

Mensuration

Quick revision notes [Open it online](#)

Name: _____

Date: _____

At a glance

Units, areas and perimeters, circles and sectors, surface area and volume of every solid, and working backwards.

Volumes of a cone, pyramid and sphere, and the curved surface areas of a cone and sphere, are on the formula list; the rest are not.

1. Units
2. Area and perimeter of 2D shapes
3. Circles, arcs, sectors and segments
4. Prisms, cuboids and cylinders
5. Pyramids, cones and spheres
6. Working backwards

1. Units

☐ I revised this

- Length: 1 km = 1000 m; 1 m = 100 cm; 1 cm = 10 mm.
- Area: square the conversion — $1 \text{ m}^2 = 100^2 = 10\,000 \text{ cm}^2$; $1 \text{ cm}^2 = 100 \text{ mm}^2$.
- Volume: cube it — $1 \text{ m}^3 = 100^3 = 1\,000\,000 \text{ cm}^3$.
- Capacity: 1 litre = $1000 \text{ cm}^3 = 1000 \text{ ml}$; $1 \text{ cm}^3 = 1 \text{ ml}$.

Convert	Length	Area	Volume
m → cm	× 100	× 10 000	× 1 000 000
cm → mm	× 10	× 100	× 1000
km → m	× 1000	× 1 000 000	—

Worked example

Convert 3.5 m^2 to cm^2 .

1. $1 \text{ m}^2 = 10\,000 \text{ cm}^2$.
2. $3.5 \times 10\,000$.

$35\,000 \text{ cm}^2$

2. Area and perimeter of 2D shapes

☐ I revised this

- Perimeter = distance all the way round. Area = space inside.
- Use the **perpendicular** height for triangles, parallelograms and trapezia.
- Compound shapes: split into rectangles, triangles and semicircles, then add (or subtract a hole).

Formulas

rectangle $A = lw$

triangle $A = \frac{1}{2}bh$

parallelogram $A = bh$

trapezium $A = \frac{1}{2}(a + b)h$

Worked example

A semicircle of diameter 8 cm sits on top of an 8 cm × 5 cm rectangle. Find the total area.

1. Rectangle: $8 \times 5 = 40 \text{ cm}^2$.
2. Semicircle: $\frac{1}{2} \times \pi \times 4^2 = 8\pi = 25.13 \text{ cm}^2$.

65.1 cm² (3 s.f.)

3. Circles, arcs, sectors and segments

☐ I revised this

- Circumference = $\pi d = 2\pi r$. Area = πr^2 .
- A sector is $\theta/360$ of the circle: arc length = $\theta/360 \times 2\pi r$; sector area = $\theta/360 \times \pi r^2$.
- Perimeter of a sector = arc + 2 radii.
- Segment area = sector area – triangle area (triangle = $\frac{1}{2}r^2 \sin \theta$).

Formulas

$$C = 2\pi r$$

$$A = \pi r^2$$

$$\text{arc} = (\theta/360) \times 2\pi r$$

$$\text{sector} = (\theta/360) \times \pi r^2$$

Worked example

A sector has radius 10 cm and angle 90°. Find the area of the minor segment.

1. Sector: $\frac{1}{4} \times \pi \times 100 = 78.54 \text{ cm}^2$.
2. Triangle: $\frac{1}{2} \times 10 \times 10 = 50 \text{ cm}^2$.
3. $78.54 - 50$.

28.5 cm² (3 s.f.)

Exam tip: 'In terms of π ' means leave π in: the sector area 12π , not 37.7.

4. Prisms, cuboids and cylinders

☐ I revised this

- Volume of a prism = area of cross-section × length. A cylinder is a prism with a circular cross-section.
- Surface area = total area of all faces (draw the net if unsure).
- Cylinder curved surface = $2\pi rh$ (the rectangle that wraps round); total = $2\pi rh + 2\pi r^2$.

Formulas

$$\text{prism } V = \text{cross-section area} \times \text{length}$$

$$\text{cylinder } V = \pi r^2 h$$

$$\text{cylinder curved SA} = 2\pi rh$$

Worked example

A cylinder has radius 3 cm and height 10 cm. Find its volume and total surface area in terms of π .

1. $V = \pi \times 9 \times 10 = 90\pi \text{ cm}^3$.
2. Curved: $2\pi \times 3 \times 10 = 60\pi$; two ends: $2 \times 9\pi = 18\pi$.

$V = 90\pi \text{ cm}^3$; $SA = 78\pi \text{ cm}^2$

5. Pyramids, cones and spheres

☐ I revised this

- Pyramid and cone volume = $\frac{1}{3} \times \text{base area} \times \text{height}$.
- Cone curved surface = $\pi r l$ (l = slant height; $l^2 = r^2 + h^2$).
- Sphere: $V = \frac{4}{3}\pi r^3$, $SA = 4\pi r^2$. Hemisphere: half of each, plus the flat circle πr^2 for total SA.
- Frustum = big cone – small cone.

Formulas

pyramid/cone $V = \frac{1}{3} \times \text{base} \times h$

cone curved $SA = \pi r l$

sphere $V = \frac{4}{3}\pi r^3$

sphere $SA = 4\pi r^2$

Worked example

A cylinder (radius 2 cm, height 5 cm) has a hemisphere of radius 2 cm on top. Find the volume.

- Cylinder: $\pi \times 4 \times 5 = 20\pi$.
- Hemisphere: $\frac{1}{2} \times \frac{4}{3} \times \pi \times 8 = 16\pi/3$.
- Total = $76\pi/3 = 79.6$.

79.6 cm³ (3 s.f.)

Exam tip: The formulas for cone, pyramid and sphere are given on the formula list — but you must know which to use.

6. Working backwards

☐ I revised this

- Given the volume or area, substitute and solve for the missing length.
- Rearrange before using the calculator: $r^2 = V \div (\pi h)$, then square root.
- Equal volumes: liquid poured from one container into another keeps its volume.

Worked example

A cylinder has volume 500 cm³ and height 8 cm. Find its radius.

- $500 = \pi r^2 \times 8$.
- $r^2 = 500 \div (8\pi) = 19.89\dots$
- $r = \sqrt{19.89\dots}$

4.46 cm (3 s.f.)

Common mistakes

Don't write	Write instead
✗ Using the diameter as the radius	✓ Halve the diameter first
✗ Cone volume $\pi r^2 h$	✓ It's $\frac{1}{3}\pi r^2 h$
✗ $1 \text{ m}^2 = 100 \text{ cm}^2$	✓ $1 \text{ m}^2 = 10\,000 \text{ cm}^2$
✗ Sector perimeter = arc length only	✓ Add the two radii
✗ Using the slant height as h in a cone's volume	✓ Volume uses the vertical height

In the exam

- Write the formula, substitute, then calculate — each step can earn a mark.
- Keep π in until the end (or use the π key), then round.
- Check units: area in cm², volume in cm³.

My notes