RECOGNISING ACHIEVEMENT

Mathematics for Engineering

Level 3 Certificate in Mathematics for Engineering H860

Version 08.01

QAN 500/4136/8

Contents

1 About this Qualification

This document contains the specification for OCR's Level 3 Certificate in Mathematics for Engineering for teaching from September 2008.

The aim in preparing this specification has been to promote the teaching and learning of mathematics appropriate to engineering, post GCSE, in schools and colleges.

The broad objectives in designing the scheme have been to include a sufficient range of applied mathematical topics to allow schools and colleges to deliver a course to suit the requirements of potential engineering students.

This specification has been designed to develop the knowledge and understanding required to enable progression to qualifications along the vertical and horizontal planes in the National Qualifications Framework.

For example a candidate achieving a Level 3 Certificate in Mathematics for Engineering may:

- undertake additional Level 3 qualifications part-time or full-time in further education, eg OCR Level 3 Principal Learning in Engineering, Diploma in Engineering, Diploma in Manufacturing, Diploma in Construction and the built environment.
- undertake Level 4 qualifications and above, part-time or full-time in further or higher education, eg BEng or MEng.
- progress into employment at technician level.

This qualification in its own right forms part of the Additional and Specialist Learning for the Diploma in Engineering.

1.1 The Level 3 Certificate

The Level 3 Certificate is a 'stand-alone' linear qualification and can be used as Additional Specialist Learning for the Diploma in Engineering, the Diploma in the Construction and the Built Environment and the Diploma in Manufacturing.

From September 2008 the Level 3 Certificate is made up of two externally assessed components. The components will be sat in the same examination series.

1.2 Qualification Title and Level

This qualification is shown on a certificate as:

- OCR Level 3 Certificate in Mathematics for Engineering.

This qualification is Level 3 in the National Qualification Framework (NQF).

1.3 Aims

The aims of this specification are to enable candidates to:

- study the theory of mathematics and then apply this theory in a variety of engineering contexts;
- develop their understanding of mathematics mathematical processes and the application of mathematics in a way that promotes confidence and fosters enjoyment;
- develop abilities to reason logically and recognise incorrect reasoning, to generalise and to construct mathematical proofs;
- extend their range of mathematical skills and techniques and use them in more difficult, unstructured engineering problems;
- develop an understanding of coherence and progression in mathematics and of how different areas of mathematics can be connected to solve engineering problems;
- recognise how a situation may be represented mathematically and understand the relationship between 'real world' engineering problems and mathematical models and how these can be refined and improved;
- use mathematics as an effective means of communication within an engineering context;
- read and comprehend mathematical arguments and articles concerning applications of mathematics in an engineering context;
- acquire the skills needed to use technology such as calculators and computers effectively, recognise when such use may be inappropriate and be aware of limitations;
- develop an awareness of the relevance of mathematics to the field of engineering, to the world of work and to society in general;
- take increasing responsibility for their own learning and the evaluation of their own mathematical development.

1.4 Prior Learning/Attainment

This qualification is available to anyone who is capable of reaching the required standards. It has been developed free from any barriers that restrict access or progression thereby supporting equality and diversity.

It is advisable that anyone embarking upon this course should previously have studied GCSE Mathematics at Higher tier or equivalent and/or be fully familiar with such mathematical content.

The mathematics within this unit can be taught and applied within the contexts of engineering, construction, science and manufacturing, particularly with the Diplomas for Engineering, Manufacturing and Product Design or the Construction and the Built Environment. It is recommended that the teaching of this qualification should be integrated with the teaching of relevant principal learning units.

All centre staff involved in the assessment or delivery of this qualification should understand the requirements and match them to the needs and capabilities of individual learners before entering them as candidates for this qualification. There is no requirement for learners to achieve any qualification before progressing onto this qualification although, as a general guide, learners with qualification profiles comparable to Level 2 of the National Qualifications Framework (NQF) will normally be at a level suitable for entry onto a programme leading to this qualification. Individuals should be considered equally for entry whether they hold certificates easily recognisable against the NQF or present more varied profiles for consideration.

