Acle Academy

YEAR 11, FOUNDATION 3 YEAR GCSE, GEOMETRY AND MEASURES, MATHS

Rationale and Context of Unit:	Core curriculum content:	Tier 2 & Tier 3 vocabulary explicitly taught:

MEASURES
• Apply and interpret limits of accuracy
• Use standard units of measure and related concepts (length, area, volume / capacity, mass, time, money etc)
• Use standard units of mass, length, time, money and other measures (including standard compound measures) using decimal quantities where appropriate
• Change freely between related standard units (e.g. time, length, area, volume / capacity, mass) and compound units (e.g. speed, rates of pay, prices, density, pressure) in numerical and algebraic contexts
• Use compound units such as speed, rates of pay, unit pricing, density and pressure
 	
CONSTRUCTIONS AND LOCI
• Use the standard ruler and compass constructions:
  • perpendicular bisector of a line segment
  • constructing a perpendicular to a given line from / at a given point
	VOLUME
	• Compare lengths, areas and volumes using ratio notation
	• scale factors
	• Make links to similarity
	• Know and apply formulae to calculate the volume of cuboids and other right prisms (including cylinders)
	• Calculate the volume of spheres, pyramids, cones and composite solids
	• Calculate exactly with multiples of `pi`
	
	TRIGONOMETRY
	• Know and use the trigonometric ratios
	• Apply them to find angles and lengths in right-angled triangles in two dimensional figures (Review of year 10 - 3 year route)
	• Know the exact values of sinθ and cos θ for θ = 0˚, 30˚, 45˚, 60˚ and 90˚
	• Know the exact value of tan θ for θ = 0˚, 30˚, 45˚ and 60˚
	• Compare lengths using ratio notation (Review of Year 10 - 3 year route)
	• Make links to trigonometric ratios
		Length, area, volume, ratio, scale factor, similar, cuboid, prism, sphere, pyramid, cone, composite solid, multiple, pi, exact, trigonometry, angle, right angled triangle, exact value, sine, cosine, tangent, hypotenuse, angle ratio notation, vector, column, positive, negative, direction, magnitude, addition, subtraction, multiplication, division, scalar.
		
		Highlighted words **MUST** be explicitly taught, defined and recorded in student books as they are first met. Other listed words may be introduced verbally or written in a similar format.

• bisecting a given angle • Know that the perpendicular distance from a point to a line is the shortest distance to the line • Use these to construct given figures and solve loci problems **CONGRUENCE AND SIMILARITY** • Use the basic congruence criteria for triangles (SSS, SAS, ASA, RHS) • Apply angle facts, triangle congruence, similarity and properties of quadrilaterals to conjecture and derive results about angles and sides, including Pythagoras' Theorem and the fact that the base angles of an isosceles triangle are equal, and use known results to obtain simple proofs • Apply and use the concepts of congruence and similarity, including the relationships between lengths in similar figures **INTRODUCTION TO TRIGONOMETRY** • Know and use the trigonometric ratios $\sin\theta = \frac{opposite}{hypotenuse}$, $\cos\theta = \frac{adjacent}{hypotenuse}$, and $\tan\theta = \frac{opposite}{adjacent}$;	**VECTORS** • Apply addition and subtraction of vectors, multiplication of vectors by a scalar, and diagrammatic and column representation of vectors	

• Apply them to find angles and lengths in right-angled triangles in two dimensional figures
• Compare lengths using ratio notation
 	
FURTHER PERIMETER AND AREA
• Identify properties of the faces, surfaces, edges and vertices of: cubes, cuboids, prisms, cylinders, pyramids, cones and spheres (review of Year 9)
• Calculate the perimeter of a 2D shape and composite shapes (review of Year 9)
• Calculate the area of composite shapes (review of Year 9)
• Find the surface area of pyramids and composite solids
• Know and apply formulae to calculate area of:
  • triangles
  • parallelograms
  • trapezia
• (review of Year 9)
 	
FURTHER CIRCUMFERENCE AND AREA
• Identify and apply circle definitions and properties, including centre, radius, chord, diameter, circumference, tangent, arc, sector and segment (review of Year 9)
• Know and use the formulae		

