Unit 92: Mathematics for Aircraft Maintenance

Unit code: R/600/9069

QCF Level 2: BTEC Firsts

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit will develop a range of mathematical skills needed to solve aircraft maintenance related problems. Learners will use arithmetic and number systems, algebraic and trigonometric methods and geometric techniques.

Unit introduction

This unit will develop the specific mathematical knowledge and skills required to successfully complete the European Aviation Safety Agency (EASA) Part 66 mathematics module.

Aircraft maintenance technicians need to be able to quickly check vital mathematical data while carrying out maintenance activities. This unit has been designed to give learners the arithmetic, algebraic, trigonometric and geometric skills that are needed to check and interpret the mathematical data essential for aircraft maintenance.

The unit introduces learners to the arithmetic laws and decimal numbers, powers, estimation techniques and the nature and manipulation of fractions. Denary, binary, octal and hexadecimal number systems are covered, providing learners with the necessary foundation for the study of avionic microelectronics.

The laws of indices and logarithms are introduced, together with their use in simplifying algebraic expressions and the use of logarithms to simplify arithmetic operations. Learners will develop an understanding of factors and factorisation as a means of simplifying and manipulating algebraic expressions and transposing engineering formulae. Linear and quadratic equations are covered, as is their solution using graphs, simultaneous equations, factorisation and the quadratic formula.

Learners will be introduced to the basic trigonometric ratios and Pythagoras' theorem and their use in the solution of right-angled triangles. Cartesian and polar coordinates, graphs of the trigonometric functions, areas and volumes of regular solids, together with a few simple engineering applications of these principles will also be covered.

In the final learning outcome, the geometry of the circle and selected geometric theorems are covered and these theorems and other techniques are applied to the solution of simple engineering problems, including geometric constructions.

Learning outcomes

On completion of this unit a learner should:

1 Be able to use arithmetic and number systems

2 Be able to use algebraic laws and methods to simplify expressions, manipulate formulae and solve engineering equations

3 Be able to use trigonometric methods and standard formulae to solve engineering problems and determine areas and volumes of solids

4 Be able to apply geometric theorems of the circle and geometric techniques to solve geometric problems and produce constructions.

Unit content

1 Be able to use arithmetic and number systems

Arithmetic laws and operations: numbers types, laws and operations; positive and negative integers, rational, irrational and real numbers, the laws of signs, the laws of precedence (BODMAS), arithmetic operations (addition, subtraction, multiplication and division); decimal numbers, powers of ten, estimation techniques; fractions (numerator, denominator, lowest common multiple (LCM), highest common factor (HCF), proper and improper fractions, multiplication, division, addition and subtraction of fractions); percentages and averages, ratio and proportion, constant of proportionality

Number systems: denary numbers and base ten, binary numbers and base 2, conversion of denary to binary and binary to denary, least significant digit (LSD), most significant digit (MSD), other number systems (such as octal numbers to base 8 and hexadecimal to base sixteen, conversion of binary to hexadecimal and hexadecimal to binary)

2 Be able to use algebraic laws and methods to simplify expressions, manipulate formulae and solve engineering equations

Indices: numbers in index form (power, base, index), laws of indices ($a^m \times a^n = a^{m+n}$, $\frac{a^m}{a^n} = a^{m-n}$, $(a^m)^n = a^{mn}$), simplification and evaluation of expressions using the laws of indices;

significance and form of logarithms eg logarithms (to base 10), natural logarithms (base e), characteristic and mantissa of a logarithm, antilogarithms, use of logarithms and logarithm tables to perform arithmetic operations (multiplication, division, finding powers and roots)

Factorisation: multiply expressions in brackets by a number, symbol or by another expression in a bracket; by extraction of a common factor eg $ax + ay$, $a(x + 2) + b(x + 2)$; by grouping eg $ax - ay + bx - by$; factorise quadratic expressions eg $a^2 - b^2$, $a^2 + 2ab + b^2$; simply expressions by multiplication, cancellation and factorisation

Transposition and evaluation of formulae: apply the laws of algebra and arithmetic to transpose eg formulae involving linear terms, formulae involving powers and roots, formulae involving fractions, formulae involving the isolation of a common factor

Linear equations and straight line graphs: solve linear equations using the laws and techniques of algebra and arithmetic; solve linear equations graphically eg law of a straight line $y = mx + c$, straight line graph (coordinates on a pair of labelled Cartesian axes, positive or negative gradient, intercept, plot of a straight line, solving the law of a straight line); solve simultaneous linear equations analytically and graphically

