

Chapter 2 Fractions, decimals and percentages

Specification

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| FS coverage and range | Understand and use equivalences between fractions, decimals and percentages Carry out calculations with numbers of any size in practical contexts, to a given number of decimal places |
| FS exemplification | Simplifying fractions Finding fractions of a quantity Improper and mixed numbers Percentages of a quantity Convert between fractions, decimals and percentages Order fractions, decimals and percentages Writing one number as a fraction of another Add, subtract, multiply and divide numbers up to two decimal places Estimate answers to calculations |

GCSE

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| GCSE specification | <p>N a Add, subtract, multiply and divide any number</p> <p>N h Understand equivalent fractions, simplifying a fraction by cancelling all common factors</p> <p>N j Use decimal notation and recognise that each terminating decimal is a fraction</p> <p>N l Understand that 'percentage' means 'number of parts per 100' and use this to compare proportions</p> <p>N m Use percentage, repeated proportional change</p> <p>N o Interpret fractions, decimals and percentages as operators</p> <p>N u Approximate to specified or appropriate degrees of accuracy, including a given power of ten, number of decimal places and significant figures</p> |
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| Edexcel GCSE course | <p>Specification A:</p> <p>Foundation: Chapter 1, 5.1, 5.7–5.10, 8.1–8.5, 8.8, 10.1, 19.1–19.4</p> <p>Higher: Chapter 1, 3.1–3.2, 4.1, 4.3–4.6, Chapter 14</p> <p>Specification B:</p> <p>Foundation Unit 1: 1.1, 1.5, 3.1, 3.10, 5.1, 5.4; Unit 2: 1.2, 1.4–1.6, 1.9, 3.1, 3.3–3.4, 3.6–3.10, 4.2–4.8, 5.1–5.3; Unit 3: 1.2–1.4, 2.1–2.2</p> <p>Higher Unit 1: 1.6, 2.1, 2.6, 5.1–5.2; Unit 2: 1.3, 2.1–2.4, 3.1–3.6, 4.1–4.2; Unit 3: 1.1–1.2, 1.4, 3.1–3.4</p> |
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2 Fractions, decimals and percentages

Resources

General resources

Calculators
Ordinary dice
Show-me boards

Resource sheets

2.1, 2.2, 2.3

Links

<http://www.xe.com/ucc/> (exchange rate calculator)
<https://www.cia.gov/library/publications/the-world-factbook/index.html>
<http://www.amazon.com/> and <http://www.amazon.co.uk/> (or similar for price comparison)
<http://www.censusatschool.org.uk>

ActiveTeach resources

Video
ResultsPlus Knowledge Check
ResultsPlus Problem Solving
Question Audio
Animations

Lesson 1

Objectives

- Find fractions and percentages of quantities in practical problems
- Use decimal, fraction and percentage equivalences to find solutions to practical problems

Starter

- Ask students to generate six fractions by rolling an ordinary dice twice for each fraction. The first roll gives the numerator, the second the denominator. Ask them to compare their fractions with a partner's. Ask: *Which fraction is largest? How many possible fractions are there? What types of fraction are there? Are any equivalent fractions possible?*

Main teaching and learning

- Use the fractions from the Starter to discuss equivalent fractions, improper fractions and mixed numbers.
- Ask students to write their fractions on separate pieces of paper and then work in pairs to rank them in order of size. Discuss possible strategies (for example, using a common denominator or converting all the fractions to decimals or percentages).
- Discuss the methods used to convert fractions to decimals and percentages.
- Discuss the calculation of fractions of a quantity using *Take a look: Managing on a budget* (p20). Explain that when finding $\frac{2}{5}$ of £1350, finding $\frac{1}{5}$ is the same as dividing by 5, so to find $\frac{2}{5}$ you use two stages: divide by 5 and multiply by 2. Consider whether order matters and relate to BIDMAS. Ask: *What decimal could be used?*
- Ask students to work through *Have a go* Q1–4.
- Move on to finding percentages of a quantity. Encourage students to use a decimal multiplier. Ask students to write £85 in the centre of a page and then find various percentages of £85 using non-calculator and calculator methods.

Issues and misconceptions

- When calculating $\frac{2}{5}$, students may be unclear whether to multiply or divide by 2 and 5.

Support

- Suggest strategies that students can use to identify common factors when finding equivalent fractions. Rules of divisibility will help.
- Remind students that calculation of a percentage reduction (Q2) will involve change as a fraction of the original amount.

Extension

- When you ask students to find percentages of £85, include percentages greater than 100% and decimal percentages.

Plenary

- Display five decimals, five percentages and five fractions. Include four sets of three equivalent fractions, percentages and decimals. Ask students to spot the three numbers which do not have matching equivalents shown.

Formative assessment

- Check how accurately students ranked their fractions and found percentages of £85, identifying any misconceptions. Ask students to self-assess their understanding using a traffic light scale.

Homework

- Ask students to make a poster to show how to convert between decimals, fractions and percentages.

