Accredited

GCSE (9–1)
Delivery Guide

J560

MATHEMATICS

Theme: Fractions, Decimals and Percentages

April 2015

OCR
Oxford Cambridge and RSA

CONTENTS

Introduction

Delivery guides are designed to represent a body of knowledge about teaching a particular topic and contain:

- Content: a clear outline of the content covered by the delivery guide;
- Thinking Conceptually: expert guidance on the key concepts involved, common difficulties learners may have, approaches to teaching that can help learners understand these concepts and how this topic links conceptually to other areas of the subject;
- Thinking Contextually: a range of suggested teaching activities using a variety of themes so that different activities can be selected that best suit particular classes, learning styles or teaching approaches.

If you have any feedback on this Delivery Guide or suggestions for other resources you would like OCR to develop, please email resources.feedback@ocr.org.uk.

KEY

Click to view associated resources within this document.

▶ Click here Click to view external resources

Curriculum Content

GCSE content Ref.	Subject content	Initial learning for this qualification will enable learners to…	Foundation tier learners should also be able to…	Higher tier learners should additionally be able to…	DfE Ref.
OCR 2	**Fractions, Decimals and Percentages**				
2.01	**Fractions**				
2.01a	Equivalent fractions	Recognise and use equivalence between simple fractions and mixed numbers. e.g. $\dfrac{2}{6} = \dfrac{1}{3}$ $2\dfrac{1}{2} = \dfrac{5}{2}$			N3
2.01b	Calculations with fractions	Add, subtract, multiply and divide simple fractions (proper and improper), including mixed numbers and negative fractions. e.g. $1\dfrac{1}{2} + \dfrac{3}{4}$ $\dfrac{5}{6} \times \dfrac{3}{10}$ $-3 \times \dfrac{4}{5}$	Carry out more complex calculations, including the use of improper fractions. e.g. $\dfrac{2}{5} + \dfrac{5}{6}$ $\dfrac{2}{3} + \dfrac{1}{2} \times \dfrac{3}{5}$	*[see also Algebraic fractions, 6.01g]*	N2, N8

Curriculum Content

GCSE content Ref.	Subject content	Initial learning for this qualification will enable learners to…	Foundation tier learners should also be able to…	Higher tier learners should additionally be able to…	DfE Ref.
2.01c	Fractions of a quantity	Calculate a fraction of a quantity. e.g. $\dfrac{2}{5}$ of £3.50 Express one quantity as a fraction of another. *[see also Ratios and fractions, 5.01c]*	Calculate with fractions greater than 1.		N12, R3, R6
2.02	**Decimal fractions**				
2.02a	Decimals and fractions	Express a simple fraction as a terminating decimal or vice versa, without a calculator. e.g. $0.4 = \dfrac{2}{5}$ Understand and use place value in decimals.	Use division to convert a simple fraction to a decimal. e.g. $\dfrac{1}{6} = 0.16666...$	Convert a recurring decimal to an exact fraction or vice versa. e.g. $0.4\dot{1} = \dfrac{41}{99}$	N10, N2
2.02b	Addition, subtraction and multiplication of decimals	Add, subtract and multiply decimals, including negative decimals, without a calculator.			N2
2.02c	Division of decimals	Divide a decimal by a whole number, including negative decimals, without a calculator. e.g. $0.24 \div 6$	Without a calculator, divide a decimal by a decimal. e.g. $0.3 \div 0.6$		N2