• Circumference of a circle = $2\pi r$ or πd • Area of a circle = πr^2 • Calculate the perimeter of 2D shapes including circles and composite shapes • Calculate areas of circles and composite shapes (review of Year 9) • Calculate surface area of spheres, cones and composite solids • Calculate arc lengths, angles and areas of sectors of circles • Calculate exactly with multiples of π **PROPERTIES OF POLYGONS** • Derive and use the sum of angles in a triangle (e.g. to deduce and use the angle sum in any polygon, and to derive properties of regular polygons) • Derive and apply the properties and definitions of: special types of quadrilaterals, including square, rectangle, parallelogram, trapezium, kite and rhombus • and triangles and other plane figures using appropriate language		

Challenge and Support:	World wide learning/ links to 21st century:	Cultural capital/ Industry/ Enrichment:

GEOMETRY AND MEASURES
 	
Properties and constructions
1. use conventional terms and notations: points, lines, vertices, edges, planes, parallel lines, perpendicular lines, right angles, polygons, regular polygons and polygons with reflection and/or rotation symmetries; use the standard conventions for labelling and referring to the sides and angles of triangles; draw diagrams from written description
2. use the standard ruler and compass constructions (perpendicular bisector of a line segment, constructing a perpendicular to a given line from/at a given point, bisecting a given angle); use these to construct given figures and solve loci problems; know that the perpendicular distance from a point to a line is the shortest distance to the line
3. apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles; understand and use alternate and corresponding angles on parallel lines; derive and use the sum of angles in a triangle (e.g. to deduce and use the angle sum in any polygon, and to derive properties of regular polygons)
4. derive and apply the properties and definitions of: special types of quadrilaterals, including square, rectangle, parallelogram,
	• Freight costs are dependent upon the volume of material being transported. Freight rates are calculated using the container volume measured against the length of the container. The longer the container the higher the freight cost.
	• Trigonometry means 'triangle measurements' and it is very useful for finding lengths of sides and size of angles. Trigonometry is used to determine lengths and angles in navigation, surveying, astronomy, engineering, construction and even in the placement of satellites and satellite receivers.
	• Vectors have huge applications in the physical world. For example, mathematical modelling of objects sliding down slopes with varying amounts of friction, working out how far objects can tilt before they tip over and making two ships don't crash in the night. All these problems involve the use of vectors.
		Search Algebra for all ages
		
		NRICH website – access current articles and enrichment activities.
		
		• NRICH provides thousands of free online mathematics resources for ages 3 to 18 - completely free and available to all via their website (nrich.maths.org/). These resources aim to:
		  ○ Enrich and enhance the experience of the mathematics curriculum for all learners
		  ○ Develop mathematical thinking and problem-solving skills
		  ○ Offer challenging, inspiring and engaging activities
		• Problem solving opportunities – Applied Mathematics.
		• Challenge problems.
		• Extension work.
		• Assessment sections in texts

trapezium, kite and rhombus; and triangles and other plane figures using appropriate language 5. use the basic congruence criteria for triangles (SSS, SAS, ASA, RHS) 6. apply angle facts, triangle congruence, similarity and properties of quadrilaterals to conjecture and derive results about angles and sides, including Pythagoras' Theorem and the fact that the base angles of an isosceles triangle are equal, and use known results to obtain simple proofs 7. identify, describe and construct congruent and similar shapes, including on coordinate axes, by considering rotation, reflection, translation and enlargement (including fractional **and negative** scale factors) 10 8. **describe the changes and invariance achieved by combinations of rotations, reflections and translations** 9. identify and apply circle definitions and properties, including: centre, radius, chord, diameter, circumference, tangent, arc, sector and segment 10. **apply and prove the standard circle theorems concerning angles, radii, tangents and chords, and use them to prove related results** 11. solve geometrical problems on coordinate axes		

12. identify properties of the faces, surfaces, edges and vertices of: cubes, cuboids, prisms, cylinders, pyramids, cones and spheres 13. construct and interpret plans and elevations of 3D shapes. Mensuration and calculation 14. use standard units of measure and related concepts (length, area, volume/capacity, mass, time, money, etc.) 15. measure line segments and angles in geometric figures, including interpreting maps and scale drawings and use of bearings 16. know and apply formulae to calculate: area of triangles, parallelograms, trapezia; volume of cuboids and other right prisms (including cylinders) 17. know the formulae: circumference of a circle = $2\pi r = \pi d$, area of a circle = πr^2; calculate: perimeters of 2D shapes, including circles; areas of circles and composite shapes; surface area and volume of spheres, pyramids, cones and composite solids 18. calculate arc lengths, angles and areas of sectors of circles 19. apply the concepts of congruence and similarity, including the relationships between lengths, **areas and volumes** in similar figures 20. know the formulae for: Pythagoras' theorem, $a^2 + b^2 = c^2$, and the trigonometric ratios, $\sin\theta = \frac{opposite}{hypotenuse}$, $\cos\theta = \frac{adjacent}{hypotenuse}$, and		