Lesson 2

Objectives

- Add, subtract, multiply or divide with decimals in practical problems
- Round to an appropriate number of decimal places in practical problems
- Increase or decrease quantities using percentages in practical problems

Starter

- Ask the students: *If you take off 50% and then add 50% back on, will you get back to what you started with?* Ask students to vote yes, no or don't know and then discuss their ideas in pairs. Then ask them to vote again and invite explanations.

Main teaching and learning

- Discuss rounding in the context of accuracy of measurement of a person's height. Use *Take a look*: Converting height (p21) and follow the method given to convert some students' heights in feet and inches to metres. Highlight the fact that two decimal places in metres corresponds to centimetres.
- Return to the percentages of £85 activity from Lesson 1 and use it to explore the use of percentage multipliers to increase or decrease.
- Divide students into pairs and give each pair a set of matching cards from Resource sheet 2.1. Ask students to sort them into pairs (e.g. 'Increase by 20%' matches ' $\times 1.2$ ').
- Ask students to complete *Have a go* Q5–10.

Issues and misconceptions

- The Starter activity addresses a common misconception about compound percentage change, but students may find it helpful to have a visual representation of the situation. For example:
 - £100 reduced by 50% is £50
 - £50 increased by 50% is £75
 - The 50% added back on is 50% of only £50.
- Students may confuse pound and pence units, especially where decimal quantities of pence are given as in Q6 and Q10.

Support

- Encourage students to make an estimate of a likely answer before carrying out detailed calculations.

Extension

- Ask students to make a poster showing multipliers for various percentage increases and decreases.

Plenary

- Pose the following question:
On 1 December 2008, VAT on goods was reduced from 17.5% to 15%. Does this mean that all goods were reduced by 2.5%?
- Discuss students' answers and relate the situation to the Starter activity.

Formative assessment

- Ask students to peer-assess answers to Q5–10, marking the numerical answers and awarding a smiley face for every solution where the final answer was rounded appropriately (note that Q10 does not require rounding).

Homework

- Ask students to find a variety of examples of percentages being used in real life (for example, in newspapers, magazines or leaflets).

Lesson 3

Objectives

- Use exchange rates in practical problems
- Decide if it is appropriate to multiply or divide with decimals in practical problems

Starter

- Show current exchange rates between £GBP and other currencies (for example, see www.xe.com/ucc/).
- Ask: *If I exchanged £100, how much would I get in each of the other currencies? In which do I have more than 100 and in which less than 100 of the new currency unit?*

Main teaching and learning

- Discuss the number of decimal places given for the currency conversions. Choose one of the currencies and round to various numbers of decimal places. Compare with a figure for the appropriate country's population (data can be obtained at <https://www.cia.gov/library/publications/the-world-factbook/index.html>). Discuss the suitability of various degrees of accuracy in these different contexts.
- Divide students into small groups and give each group a set of decimal calculation cards from Resource sheet 2.2. These show calculations involving dividing or multiplying decimals. Students should work together to match the question cards with their answers and discuss the strategies used. Strategies should include estimation, working out the last digit and inverse operations. Students can check accuracy using calculators.
- Work through *Take a look: Changing exchange rates* (p24), then investigate the purchase price of an item from websites in two countries using different currencies (for example, amazon.com and amazon.co.uk). Ask students to work out which is cheaper.
- Ask students to complete *Have a go* Q11–13.

Issues and misconceptions

- Some students may have experience of gross profit margin calculations so ensure that they calculate profit as a percentage of original cost price in Q12. Working through *Take a look: Making cakes* (pp24–5) will address this.
- For Q13, encourage students to use the royalties figure to work out how much 1% would be and hence the 100% original sales.

Support

- Students may find it helpful to draw arrows between different currencies, showing the conversion factors used and whether to multiply or divide.
- Encourage students to decide in advance whether an answer is going to be larger or smaller than an original quantity.

Extension

- Ask students to plot conversion graphs using the data from the Starter activity.

Plenary

- Ask: *We can't really ever be 110% certain, so can we have 110% profit?* Discuss students' ideas using, for example, a £100 original cost price.

Formative assessment

- Ask students to check and then rate their accuracy of estimation by using calculators in the card matching activity.

Homework

- Assign each student an amount of money to spend on a day out. Ask them to work out their budget for activities of their choice including any transport, entrance and food costs. They should work out what percentage of their budget they spend on each category.

Lesson 4

Objectives

- Use proportion in practical problems
- Express one quantity as an approximate fraction or percentage of another quantity, as a strategy to solve a practical problem

Starter

- Write '1 hour = 60 minutes' at the centre of the board, then write various numbers of minutes around it. Ask students to give these as fractions, decimals or percentages of an hour. For example, 45 minutes is $\frac{3}{4}$ of 60 minutes or 0.75 hour (not 0.45).
- Ask: *In everyday life, what fractions of an hour would probably be rounded to $\frac{1}{4}$ of an hour?* Ask students to contribute using show-me boards.