Curriculum Content

GCSE content Ref.	Subject content	Initial learning for this qualification will enable learners to…	Foundation tier learners should also be able to…	Higher tier learners should additionally be able to…	DfE Ref.
2.03	**Percentages**				
2.03a	Percentage conversions	Convert between fractions, decimals and percentages. e.g. $\dfrac{1}{4} = 0.25 = 25\%$ $1\dfrac{1}{2} = 150\%$			R9
2.03b	Percentage calculations	Understand percentage is 'number of parts per hundred'. Calculate a percentage of a quantity, and express one quantity as a percentage of another, with or without a calculator.			R9, N12
2.03c	Percentage change	Increase or decrease a quantity by a simple percentage, including simple decimal or fractional multipliers. Apply this to simple original value problems and simple interest. e.g. Add 10% to £2.50 by either finding 10% and adding, or by multiplying by 1.1 or $\dfrac{110}{100}$ Calculate original price of an item costing £10 after a 50% discount.	Express percentage change as a decimal or fractional multiplier. Apply this to percentage change problems (including original value problems). [see also Growth and decay, 5.03a]		R9, N12

Curriculum Content

GCSE content Ref.	Subject content	Initial learning for this qualification will enable learners to…	Foundation tier learners should also be able to…	Higher tier learners should additionally be able to…	DfE Ref.
2.04	**Ordering fractions, decimals and percentages**				
2.04a	Ordinality	Order integers, fractions, decimals and percentages. e.g. $\dfrac{4}{5}$, $\dfrac{3}{4}$, 0.72, -0.9			N1, N2, R9
2.04b	Symbols	Use $<$, $>$, $\leq$, $\geq$, $=$, $\neq$			N1

Curriculum Content

This delivery guide provides support for the delivery of the following topic areas from the curriculum content:

- calculation with simple fractions and mixed numbers
- calculation with decimals
- calculation with percentages, including percentage change and percentage change reversal
- conversion between fractional, decimal and percentage forms
- ordering quantities expressed in fractional, decimal and percentage forms.

The following activities are designed to give learners practice in each of the basic skills.

Activities	Resources
[2.01a] Fractions (General) (National STEM Centre: Nelson Thornes (OUP)) http://www.nationalstemcentre.org.uk/elibrary/maths/resource/10523/fractions The first resource here, Fractions (General), contains nine maths ideas exploring what is meant by a fraction and equivalence. Activities include: showing fractions by shading, using squared paper and isometric paper; exploring the fraction of a word made up of a particular letter; and investigating when cancelling is possible. There are resource sheets for learners to find equivalent fractions and a task exploring whether the value of a fraction gets larger or smaller when 1 is added to the numerator or the denominator. The resources on this website are free to use, but a login is required.	▶ Click here
[2.01a] [2.01b] Fractions Jigsaw (NRICH) http://NRICH.maths.org/5467 This problem provides an opportunity to find equivalent fractions and carry out some simple additions and subtractions of fractions in a context that may challenge and motivate learners.	▶ Click here

Curriculum Content

Activities	Resources
[2.01b] Fractions (Addition and Subtraction) (National STEM Centre: Nelson Thornes (OUP)) http://www.nationalstemcentre.org.uk/elibrary/maths/resource/10523/fractions The second resource here, Fractions (Addition and Subtraction), contains seven short activities that encourage learners to discuss the process of adding fractions. Tasks include: completing magic squares using fractions; forming and exploring patterns by adding fractions; and picking pairs of fractions that will add up to less than one. The resources on this website are free to use, but a login is required.	▶ Click here
[2.01b] Fractions (Multiplication and Division) (National STEM Centre: Nelson Thornes (OUP)) http://www.nationalstemcentre.org.uk/elibrary/maths/resource/10523/fractions The third resource here, Fractions (Multiplication and Division), contains nine ideas requiring learners to decide whether to use multiplication or division of fractions in a variety of situations in order to solve problems. It also looks at patterns in multiplying and dividing fractions and the link to multiplying fractions when dealing with probability is made. The resources on this website are free to use, but a login is required.	▶ Click here
[1.01a] [2.02b] Multiplication – Lattice Method including grid decimals A simple PowerPoint that demonstrates how to multiply integers using the lattice method. Using this method greatly reduces the need for carrying and is only reliant on the ability to multiply single digit numbers and position the results correctly in the box. This presentation develops the concept used for integers and shows how the grid can be altered to multiply decimal values. Learners have the opportunity to see the skill demonstrated with animated worked solutions and then practise on given questions, which they may check using a calculator or other valid method.	▶ Click here
[1.01a] [2.02b] Multiplication – Lattice Method, estimation for decimals A similar PowerPoint to the previous task, however, the method of using estimation to decide the position of the decimal point in an answer is described.	▶ Click here
[2.03a] [2.03b] [2.03c] KS3/GCSE – 7 Percentage Starters (TES Connect) http://www.tes.co.uk/teaching-resource/KS3-GCSE-7-Percentage-Starters-PowerPoint-6110278/ A PowerPoint with a collection of multiple-choice percentage quizzes. The quizzes contain questions on: multipliers; reverse percentage; percentage increase and decrease; converting fractions and decimals to percentages; and finding percentages mentally. The content is suitable for KS3 and GCSE learners. The resources on this website are free to use, but a login is required.	▶ Click here

