



# Mathematics Equivalence Test

To prepare for your equivalence test:

- Look at the list of questions (2005-2009) - Your Equivalence test questions will cover a sample of the mathematics from the Foundation with that content. Add to your skills against the list, but do not rely on it as a substitute for your preparation.
- Try the sample papers provided by the University of Worcester and mark them using the solutions which include possible methods.
- Try the specimen GCSE papers from the four examination boards (see below).
- Try additional GCSE papers available from the examination boards and on the internet. The more recent papers are a better match to the question style than the older papers. All will help to refresh your skills and understanding.

For specimen papers from each examination board see:

<http://www.aqa.org.uk/subjects/maths/qualifications/gcse/maths-0999>

<http://www.cie.org.uk/qualifications/igcse/qualifications/igcse/mathematics-2015.html>

<http://www.educas.co.uk/qualifications/maths/igcse/>

<http://www.ocr.org.uk/qualifications/gcse-mathematics-1999-from-2016>

For additional support materials see:

<http://www.impartonmaths.com/>

<http://www.maths.com/> Maths revision for notes and information

<https://www.foundationonline.com/> will have to register

<http://www.bbc.co.uk/education/subjects/738nvw>

<https://www.bbc.com/news/education-2016-08-24>

<https://www.maths.com/> Notes, games and online simple questions

<http://www.reviseigcsemaths.co.uk/> Notes, questions and links to other

## Content list

### Audit your understanding

#### Number - Structure and calculation

- order positive and negative integers, decimals and fractions
- apply the four operations, including formal written methods for integers, decimals, fractions (proper and improper), and mixed numbers – all both positive and negative; understand and use place value (e.g. when working with decimals)
- recognise and use relationships between operations, including inverse operations (e.g. cancellation to simplify calculations and expressions); use conventional notation for priority of operations, including brackets, powers, roots and reciprocals
- use the concepts and vocabulary of prime numbers, factors (divisors), multiples, common factors, common multiples, highest common factor, lowest common multiple, prime factorisation, HCF using product notation and the unique factorisation theorem
- use positive integer powers and associated real roots (square, cube and higher); recognise powers of 2, 3, 4, 5; calculate with roots, and
- calculate exactly with fractions and multiples of  $\pi$
- calculate with and interpret standard form  $A \times 10^n$ , where  $1 \leq A < 10$  and  $n$  is an integer

#### Number - Fractions, decimals and percentages

- work interchangeably between terminating decimals and their corresponding fractions (such as 5.5 and  $5\frac{1}{2}$ , 0.375 or  $\frac{3}{8}$ )
- identify and work with fractions in ratio
- interpret fractions and percentages as operators

#### Number - Measures and units

- use standard units of mass, length, time, money and other measures using decimal quantities where appropriate
- use standard units (including standard compound units)
- estimate answers; check calculations using approximation and estimation, including using a calculator and technology
- round numbers and measures to an appropriate degree of accuracy (e.g. as specified in a problem or to a specified number of significant figures.)
- use inequality notation to specify simple error intervals due to truncation or rounding
- apply and interpret limits of accuracy

#### Algebra - Notation, vocabulary and manipulation

- use and interpret algebraic notation, including:
  - $ab$  in place of  $a \times b$
  - $2a$  in place of  $a + a$  or  $a \times 2$
  - $a^2$  in place of  $a \times a$ ,  $a^3$  in place of  $a \times a \times a$ ,  $a^2b$  in place of  $a \times a \times b$
  - $\frac{1}{h}$  in place of  $a \div b$
  - coefficients written as fractions rather than as decimals
  - brackets
- substitute numerical values into formulae and expressions, including scientific formulae
- understand and use the concepts and vocabulary of expressions, equations, formulae, identities, Inequalities, terms and factors
- simplify and manipulate algebraic expressions including those involving surds by:
  - collecting like terms
  - multiplying a single term over a bracket
  - taking out common factors
  - expanding products of two binomials
  - factorising quadratic expressions of the form  $ax^2 + bx + c$ , including the difference of two squares
  - simplifying expressions involving sums, products and powers, including the laws of indices
- understand and use the mathematical formulae  $y = mx + c$  and  $y = a(x - h)^2 + k$ , where appropriate, interpret simple expressions as directions with inputs and outputs
- know the difference between an equation and an identity; argue mathematically to show algebraic expressions are equivalent; use algebra to support and construct arguments



