

Chapter 7 Formulae

Specification

FS coverage and range Use simple formulae expressed in words for one- or two-step operations

FS exemplification Substitute numbers into a formula in words

GCSE

GCSE specification

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

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

Edexcel GCSE course

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

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, 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, 5.5–5.6

Resources

General resources

Calculators of different types – scientific and non-scientific
 Show-me boards
 Olympic medals table
 Football results

Resource sheets 7.1, 7.2

Links

<http://www.databaseolympics.com>
<http://www.footballresults.org/>

ActiveTeach resources

Video
 ResultsPlus Knowledge Check
 ResultsPlus Problem Solving
 Question Audio
 Animations

Lesson 1

Objectives

- Use the correct order of operations, BIDMAS
- Think about the appropriateness of results
- Set out solutions methodically

Starter

- Give out a number of different calculators to the class; include some scientific calculators and some basic calculators. Students could also use the calculator function on a mobile phone. Ask them to work out the answer to $5 + 4 \times 2$. Ask:
 - *Does everyone get the same answer?*
 - *Why do some get the answer 18 and some get 13? Which is correct?*
 - *Why don't all the calculators give the same result?*
- Repeat with $20 - 10 \div 2$.

Main teaching and learning

- Remind students of the BIDMAS rules.
- Give students the cards from Resource sheet 7.1, which show some simple formulae in words along with the numbers to be substituted. More cards could be produced using the same formula but with different numbers. Ask students to work out the value of the given quantity. When all students have used all the cards, compare answers in groups and decide upon the correct ones.
- Relate this to *Take a look: Mechanics' costs* (p74).
- Give students different values for the variables in the question and ask them to work out the amount charged each time.
- Ask students to complete *Have a go* Q1–4.

Issues and misconceptions

- Students frequently forget that they need to carry out operations in the correct order. Emphasise that, although the acronym BIDMAS suggests that division comes before multiplication and addition comes before subtraction, this is not the case. Division and multiplication have equal priority as do addition and subtraction. For example, the correct answer to $10 - 2 + 1$ is 9 as the operations are carried out left to right and not 7 which students would obtain by working out the equivalent to $10 - (2 + 1)$.

Support

- In the formulae card activity, restrict cards initially to those that only have two variables.

Extension

- In the formulae card activity, provide cards that include negative as well as positive numbers. Some quantities could also be given in the 'wrong' units. For example, give 10 minutes as the time for the final velocity card.

Plenary

- Display a word formula on the board. Give students easy values for the variables in the formula and ask them to write on show-me boards the subject of the formula.

Formative assessment

- Mark numerical answers for Q1–4 and discuss any discrepancies in students' answers.

Homework

- Ask students to research and bring to class a word formula that is used to work out a gas or electricity bill.

Lesson 2

Objectives

- Use the correct units when substituting values into formulae
- Convert between units of measurement
- Use appropriate units when giving solutions

Starter

- Ask: *Which is heavier: 50 kilograms or 50 pounds?* When the correct answer is agreed, ask students how they know that 50 kilograms is heavier than 50 pounds. Ask students to write down all the conversions they can think of – either in the same system of units or for converting between systems of units. Summarise these on the board and ensure that they are correct.

Main teaching and learning

- Give students the cards from Resource sheet 7.2. These are similar to those used in Lesson 1 but, this time, some of the variables are given in the 'wrong' units. As before, more cards could be produced using the same formulae but with different numbers and/or units. Ask students to work out the value of the given quantity. When all students have used all the cards, compare answers in groups and decide upon the correct ones.
- Relate this to *Take a look: Cooking dinner* (pp75–6). Give students different values for the variables in the question and ask them to work out the cooking times. Ask for the cooking times in hours and minutes.
- Ask students to complete *Have a go* Q5 and Q6.

Issues and misconceptions

- Emphasise the importance of checking that, when substituting values into a formula, the units are consistent with those given in the definitions for the variables.

Support

- Help students by pointing out the variables that have been given in the wrong units. Ensure that students know the necessary conversions and how to carry out the conversions.

Extension

- Pose the following problem: *Usain Bolt won the men's 100 metres race in the 2008 Olympics. He ran 100 metres in 9.69 seconds. Use the formula $\text{speed} = \text{distance} \div \text{time}$ to work out his speed in both metres/second and kilometres/hour. Provide suitable conversions.*

Plenary

- Go round the class asking quick-fire questions related to conversions that students should know.

Formative assessment

- Mark numerical answers for Q5. Ask one of the students to explain how they changed their original answer (1536 seconds) to minutes and seconds (25 minutes and 36 seconds). Ask students, in pairs, to do Q5 again but this time with a data connection speed of 2 megabytes/second and an 8 gigabyte film. They should give their answer in hours, minutes and seconds (1 hour, 8 minutes and 16 seconds).

Homework

- Ask students to complete Q7.

Lesson 3

Objectives

- Find relevant information from charts and tables
- Use charts and tables to do calculations
- Use charts and tables to communicate results

Starter

- Give students (or display on the board) the 2008 Olympics medal table showing the top 12 countries (<http://www.databaseolympics.com/games/gamesyear.htm?g=47>). Ask questions to check students' understanding of the information in the table. For example, ask: *What do the column headings B, S and G mean? How many medals did the UK win? Which country won 16 silver medals? Who did better overall, the UK or France?*

Main teaching and learning

- Ask students to look at the table for the top 12 countries in the 2008 Olympics. Ask: *At present, how is the order of the countries decided?* Establish that each country's medals are simply added together. Now ask students to consider whether it would be a better idea to use the following formula to place the countries in order:

Number of points = 3 × number of gold medals + 2 × number of silver medals + number of bronze medals.

- Ask: *Would the position of the countries remain the same if the formula was used?*
- Ask students to complete *Have a go* Q8 (p78).
- Divide students into pairs and give them the information from *Take a look: Ordering textbooks*. Ask each pair to work out a solution to the problem. Then discuss students' strategies and relate these to the strategy given in the solution.
- Ask students to complete Q9.

Issues and misconceptions

- Students may not read information from tables accurately. Emphasise that using a table is a very good way to summarise information in solutions to problems.

Support

- For Q8, ensure weaker students understand that the result United v Athletic 1–2 means United scored one goal and Athletic scored two. Ensure students have correctly worked out that United had one win and one draw before they attempt to use the formula.

Extension

- Return to *Take a look: Ordering textbooks*. Ask: *If 7A and 7B use extension books and all other classes use core books, would this affect the cost of the new books, assuming all books cost the same?*

Plenary

- For Q8 supply the following additional results: Athletic v Wanderers 3–2; Athletic v City 0–1; Wanderers v City 1–1. Ask students to work out the number of league points each team has after six matches.
- Ask: *If the formula was changed to 'Number of points = number of wins × 3 + number of draws × 2', would this affect the order of the teams?*

Formative assessment

- Display on the board a table of football results (real or fictional – you can use www.footballresults.org for this). Ask: *If each team was awarded two points for a win and one point for a draw, how many points would be awarded to the top five teams?*

Homework

- Ask students to complete Q10.