2 Profile of the qualification

2.1 Profile of the qualification

Title	OCR Level 3 Certificate in Mathematics for Engineering			
OCR code	H860			
Level	This qualification has been accredited onto the National Qualifications Framework (NQF) at Level 3.			
QAN	500/4136/8 (Qualification Accreditation Number)			
Age group approved	Pre-16	16-18	18+	19+
		✓	✓	✓
This qualification is suitable for	• Learners studying in preparation for employment in the engineering sector at technician level • Learners wishing to gain a Level 3 qualification to support further study in FE and HE in the engineering sector • Learners wishing to gain a Level 3 qualification to support further study in FE and HE in any other sector or subject area.			
Entry requirements	There are no formal entry requirements for this qualification.			
Qualification structure	Please refer to section 1.1. To achieve this qualification, learners must complete both components.			
External assessment	Both components are externally assessed.			
Grading	This qualification is graded A* - E			
Funding	Information not yet available			
Performance figures	Information not yet available			
Last session date*	June 2013	**Revised date:**		

*OCR will inform centres of changes to these dates. All centre records must be updated accordingly.

3 Component content

The information contained in this component is structured in the same way as the Principal Learning. This will help centre staff and learners to understand fully the requirements of this qualification. This component contains 8 distinct sections. Some cover mandatory requirements, others provide advice and guidance. The 8 sections are described below.

Component level

This section indicates whether the component is at level 1, 2 or 3 on the National Qualifications Framework.

Component size

This section indicates the size of the component in terms of the guided learning hours needed for its completion (see section 5.5).

Component overview

This section provides an overview of the component

Learning outcomes

This section indicates the learning outcomes that a learner will achieve when meeting the assessment criteria associated with the component.

Assessment criteria

This section indicates the criteria that a learner will be assessed against.

For this externally assessed component the learner's skills, knowledge and understanding will be assessed through two examinations.

Content

This section provides information on what should be covered in the teaching programme for the component. The section will provide information on the breadth and depth of the content to be taught and it will supplement the learning outcomes. The information should enable the centre to prepare to deliver the component and ultimately help prepare learners for the external assessment. The question papers will be set in the context of the content.

Form of assessment

This section indicates whether the component will be internally or externally assessed. It specifies the mandatory requirements in relation to the assessment of the component.

Approaches to learning and teaching

This section provides additional guidance for tutors on the variety of methods that can be used to develop knowledge, understanding and skills through a range of learning strategies.

Component

Qualification/Component level Level 3	**Component size** 180 Guided Learning Hours 3 hours 30 minutes will be spent on the examinations

Component overview

The aim of this component is provide the mathematical knowledge and skills needed for the study of engineering.

From the knowledge and understanding of the theory, candidates should develop the ability to develop models and solve problems in the context of engineering.

Practical engineering examples are included to assist the understanding and application of certain mathematical techniques.

Learning outcomes	Assessment criteria	Content
The learner will: 1 understand the idea of mathematical modelling	The learner can: 1.1 identify the assumptions made in establishing a specific mathematical model 1.2 describe and use the modelling cycle	This learning outcome is concerned with the construction of abstract mathematical models from given real life situations in engineering. Techniques to analyse and deduce results from the models are covered in other LOs Fundamental laws of physics including Newton's laws of motion, Hooke's law, Newton's law of cooling, Ohm's law, Kirchhoff's law, Lenz's law, Boyle's law Particular situations are: Projectiles; simple dynamic models involving a spring and a damper; simple electronic circuits involving a resistor, capacitor and inductor; flow of liquid through pipes and tanks, linear and circular movement of objects under the influence of forces and friction; problems involving elasticity, stress and strain; heating and cooling of liquids
2 be familiar with a range of models involving change, and growth and decay.	2.1 use mathematical functions related to growth and decay	This learning outcome is concerned with recognising particular characteristics of mathematical models associated with rates of change and applying appropriate techniques for their analysis and solution. This will include knowledge of exponential functions and the laws of logs. Content includes: e^{kt}, k^x where k is + or –, whole number or fraction.