Solve quadratic expressions and equations: eg solve equations of the form $ax^2 + bx + c$ with real roots, graphically (Cartesian coordinates, table of values, parabolic shape, effects of altering the constants (a, b and c), roots of the equation at the x-axis), factorisation by use of formula

3 Be able to use trigonometric methods and standard formulae to solve engineering problems and determine areas and volumes of solids

Trigonometric ratios and measurement: ratios (sine, cosine and tangent) for right-angled triangle; use of tables to find angles for sine, cosine and tangent ratios; use of ratios, Pythagoras' theorem and area rule $A = 0.5bh$ to solve right-angled triangles

Graphs of trigonometric functions: rectangular (Cartesian) and polar coordinate systems, use of trigonometric ratios and Pythagoras' theorem to convert rectangular to polar and vice versa $r = \sqrt{x^2 + y^2}$, $\tan\theta = \frac{y}{x}$, $y = r\sin\theta$, $x = r\cos\theta$; values and plots for sine/cosine/tangent functions from 0° to 360°; periodic properties of the trigonometric functions; problems eg determination of variables from graphs of trigonometric functions, resolution of forces for a vector diagram, angles of elevation/depression, determination of bearings from given data

Area and volume of solids: eg standard formulae to solve surface areas and volumes of regular solids eg circle $A = \pi r^2$, $A = \pi d^2/4$ parallelogram $A =$ base multiplied by the perpendicular height between parallel sides, volume of a cylinder $= \pi r^2 h$, total surface area of a cylinder $2(\pi rh + \pi r^2)$, volume of sphere $= \frac{4}{3} \pi r^3$, surface area of a sphere $= 4 \pi r^2$, volume of a cone $= \frac{1}{3} \pi r^2 h$, curved surface area of cone $= \pi r$ x slant height

4 Be able to apply geometric theorems of the circle and geometric techniques to solve geometric problems and produce constructions

The circle: elements eg diameter, radius, centre, circumference, tangent, point of tangency, chord, sector, minor and major segments; theorems eg the angle of an arc subtended at centre is twice the angle it subtends at the circumference, angles in the same segment of a circle are equal, the triangle on a semi-circle is always right-angled, the opposite angles of any cyclic quadrilateral are equal to 180 degrees; tangency theorems eg a tangent to a circle is at right angles to a radius drawn from the point of tangency, the angle between a tangent and a chord drawn from the point of tangency equals half of the angle at the centre subtended by the chord, if two circles touch either internally or externally then the line that passes through their centres also passes through the point of tangency; applying geometric theorems to engineering problems eg gear wheels in mesh, marking out, finding centre of round bar, sheet metal developments

Geometric constructions: using theorems of the circle and other techniques eg to bisect a given angle when the arms of the angle meet, bisect a given angle when the arms do not meet, set out angles using the trigonometric ratios, find the centre of a given circle, draw a common external tangent to two given circles, draw the inscribed circle for a given triangle, draw a hexagon given the length of one side, blend an arc in a right angle, draw an arc from the point to a circle of radius *r*

