Unit 17 · Solid Objects

STUDY NOTES

Key terms

Plane figure: flat; length and breadth, no thickness: rectangle, square, circle.

Solid object: takes up space; length, breadth and height.

Face (**F**): a flat (plane) surface of a solid.

Edge (**E**): the straight line where two faces meet.

Vertex (**V**): a corner, where edges meet; plural **vertices**.

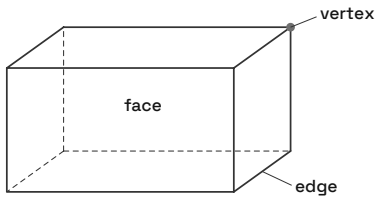
Cuboid: 6 rectangular faces (brick, book, chalk box).

Cube: a cuboid with 6 **equal squares**; all 12 edges equal (a die).

Skeleton model: only the edges (sticks) and vertices (joints).

Curved surface: bends; a ruler laid on it doesn't touch all along.

Cuboid and cube



The dashed lines are the edges at the back.

- both
  - **6 faces**
  - **12 edges**
  - **8 vertices**
- at each vertex: **3 faces** and **3 edges** meet
- cuboid: only **opposite** faces equal; edges in 3 groups of 4 equal (lengths, breadths, heights)
- every cube is a cuboid; not every cuboid is a cube
- a cuboid becomes a cube when **all its edges are equal**
- skeleton cube: 12 equal sticks, 8 joints; cuboid: 8 short + 4 long sticks (two squares joined)
- three pairs of parallel faces
  - top–bottom
  - front–back
  - left–right

Euler's rule

$V - E + F = 2$	V vertices, E edges, F faces **Use:** solids with only flat faces: cube, cuboid

- same as $V + F = E + 2$: $8 + 6 = 14 = 12 + 2$
- find the one missing: $V = 8$, $F = 6$: $8 - \mathrm{E} + 6 = 2 \rightarrow \mathbf{E = 12}$
- $V = 8$, $E = 12$: $8 - 12 + \mathrm{F} = 2 \rightarrow \mathbf{F = 6}$; $E = 12$, $F = 6 \rightarrow \mathbf{V = 8}$
- why 2: each bottom corner brings 2 vertices, 3 edges, 1 side face: $2 - 3 + 1 = 0$; top and bottom faces give the 2
- a box with a triangle at each end: V 6, E 9, F 5 $\rightarrow$ $6 - 9 + 5 = 2$

Cylinder, cone, sphere

Solid	Flat faces	Curved surfaces	Vertices
cylinder	2 equal circles, parallel	1	0
cone	1 circle (base)	1	1
sphere	0	1	0

- straight edges: **0** for all three; curved edges: cylinder 2, cone 1
- all three **roll**; a box only slides or tips
- cylinder rolls in a straight line
- cone round in a circle about its vertex
- sphere any way
- sphere: every point the same distance from its center
- cylinder
  - tin
  - pipe
  - gas cylinder
  - prayer wheel
- cone: birthday cap, ice-cream cone
- sphere: football, marble
- a glass is a cylinder (hollow, same shape)

COMMON MISTAKES

✗ every edge counted round each face: $6 \times 4 = 24$
✓ each edge is in two faces: $24 \div 2 = 12$.

✗ a cube has fewer vertices than a cuboid
✓ both have 8.

✗ $V - E + F = 2$ used for a cylinder
✓ only flat faces; a cylinder gives $0 - 2 + 3 = 1$.

✗ a cylinder has straight edges
✓ its 2 edges are curved.