Learning outcomes	Assessment criteria	Content
	2.2 solve problems involving exponential growth and decay	$log\ a + log\ b = log\ (ab)$ $log\ (ab) = log\ a + log\ b$ *if both* $a > 0$ *and* $b > 0$ $log\ a - log\ b = log\left(\frac{a}{b}\right)$ $log\left(\frac{a}{b}\right) = log\ a - log\ b$ *if both* $a > 0$ *and* $b > 0$ $n\ log\ a = log\left(a^n\right)$, $log\left(a^n\right) = n\ log\ a$ *if* $a > 0$ such as $e^x + e^{-x} = k$ $ln\ x + ln\ x^y = k$, $1n\ x + 1n\ x^y = k$, $1n\ x^y + ln\ x^z = k$ The force *F* on the taut side of a drive belt is given approximately by $F = ke^{\mu\theta}$ where θ is the angle of lap Introduction to the basic formulae involving growth and decay: $y = a(1+ r)^x$, $y = a(1- r)^x$, $y = ae^{bx}$ Solution and graphical interpretation of these equations Content includes radioactive decay, discharge of a battery, charging capacitor, changing sound intensity, liquid heating up in a warm room, compound interest

Learning outcomes	Assessment criteria	Content
	2.3 set up and solve a differential equation to model a physical situation	Solution of first order linear differential equations requiring direct integration, separation of variable and integrating factor techniques. Standard solutions to second order linear differential equations with constant coefficients. Applying initial conditions to find particular solutions. Work done in isothermal expansion content includes: Mixing of solutions Capstan Ventilation of lecture room Belt drive RL and RC circuits $\frac{dF}{d\theta} = \mu F$ $\frac{dl}{dt} = -\frac{R}{L}I$ $\frac{dQ}{dt} + \frac{1}{RC}Q = 0$

Learning outcomes	Assessment criteria	Content
3 understand the use of trigonometry to model situations involving oscillations	3.1 solve problems in engineering requiring knowledge of trigonometric functions.	This learning outcome is concerned with the analysis and solution of models which require the application of trigonometry. Standard trigonometric functions and identities Power factor correction Projectile motion Navigation Identify frequency, phase angle and amplitude in the oscillation involving, such as $y = 2 \cos 3 (t - 0.25 \pi)$ Find the solutions of: $2 \cos 3 (t - 0.25 \pi) = 1$ in the interval $-\pi \leq t < \pi$
	3.2 relate trigonometrical expressions to situations involving oscillations.	Oscillations in mechanical and electrical contexts Mathematical representation of frequency, period, amplitude and phase. Harmonics, resonance, bandwidth. Relationship between time domain and frequency domain Amplitude, angular frequency, phase angle

Learning outcomes	Assessment criteria	Content
4 understand the mathematical structure of a range of functions and be familiar with their graphs	4.1 identify and describe functions and their graphs	Plot and analyse functions of the form $F(x) = ax + b,\ 1/(ax + b),\ Ae^{ax},\ A\log_n x,\ Ax^n$ $f(x) = ax^n + b$, where a and b are real numbers and n is an integer. Composite functions, of the form if $f(x) = x^2$, $g(x) = x + 1$ then $f(g(x)) = (x+1)^2$, $g(f(x)) = x^2 + 1$ Poles, zeros and asymptotes. Inverse functions, of the form if $f(t) = 2t$, $f^{-1}(t) = 0.5t$, $f(x) = 2(x + 3)$: inverse function is $0.5x - 3$ Types of functions to be considered include: linear, rational, composite etc. step functions, ramp function, modulus function, odd and even functions. Velocity-time graphs