## Algebra - Graphs

work with coordinates in all four quadrants

plot graphs of equations that correspond to straight line graphs in the coordinate plane; use the form  $y = mx + c$  to identify parallel lines

find the equation of the line through two given points

identify and interpret gradients and intercepts of linear functions graphically

identify and interpret roots, intercepts and turning points of quadratic functions graphically; deduce roots (of quadratic functions) algebraically

recognise, sketch and interpret graphs of linear, quadratic, simple cubic functions and the reciprocal function  $y = 1/x$  with  $x \neq 0$

plot and interpret graphs including reciprocal graphs to find approximate solutions to problems

plot and interpret graphs of non-standard functions in real contexts to find approximate solutions to problems

plot and interpret graphs to find approximate solutions to problems such as simple kinematic problems involving distance, speed and acceleration

## Algebra - Solving equations and inequalities

solve linear equations in one unknown algebraically including those with the unknown on both sides of the equation; find approximate solutions using a graph

solve quadratic equations algebraically by factorising; find approximate solutions using a graph

solve two simultaneous linear equations in two variables algebraically; find approximate solutions using a graph

translate simple situations or procedures into algebraic expressions or formulae; derive and solve an equation (or two simultaneous equations) and interpret the solution

solve linear inequalities in one variable; represent the solution set on a number line

## Algebra - Sequences

generate terms of a sequence from either a term to term or a position to term rule

recognise and use sequences of triangular, square, cube numbers, simple arithmetic progression

recognise and use the formulae for the  $n$ th term of an arithmetic progression where  $n$  is an integer and  $r$  is a rational number  $> 0$

deduce expressions to calculate the  $n$ th term of linear sequences

## Ratio, proportion

change freely between comparable standard units (e.g. time, length, area, volume/capacity, mass) in numerical contexts

change freely between comparable standard units in algebraic contexts

use scale factors, scale diagrams and maps

express one quantity as a fraction of another where the fraction is in simplest form

use ratio notation including reduction to simplest form

divide a given quantity into two parts in a given ratio

express the division of a quantity into two parts as a ratio

apply ratio to real contexts and problems (such as those involving concentrations)

express a multiplicative relationship between two quantities as a ratio or a fraction

understand and use proportion as equality of ratios

relate ratios to fractions and to linear functions

define percentage as a ratio

interpret percentages and percentage changes as a fraction or a decimal, and interpret these multiplicatively

express one quantity as a percentage of another

express the two quantities as percentages

work with percentages greater than 100%

solve problems involving percentages

solve problems involving percentages

solve problems involving percentages

use compound units such as speed units for pay, unit pricing, density and pressure



compare lengths, areas and volumes using ratio notation and make links to scale factors and similarity (including trigonometric ratios)

understand that  $X$  is inversely proportional to  $Y$  is equivalent to  $Y$  is proportional to  $1/X$ ; interpret equations that describe direct and inverse proportion

interpret the gradient of a 'straight' line graph as a rate of change; recognise and interpret graphs that illustrate direct and inverse proportion

set up and solve growth and decay problems, including compound interest; interpret the annual

### Geometry and measures - Properties and constructions

use conventional terms and notations: points, lines, vertices, edges, planes, parallel lines, perpendicular lines, right angles, angles, regular polygons and polygons with  $n$  sides, rotation symmetries

use the standard conventions for labelling arcs, angles and the sides of

draw diagrams from written description

use the standard ruler and compass constructions (perpendicular bisector of a line segment, bisecting a given angle, constructing a perpendicular to a given line from a given point, bisecting a given arc); use these to construct given figures and solve for problems; know that the perpendicular distance from a point to a line is the shortest distance to the line

apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles, angles subtended and use alternate and corresponding angles on parallel lines; derive and use the properties of regular polygons.)