$\tan\theta = \frac{opposite}{adjacent}$; apply them to find angles and lengths in right-angled triangles **and, where possible, general triangles** in two **and three** dimensional figures 21. know the exact values of $\sin\theta$ and $\cos\theta$ for θ = 0°, 30°, 45° , 60° and 90°; know the exact value of $\tan\theta$ for θ = 0°, 30°, 45° and 60° 22. **know and apply the sine rule, $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$, and cosine rule, $a^2 = b^2 + c^2 - 2bc \cos A$, to find unknown lengths and angles** 23. **know and apply** **Area = $\frac{1}{2} ab \sin C$** **to calculate the area, sides or angles of any triangle.** 11 Vectors 24. describe translations as 2D vectors 25. apply addition and subtraction of vectors, multiplication of vectors by a scalar, and diagrammatic and column representations of vectors; **use vectors to construct geometric arguments and proofs**		

Historical, Social, Moral, Spiritual, Cultural context:	Cross curricular links/ literacy/numeracy:	Common misconceptions:
• Explore key mathematicians and links to Geometry e.g Euclid on you tube • History of imperial Measures- google search images.	• Textiles: finding area of materials • Geography coordinate units • History measures/storming castle trip	• Two line segments that do not touch are perpendicular if they would meet at right angles when extended • Pupils may believe, incorrectly, that: - perpendicular lines have to be horizontal / vertical - only straight lines can be parallel - all triangles have rotational symmetry of order 3 • Some pupils may think that all trapezia are isosceles • Some pupils may think that a diagonal cannot be horizontal or vertical • Two line segments that do not touch are perpendicular if they would meet at right angles when extended. Therefore, the diagonals of an arrowhead (delta) are perpendicular despite what some pupils may think • Some pupils may write amounts of money incorrectly; e.g. £3.5 for £3.50, especially if a calculator is used at any point • Some pupils may apply an incorrect understanding that there are 100 minutes in a hour when solving problems • Some pupils may struggle when converting between 12- and 24-hour clock notation; e.g. thinking that 15:00 is 5 o' clock

		• Some pupils may use the wrong scale of a protractor. For example, they measure an obtuse angle as 60° rather than 120°. • Some pupils may think it's the 'base' angles of an isosceles that are always equal. For example, they may think that a = b rather than a = c. • Some pupils may use the sloping height when finding the areas of parallelograms, triangles and trapezia • Some pupils may think that the area of a triangle is found using area = base × height • Some pupils may think that you multiply all the numbers to find the area of a shape • Some pupils may confuse the concepts of surface area and volume Some pupils may only find the area of the three 'distinct' faces when finding surface area • Some pupils will wrestle with the idea that a line x = a is parallel to the y-axis • When describing or carrying out a translation, some pupils may count the squares between the two shapes rather than the squares that describe the movement between the two shapes. • When reflecting a shape in a diagonal mirror line some students may draw a translation • Some pupils may think that the centre of rotation is always in the centre of the shape

		• Some pupils will confuse the order of x- and y-coordinates When constructing axes, some pupils may not realise the importance of equal divisions on the axes.

Assessment timeline:

- Topic test assessments are conducted at the end of each topic. These are roughly after 2 weeks per topic, but this may vary.
- Pre-checks are conducted at the start of the topic to test student prior knowledge. This informs lesson planning and delivery.
- Tracking assessments are conducted once a term with end of year formal exams, for reporting and checking cumulative knowledge.
- Testing data leads to discussions about setting, intervention groups and individual in-class intervention.
- All students have access to a wide range of resources to develop their understanding.

Home learning

- Homework is set weekly for each group. This will often be via interactive websites with immediate feedback and support.
- Teachers have the autonomy to use whichever resource they wish within the criteria set for the topic.
- Students have access to lots of resources at home, including: Kerboodle, MyMaths, Mathswatch, PiXL Maths APP, PiXL Tmes Table App.

Feedback

- Feedback is given after each topic test, tracking assessment and end of year exams. After tracking and end of year exams, this will include “Formative Marking” sheets which give feedback question by question to help support the students with priorities for further work.

Length of unit (duration indicated in lessons)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Unit:																													