Learning outcomes	Assessment criteria	Content
	4.2 analyse functions represented by polynomial equations	Solve quadratic equations using factorisation, completing the square and the standard formula x $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ Formats are $x^2 - 6x + 16 \equiv (x-3)^2 + 7$; $x^2 + 4x - 5 \equiv (x+2)^2 - 9$ $x^2 - 7x + 6 \equiv (x-1)(x-6)$ $x^2 - 6x + 9 \equiv (x-3)^2$ Plot and analyse functions of the form $F(x) = ax^3 + bx^2 + cx + d$ Factorisation of polynomial functions. Polynomial division. Factor theorem, Remainder theorem. Formats are $y = -x^2 + 6x - 5$, projectile path. $y = x^2 + 4$; $y = x^2 - 4$; $y = (x-4)^2$; $y = (x+4)^2$; $y = 3x^2$; $y = (3x+2)^2$ $y = x^3 - 4x$; $y = x^3 - 4x^2$ - Cubic splines $y = x^3 - x^2 + 6x - 6$; $y = (x-2)^3$; $y = (x+2)^3$ Radiation heat loss, deflection of a beam.

Learning outcomes	Assessment criteria	Content
5 know how 2-D and 3-D coordinate geometry is used to describe lines, planes and conic sections within engineering design and analysis	5.1 use equations of straight lines, circles, conic sections, and planes	Determine the equation of a straight line in the form $y=mx+c$, and $ax+by=c$ Determine the equation of a plane in the form $ax+by+cz = d$. General equation of a conic section $Ax^2+Bxy+Cy^2+Dx+Ey+F=0$ Particular cases for a circle, ellipse, parabola, hyperbola and rectangular hyperbola, in the forms $(x-4)^2+(y-b)^2=r^2$, $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, $y^2=4ax$, $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$, $xy=c^2$. Ideal Gas Law Data from an experiment to verify Ohm's law or Hooke's law Stress-strain and Resistance-temperature graphs Linear thermal expansion Velocity of an object with constant acceleration Architecture and Structures, roofs of stadiums, power station cooling towers, suspension bridge cables Hyperboloidal gear sets Car head lamp reflectors, satellite dishes

Learning outcomes	Assessment criteria	Content
	5.2 calculate distances	Distance between two points in 2-D and 3-D space; distance between a point and a line or a plane
	5.3 describe relationships between lines in 3-D	Determine the line formed by the intersection of two planes Determine lines normal to a plane Determine the angle attained by two lines in 3-D space Find a general point on a line Find the angle between two lines

Learning outcomes	Assessment criteria	Content
6 know how to use differentiation and integration in the context of engineering analysis and problem solving	6.1 calculate the rate of change of a function	Elementary rules of differentiation. If $y = x^n$ then $\frac{dy}{dx} = nx^{n-1}$ If $y = f(x) + g(x)$ then $\frac{dy}{dx} = f'(x) + g'(x)$ Standard derivatives. Product rule, quotient rule function of a function rule. Specifically in the following formats: $2e^x$, $\sin x + \ln x$, $3\sin x - 2e^{-x}$, $x \sin 2x$, $\frac{e^x}{x^2+1}$ Equation of the tangent and normal to the curve in the form $y = x^2 - x + 2$ at $x = 3, 0, -0.5$ $P = I^2R$; find rate of change of P with respect to I EMF in search coil. $E = -N\frac{d\phi}{dt}$
	6.2 use derivatives to locate and classify stationary points of a function of one variable	Use the principle, $\frac{dy}{dx} = 0$, to determine stationary points. Use the second derivate, $\frac{d^2y}{dx^2}$, to determine maxima, minima and points of inflection. Maximum power transmitted by a belt

