4.7 Mensuration: perimeter, area, surface and volume

Name: _____ Class: _____ Date: _____ **Total: 28 marks**

KEY WORDS sector • volume

Mensuration: perimeter, area, surface and volume

Objective

Find perimeters and areas of composite shapes, circles and sectors; surface areas and volumes of prisms, cylinders, cones and spheres; convert metric units (objectives Foundation 4.9–4.10 and Higher 4.9, 4.10).

1 Key knowledge and worked examples

Area toolkit. Triangle $\frac{1}{2}bh$, parallelogram bh, trapezium $\frac{1}{2}(a+b)h$, circle πr^2 with circumference $2\pi r$. Higher sectors: arc $= \frac{\theta}{360} \times 2\pi r$, area $= \frac{\theta}{360} \times \pi r^2$ – for $r = 9$, $\theta = 40°$: arc $2\pi \approx 6.28$, area $9\pi \approx 28.3$. Composite shapes split into parts before any formula is applied.

Solids. Prism = cross-section × length; cylinder $V = \pi r^2 h$, surface $2\pi r^2 + 2\pi rh$; cone $V = \frac{1}{3}\pi r^2 h$, curved surface πrl with l the slant; sphere $V = \frac{4}{3}\pi r^3$, surface $4\pi r^2$. Unit chains: area 100^2, volume 100^3 between cm and m.

2 Practice

2.1 Find the area of a trapezium with parallel sides 7 cm and 11 cm and height 4 cm. [2]

2.2 Find the circumference and area of a circle of radius 5 cm, exact in terms of π. [2]

2.3 A sector has $r = 9$ cm and $\theta = 40°$. Find its arc length. [2]

2.4 Find the volume of a cylinder with $r = 5$ cm and $h = 10$ cm, in terms of π. [2]

2.5 A cone has $r = 3$ cm and $h = 4$ cm. Find its slant, volume and curved surface area, in terms of π where exact. [4]

3 Exam-style questions

3.1 *(Edexcel 4MA1 2HR June 2024 Q10, adapted.)* Hexagon $ABCDEF$ has $AB \parallel FC \parallel ED$ with $AB = 11$ cm, $ED = FC = 23$ cm, the perpendicular distance between FC and ED equal to 4.7 cm, and $BC = 5$ cm making a 30° angle with FC. Find the area of the hexagon. [5]

3.2 *(Original.)* A sphere has radius 6 cm. (a) Find its volume in terms of π. (b) Find its surface area in terms of π. (c) A cylinder has the same radius and the same volume; find its height. [5]

3.3 *(Original.)* A barn silo is a cylinder ($r = 2$ m, $h = 5$ m) topped by a hemisphere. (a) Find the total volume in terms of π. (b) Find the total surface area in terms of π. [6]