Year 9 Circles, Area and Volume – Revision Notes

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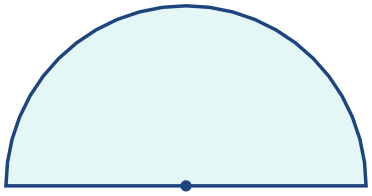
Year 9 · Maths · Circles, Area, Surface Area and Volume · Key ideas and worked examples

For grown-ups and learners: read each part and try the worked example. Then work through the sheets: Foundation, Developing, Challenge, then Mixed Practice to revise everything. Show your working: it earns marks in tests and helps you spot mistakes.

1. Area and circumference of a circle

For a circle of radius r: **circumference C = 2πr = πd** and **area A = πr²**. Use π = 3.14 when asked, or leave π in the answer (**in terms of π**). A circle of radius 5 cm has C = 10π cm and A = 25π cm² = 78.5 cm². To work backwards, undo the formula: if A = 50.24 cm², then r² = 50.24 ÷ 3.14 = 16, so r = 4 cm. A semicircle has half the area, and its perimeter is the curved edge **πr** plus the diameter **2r**.

Example: Find the area of a circle with diameter 20 m. Use π = 3.14.
→ r = 20 ÷ 2 = 10 m
→ A = πr^2 = 3.14 × 100 = 314 m^2
Answer: 314 m^2



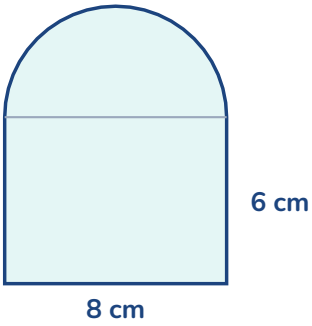
2. Very small and very large units

Prefixes tell you the power of 10: **kilo** = 1000, **mega** = 1 000 000, **giga** = 1 000 000 000, **milli** = 1/1000, **micro** = 1/1 000 000 and **nano** = 1/1 000 000 000. So 1 micrometre = 1000 nanometres, 1 gigalitre = 1000 megalitres and 1 gram = 1000 milligrams = 1 000 000 micrograms. Going to a **smaller** unit, **multiply**; going to a **bigger** unit, **divide**. Remember 1 litre = 1000 cm³ and 1 cm³ = 1 mL.

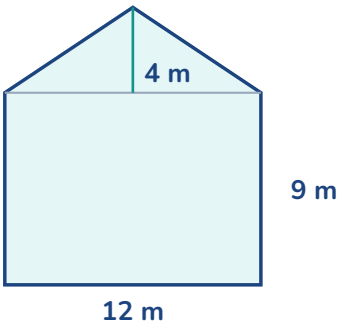
Example: Convert 12 nanograms to milligrams.
→ 1 milligram = 1 000 000 nanograms
→ 12 ÷ 1 000 000 = 0.000012 milligrams
Answer: 0.000012 milligrams

3. Compound shapes

Split a compound shape into rectangles, triangles and parts of circles. **Add** the parts, or **subtract** a hole. First **estimate** with π ≈ 3 and rounded lengths, so you know roughly what to expect: a circle of radius 9.8 cm has an area of about $3 \times 10^2 = 300$ cm².

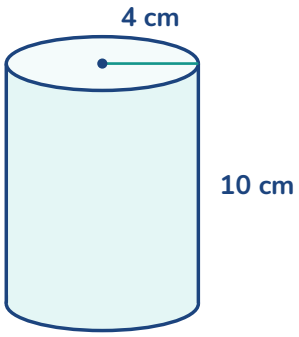


Example: The end wall of a shed is a rectangle 12 m wide and 9 m high with a triangle of height 4 m on top. Find the area of the wall.
→ Rectangle $12 \times 9 = 108$ m^2; triangle $\frac{1}{2} \times 12 \times 4 = 24$ m^2
→ Total: 132 m^2
Answer: 132 m^2

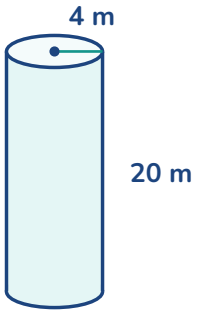


4. Volume of prisms and cylinders

A prism has the same **cross-section** all along its length, so it is a stack of identical slices: **volume = area of cross-section × length**. A cylinder is a prism with a circular cross-section, so **$V = \pi r^2 h$**. A cylinder of radius 4 cm and height 10 cm has $V = 3.14 \times 16 \times 10 = 502.4$ cm³.



Example: A cylinder has radius 4 m and height 20 m. Find its volume in terms of π.
→ $V = \pi r^2 h$
→ $= \pi \times 4^2 \times 20$
→ $= 320\pi \text{ m}^3$
Answer: $320\pi \text{ m}^3$



5. Surface area and planes of symmetry

The **surface area** is the total area of all the faces: a cuboid has three pairs of equal rectangles, a triangular prism two triangles and three rectangles, and a square-based pyramid a square and four triangles. Unroll the curved surface of a cylinder and it is a rectangle 2πr by h, so a closed cylinder has **surface area $2\pi r^2 + 2\pi rh$**. A **plane of symmetry** cuts a solid into two mirror-image halves: a cuboid with all sides different has 3, a cube has 9 and a cylinder has infinitely many.

Example: A cylinder open at the top has radius 6 cm and height 9 cm. Find its total surface area in terms of π.
→ One circle (the base): $1 \times \pi \times 6^2 = 36\pi$
→ Curved surface: a rectangle 2πr by h = $2 \times \pi \times 6 \times 9 = 108\pi$
→ Total: $144\pi \text{ cm}^2$
Answer: $144\pi \text{ cm}^2$

Think like a mathematician: test a few cases (**specialising**), look for the rule that always works (**generalising**), and explain why you are sure (**convincing**). When you check someone's working, say what is wrong and how to **improve** it.

Common mistakes: using the diameter in πr^2. Squaring π as well as r. Dividing cm^3 by 100 instead of 1000 for litres. Forgetting the ends of a cylinder, or the straight edge of a semicircle.