Learning outcomes	Assessment criteria	Content
		Maximum volume of a box from a fixed amount of material and fixed volume of box using the minimum amount of material. Open box, closed box. Rectangular and cylindrical boxes
	6.3 find definite and indefinite integrals of functions	Elementary rules of integration: $\int x^n = \frac{x^{n+1}}{n+1}$, $n \neq -1$ If $y = f(x)$ and $g(x)$ then $\int y dx = \int f(x)dx + \int g(x)dx$ Standard integrals. Integration by parts, integration by partial fractions. Integrals of the form $\int \frac{f'(x)}{f(x)} dx$ and $\int f(x).f'(x)dx$ Relationship between acceleration, velocity and displacement for linear and angular motion Tension and energy in a stretched spring Mean value of a half sine wave, a full sine wave, RMS value of a half sine wave, a full sine wave Magnitude of the magnetic field at point due to the current in a straight wire

Learning outcomes	Assessment criteria	Content
		Energy stored in an inductor after a certain time under varying voltage Reaction time in a second-order chemical reaction
	6.4 use integration to find areas and volumes	Use $\int_a^b f(x)dx$ to determine the area between a curve and the *x* axis and the limits $x = a$ and $y = b$ Use $\int_a^b f(x) - g(x)dx$ to determine the area between the curves and the limits $x = a$ and $x = b$ Use $\int_a^b \pi\, y^2 dx$ and $2\pi\int_a^b xydx$ to determine volumes of revolution. Use standard integrals to determine the centroid of a uniform lamina.

Learning outcomes	Assessment criteria	Content
7 understand the methods of linear algebra. Know how to use algebraic processes	7.1 solve engineering problems using vector methods	Vector representation, scalar and vector quantities. Components of a vector, vectors in space, direction cosine, addition of vectors, scalar product, vector product, angle between two vectors Resultant of vectors. Resolving a vector into two perpendicular components Forces on a robot manipulator Work done against force. Find the work done in moving an object in a straight line
	7.2 use matrices to solve two simultaneous equations in two unknowns	Matrix notation, square matrix, rectangular matrix, row and column vectors. Addition, subtraction and multiplication of matrices. Determinants and the inverse of a square matrix Use of matrices to represent simultaneous equation. Solution of simultaneous equations using the matrix inverses and Cramer's rule
	7.3 solve problems involving arithmetic and geometric sequences and series	Identification of arithmetic and geometric series. Determination of individual terms within and summation of arithmetic and geometric series Summation of infinite series and convergence Definition and use of Binomial series

Learning outcomes	Assessment criteria	Content
		Simple interest. Compound interest. Interest on borrowed sum, total interest paid Discounted cash flow Discharging a capacitor
	7.4 use inequalities	Plotting linear inequalities on a graph. Construction of linear programmes from given situations involving up to three variables Solution of linear programmes involving two variables using graphical techniques for example machine utilisation, mixtures, production planning
	7.5 manipulate complex numbers use complex numbers to solve engineering problems	Definition of a complex number with reference to real and imaginary parts Representation of a complex number in graphical form, in the form $a + bj$, polar form and exponential form. Complex number arithmetic AC linear circuits. Complex impedance of resistor, capacitor or inductor

Learning outcomes	Assessment criteria	Content
8 understand how to describe engineering situations using statistics and use probability as a measure of likelihood	8.1 summarise a set of data	Concept of discrete and continuous data. Frequency distributions, density functions and cumulative frequency Construction of box plots, bar charts, histograms, pie charts, frequency tables. Standard statistical measures – mean, median, mode, range standard deviation content includes discrete and continuous distributions Construct a box plot from the data in a table Mean and standard deviation of data Dimensional variations of mass produced components
	8.2 describe a random sample and how it might be taken	Defining a realistic population, determination of an appropriate sample size Types of sampling Inference of population statistics from sample statistics. Simple hypothesis testing
	8.3 use methods of probability to help solve engineering problems	Basic probability theory. Exclusive and non-exclusive events, dependent and independent events, laws of addition and multiplication, conditional probability. Use Binomial and Poisson distributions. Mean and standard deviation of a distribution

Learning outcomes	Assessment criteria	Content
		Use of the Normal and exponential continuous distribution functions to determine probabilities including in Series and Parallel connections Defects in batches Selection with and without replacement Reliability
9 construct rigorous mathematical arguments and proofs in engineering contexts	9.1 use precise statements, logical deduction and inference 9.2 manipulate mathematical expressions 9.3 construct extended arguments to handle substantial problems	Learners will be expected to construct and present clear mathematical arguments, consisting of logical deductions and precise statements involving correct use of symbols and connecting language. In particular terms such as 'equals', 'identically equals', 'therefore', 'because', 'implies', 'is implied by', 'necessary', 'sufficient', and notations such as ⇨,⇦, ⇔, should be understood and used accurately. In addition, learners are expected to know about mathematical proof: Proof by contradiction Disproof by counter-example.

