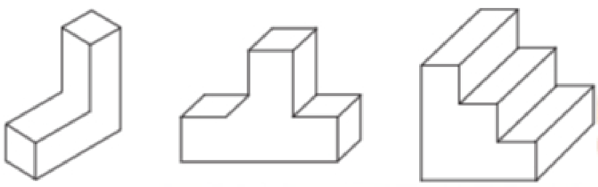
(d) Rhombus

Orientation: A special tilted case where all projected edges remain equal.

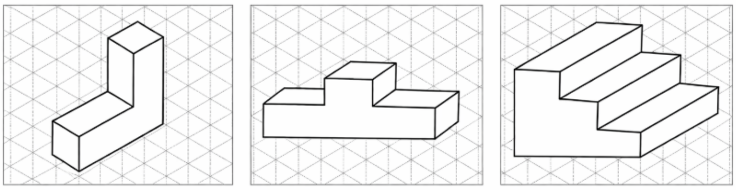
(e) Hexagon (maximum case)

Orientation: The cube is oriented so that three faces are equally visible (e.g., looking along a body diagonal).

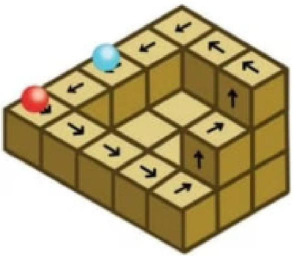
52. Draw the following figures on the isometric grid.



Ans. :



53. Is there anything strange about the path of this ball? Recreate it on the isometric grid.



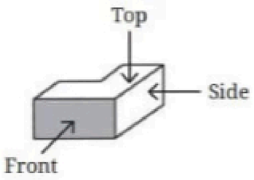
Ans. : The picture shows the Penrose staircase. It is an optical illusion showing a loop of stairs that appears to rise or descend forever. Each step looks locally consistent, but the structure cannot exist in reality. The illusion works by exploiting perspective and depth cues, creating the impression of continuous motion without a true beginning or end. On a Penrose staircase, a ball would have no physically possible path at all-because the staircase itself cannot exist as a single, consistent object in real 3D space. However, we can still answer the question in two ways:

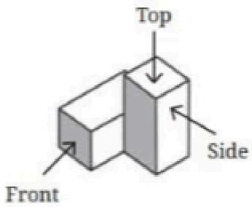
- Every step appears to slope downward, yet the staircase loops back to the starting point.
  When the ball is released, it rolls "down" the stairs, goes around the loop, and keeps rolling forever, always downhill. This creates a perpetual- motion illusion - a never-ending descent with no lowest point.
- If we have a Penrose staircase in the real world, at least one section would slope upward or the staircase would have to twist or break. The loop would not close. So the ball would roll down until it reaches a lowest point, then stop or roll back the way it came. There is no continuous path where the ball can always go down and still return to the start.

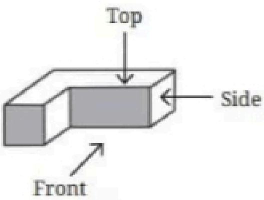
54. Find the front view, top view and side view of each of the following solids, fixing its orientation with respect to the vertical, horizontal and side planes: cube, cuboid, parallelepiped, cylinder, cone, prism, and pyramid.

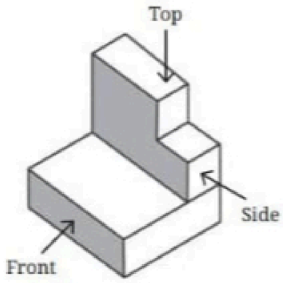
Ans. :

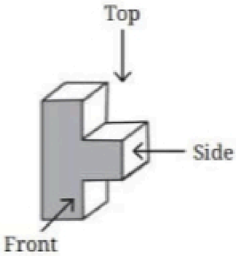
55. Draw the top view, front view and the side view of each of the following combinations of identical cubes.

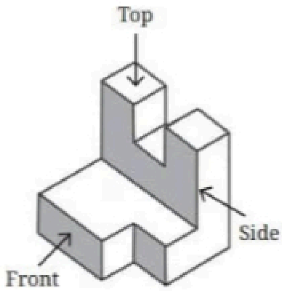




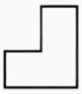
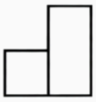
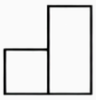
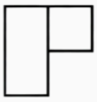
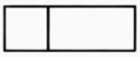
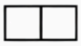
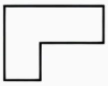
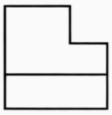
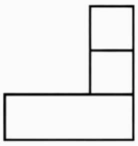
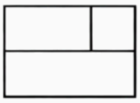
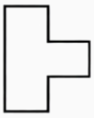
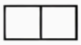
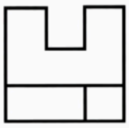
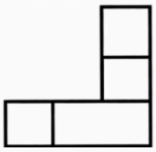
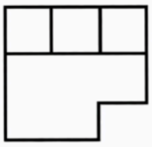








Ans. :

	Front View	Side View	Top View
(*a*)			
(*b*)			
(*c*)			
(*d*)			
(*e*)			
(*f*)			

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