Qualifications and Curriculum Authority
Llywodraeth Cynulliad Cymru
Welsh Assembly Government
Rewarding Learning

# GCSE mathematics subject criteria

October 2006

QCA/06/2901

# Contents

## 1 Introduction

1.1 These criteria define the subject-specific essentials for GCSE specifications in mathematics. Specifications must also meet the requirements of the appropriate national curriculum order for mathematics and the regulatory authorities' general requirements, including the Common and GCSE criteria.

1.2 A specification that meets the mathematics requirements of the appropriate national curriculum order must use the title Mathematics.

1.3 Any specification, which contains significant elements of the subject mathematics, must be consistent with the relevant parts of these criteria.

## 2 Aims

2.1 The aims of all specifications must be consistent with national curriculum requirements.

## 3 Specification content

3.1 A specification must address the programmes of study from the relevant national curriculum orders for England and/or Wales and the statutory requirements for key stage 4 in Northern Ireland.

3.2 A specification entitled Mathematics must specify, for each tier, the content on which assessment will be based.

## 4 Key skills

4.1 GCSE specifications in mathematics should provide opportunities for developing and generating evidence for assessing relevant key skills from the list below. Where appropriate, these opportunities should be directly cross-referenced at specified level(s), to the key skills standards.

- application of number
- communication
- improving own learning and performance

- information and communication technology
- problem solving
- working with others

## 5 Assessment objectives

5.1 A specification must require candidates to demonstrate their knowledge, understanding and skills in the following assessment objectives. These relate to the knowledge, skills and understanding in the relevant programme of study.

AO1 Using and applying mathematics
AO2 Number and algebra
AO3 Shape, space and measures
AO4 Handling data

## 6 Schemes of assessment and assessment components

6.1 Each scheme of assessment must involve only external assessment. Linear assessment schemes require 100% terminal assessment. Staged assessment schemes must include a terminal examination with a minimum weighting of 50%.

6.2 The weightings for assessment objectives 2–4 given in 5 are:

AO2 50–55%
AO3 25–30%
AO4 18–22%

6.3 A minimum of 20% of the assessment should be attributable to AO1 in contexts provided by the other assessment objectives.

6.4 Each scheme of assessment must have two tiers of assessment: a foundation tier awarding grades G–C and a higher tier awarding grades D–A*.

6.5 In assessing AO2, AO3 and AO4:

6.5.1 Assessment of number and algebra in each tier should match the division in the relevant programme of study (foundation tier [3:2], higher tier [2:3]).

6.5.2 Assessment of manipulative algebra must be given a minimum weighting of 6% for foundation tier and 22% for higher tier.

6.5.3 A weighting of 50% of the overall assessment must be allocated to assessments in which candidates may not use a calculator. A weighting of 50% of the assessment must be allocated to assessments in which candidates are permitted to use a calculator.

6.5.4 The minimum weighting for questions demanding the unprompted solution of multi-step problems must be 6% for foundation tier and 10% for higher tier.

6.5.5 Examination papers must offer an appropriate balance of questions focused on the grades available in the tier. In each tier 50% of the weighting must be focused on the lowest two grades and 25–30% of the weighting must be focused on the top two grades.

6.5.6 The content of the higher tier subsumes the content of the foundation tier.

## 7 Grade descriptions

7.1 Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The descriptions must be interpreted in relation to the content in the specification; they are not designed to define that content. The grade awarded will depend in practice upon the extent to which the candidate has met the assessment objectives overall. Shortcomings in some aspects of candidates' performance in the assessment may be balanced by better performance in others.

 

## 7.2 **Grade F**

In order to carry through tasks and solve mathematical problems, candidates identify and obtain necessary information; they check their results, considering whether these are sensible. Candidates show understanding of situations by describing them mathematically using symbols, words and diagrams. They draw simple conclusions of their own and give an explanation of their reasoning.

Candidates use their understanding of place value to multiply and divide whole numbers and decimals by 10, 100 and 1000. They order, add and subtract negative numbers in context. They use all four operations with decimals to two places. They reduce a fraction to its simplest form by cancelling common factors and solve simple problems involving ratio and direct proportion. They calculate fractional or percentage parts of quantities and measurements, using a calculator where necessary. Candidates understand and use an appropriate non-calculator method for solving problems involving multiplying and dividing any three-digit by any two-digit number. In solving problems with or without a calculator, candidates check the reasonableness of their results by reference to their knowledge of the context or to the size of the numbers, by applying inverse operations or by estimating using approximations. Candidates explore and describe number patterns and relationships including multiple, factor and square. They construct, express in symbolic form, and use simple formulae involving one or two operations.