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 define integers and rational numbers and give two examples of each [IE1, IE4]	**M1** solve two problems that require the conversion of denary to hexadecimal and vice-versa	**D1** for two separate complex solids made up from regular shapes, determine the surface area, the volume and weight of each solid, given their densities
P2 apply the laws of signs and precedence and use arithmetic operations to manipulate and simplify four arithmetic expressions [IE1, IE4]	**M2** solve graphically a pair of simultaneous equations and check the solution using an analytical method	**D2** solve two separate aircraft engineering problems, one that requires the combined use of arithmetic operations and ratios and the other that requires the combined use of trigonometric functions and geometric theorems.
P3 use powers of ten and arithmetic operations to obtain estimates to a stated accuracy, for three arithmetic expressions that have two, three and four terms, respectively [IE1, IE4]	**M3** solve two quadratic equations, one using factorisation and the other by use of the quadratic formula	
P4 manipulate and simplify four separate expressions involving fractions, that collectively require use of all basic arithmetic operations	**M3** solve two engineering problems where each involves the application of a geometric theorem.	
P5 solve two problems on percentages, averages and ratios/proportion, respectively [IE1, IE4]		
P6 solve two problems that require the conversion of denary to binary numbers and two problems that require the conversion of binary to denary [IE1, IE4]		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P7 manipulate and simplify three algebraic expressions using the laws of indices [IE1, IE4]		
P8 explain the meaning of the characteristic and mantissa of a logarithm and use logarithm and anti-logarithm tables to perform the arithmetic operations of multiplication, division, powers and roots [IE1, IE4]		
P9 factorise algebraic expressions containing two, three and four terms by extraction and grouping of common factor/s [IE1, IE4]		
P10 transpose and evaluate two formulae that involve linear terms, powers and roots and fraction [IE1, IE4].		
P11 solve a linear equation by plotting a straight line graph using experimental data and use it to deduce the gradient, intercept and equation of the line [IE1, IE4]		
P12 plot a quadratic equation with real roots on Cartesian coordinates and from the graph find the roots of the equation [IE1, IE4]		
P13 solve triangular measurement problems that involve the use of Pythagoras' theorem and the sine, cosine and tangent functions [IE1, IE4]		
P14 use Pythagoras' theorem and the basic trigonometric ratios to convert two Cartesian coordinates to polar coordinates and two polar coordinates to Cartesian coordinates [IE1, IE4]		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P15 plot each of the three basic trigonometric functions over one complete cycle and determine for each plot the value of the function at 45°, 90° and 180° [IE1, IE4]		
P16 solve problems that involve finding the area of a circle and the surface area and volume of a sphere and right cylinder [IE1, IE4]		
P17 sketch and label a circle showing the diameter, circumference, tangent to a point, sector and major and minor segments [IE1, IE4]		
P18 solve two geometric problems that require knowledge of two different geometric theorems, associated with the circle [IE1, IE4]		
P19 produce constructions for bisecting a given angle, finding the centre of a circle and drawing the inscribe circle for a given triangle [IE1, IE4].		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

This unit has been designed primarily for those learners who are, or intend to be, aircraft maintenance technicians. Where tutors are delivering the unit as preparation for the EASA Part 66 mathematics module they will need to emphasise the non-calculator approach used by the EASA examination.

The learning outcomes are best delivered in order. When delivering learning outcome 1, only the laws of signs and the law of precedence for arithmetic operations need to be emphasised. Examples of the simplification of arithmetic expressions should be given that involve the use of both these laws. The complexity of the decimal numbers involved will depend on whether the centre is allowing the use of calculators. For these exercises and indeed for all the numerical content, it would be better to restrict the use of calculators to that of a checking function.

When delivering the unit content on estimation techniques, the use of reducing numbers to standard form should prove useful. When delivering the content on fractions, examples involving the use of all the arithmetic operations should be given. Tutors should try to use relevant examples that involve simple engineering applications when covering percentages, averages, ratio and proportion. When delivering the content on number systems, emphasis should be placed on binary numbers and their use and conversion. Once the conversion of binary numbers has been fully understood, the use and conversion of octal and especially hexadecimal numbers can be explained and practised.

A knowledge of the laws of logarithms is not required for this unit, but tutors should provide an explanation of the significance of logarithms and their form (to base 10 and to base e). Those learners preparing for the EASA Part 66 examination will need to understand the significance of the mantissa and characteristics of a logarithm and how numerical problems involving multiplication, division and finding powers and roots can be simplified using log tables. Tutors should note when delivering this material that no tables are allowed to be used in EASA examinations. Therefore learners only need to recognise the form/significance of logarithms to provide an estimate of the denary numbers involved in a calculation. This is also true when learners are required to estimate values for the square and square root of numbers.

Factorisation involving bracketed expressions and removing common factors, together with a full understanding of the rules and methods used to manipulate and evaluate formulae should be taught before the content on linear and quadratic equations. The analytical solution of linear equations and the significance of the equation of a straight line can be taught before the graphical solution of these equations. Once learners are competent in solving single linear equations both analytically and graphically, pairs of simultaneous linear equations can be introduced. Finally quadratic equations can be taught using graphs and the quadratic formula for their solution. Again, some simple tutor-led problems involving the engineering application of algebraic methods, formulae and equations could be introduced and practised by learners.