Learning outcomes	Assessment criteria	Content
10 comprehend translations of common realistic engineering contexts into mathematics	10.1 read critically and comprehend substantial mathematical arguments or examples of applications	Learners will be able to read critically, comprehend substantial mathematical arguments, and reason and draw conclusions by considering a specific engineering context. Learners will communicate their understanding.

Form of assessment

Requirements for assessment

This component will be set and assessed externally. The assessment will take the following format:

Component 1:

1 paper of 2 hours consisting of a number of questions of different lengths and mark allocations

Component 2:

1 paper of 1 hour 30 minutes consisting of a number of questions of different lengths and mark allocations. The questions will be based on an engineering scenario for which there will be pre-release material.

Both components must be sat in the same examination series.

Marking criteria

The total number of marks for this qualification is 100.

Sample assessment material has been developed for both components. It exemplifies the demands we make on the learner in the assessment and through the mark scheme the standard expected of the learner in the assessment. Guidance on the allocation of marks will be detailed in the sample assessment material.

Approaches to learning and teaching

The aim of this qualification is to develop learners' mathematical understanding. The qualification should be delivered in the context of Engineering, so that it can be brought alive, de-mystifying the subject and making it accessible to and achievable by, all students.

Learning through case studies could be utilised, with a teacher-led, dynamic, participant-based approach, built around selected case studies. Through discussion, analysis and sometimes role-play, learners will arrive at new insights about the use of mathematics in engineering. The Royal Academy of Engineering and the Maths Task Group have developed a series of exemplars in conjunction with industry on how maths is used in engineering. These exemplars show how the maths within this syllabus is developed and used by engineers in an industrial context. These exemplars can be found as 'Mathematics for the Engineering 14-19 Diploma' by following the links from:

http://www.raeng.org.uk/education/diploma/maths/default.htm

Another approach is the use of simulations. These can include physical activities that can be used to give a learning experience of engineering and mathematics in an effective and time efficient way, showing how small performance differences can make a significant impact.

Use of computer-based simulation can also be used as a pedagogical tool to encourage learning. The learner's ability to translate the mathematics to a simulated exercise, and the learning they derive from it reinforces the learning outcomes for this qualification.

Applied learning will enhance the teaching of this qualification. It is suggested that opportunities for applied learning are sought within other units/courses being taken by learners.

Opportunities to use and apply the mathematics from this qualification exist in other units within the engineering diploma and in the extended project.

CALCULATORS AND COMPUTERS

Candidates should be encouraged to make appropriate use of graphical calculators and computers eg using graphical calculators to plot polynomial curves or using computers to run a modelling exercise of an engineering process. They should recognise when their use could be inappropriate, the limitations and the need for answers to have an appropriate accuracy.

Candidates will be allowed to use calculators in the exams for this qualification

4 Scheme of Assessment

4.1 Level 3 Certificate Scheme of Assessment

Level 3 Certificate in Mathematics for Engineering (H860)	
Component 1: (01)	
60% of the total marks 2 hrs written paper 60 marks	This question paper consists of a number of questions of different lengths and mark allocations. Candidates answer all questions. This component is externally assessed.
Component 2: (02)	
40% of the total marks 1 hr 30 m written paper 40 marks	This question paper consists of a number of questions of different lengths and mark allocations. This question paper is based on pre-release material which will consist of an engineering related case study. This will enable students to familiarise themselves with any technical language related to the case and allow them to identify areas within the specification that might relate to the case. Students will not be able to take an annotated copy into the exam but they will be given a new copy of the case study in the exam. Candidates answer all questions. This component is externally assessed.

