Unit 15 · Plane Shapes

STUDY NOTES

Key terms

Plane shape: drawn on a flat surface; closed by straight lines it is named by its sides: 3 a **triangle**, 4 a **quadrilateral**.

Ticks: small marks on sides that are equal.

Vertices: the corners (one: **vertex**); △ stands for "triangle".

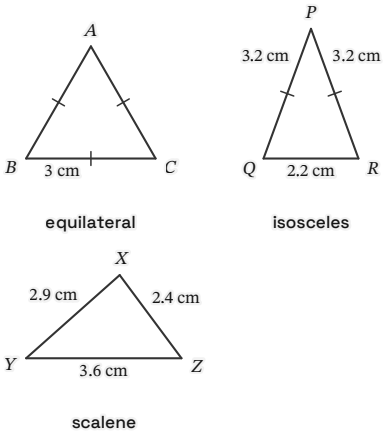
Diagonal: a line from corner to corner.

Truss: a frame of triangles; can't change shape.

Triangles by sides

Name	Sides
equilateral	all three equal
isosceles	any two equal
scalene	all three different

- 5, 5, 5 cm → equilateral
- 6, 4, 6 cm → isosceles
- 7, 4, 5 cm → scalene
- PQ 2.7, QR 5, PR 4.6 cm → scalene
- equilateral is isosceles too; give the **best name**: equilateral
- three sticks make no triangle when one is as long as the other two together, or longer: 3, 4, 8 cm (3 + 4 < 8)



Ticks show the equal sides.

Triangles by angles

Name	Angles
acute-angled	all three less than 90°
right-angled	one angle 90°
obtuse-angled	one angle more than 90°

- look at the **biggest** angle
  - less than 90° → acute-angled
  - 90° → right-angled
  - more → obtuse-angled
- every triangle has at least **two acute** angles; never two right or two obtuse angles
- 75°, 45°, 60° → acute-angled
- 90°, 41°, 49° → right-angled
- 125°, 23°, 32° → obtuse-angled
- the three angles add up to **180**°
- one angle
  - 120° → always obtuse-angled
  - 90° → always right-angled
  - 60° → any of the three

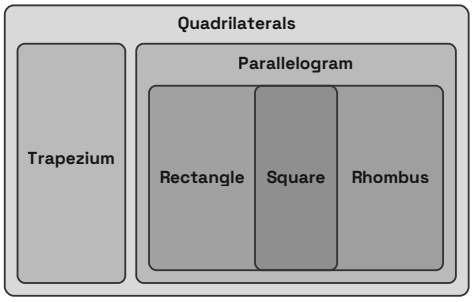
Two names each

- one name by sides + one by angles: **right-angled isosceles** (a square cut along its diagonal)
- equilateral: always acute-angled (each angle **60**°)
- isosceles and scalene: acute-, right- or obtuse-angled
- right-angled scalene: sides 3, 4, 5 cm
- six pairs possible, not nine

Quadrilaterals

Shape	Sides	Angles
rectangle	opposite sides equal	all 90°
square	all four equal	all 90°
parallelogram	both pairs of opposite sides parallel	opposite angles equal
rhombus	all four equal	need not be 90°
trapezium	**only one** pair of opposite sides parallel	

- parallelogram
  - opposite sides **equal**
  - opposite angles **equal**
  - angles next to each other add to **180**° (60° + 120°)
- rhombus: opposite sides parallel → a parallelogram
- trapezium: its parallel sides have **different lengths**; test with perpendiculars: AX = BY → AB ∥ CD
- two equal parallel segments joined at their ends → a parallelogram; different lengths → a trapezium



Boxes inside boxes: a square is in both the rectangle box and the rhombus box.

How they are related

- **square**: 4 names
  - square
  - rectangle
  - rhombus
  - parallelogram
- rectangle and rhombus: 2 names each, with parallelogram; trapezium: 1
- every square is a rectangle; not every rectangle is a square
- parallelogram with all angles 90° → rectangle; with all sides equal as well → square
- **best name**: four equal sides and right angles → square
- naming one: measure sides (opposite equal? all equal?) and angles (all 90°?); check pairs of parallel sides with a set square
- CDEF: CF = DE = 4 cm, DC = EF = 2.5 cm, all 90° → rectangle (not a square)

By folding paper

- torn paper, each fold laid along the last → square corners → a **rectangle**
- rectangle, short edge folded onto the long edge, strip cut off → a **square**
- tangram: a square cut into 7 pieces; corners 45°, 90°, 135°; its only rhombus is a square

Why triangles are stiff

- three sides fix a triangle: only **one** triangle from three sticks → its angles can't change
- four sides don't fix the angles: a square of sticks leans into a rhombus
- one **diagonal** stick → two triangles → stiff (a gate's one sloping bar)
- triangles
  - bridges
  - roofs
  - towers
  - bicycle frames

COMMON MISTAKES

✗ one acute angle → acute-angled
✓ all three must be acute; check the biggest.

✗ an equilateral triangle is not isosceles
✓ it has two equal sides too; best name equilateral.

✗ a square is not a rhombus
✓ all four sides equal: a special rhombus.

✗ a shape with both pairs of sides parallel called a trapezium
✓ that is a parallelogram; a trapezium has only one pair.

✗ a rhombus is a square
✓ only when its angles are 90°.