Once the trigonometric ratios and Pythagoras have been introduced, learners can use them to solve right-angled triangles. For this unit, the use of the sine and cosine rule should not be taught. Graphs of trigonometric functions and the use of polar coordinates need to be covered and should include the conversion of Cartesian to polar coordinates and vice versa. Engineering applications on the use of the trigonometric functions could also be introduced at this stage.

When delivering the unit content on circles, all elements of the circle should be introduced before the relevant theorems are covered. Once learners have mastered all these aspects of geometry, it should be applied to engineering applications. For example, the use of geometry associated with marking out, technical drawing, angles of depression/elevation and aircraft bearings could be used.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Whole-class teaching: • introduction to unit content, scheme of work and assessment strategy • discuss positive and negative integers, real numbers, rational and irrational numbers and literal numbers ie symbol representation of numerical numbers - define and give examples of each. Introduce the laws of signs and precedence (BODMAS) and demonstrate their use when manipulating and simplifying arithmetic expressions, using addition, subtraction, multiplication and division • explain decimal numbers and the use of powers of ten and numbers in standard form, to provide estimates of arithmetic expressions • discuss significant figure and decimal place accuracy, the determination of estimates to varying degrees of accuracy and how errors vary according to magnitude of numbers and arithmetic operations • explain the use, manipulation and simplification of proper and improper fractions, (including numerator, denominator, lowest common multiple, highest common factor) and discussion of the solution of fractions involving, multiplication, division, addition, subtraction and cancelling • show how to determine percentages, averages, ratios and proportion, including inverse proportion and the constant of proportionality and to demonstrate the use of these techniques to solve simple scientific and engineering problems • explain the use and nature of binary numbers (including base 2, significance of least significant bit and most significant bit and on/off state). Conversion of denary to binary and binary to denary • discuss other number systems, their use and the methods used for their conversion, octal and hexadecimal. Show how to convert denary to hexadecimal and vice-versa. *Individual learner activities:* • tutor-led exercises involving numbers, the use of arithmetic laws and the manipulation and simplification of numerical expressions of varying degrees of difficulty • solution of problems involving the determination of estimates for a range of arithmetic expressions • solution of problems involving the manipulation and simplification of fractions, with a varying number of terms and complexity • solution of problems involving percentages, averages, ratios, proportion • solution of problems involving the conversion of denary numbers to binary and to hexadecimal and vice-versa
Prepare for and carry out **Assignment 1: Arithmetic Laws, Operations and Number Systems** (P1, P2, P3, P4, P5, P6, M1)
Whole-class teaching: • explain numbers in index form (power, base, index), discuss the laws of indices, showing examples of the use of each law • explain the significance and form of logarithms (to the base 10), and natural logarithms (to base e) and using tables define the characteristics and mantissa of a logarithm • demonstrate use of logarithms to simplify and perform arithmetic operations such as long multiplication, long division and finding powers and roots.

Topic and suggested assignments/activities and/assessment
Individual learner activities: • exercises on the solution of problems involving the simplification and/or evaluation of expressions involving indices and the use of logarithm tables to perform selected arithmetic operations (checking solutions using a calculator). *Whole-class teaching:* • explain the use of factorisation for simplifying and manipulating algebraic expressions • demonstrate how to multiply bracketed expression by a number, symbol or another bracketed expression, how to extract common factors and how to factorise quadratic expressions • demonstrate how to simplify expressions by use of multiplication, cancellation and factorisation • explain and show how the laws of arithmetic and algebra may be used to transpose and evaluate formula. *Individual learner activities:* • exercises on the solution of problems involving factorisation, the transposition and evaluation of a range of formula and solution of linear and quadratic equations. *Whole-class teaching:* • show how linear equations may be solved analytically and how they can be represented graphically by a straight-line graph • explain the significance of the law of a straight-line graph and of the gradient (positive/negative) and intercept • demonstrate how to plot straight-line graphs (using experimental data) and use them to find the required parameters of a linear equation. • explain how to solve a pair of simultaneous linear equations graphically and then analytically using elimination and substitution • explain how to solve quadratic equations graphically and analytically by factorisation and by use of the quadratic formula. *Individual learner activities:* • exercises on plotting and solving graphically linear equations and paired simultaneous linear equations. Solving problems involving linear and linear simultaneous equations analytically • exercises on the graphical and analytical solution of quadratic equations and a further exercise on scientific and engineering problems, requiring the solution of linear simultaneous equations and quadratic equations.
Prepare for and carry out **Assignment 2: Algebraic and Graphical Methods, Formulae and Equations** (P7, P8, P9, P10, P11, P12, M2, M3)
Whole-class teaching: • introduce Pythagoras' theorem, the trigonometric ratios and the relationship of the trigonometric ratios and Pythagoras to the solution of right-angled triangles, including finding areas • explain the use and form of Cartesian and polar coordinate systems and the use of the trigonometric ratios and Pythagoras' theorem to convert Cartesian to polar coordinates and vice-versa • introduce graphs of the trigonometric functions and note their periodic nature and values for sine/cosine plots between 0° and 360° and tangent plot between 0° and 180°. Note the relationship between these values and the values to be found using a calculator and/or tables • explain the use of standard formulae for solving problems involving the areas, surface areas and volumes of laminar and right solids and for other more complex problems involving a combination of these solid shapes together with other parameters like weight, mass and density.