Curriculum Content

Activities	Resources
[2.03b] Percentages of a Quantity Jigsaw A simple jigsaw finding different percentages of 480; this could be used as a starter activity or to check understanding of this topic.	▶ Click here
[2.03c] Reverse Percentages – no calculator (Manga High.com) https://www.mangahigh.com/en-gb/maths_games/number/percentages/reverse_percentages_-_no_calculator An interactive online game to find the original amount, a repeated percentage or a different percentage of the original amount. Written rather than mental strategies, such as the unitary method, may need to be used to equate an amount with the percentage it represents. Good for practice once the skill has been established. The resources on this website are free to use without a login, but they are not supported by all browsers.	▶ Click here
[2.02a] Converting Repeating Decimals to Fractions (Khan Academy) https://www.khanacademy.org/math/algebra/solving-linear-equations-and-inequalities/conv_rep_decimals/v/coverting-repeating-decimals-to-fractions-1 A series of short videos demonstrating how to convert recurring decimals to fractions. The notation used for the recurring decimals is the bar rather than the dot notation, but this could lead to a discussion clarifying the correct use of dot notation to ensure that all learners clearly understand. Useful as a starter or as a revision exercise.	▶ Click here
[2.03a] Interactive Equivalent FDP Ordering (TES Connect) http://www.tes.co.uk/teaching-resource/Interactive-Equivalent-FDP-Ordering-Fractions-KS3-6106633/ This Excel spreadsheet resource can be used on an IWB to randomly generate fractions, decimals and percentages for learners to order from smallest to largest. You will need to enable macros on opening. Fractional denominators are factors of 100, so learners should not require calculators to convert to percentages or decimals. The value of the denominator can be changed by selecting a scroll bar, whilst the decimals and percentages are then chosen randomly. The resources on this website are free to use, but a login is required.	▶ Click here
[2.01a] [2.02b] [2.02c] [2.03a] [2.03b] [2.04a] Number Lessons (National STEM Centre: Department for Education) http://www.nationalstemcentre.org.uk/elibrary/maths/resource/5078/section-three-number-lessons This set of five units of number work contains a series of lesson plans which contain, amongst other things: calculations involving fractions and decimals; ordering decimals and the equivalence of fractions and decimals; multiplying and dividing decimals by 10 or 100; equivalence of fractions; equivalence of fractions and percentages; percentages of whole numbers; and proportional thinking. The resources on this website are free to use, but a login is required.	▶ Click here

Thinking Conceptually

Approaches to teaching the content

Prior to working with decimals or percentages, learners must gain a sound understanding of fractions – not just the mechanics of working with fractions, but what they represent and what they mean. If this in-depth understanding is not secure then learners generally have difficulty retaining the methodology in the long term. Learners' understanding should be deepened by a hands-on approach to this subject. This could incorporate elements of geometry as well as practical contexts. It is vital to understanding that learners are able to explain why two fractions are equivalent, with reference to the number and size of the parts of each, as much fraction theory is based upon this concept.