derive and apply the properties and definitions of: special types of quadrilaterals, including squares, rectangle, parallelogram, trapezium, kite and rhombus; triangles; other plane figures, using appropriate language

use the basic congruence criteria for triangles (SSS, SAS, ASA, AAS)

apply angle facts, triangle congruence, similarity and properties of quadrilaterals to conjecture and derive properties; know that the base angles of an isosceles triangle are equal; use known results to obtain simple proofs

identify and apply circle definitions and properties, including: centre, radius, chord, diameter, circumference, tangent, arc, sector and segment

solve geometrical

identify properties of the faces, surfaces, edges and vertices on cubes, cuboids, prisms, cylinders, pyramids, cones and spheres

interpret and construct plans and elevations of 3D shapes

### Geometry and measures - Measurement and calculation

use standard units of measure and related concepts (length, area, volume/capacity, mass, time, money, etc.)

measure line segments and angles in geometric figures and scale drawings including interpreting maps including use of bearings

know and apply formulae to calculate: area of triangles, parallelograms, trapezia; volume of cuboids and other right prisms (including cylinders)

know the formulae: circumference of a circle =  $2\pi r = \pi d$ , area of a circle =  $\pi r^2$ ; calculate perimeters of 2D shapes, including circles, areas of circles and composite shapes, surface area of cones, composite solids; volume of spheres, pyramids, cones, composite solids

calculate arc lengths, angles and areas of sectors of circles

apply the concepts of congruence and similarity

know the formulae for: Pythagoras' theorem,  $a^2 + b^2 = c^2$ ; the trigonometric ratios,  $\sin \theta = \text{opposite/hypotenuse}$ ,  $\cos \theta = \text{adjacent/hypotenuse}$  and  $\tan \theta = \text{opposite/adjacent}$ ; apply them to find angles and lengths in right-angled triangles in two dimensional figures

know the exact values of  $\sin \theta$  and  $\cos \theta$  for  $\theta = 0^\circ, 30^\circ, 45^\circ, 60^\circ$  and  $90^\circ$ ; know the exact value of  $\tan \theta$  for  $\theta = 0^\circ, 30^\circ, 45^\circ$  and  $60^\circ$

### Geometry and measures - Vectors

describe translations as 2D vectors

apply addition and subtraction of vectors, multiplication of a vector by a scalar, graphical and column representations of vectors

## Probability

record, describe and analyse the frequency of outcomes of processes using frequency trees

apply ideas of fairness, fairness and equally likely events to calculate expected outcomes of multiple future experiments

relate relative expected frequencies to a probability scale

apply the principle that the sum of probabilities for all possible outcomes of an event sum to one

understand that empirical unbiased samples tend towards theoretical probability distributions, with increasing sample size

enumerate sets and combinations of sets systematically, using tables, grids, venn diagrams and tree diagrams

construct theoretical possibility spaces for single and combined experiments with equally likely outcomes; use these to calculate theoretical probabilities

calculate the probability of independent events

## Statistics

infer properties of populations and distributions from a sample whilst knowing the limitations of sampling

interpret and construct tables, charts and diagrams, including frequency tables, bar charts, pie charts, pictograms for categorical data, vertical line charts for grouped discrete numerical data

interpret and construct tables and line graphs for time series data and know their appropriate use

interpret, analyse and compare the characteristics of data sets from univariate empirical distributions through:

- appropriate graphical representation (forming, describing, summarising and extracting)
- appropriate measures of central tendency (median, mean, mode and modality)

including consideration for outliers)

apply statistics to describe a population

use and interpret scatter graphs of bivariate data, recognising correlation

know that [correlation] does not indicate causation, draw estimated lines of best fit, make predictions, interpolate and extrapolate, identify trends whilst knowing the dangers of so doing