Topic and suggested assignments/activities and/assessment
Individual learner activities: • tutor-led exercises on the solution of right-angled triangles and the solution of simple engineering problems associated with right-angled triangles • tutor-led solution of problems associated with the plotting and the determination of values for the trigonometric ratios such as bearings and polar plots • exercises on measuration problems concerned with finding the area, volume, mass, weight and/or density of regular solids and any combinations of these solids.
Prepare for and carry out **Assignment 3: Trigonometry, Graphs and Measuration** (P13, P14, P15, P16, D1)
Whole-class teaching: • define the elements of a circle and explain the key theorems and their use in solving geometric problems associated with the circle • explain and show how theorems of the circle and other techniques may be used for geometric constructions (such as the bi-section of a line, setting out angles using the trigonometric ratios, drawing the inscribed circle for a given triangle, drawing a hexagon given one side etc). Individual learner activities: • tutor-led solution of problems on theorems associated with the circle or elements of the circle • tutor-led solution of practical problems involving, measuration, technical drawing and marking out.
Prepare for and carry out **Assignment 4: Geometric Theorems, Techniques and Constructions** (P17, P18, P19, M4, D2)
Feedback on assessment and unit evaluation

Assessment

Because of the unique non-calculator approach recommended for the delivery and assessment of this unit, special care should be taken when designing assessment material, to ensure that it is not overly complex. It is also recommended that for learners who intend to enter for the EASA Part 66 mathematics examination, a more formal approach to assessment is adopted.

In order to ensure that the unit content is assessed in sufficient detail there are a relatively large number of pass criteria. However they are reasonably simple and should not prove too demanding.

To achieve a pass, learners need to define integers (positive/negative) and rational numbers and provide examples of each (P1). They must apply the laws of signs and precedence when using arithmetic operations to manipulate and simplify arithmetic expressions (P2). Learners must use the powers of ten, numbers in standard form and arithmetic operations to obtain estimates to a stated accuracy for arithmetic expressions with an increasing number of terms and complexity (P3). They must manipulate and simplify four expressions involving fractions that require the use of all four basic arithmetic operations (P4). They will also need to solve problems that involve percentages, averages, ratios and proportion (P5) and that require the conversion of denary to binary numbers and vice-versa (P6).

Learners need to manipulate and simplify algebraic expression using the laws of indices (P7). They will need to explain the meaning of the characteristics and mantissa of a logarithm and be able to use logarithm tables to perform and simplify arithmetic operations that involve multiplication, division, powers and roots (P8). They must also be able to factorise algebraic expressions of varying complexity, by extracting and grouping the common factors (P9). Learners must be able to transpose and as appropriate evaluate formulae that involve linear terms, powers and roots and fractions (P10). They must be able to solve linear equations graphically and find the intercept, gradient and equation of the straight line (P11). They must be able to plot a quadratic equation on Cartesian coordinates and find the roots of the equation from the graph (P12).

Learners must be able to solve triangular measurement problems using the sine, cosine and tangent functions and Pythagoras' theorem (P13). They need to convert Cartesian coordinates to polar coordinates and vice-versa, using Pythagoras' theorem and basic trigonometric functions (P14). Learners must be able to plot the three basic trigonometric functions (sine, cosine, tangent) over a complete cycle and find values of these functions at selected angles, as required (P15). They must be able to solve problems that involve finding the area of a circle and finding the surface area and volume of a sphere and right-cylinder.

