

Geometry and measures

9260 unit 3.3 full package: Core G1-G26 with Extension additions, specimen-family anchors, unsampled lines labelled

1. Unit 3.3 at a glance

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Core G1-G26: angle facts through constructions, mensuration, similarity, trigonometry, transformations, vectors and matrices. Extension adds the full circle-theorem programme with proof, congruence conditions, bearings, sphere/pyramid/cone/frustum formulae, k - k^2 - k^3 similarity, sectors, 3D Pythagoras and trigonometry, the sine/cosine rules with half-angle, combined transformations with fractional and negative factors, vector geometry, and the 2×2 matrix programme.

Must-know (no formulae sheet): $2\pi r$ and πr^2 ; sector fractions of 360; sphere $\frac{4}{3}\pi r^3$ and $4\pi r^2$; $a^2 = b^2 + c^2 - 2bc \cos A$; sine rule; Area = half $a b \sin C$.

2. Angles and polygons

Angles and polygons

Point 360, line 180, vertically opposite equal; alternate, corresponding, interior angles between parallels (never 'Z angles'); triangle sum 180 with the isosceles, equilateral and scalene families.

Polygon sums: interior $(n-2) \times 180$, exterior $360/n$, centre angle $360/n$ for regular polygons. Quadrilateral properties and symmetry counts: a regular hexagon has 6 lines and order 6.

3. Congruence, similarity, circles

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Congruence conditions (Extension): SSS, SAS, ASA, RHS. Similarity: lengths k , areas k^2 , volumes k^3 - the 2E specimen's similar solids give 864 cm³.

Circle theorems (Extension): centre double circumference; semicircle 90; same segment equal; cyclic quadrilateral opposite angles 180; tangent perpendicular radius; equal tangents; centre-perpendicular bisects chord; alternate segment. The verified chain: 35 degrees at the circumference gives 70 at the centre, and the opposite-arc angle is half of $290 = 145$, with $35 + 145 = 180$ (cyclic quadrilateral) - every step named.

4. 3D shapes, constructions, bearings

3D shapes, constructions, bearings

Faces, edges, vertices of the solid families; plans and elevations (a specification line not sampled). Bearings: three-figure, clockwise from north - the 2E specimen's 252 degrees comes from a return-bearing chain.

Ruler-and-compass constructions: perpendicular bisector, perpendicular from/at a point, angle bisector, 60-degree angle - used for figures and loci; the perpendicular distance from a point to a line is the shortest. Leave the arcs visible.

5. Mensuration and similarity

Mensuration and similarity

Areas: half- $b \cdot h$, $b \cdot h$, half $(a+b)h$; volume $V = Ah$; circle $2\pi r$ and πr^2 .

Sectors (Extension): $\frac{\theta}{360}$ of the circle. The 1E cone proportion finds $p = 15$.

Solids (Extension): sphere, pyramid, cone with frustums by subtraction - a cone $r = 5$, $h = 12$ has slant 13, volume 100π and curved surface 65π . Similar ratios: lengths k , areas k^2 , volumes k^3 .

6. Trigonometry 2D and 3D

Trigonometry 2D and 3D

Pythagoras and SOH CAH TOA in right triangles; 3D problems (Extension) extract the right triangle first - the 1E specimen ends at 62.7 degrees.

Sine and cosine rules with Area = half $a b \sin C$ (Extension): the 2E cosine rule gives 102.6 degrees, and $\cos x = 8/11$ gives 43.3 degrees. Worked chain: $a = 9$, $b = 11$, $C = 72$ gives $c = 11.9$, then $A = 46.3$ with the angle sum checking 180.

7. Transformations, vectors, matrices

Transformations, vectors, matrices

Transformations with combined and fractional/negative scale factors (Extension): an inverted, shrunken image on the opposite side of the centre. Vectors: sums, differences, scalar multiples, simple geometry - the 2E specimen proves CB parallel MN via a half ratio.

2x2 matrices (Extension): multiplications, the identity I, unit-square transformations - rotation 90: $\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$; reflection in $y = -x$: $\begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix}$ (the 1E specimen's matrix); enlargement k : $\begin{bmatrix} k & 0 \\ 0 & k \end{bmatrix}$. Combinations multiply in order; solve $Mx = b$ as simultaneous equations (the 1E pairs $(6, -1/2)$ and $(-2, -5/2)$).

Check yourself

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Angle facts and polygon sums; quadrilaterals and symmetry; congruence conditions; similarity ratios in every direction; the circle-theorem bank with proof reasons.

Solid properties; plans and elevations; bearings; constructions and loci; area, volume, sector, sphere, cone and frustum formulae; 2D and 3D trigonometry with the sine and cosine rules; transformations including negative factors; vector geometry; matrix multiplication, identity, unit-square transformations and combinations.