

Chapter 7 Formulae and equations

Specification

FS coverage and range Understand and use simple formulae and equations involving one- or two-step operations

FS exemplification Substitute numbers into a formula
Derive a formula in words
Changing the subject of a formula
Inverse operations
Formulae may include brackets

GCSE

GCSE specification

N q Understand and use number operations and the relationships between them, including inverse operations and hierarchy of operations

A d Set up and solve simple equations **including simultaneous equations in two unknowns**

A f Derive a formula, substitute numbers into a formula and change the subject of a formula

Edexcel GCSE course

Specification A:
Foundation 1.5, 5.4, 5.6, 5.11, 9.4, 10.2, 21.1–21.7, 28.1–28.6
Higher Chapter 1, 2.2, 4.7, 13.1–13.5, 14.5, 16.4–16.5, 19.5–19.8, 22.1–22.3

Specification B:
Foundation Unit 1: 3.1; **Unit 2:** 1.5, 3.4, 3.6, 3.11, 7.9, 8.4, 13.1–13.4; **Unit 3:** 1.1, 3.1–3.7, 6.1–6.2
Higher Unit 1: 2.1; **Unit 2:** Chapter 1, 3.7, 6.2–6.3, 7.2, 10.2–10.3; **Unit 3:** 1.1–1.2, 3.4, 4.1–4.5, 5.5–5.6, 7.1–7.3

Resources

General resources Show-me boards
Calculators

Links <http://www.elook.org/nutrition/>
<http://www.math.about.com/od/formulas/u/MathForm.htm>

ActiveTeach resources Video
ResultsPlus Knowledge Check
ResultsPlus Problem Solving
Question Audio
Animations

Lesson 1

Objectives

- Choose appropriate values and variables
- Substitute into formulae
- Use the correct order of operations
- Show methods in a clear and concise way

Starter

- Give students quick-fire number questions based on the order of operations. For example, $2 + 2 \times 3$ and 2×3^2 . Students should write their answers on show-me boards.

Main teaching and learning

- Use the Know Zone (p66) to clarify the importance of BIDMAS.
- Introduce word formulae. Ask: *What do word formulae describe? What is the difference between formulae and equations? What is a variable?* With the use of an example, emphasise that each variable has many values and that the formula is a set of rules that describe the relationship between the different variables.
- Ask students to list any formulae that they already know. Develop students' understanding by demonstrating how word formulae can be created, converted to algebraic formulae and used to calculate values. Use one of the formulae suggested by students or the perimeter of a rectangle as an example.
- Use the Know Zone to discuss good practice when setting out solutions, including stating the values of variables at the start.
- Ask students to find c if $a = b + 2c$, when $a = 10$ and $b = 4$. Share solutions verbally and discuss the process of finding variables which are not the subject of the formula.
- Use the ResultsPlus Knowledge Check to ensure that students have the maths skills needed for the chapter. Ask students to complete *Have a go* Q1–3 (pp67–8).

Issues and misconceptions

- Students may be more familiar with BODMAS than BIDMAS. They may have learnt that the 'O' stands for 'order' or 'over'. Clarify that 'indices' means the same as 'order'.
- Students may struggle to process information using a calculator when given a formula. Encourage students to work out the solution in small steps while focusing on BIDMAS.
- In Q3, students may not realise that overtime hours have to be subtracted from total hours to calculate basic hours.

Support

- For Q1, discuss how to calculate $\frac{5}{9}$ of 90. For Q3, encourage students to write a separate line of working for each of the following: stating variables, substituting in, working out brackets, multiplying and dividing, adding, stating final answer.

Extension

- Ask students to construct a graph to show the relationship between F and C , given in Q1.

Plenary

- Pose the following question: A star is classified as variable if its apparent brightness as seen from Earth varies over time. Using what you know about variables in formulae, do you think astronomers came up with a good name?

Formative assessment

- Students peer-assess answers to Q1–3, in particular how the method has been set out.

Homework

- Ask students to list five everyday formulae. For example, speed = distance \div time.