When constructing models and when drawing, or using shapes, candidates measure and draw angles as accurately as practicable, and use language associated with angle. They know the angle sum of a triangle and that of angles at a point. They identify all the symmetries of 2-D shapes. They know the rough metric equivalents of imperial units still in daily use and convert one metric unit to another. They make sensible estimates of a range of measures in relation to everyday situations. Candidates calculate areas of rectangles. Candidates use coordinates in all four quadrants to locate and specify points.

Candidates understand and use the mean of discrete data. They compare two simple distributions using the range and one of the mode, median or mean. They interpret graphs and diagrams, including pie charts, and draw conclusions. They understand and use the probability scale from 0 to 1. Candidates make and justify

 

estimates of probability by selecting and using a method based on equally likely outcomes or on experimental evidence as appropriate. They understand that different outcomes may result from repeating an experiment.

## 7.3 **Grade C**

Starting from problems or contexts that have been presented to them, candidates refine or extend the mathematics used to generate fuller solutions. They give a reason for their choice of mathematical presentation, explaining features they have selected. Candidates justify their generalisations, arguments or solutions, showing some insight into the mathematical structure of the problem. They appreciate the difference between mathematical explanation and experimental evidence.

In making estimates candidates use appropriate techniques and multiply and divide mentally. They solve numerical problems involving multiplication and division with numbers of any size using a calculator efficiently and appropriately. They understand the effects of multiplying and dividing by numbers between 0 and 1. They use ratios in appropriate situations. They understand and use proportional changes. Candidates find and describe in symbols the next term or the $n$th term of a sequence, where the rule is linear. Candidates calculate one quantity as a percentage of another. They multiply two expressions of the form $(x + n)$; they simplify the corresponding quadratic expressions. They solve simple polynomial equations by trial and improvement and represent inequalities using a number line. They formulate and solve linear equations with whole number coefficients. They manipulate simple algebraic formulae, equations and expressions. Candidates draw and use graphs of quadratic functions.

Candidates solve problems using angle and symmetry properties of polygons and properties of intersecting and parallel lines. They understand and apply Pythagoras' theorem when solving problems in two-dimensions. Candidates solve problems involving areas and circumferences of circles. They calculate lengths, areas and volumes in plane shapes and right prisms. Candidates enlarge shapes by a positive whole number or fractional scale factor. They appreciate the imprecision of measurement and recognise that a measurement given to the nearest whole number may be inaccurate by up to one half in either direction.

 

They understand and use compound measures such as speed. Candidates use mathematical instruments to carry out accurate constructions of loci

Candidates construct and interpret frequency diagrams with grouped data. They specify hypotheses and test them. They determine the modal class and estimate the mean, median and range of a set of grouped data, selecting the statistic most appropriate to their line of enquiry. They use measures of average and range with associated frequency polygons, as appropriate, to compare distributions and make inferences. Candidates understand relative frequency as an estimate of probability and use this to compare outcomes of experiments.

7.4 **Grade A**

Candidates give reasons for the choices they make when investigating within mathematics itself or when using mathematics to analyse tasks: these reasons explain why particular lines of enquiry or procedures are followed and others rejected. Candidates apply the mathematics they know in familiar and unfamiliar contexts. Candidates use mathematical language and symbols effectively in presenting a convincing reasoned argument. Their reports include mathematical justifications, explaining their solutions to problems involving a number of features or variables.

Candidates manipulate simple surds. They determine the bounds of intervals. Candidates understand and use direct and inverse proportion. They manipulate algebraic formulae, equations and expressions, finding common factors and multiplying two linear expressions. In simplifying algebraic expressions, they use rules of indices for negative and fractional values. They solve problems using intersections and gradients of graphs.

Candidates sketch the graphs of sine, cosine and tangent functions for any angle and generate and interpret graphs based on these functions. Candidates use sine, cosine and tangent of angles of any size, and Pythagoras' theorem when solving problems in two and three dimensions. They use the conditions for congruent triangles in formal geometric proofs. They calculate lengths of circular arcs and areas of sectors, and calculate the surface area of cylinders and volumes of cones and spheres. They understand and use the effect of enlargement on areas and volumes of shapes and solids

 

Candidates interpret and construct histograms. They understand how different methods of sampling and different sample sizes may affect the reliability of conclusions drawn; they select and justify a sample and method, to investigate a population. They recognise when and how to work with probabilities associated with independent and mutually exclusive events.