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| **UNIT 13: Sine and cosine rules, *ab* sin *C*, trigonometry and Pythagoras’ Theorem in 3D, trigonometric graphs, and accuracy and bounds** |

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**SPECIFICATION REFERENCES**

N16 apply and interpret limits of accuracy, **including upper and lower bounds**

A5 understand and use standard mathematical formulae; rearrange formulae to change the subject

A8 work with coordinates in all four quadrants

A12 recognise, sketch and interpret graphs of linear functions, quadratic functions, simple cubic functions, the reciprocal function  with *x* ≠ 0, **exponential, functions   
*y* = *kx* for positive values of *k*, and the trigonometric functions (with arguments in degrees) *y* = sin *x*, *y* = cos *x* and *y* = tan *x* for angles of any size**

A13 **sketch translations and reflections of a given function**

G11 solve geometrical problems on coordinate axes

G20 know the formulae for: Pythagoras’ Theorem *a*2 + *b*2 = *c*2 and the trigonometric ratios, sine, cosine and tan; apply them to find angles and lengths in right-angled triangles **and, where possible, general triangles** in two **and three** dimensional figures

G21 know the exact values of sin *θ* 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°

G22 **know and apply the sine rule**  **=**  **=** **, and cosine rule   
*a*2 = *b*2 + *c*2 – 2*bc* cos *A*, to find unknown lengths and angles**

G23 **know and apply Area = *ab* sin *C* to calculate the area, sides or angles of any triangle**

**PRIOR KNOWLEDGE**

Students should be able to use axes and coordinates to specify points in all four quadrants.

Students should be able to recall and apply Pythagoras’ Theorem and trigonometric ratios.

Students should be able to substitute into formulae.

**KEYWORDS**

Axes, coordinates, sine, cosine, tan, angle, graph, transformations, side, angle, inverse, square root, 2D, 3D, diagonal, plane, cuboid

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| **13a. Graphs of trigonometric functions**  (A8, A12, A13, G21) | **Teaching time**  5–7 hours |

**OBJECTIVES**

By the end of the sub-unit, students should be able to:

* Recognise, sketch and interpret graphs of the trigonometric functions (in degrees)   
  *y* = sin *x*, *y* = cos *x* and *y* = tan *x* for angles of any size.
* Know the exact values of sin *θ* and cos *θ* for *θ* = 0°, 30°, 45° , 60° and 90° and exact value of tan *θ* for *θ* = 0°, 30°, 45° and 60° and find them from graphs.
* Apply to the graph of *y* = f(*x*) the transformations *y* = –f(*x*), *y* = f(–*x*) for sine, cosine and tan functions f(*x*).
* Apply to the graph of *y* = f(*x*) the transformations *y* = f(*x*) + *a*, *y* = f(*x* + *a*)   
  for sine, cosine and tan functions f(*x*).

**POSSIBLE SUCCESS CRITERIA**

Match the characteristic shape of the graphs to their functions and transformations.

**OPPORTUNITIES FOR REASONING/PROBLEM SOLVING**

Match a given list of events/processes with their graph.

Calculate and justify specific coordinates on a transformation of a trigonometric function.

**NOTES**

Translations and reflections of functions are included in this specification, but not rotations or stretches.

This work could be supported by the used of graphical calculators or suitable ICT.

Students need to recall the above exact values for sin, cos and tan.