Main teaching and learning

- Divide students into small groups and give each of the students within a group information about the costs of a different day out, including the amount spent on different categories. (You could use students' answers to the Homework for Lesson 3.)
- Ask students to work out the approximate fraction and percentage spent on each category for their day out. They should then compare the results for each day out within their group. Conduct a class discussion about similarities and differences and consider whether the total available to spend has an effect on the proportions spent on different categories.
- Work through *Take a look*: Budgeting (p26) with the students.
- Ask students to complete *Have a go* Q14–15 and Q17. Emphasise that these are open questions so students should plan their work carefully and ensure that they can justify calculations.

Issues and misconceptions

- Students may find decimal proportions of an hour challenging, for example 45 minutes is $\frac{3}{4}$ of 60 or 0.75 hour (not 0.45).
- When working through Q14 and Q17, students need to take care when dealing with thirds, using sensible rounding as required.

Support

- Students may find the text in Q17 off-putting. Encourage them to plan step-by-step calculations.

Extension

- Ask students to consider which type of room has the highest/lowest occupancy in Q15.

Plenary

- Ask students to work with a partner on Q16 and then compare their solution with another pair's solution. Check any assumptions made. For example, is the diagram to scale?

Formative assessment

- Ask students to peer-assess answers to Q14–17, comparing and rating the commentary accompanying the calculations. Encourage them to use assessment criteria related to clarity of working, accuracy and justification of calculations.

Homework

- Ask students to complete Q18. They should justify all calculations and ensure that their final decision is clearly communicated.

Lesson 5

Objectives

- Use a range of calculation techniques using fractions, decimals and percentages
- Interpret and communicate solutions to multi-stage practical problems, and use calculations to justify any statements made

Starter

- Mark out a 100 cm length on the wall or floor. Ask students to make calculations in order to mark off sections representing $\frac{4}{13}$, $\frac{9}{16}$ and 5% of the total length. Consider issues of rounding for practicality.

Main teaching and learning

- Present the idea that questions involving percentages often fall into two categories:
 - Questions where a fraction is converted to a percentage – percentage change, profit and loss, etc.
 - Questions where a percentage of a quantity is calculated – increasing or decreasing by a percentage, etc.
- Give students a selection of closed questions from Resource sheet 2.3 to sort into these two groups.
- Ask students to think of three items that they might buy at a car boot sale and then sell on eBay. Ask them to think of the cost and selling price for each item and then roll a dice to find out how many they have sold. They should then calculate their profit/loss, first on each item and then overall, to see which player has made the most profit (or the least loss).
- Ask students to complete *Have a go* Q19–21 (p30).

Issues and misconceptions

- In Q19, ensure that students identify the purchase price as the original price and find the difference between that and the sale price, rather than using the figures given to form a fraction.

Support

- Ensure that students realise that rounding is required in Q21. If necessary, relate to the Starter activity.
- Check that students clearly identify the correct original figure to use in Q19 and Q20.

Extension

- Ask students to display graphically the information from either Q19 or Q20.

Plenary

- Ask students to consider the three different types of furniture in Q19. By just inspecting the figures, they should rank them in order of profitability and then check their ranking by calculation.

Formative assessment

- Ask students to peer-assess the accuracy of the diagrams drawn for Q21.

Homework

- Ask students to write two questions of their own, one from each of the categories discussed in the lesson:
 - Where a fraction is converted to a percentage
 - Where a percentage of a quantity is calculated.

Lesson 6

Objectives

- Use a range of calculation techniques using fractions, decimals and percentages
- Interpret and communicate solutions to multi-stage practical problems, and use calculations to justify any statements made

Starter

- Write the word 'significant' on the board and invite students to provide definitions.
- Compare the significance of being 1 minute late for the following: a party, school/college, a football tackle, a train.
- Emphasise that the significance of a result always needs to be considered in the context of the actual situation.

Main teaching and learning

- Ask students to work in pairs to complete *Have a go* Q22 (p31). Encourage them to consider first how the different numbers in the table relate to each other. Which are relevant, which are less so? Discuss students' conclusions.
- Provide statistical data from the results of published surveys from www.censusatschool.org.uk or a similar website. Data can be in printed form but access to spreadsheet versions and ICT would facilitate faster analysis. Ask students to choose a simple hypothesis to investigate by analysing proportions in raw data using fractions, decimals and percentages. Encourage fast analysis of raw data to reach quick headline-style conclusions rather than lengthy statistical analysis at this stage.
- Ask students to work together in groups to produce a presentation, poster or newspaper-style article on their findings.

Issues and misconceptions

- Ensure that students are able to identify which numbers to use in appropriate calculations.

Support

- Ask students how they intend to compare the actual data in the table with the survey claim in Q22, and similarly for their real data set.

Extension

- Ask the students to consider what other questions could have been asked in Q22 and to compare the non-response rates in the three cities.

Plenary

- Display and compare students' posters or article headlines. Ask groups to give their presentations to the rest of the class.

Formative assessment

- Assess the strategies students use to reduce the information in a large data set, using proportions expressed in fractions, decimals or percentages, through observation of group work. Identify possible improvements. Give immediate feedback to groups as part of the Plenary activity.

Homework

- Ask students to complete an exam-style question based on Chapter 2 content (for example, Level 2 Sample Assessment Materials Q3).