

QUADRATIC EQUATIONS

$$ax^2 + bx + c = 0$$

There are three main methods to solve

1. factorising (always try first)
2. using the 'formula'
3. completing the square

Factorising

To solve $x^2 - 4x - 21 = 0$

$$(x + 3)(x - 7) = 0 \Rightarrow x = -3, \text{ or } x = 7$$

Formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$b^2 - 4ac$ is called the discriminant

- If $b^2 - 4ac = 0$ then there are two equal solutions.
- If $b^2 - 4ac > 0$ then there are two different (distinct) real solutions.
- If $b^2 - 4ac < 0$ then there are two complex conjugate solutions of the form $a \pm bj$ where a and b are real numbers; sometimes the letter i is used instead of j .

Completing the square

$$\begin{aligned} \text{to solve } & x^2 - 4x + 3 = 0 \\ \Rightarrow & (x - 2)^2 - 4 + 3 = 0 \\ \Rightarrow & (x - 2)^2 = 1 \\ \Rightarrow & x - 2 = \pm\sqrt{1} \\ \Rightarrow & x = 2 \pm \sqrt{1} \\ \Rightarrow & x = 3 \text{ or } 1 \end{aligned}$$

Note in this case the left-hand side factorises, and this would have been an easier method.

(The above is the type of information found in the mathscard app)

TOPIC AREAS IN CERTIFICATE

The qualification covers the following topic areas:

1. Mathematical models in engineering
2. Proportion and linear laws
3. Polynomial curves
4. Functions
5. Trigonometric functions and identities
6. Exponential and logarithmic functions
7. Sequences and series
8. Rates of change and differentiation
9. Stationary points and optimisation
10. Indefinite integration
11. Definite integration and applications
12. Further techniques of integration
13. Factors and remainder theorems, inequalities
14. Complex numbers
15. Vector methods
16. Matrices and determinants
17. Modelling with differential equations
18. Geometry of conic sections
19. 2D and 3D geometry
20. Descriptive statistics
21. Probability

For more details, see

http://www.ocr.org.uk/qualifications/type/ogq/maths/eng_l3_cert/index.html

Mathematics for Engineering

Level 3 Certificate (H860)

$$f(x) \sim a_0 + \sum_{n=1}^{\infty} \left(a_n \cos \frac{n\pi x}{L} + b_n \sin \frac{n\pi x}{L} \right)$$

$$P = \frac{1}{2} \rho A V^3$$

A qualification for those who aspire to an engineering degree

Blyth wind farm, Northumberland, photograph courtesy of E.ON Climate & Renewables



What is *Mathematics for Engineering*?

Mathematics for Engineering is an OCR 'stand-alone' qualification and can be used as a part of Additional Specialist Learning (ASL), building on the mathematical content of the Diploma in Engineering. In addition, it can be used in the Diploma in Construction and the Built Environment and the Diploma in Manufacturing and Product Design, although in these cases students would need the additional mathematics contained in OCR's Level 3 Certificate in Mathematical Techniques and Applications for Engineers (H865) to bring them to the standard required to start *Mathematics for Engineering*. As a 'stand-alone' qualification, it can be taken by anyone wishing to gain the mathematical skills needed to study engineering.

What is different about the qualification?

The qualification is intentionally contextual in its approach and should benefit the learner who likes to understand how what is being taught is used.

What is the qualification for?

This qualification is designed to promote the teaching and learning of mathematics essential for engineering, and fulfils the mathematical entry requirements of most engineering degrees in Britain.

Who developed the specification?

Mathematics for Engineering was designed under the auspices of the Engineering Professors' Council, The Higher Education Academy's Engineering Subject Centre, The Royal Academy of Engineering, experts from universities and other bodies involved in engineering education, helped by experts in the teaching of mathematics in schools and by engineers. The final specification was written by OCR.

What do you need to know before you start?

Mathematics for Engineering (H860) builds on the skills acquired in Unit 8 of the Advanced Engineering Diploma or OCR's H865. H860 can also be studied by those taking other diplomas at the appropriate level. It is recommended that the prerequisite mathematics is acquired prior to studying *Mathematics for Engineering*. Anyone that has not successfully studied either Unit 8, H865 or does not have the equivalent mathematical knowledge will find *Mathematics for Engineering* (H860) very challenging.

Does the qualification attract a UCAS tariff?

For an A grade, the *Mathematics for Engineering* (H860) qualification attracts 90 UCAS points which is 50% more than an AS qualification.

How is it examined?

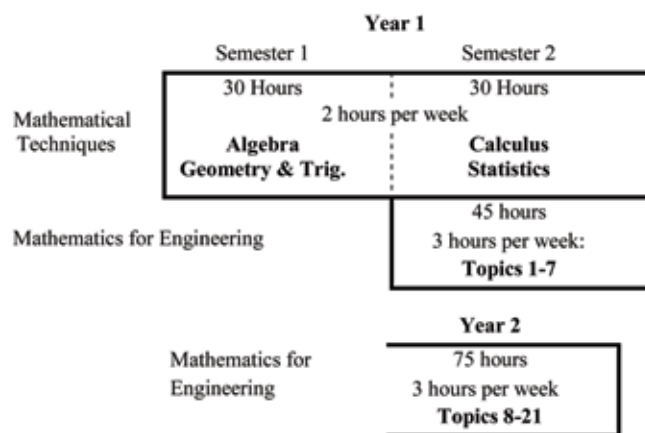
There is a two-part exam at the end of the qualification. Paper one comprises questions aimed at examining a student's understanding across the breadth of the syllabus, while the second paper is based around a real engineering scenario and examines a student's ability to use mathematics in engineering situations. The scenario, but not the questions, is released prior to the examination.

How could it be taught?

It is recommended that the teaching sequence of Unit 8 (or H865) and *Mathematics for Engineering* follows the time schedule shown below, allowing students who find Unit 8 challenging the time to develop essential skills prior to *Mathematics for Engineering*.

It is advisable that the delivery of algebra, geometry and trigonometry in the first thirty-hour block of Unit 8 takes place before starting *Mathematics for Engineering*. The second thirty hours of Unit 8, which cover introductory calculus and statistics, are later reinforced and developed in *Mathematics for Engineering*. - Topics 1-7 may be covered in any order. Topics 8-21 are delivered in a further 75 hours in the following year.

A possible scheme of work can be found on the OCR web site, the address of which is given at the end of this document.



Note that all hours given in this document are indicative and will vary according to the teaching approach taken.

Some useful information Give this to a student who wants to find out more

The following web sites gives more information about the Diploma and mathematics

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

http://engineeringdiploma.com/students_parents.aspx

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

http://www.direct.gov.uk/en/EducationAndLearning/QualificationsExplained/DG_070676

<http://www.mei.org.uk/index.php?section=industry&page=diploma>

<http://www.furthermaths.org.uk/diploma.php>

Maths App

Mathscard app is completely free of charge and, even better, works on over 150 different devices, including Nokia, Samsung, Sony Ericsson, Android, iPhone, iPod touch, BlackBerry, and many more!

From your mobile, simply browse to www.mathscard.co.uk/mobile. The webpage then provides links to download the app for each type of handset (iPhone/iPod touch, BlackBerry, Android, Nokia, Samsung, Sony Ericsson, LG etc.)