Unit 16 · Solid Objects

STUDY NOTES

WHAT THE BLE ASKS

- **CDC's grid:** Geometry (Units 13, 14, 15, 16, 17, 18, 19, 20 together): 15 of 50 marks
- **In our 10 model papers:** 1-mark ×10
- **Model paper:** no question on solids; the grid wants every topic of an area in proportion, so a short part can come
- 1 or 2 marks is our estimate, not CDC's
- the Grade 7 model paper shows the kind: a rectangle with two circles: "name the solid this net makes" (1 mark, knowledge)

Key terms

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

Face (surface); **edge**: where two faces meet; **vertex**: where edges meet.

Prism: two parallel, congruent **bases** joined by **lateral surfaces** (here rectangles); named after its base.

Pyramid: a polygon for its base; triangular faces meeting at one point, its **vertex** (apex); named after its base.

Height of a pyramid: from the apex straight down to the base, at right angles, not along a face.

Tetrahedron: four triangular faces (a triangular pyramid); **regular**: all four equilateral.

Cone: a circular base, one curved surface narrowing to a point.

Cylinder: two parallel, congruent circles joined by one curved surface.

Net: a flat shape that folds into a solid, covering every face once, nothing overlapping.

Formulas

$F + V = E + 2$	F faces, V vertices, E edges **Use:** solids with flat faces and no holes (Euler)
$2\pi r$	the base's circumference **Use:** cone's arc; cylinder's rectangle length

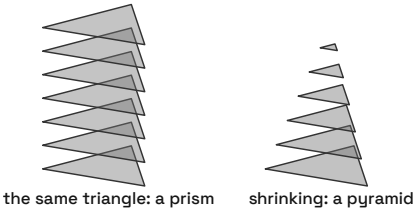
- a cylinder: $F + V = 3$, $E + 2 = 4$: not for curved surfaces

Prism and pyramid

	Prism	Pyramid
Bases	2, congruent, parallel	1
Lateral surfaces	rectangles	triangles
Slices parallel to the base	all the same	smaller and smaller
Faces, n-sided base	$n + 2$	$n + 1$
Vertices	$2n$	$n + 1$
Edges	$3n$	$2n$

Solid	F	V	E
Triangular prism	5	6	9
Square pyramid	5	5	8

- to find a prism's bases: the two faces the same and parallel, **not** the bottom
- a tent on its rectangular floor is a triangular prism: its bases are the triangles at the ends
- regular base, apex above its middle: all triangular faces congruent
- count: F, V, E in a table, then check with $F + V = E + 2$



the same triangle: a prism — shrinking: a pyramid

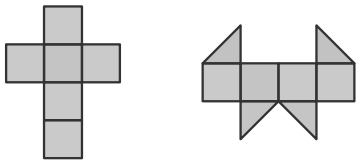
Every slice of a prism is the same; every slice of a pyramid is the same shape, smaller as you go up.

Nets

- a solid has many nets, using whole faces
  - a cube 11
  - a tetrahedron 2
  - a cuboid with three different lengths 54
- joined edges must be equal

Cube: test six squares

1. choose a square as the **floor**
2. fold the rest in your head: left, right, front, back, lid
3. six different names → a net; a name twice → it fails



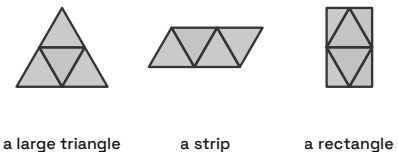
Two of a cube's eleven nets.

Bad at a glance:

- four squares meet at one point (a 2 × 2 block): only three faces meet at a corner
- a square has two opposites: in a line of three, the end squares are opposite faces
- these catch 17 of the 24 shapes that fail, not all; in doubt, name the faces

Tetrahedron: four equal triangles join in three ways

- the large triangle
- the strip
- the fan of four round one point (fails)



The two nets of whole triangles; the rectangle cuts two faces in half.

Net	Solid
rectangle and two circles	cylinder
sector and one circle	cone
six rectangles	cuboid
three rectangles and two triangles	triangular prism

Cone: arc of the sector = $2\pi r$; sector's radius = **slant height** l; the more paper you keep, the wider and lower the cone

Cylinder: one pair of the rectangle's sides = $2\pi r$, the other = height h

Back to the box

- 11 cm × 8 cm × 4 cm: $2 \times (88 + 44 + 32) = 328$ cm^2; A4 has about 624 cm^2
- area is no trouble; the shape is: a different net
- strip round the long way: $11 + 4 + 11 + 4 = 30$ cm: 3 mm too long
- the other way: $8 + 4 + 8 + 4 = 24$ cm long, $11 + 4 + 4 = 19$ cm tall: fits
- check the longest line of faces first

Where it is used

- boxes and cartons: printed and cut flat, as nets
- ridge tent: a triangular prism
- gable roof: a triangular prism; hip roof on a square building: pyramid-shaped

COMMON MISTAKES

✗ edges counted as faces, or the reverse
✓ a table of F, V, E, then the check.

✗ prisms and pyramids treated as one
✓ two bases, or a point?

✗ a tent called a rectangular prism
✓ the bases are the triangles.

✗ a pyramid's sloping edge as its height
✓ straight down from the apex.

✗ right number of faces, so a net
✓ six squares aren't always a cube: name them.

✗ $F + V = E + 2$ on a cylinder
✓ flat faces only.