Once fractions have been mastered, learners have a better understanding of decimal places and recognise that percentages are nothing more than a simple fractional value that is always out of 100. Simple conversion between fractions whose denominators are factors of 100 and decimals and percentages can then be easily understood by many.

Common misconceptions or difficulties learners may have

With decimals learners often:

- think that the value of a decimal depends on the number of digits it contains
- misinterpret a calculator display – for example 16.5 being interpreted as £16.05 rather than £16.50.

With fractions learners often:

- ignore numerators when comparing fractions or think that a larger denominator means a larger fraction
- add numerators and denominators when adding fractions

- put all fractions over a common denominator even when it is not necessary – such as when multiplying
- double the numerator and denominator when doubling a fraction
- confuse decimal and fraction notation, for example thinking that

$$\frac{2}{5} = 2.5.$$

With percentages learners often:

- misunderstand inverse percentage calculations, working out the percentage of the final amount and adding or subtracting it, rather than reversing the change using a valid method such as the unitary method
- have difficulty understanding the meaning of a percentage that is more than 100%.

Conceptual links to other areas of the specification – useful ways to approach this topic to set learners up for topics later in the course

Efficient methods for adding and subtracting or simplifying fractions are vital for learners to progress to the more challenging skill of adding and subtracting or simplifying rational algebraic expressions.

Probability theory clearly incorporates knowledge of fractions, decimals and percentages.

The following activities are designed to give learners a more in depth understanding of a process, rather than simply practising the basic skill.

Thinking Conceptually

Activities	Resources
[2.01b] Rules of Fractions Investigation This resource presumes that learners understand how to add and multiply fractions. The prompt sheet is optional, but may help learners who are less confident. Working in small groups (around four works well), learners discuss the initial question and should try to come up with an idea of how to go about the problem. This may be as basic as just trying some examples to find out if it works rather than starting with any algebraic method. Learners should then be encouraged to construct a clear and logical proof to justify their solutions.	▶ Click here ▶ Click here
[2.02b] Multiplications Can Increase or Decrease (National STEM Centre: Centre for Innovation in Mathematics Teaching) http://www.nationalstemcentre.org.uk/elibrary/maths/resource/8524/multiplications-can-increase-or-decrease This resource explores why multiplication does not always increase the size of a number. It explains how, by putting the term 'multiplying' into a context with which learners can identify and making a situation meaningful, this common misconception can be addressed. The resources on this website are free to use, but a login is required.	▶ Click here
[2.04a] Farey Sequences (NRICH) http://NRICH.maths.org/2086 This problem offers the opportunity to practise the important skill of ordering fractions while investigating and making conjectures about an intriguing sequence of sequences. There is a chance to work on a variety of questions at different levels.	▶ Click here
[2.02b] Multiplying Decimals (National STEM Centre: Centre for Innovation in Mathematics Teaching) http://www.nationalstemcentre.org.uk/elibrary/maths/resource/8555/multiplying-decimals This resource illustrates the common mistakes learners make when multiplying two decimal values. It suggests that the language used could be adjusted so that the term 'times' is interchanged with 'of', thus one-tenth of one-tenth is equal to one one-hundredth. The resources on this website are free to use, but a login is required.	▶ Click here