Learners must sketch and label a circle showing various elements that include a diameter, circumference, tangent to a point, sector and minor and major segments (P17). They need to solve two problems that require knowledge of two different geometric theorems, associated with the circle (P18). They will also need to produce constructions for bisecting an angle, finding the centre of a circle and drawing an inscribed circle within a given triangle (P19).

To achieve a merit grade, learners must solve two problems that involve the conversion of denary to hexadecimal and vice-versa (M1). They will need to solve a pair of linear simultaneous equations graphically and be able to check their graphical solution analytically (M2). Learners must be able to solve two quadratic equations, one using factorisation and the other using the quadratic formula (M3). They must also solve two engineering problems where each involves the application of a geometric theorem (M4).

To achieve a distinction grade, learners must determine the surface area, volume and weight of two separate complex solids, given their densities (or some other relevant facts) (D1). They must be able to solve two separate aircraft engineering problems, one that requires the combined use of arithmetic operations and ratios and the other that requires the combined use of trigonometric functions and geometric theorems (D2).

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4, P5, P6, M1	Arithmetic Laws, Operations and Number Systems	A formal assignment requiring learners to respond to written tasks.	Written response to set tasks, carried out under controlled conditions.
P7, P8, P9, P10, P11, P12, M2, M3	Algebraic and Graphical Methods, Formulae and Equations	A formal assignment (designed in two sections the first covering pass criteria, the second covering merit criteria) both requiring learners to respond to written tasks.	Written response to set tasks (in two sections), carried out under controlled conditions.
P13, P14, P15, P16, D1	Trigonometry, Graphs and Measuration	A formal assignment requiring learners to respond to written tasks.	Written response to set tasks, carried out under controlled conditions.

Criteria covered	Assignment title	Scenario	Assessment method
P17, P18, P19, M4, D2	Geometric Techniques, Theorems and Constructions	Two part assignment consisting of a formal written part (P17 – P19) and an investigative assignment part (M4, D2).	Written response to set tasks, carried out under controlled conditions (P17 – P19) and a written report resulting from investigation (M4, D2).

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Engineering sector suite. This unit has particular links with:

Level 1	Level 2	Level 3
		Principles and Applications of Aeronautical Mechanical Science
		Principles and Applications of Aeronautical Physical Science

This unit has been mapped against the EASA Part 66 examinations and covers all the knowledge requirements for Module 1: Mathematics.

This unit also contributes knowledge towards SEMTA Level 3 National Occupational Standards in Aeronautical Engineering, particularly:

- Unit 5: Marking Out Composite and/or Metallic Aircraft Components.

Essential resources

Learners will need access to a set of standard mathematical tables, that include logarithms, anti-logarithms, squares and roots and possess an electronic scientific calculator, only to be used as directed.

Employer engagement and vocational contexts

Much of the work for this unit can be set in the context of learners' work placements or be based on case studies of local employers. Further information on employer engagement is available from the organisations listed below:

- Work Experience/Workplace learning frameworks — Centre for Education and Industry (CEI -University of Warwick) — www.warwick.ac.uk/wie/cei/
- Learning and Skills Network — www.vocationallearning.org.uk
- Network for Science, Technology, Engineering and Maths Network Ambassadors Scheme — www.stemnet.org.uk
- National Education and Business Partnership Network — www.nebpn.org
- Local, regional Business links — www.businesslink.gov.uk
- Work-based learning guidance — www.aimhighersw.ac.uk/wbl.htm

Indicative reading for learners

Textbooks

Dingle L and Tooley M — *Aircraft Engineering Principles* (Elsevier Science & Technology, 2005) ISBN 07506501 5X

Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
Independent enquirers	identifying questions to answer and problems to resolve and analysing and evaluating information when solving a range of mathematical problems.

Although PLTS are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Reflective learners	setting goals with success criteria for their development and work.

Functional Skills — Level 2

Skill	When learners are ...
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	solving routine aeronautical and general engineering problems, set within aircraft maintenance contexts and situations
Identify the situation or problem and the mathematical methods needed to tackle it	recognising the relevant parameters to be solved and formulae to be applied to given aeronautical and general engineering problems
Select and apply a range of skills to find solutions	selecting and applying formulae to solve scientific and general engineering problems
Use appropriate checking procedures and evaluate their effectiveness at each stage	checking their results of solutions to mathematical problems, using another appropriate method
English	
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	selecting, reading and using appropriate mathematical/scientific data to solve engineering problems