



Attempt questions first; check the separate key afterward. Show all working. Draw accurate figures where required.

A. Very short answers - 1 mark each

1. What does self-similarity mean?
2. Give an example of a self-similar geometric pattern.
3. A pattern has 3 branches from every tip. Starting with 1 tip, find tips after 4 stages.
4. Find tips after 6 stages.
5. A segment is replaced by 4 segments each one-third as long. Find the total-length factor.
6. Starting at 9 cm, find total length after 2 stages.
7. State the numbers of faces, edges and vertices of a cube.
8. State these counts for a triangular prism.
9. Verify $V - E + F = 2$ for a cuboid.
10. Verify it for a square pyramid.
11. Draw a valid cube net.
12. Explain why six squares do not always form a cube net.
13. A cube is painted outside and cut into 27 equal cubes. How many have 3 painted faces?
14. How many have no painted face?
15. For a cube cut into 64 equal cubes, count pieces with exactly 2 painted faces.
16. Count pieces with exactly 1 painted face.
17. Sketch front, top and side views of a cylinder standing upright.
18. Sketch these views for a cuboid.
19. A Sierpinski-style triangle retains 3 of 4 equal subtriangles at each stage. Find the retained fraction after 2 stages.
20. Find it after 3 stages.

C. Application / reasoning - 3 marks each

21. Which solid has a circular base and one vertex?

22. Which solid has two circular bases and no vertices?
23. Draw two different arrangements of 4 unit cubes.
24. Can different solids share the same front view?
25. A regular tetrahedron has 4 faces and 6 edges. Find vertices using Euler's relation.
26. A convex polyhedron has 8 vertices and 12 edges. Find faces.
27. A cube is cut into 125 equal cubes after its outside is painted. Count unpainted pieces.
28. For that painted cube, count pieces with exactly two painted faces.
29. A pattern replaces each segment by 5 segments one-fourth as long. Find its length factor after two stages.
30. A convex polyhedron has 10 faces and 16 vertices. Find edges.
31. Draw a square-pyramid net and identify the base and lateral faces.
32. Explain how a natural branching pattern differs from an exact mathematical fractal.
33. Draw three stages of your own self-similar construction.
34. A $3 \times 2 \times 2$ block is built from unit cubes. Find number of cubes.
35. Find its exposed area in square units and explain your count.

ANSWER KEY - Numerical / closed questions

- 3) 81. 4) 729. 5) $4/3$. 6) 16 cm. 7) 6, 12, 8. 8) 5, 9, 6. 9) $8 - 12 + 6 = 2$. 10) $5 - 8 + 5 = 2$. 11) 8. 12) 1. 13) 24. 14) 24. 15) $9/16$. 16) $27/64$. 17) Cone. 18) Cylinder. 19) Yes. 20) 4. 21) 6. 22) 27. 23) 36. 24) $25/16$. 25) 24. 26) 12. 27) 32.