Thinking Conceptually

Activities	Resources
[2.02a] Decimals and their Equivalent Fractions (Centre for Innovation in Maths Teaching, Plymouth) http://www.cimt.plymouth.ac.uk/resources/help/miscon4.pdf This resource addresses the misconception that decimals and fractions are different and therefore a decimal cannot be written in fractional form. It provides an explanation of how the misconception arises so easily, together with some exercises aimed at reinforcing the correction needed. It is hoped that a study of the reason, together with practice of the exercises, will help to eliminate these errors.	▶ Click here
[1.01a] [1.03a] [2.02b] Broken Calculator (National STEM Centre: Subtangent) http://www.nationalstemcentre.org.uk/elibrary/maths/resource/596/broken-calculator Is it possible to use the broken calculator to make a given set of numbers? There are six levels of difficulty in this activity, starting with whole numbers, then introducing negative numbers and decimals. The broken keys vary at each level giving the opportunity to use the memory function and power keys, which will challenge learners' knowledge of square numbers. A worksheet, which could be used as an introduction, accompanies this game. Learners are required to show how they would use each calculator to generate the numbers from one to twenty. The resources on this website are free to use, but a login is required.	▶ Click here
[2.03b] Put Out the Flags (NRICH) http://NRICH.maths.org/1115 This problem provides useful practice in calculating with percentages. It can be approached by trial and improvement but the equivalence between fractions and percentages is very useful.	▶ Click here
[2.03b] [2.03c] One or Both (NRICH) http://NRICH.maths.org/794 An interesting problem involving the basic concept of a percentage, embodying the ideas behind percentage increase. It could also be visually presented using a Venn diagram. A great resource to use with small groups as a short investigation exercise.	▶ Click here

Thinking Conceptually

Activities	Resources
[2.01a] [2.04a] Ordering Fractions and Decimals N1 (National STEM Centre: Department for Education Standards Unit) http://www.nationalstemcentre.org.uk/elibrary/maths/resource/1958/ordering-fractions-and-decimals-n1 In this resource, learners learn to: interpret decimals and fractions using scales and areas; find equivalent fractions; order and relate fractions and decimals; and reflect on and discuss these processes. Learners will have met these concepts before. Many, however, may still have misconceptions and difficulties. Typically, these include: confusing decimal and fraction notation; believing that the magnitude of a decimal depends on the number of digits it contains; and ignoring numerators when comparing fractions. During the session, learners will confront and discuss such misconceptions. This activity aims to build a more connected understanding of all these ideas. The resources on this website are free to use, but a login is required.	▶ Click here
[2.02a] Tiny Nines (NRICH) http://NRICH.maths.org/1832 This simple activity explores the connection between fractional and decimal representations. It should allow learners to develop their thinking and deepen their understanding of why some fractions convert to terminating decimals whilst others do not.	▶ Click here

Thinking Contextually

When introducing context to mathematics in the classroom, it is important that the context is meaningful for the learners; otherwise the purpose of the context is lost.

If the learners have had a similar experience in real life, they will be able to draw on that knowledge, contextualise and solve the problem through the application of their knowledge, as intended. Allowing the learners to investigate scenarios and simulate real life will allow them to explore the mathematics in their own way, rather than being guided. This encourages independent thinking and reasoning.

Working with money

Activities	Resources
[2.02b] Bank Balance (National STEM Centre: Nuffield Foundation) http://www.nationalstemcentre.org.uk/elibrary/maths/resource/6660/bank-balance This free-standing mathematics activity is designed as a game to give learners practice in working with money, entering items onto a bank statement and calculating the balance. To play the game, cards are placed face down in a pile. Learners then take turns to turn over a card, enter the value in the correct column of the bank statement, and work out the balance. The winner is the person with the highest balance when the cards run out. The resources on this website are free to use, but a login is required.	▶ Click here
[2.02b] My Money Mathematics: Teacher Handbook (TES Connect) http://www.tes.co.uk/teaching-resource/My-Money-Mathematics-Teacher-Handbook-6090413/ This handbook is designed to help teachers of mathematics build personal finance education into schemes of work with key stage 3 and 4 learners. It encourages a flexible approach to teaching by incorporating elements of personal finance into mathematics schemes of work. However, an integrated approach is essential for such a programme to be effective and liaison between participating departments (e.g. mathematics, citizenship, and PSHE education) should be encouraged from the outset. The My Money project takes note of this ethos and embraces a cross-curricular whole-school approach. The resources on this website are free to use, but a login is required.	▶ Click here