4.2 Learning Outcomes

This qualification has 10 Learning outcomes which are detailed in section 3 of this specification.

All learning outcomes will have some of their assessment criteria assessed in each assessment series.

All assessment criteria will be covered over the life of the qualification to ensure fairness.

LO weightings – Certificate for Mathematics in Engineering

The relationship between the qualification and the learning outcomes of the scheme of assessment is shown in the following grid.

	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10	**Total**
% weighting	15 - 25	5 - 14	5 - 14	5 - 14	3 - 10	10 - 20	5 - 15	5 - 15	3 - 10	5 - 15	**100%**

4.3 Assessment Availability

There are two examination sessions each year, in January and June. The first examination series will be held in January 2010. Candidates must complete both assessment components in the same examination series.

5 Technical Information

5.1 Making Entries

Candidates must enter for:

- Level 3 Certificate in Mathematics for Engineering (entry code H860).

Candidates must complete both assessment components in the same examination series.

5.2 Grading

A candidate's mark for each of the assessment components taken will be combined in the appropriate weighting to give the candidate's total mark for the specification. The candidate's grade will be determined by this total mark.

The Level 3 Certificate in Mathematics for Engineering is awarded on the scale A*-E. Grades are awarded on certificates. However, results for candidates who fail to achieve the minimum grade (E) will be recorded as unclassified (U) and this is not certificated.

5.3 Result Enquiries and Appeals

Under certain circumstances, a centre may wish to query the result issued to one or more candidates. Enquiries about Results for this qualification must be made immediately following the series in which the qualification was taken (by the Enquiries about Results deadline).

Please refer to the JCQ Post-Results Services booklet and the OCR Admin Guide for further guidance about action on the release of results. Copies of the latest versions of these documents can be obtained from the OCR website.

5.4 Qualification Re-sits

There are no restrictions on the number of times a candidate may re-sit this qualification. As this is a linear qualification, candidates will need to re-sit both components.

5.5 Guided Learning Hours

Level 3 Certificate in Mathematics for Engineering is 180 guided learning hours in total.

5.6 Arrangements for Candidates with Particular Requirements

For candidates who are unable to complete the full assessment or whose performance may be adversely affected through no fault of their own, teachers should consult the *Access Arrangements and Special Consideration Regulations and Guidance Relating to Candidates who are Eligible for Adjustments in Examinations*. In such cases advice should be sought from OCR as early as possible during the course.

5.7 Disability Discrimination Act

This qualification has been reviewed to identify whether any of the competences required by the subject present a barrier to candidates with a disability. Where this was the case, such competences were included only where essential to the subject.

Reasonable adjustments may be made for candidates with a disability in order to enable them to access assessments. Applications should be made on an individual basis to OCR, however, centres are encouraged to consider first the access arrangements set out in Section A of the JCQ document *Regulations and Guidance Relating to Candidates who are Eligible for Adjustments in Examinations*. Information on reasonable adjustments can be found within Section B, Chapter 9, of the above-mentioned JCQ publication. In such cases advice must be sought from OCR as early as possible during the course.

Candidates who are unable to access part of the assessment, even after exploring all possibilities through reasonable adjustments, may still be able to receive an award based on the parts of the assessment they have taken.

6 Other Specification Issues

6.1 Key Skills Mapping

These specifications provide opportunities for the development of the Key Skills of *Communication*, *Application of Number*, *Information Technology*, *Working with Others*, I*mproving Own Learning and Performance* and *Problem Solving* at Levels 2 and/or 3. However, the extent to which this evidence fulfils the Key Skills criteria at these levels will be totally dependent on the style of teaching and learning adopted.

The following table indicates where opportunities *may* exist for at least some coverage of the various Key Skills criteria at Levels 2 and/or 3 for each component.