Lesson 2

Objectives

- Choose appropriate values from tables
- Recognise when values need to be changed
- Use mathematical techniques to change values
- Explain the differences between two sets of data
- Decide if the results are appropriate

Starter

- Ask students to complete some Level 1 ratio questions. For example, ask: *If squash is made from cordial and water in the ratio 1:4, how many litres of squash do 2 litres of cordial make? Class 10X has 33 students with a boy:girl ratio of 1:2. How many students in class 10X are girls?*

Main teaching and learning

- Use *Take a look: Calculating BMI* (pp68–9) to discuss selecting appropriate values, checking values are in the correct units and using information from tables.
- Give students some height and weight data and ask them to work out the BMI: $h = 1.7$ m, $w = 93$ kg (obese); $h = 1.5$ m, $w = 40$ kg (underweight); $h = 165$ cm, $w = 60$ kg (normal). More able students could be given the height and asked to calculate the required range of weights to achieve a normal BMI.
- Read through *Take a look: Slimming club* and ask: *What information is required and what is redundant? What are you being asked to compare? Why is it important to set the work out in sections?*
- Ask students to complete *Have a go* Q4 and Q5.
- Discuss Q6 and ask students: *What do we know about Rochelle's height?* (Constant) *Do we need to calculate her current BMI?* (No) Ask students to complete Q6.

Issues and misconceptions

- Ensure that students realise that the milk data in the table for Q4 (p70) is for 244 ml.
- For Q6, ensure that students know that there are 12 inches in a foot.

Support

- For Q4, encourage students to find the nutritional information in 1 ml, then 150 ml (unitary method).
- For Q5, remind students how to share a quantity in a given ratio. For example, share £220 in a ratio of 2:3.

Extension

- Ask students to write a statement for a member of the slimming club in *Take a look: Slimming club*, detailing the importance placed on calories, fat and fibre.

Plenary

- Pose the following question: A typical CD player spins a CD at a rate (r) of 131 cm/sec and takes a time (t) of 73 minutes to play the whole CD. The length (l) of the spiral on a CD can be calculated using $l = rt$. Calculate the length of the spiral on a typical CD.

Formative assessment

- Ask students to peer-assess the calendar for Q6. Discuss what a reasonable level of detail is. For example, does it need to include every day of every month?

Homework

- Use the slimming club formula to investigate the points score for various foods. Nutritional information can be found on food packaging or at www.elook.org/nutrition/.

Lesson 3

Objectives

- Decide on a logical mathematical process
- Use a variety of inputs to analyse the effect on the final solution
- Write results to an appropriate degree of accuracy
- Advise on a number of different outcomes
- Draw conclusions and justify your solutions

Starter

- Pose the following question:
For a rectangle, if l = length, w = width and P = perimeter, which of the following are true?

$$\begin{array}{cccc}
 P = 2w + 2l & P = 2l + 2w & P = 2(l + w) & P = lw \\
 2l = P - 2w & \frac{1}{2}P = l + w & \frac{P}{2} = l + w & 2P = l + w
 \end{array}$$

Encourage students to consider what each formula represents.

Main teaching and learning

- Recap work from previous lessons. Ask: *What is redundant information? Why is it important to check the defined units for each variable? How should solutions be set out? What is meant by the acronym BIDMAS?*
- Ask students to complete *Have a go Q7* (p72).
- Discuss *Take a look: Insulation*. Ask: *What is the key information in the question? How has the solution been broken into steps? What is meant by the word 'advise'?*
- Discuss Q8. Ask: *What information is redundant? How can you break the problem into manageable steps?* Ask students to complete Q8.
- Ask students to complete Q9.

Issues and misconceptions

- For Q8, ensure that students know that there are 12 inches in a foot.

Support

- For Q8, ask students to consider how they will find h , given that it is not the subject of the formula.

Extension

- Ask students to calculate the cement required for more complex 3D shapes, based on the information in Q9.

Plenary

- As a class, describe the role each variable plays in the formulae from *Take a look: Insulation* and Q7–9.

Formative assessment

- Show students model solutions to Q7–9 and discuss how they have chosen to set out their own work.

Homework

- Ask students to use the Know Zones throughout the *Student Book* to create a sheet detailing all the formulae they need to know.
- Ask students to consider how they might construct formulae for converting units of measure.