Thinking Contextually

Activities	Resources
[2.01c] Fractions: Cutting a Cake (TES Connect: Teachers TV) http://www.tes.co.uk/teaching-resource/Teachers-TV-Fractions-Cutting-a-Cake-6085223/ A great lesson starter – this is a short video which poses the question "How can I cut a cake into 12 equal pieces with only 4 cuts?"	▶ Click here
[2.01b] [2.01c] Dividing a Cake (NRICH) http://NRICH.maths.org/1102 This problem gives learners practice in fractions (tenths) as well as in addition and subtraction in a challenging form. It involves cutting a cake with numerals on top into 3 pieces with 3 cuts so that the digits on each piece sum to the same value.	▶ Click here

Arithmetic of fractions

Activities	Resources
[2.01b] Keep it Simple (NRICH) http://NRICH.maths.org/6540 This is the first problem in a set of three linked activities. Egyptian Fractions and The Greedy Algorithm follow on. It's often difficult to find interesting contexts to consolidate addition and subtraction of fractions. This problem offers that, whilst also requiring learners to develop and analyse different strategies and explain their findings.	▶ Click here
[2.01a] [2.01b] Egyptian Fractions (NRICH) http://NRICH.maths.org/1173 This problem follows on from Keep It Simple. Unit fractions are the first fractions children meet, and here we discover some very surprising and interesting characteristics of these familiar numbers. Some of these characteristics were known to the ancient Egyptians whilst other conjectures are yet to be proved. Whilst meeting both old and new mathematical ideas, learners can improve their fluency in addition and subtraction of fractions and be challenged to generalise and explain their findings	▶ Click here

Thinking Contextually

Activities	Resources
[2.01a] [2.01b] The Greedy Algorithm (NRICH) http://NRICH.maths.org/6541 This problem follows on from Keep It Simple and Egyptian Fractions. These three problems together offer learners an opportunity to engage with some mathematical ideas in depth and not just with the rather mechanical process of adding and subtracting fractions. This problem in particular requires learners to compare fractions and may deepen their understanding of their relative sizes.	▶ Click here
[2.01c] Peaches Today, Peaches Tomorrow … (NRICH) http://NRICH.maths.org/2312 This problem offers plenty of practice in calculating fractions of integers while requiring learners to come up with problem-solving strategies. It offers a good context for thinking about factors of numbers. Introduce the first part of the problem to the class, and give them a little bit of time to work in pairs to solve it. Once learners have had a chance to work on the first challenge, share strategies and discuss any difficulties that arose. The second task requires learners to work systematically and record the steps they take clearly. Challenge learners to find the solution and to be convinced that there is no other solution. The last challenge works well as a 'simmering activity', set for learners to think about beyond the lesson – perhaps this could be set for homework. The best solution could be displayed and learners challenged to improve it.	▶ Click here
[2.02b] [2.04a] Decimals (National STEM Centre: SMILE) http://www.nationalstemcentre.org.uk/elibrary/maths/resource/7849/decimals This resource contains two packs of games, investigations, worksheets and practical activities supporting the teaching and learning of decimals, from reading decimals from a scale to multiplying two decimal numbers without a calculator. The resources on this website are free to use, but a login is required.	▶ Click here

We'd like to know your view on the resources we produce. By clicking on the 'Like' or 'Dislike' button you can help us to ensure that our resources work for you. When the email template pops up please add additional comments if you wish and then just click 'Send'. Thank you.

If you do not currently offer this OCR qualification but would like to do so, please complete the Expression of Interest Form which can be found here: www.ocr.org.uk/expression-of-interest

OCR customer contact centre

General qualifications
Telephone 01223 553998
Facsimile 01223 552627
Email general.qualifications@ocr.org.uk

A DIVISION OF
CAMBRIDGE ASSESSMENT