Comp	C	AoN	IT	WwO	IoLP	PS
1	✓	✓	✓		✓	✓
2	✓	✓	✓	✓	✓	✓

6.2 Spiritual, Moral, Ethical, Social, Legislative, Economic and Cultural Issues

Candidates are required to examine arguments critically and so to distinguish between truth and falsehood. They are also expected to interpret the results of modelling exercises and there are times, particularly in statistical work, when this inevitably raises moral, ethical, social and cultural issues. Such issues are not assessed in examination questions.

6.3 Sustainable Development, Health and Safety Considerations and European Developments

There may be opportunities for candidates to address these issues during the course of their study, however this not been addressed by the specification. Such issues are not assessed in examination questions.

6.4 Avoidance of Bias

OCR has taken great care in preparation of this specification and assessment materials to avoid bias of any kind.

6.5 Language

This specification and associated assessment materials are in English only.

6.6 Mode of delivery

OCR does not specify the mode of study or specify a time limit for the achievement of this qualification other than the expiry dates for entry and certification laid down by the regulatory authorities and detailed in the Profile of the Qualification (section 2.1).

Centres are free to deliver this qualification using any mode of delivery that meets the needs of their learners. Whatever mode of delivery is used, centres must ensure that learners have appropriate access to the resources appropriate to the task and as required by the qualification.

Centres should consider the learners' complete learning experience when designing learning programmes. This is particularly important in relation to learners studying part time alongside real work commitments where they may bring with them a wealth of experience that should be utilised to maximum effect by tutors, teachers and assessors.

6.7 Progression from this Qualification

This qualification is designed to enable candidates to progress either directly to employment, or to proceed to further qualifications. For example, candidates achieving this qualification as part of the Diploma may progress to Higher Education or to employment within the engineering sector.

7 Further Support and Information

7.1 General enquiries

For general enquiries relating to any of OCR's qualifications, please contact the OCR Customer Contact Centre:

For queries relating to vocational qualifications:
Telephone: 02476 851 509
Fax: 02476 421 944
Email: vocational.qualifications@ocr.org.uk

For queries relating to general qualifications:
Telephone: 01223 553 998
Fax: 01223 552 627
Email: general.qualifications@ocr.org.uk

(The teams in both our contact centres can help you with your queries relating to Diplomas, Principal Learning and Project.)

Alternatively, you could visit OCR's website at www.ocr.org.uk for further information on OCR qualifications.

7.2 OCR Training Events

Information on OCR's training events for centres can be found on our website by going to www.ocr.org.uk, or by contacting:

OCR Training
Customer Support Division
Progress House
Westwood way
Coventry
CV4 8JQ

Telephone: 02476 496 398
Fax: 02476 496 399
Email: training@ocr.org.uk

7.3 OCR Publications

OCR's *Publications Catalogue* (A410) lists all the qualifications that OCR offers, and contains more detail on how to order publications. It is available to download from the OCR website at www.ocr.org.uk or to order from the OCR Customer Contact Centre by telephoning 02476 851 509, or 01223 553 998.

If you would like to order any OCR Publications, please contact:

OCR Publications
PO Box 5050
Annesley
Nottingham
NG15 0DL

Telephone: 0870 770 6622
Fax: 0870 770 6621
Email: publications@ocr.org.uk

OCR Support Materials prepare extra resources to help you deliver our qualifications. These support materials can be ordered from OCR Publications and more information about the materials can be obtained from support.materials@ocr.org.uk

7.4 OCR Diplomas

OCR diplomas will be introduced into centres between 2008 and 2014. Designed principally, although not exclusively, for 14 to 19-year-olds, each diploma explores a range of widely applicable skills and knowledge within the context of one employment sector. At the heart of the diploma is the concept of applied learning – acquiring knowledge and skills through tasks or contexts that have many of the characteristics of real work.

Each diploma has three components:

Principal learning

Generic learning

Additional and specialist learning

For a full list of the Diploma work related sectors please refer to www.qca.org.uk