Lesson plan Substitution and Formulae

1. Lesson objectives

- Use the order of operations to navigate through expressions and formulae.
- Use formulae in words and numbers, recognising links between language and numbers.
- Substitute positive and negative numbers in algebraic formulae.
- Use variations of concepts to promote mathematical thinking and discussion, building on existing knowledge relevant for substitution and formulae.

2. GCSE curriculum

Algebra
A2 substitute numerical values into formulae and expressions, including scientific formulae.
A3 understand and use the concepts and vocabulary of expressions, equations, formulae, identities, inequalities, terms, and factors.

3. Lesson plan

This is an overview of the lesson. More notes can be found in the notes in the lesson slides.

Activity	Purpose of this activity	Time (min)	Guidance	Materials
Introduction	Check prior knowledge and confirm understanding of key terms. Address fundamental mathematical ideas/concepts.	15	Formative assessment – progress through the slides, each time asking, 'What's the same, what's different?' Depending on the level and confidence of learners, this could be an individual, pair or group activity. Especially confirm knowledge of variables, formulae and expressions Encourage learners to share their own examples of formulae. The tutor should make suggestions where appropriate.	Slides 2–4 Mini whiteboards Pens Calculators
Discuss and Explore 1	Expression review in context. Opportunity for pair/group work. Demonstrates that variables do not need to be named 'x', as can be seen in the examples.	10	Identify the answer but discuss the other options. Ask learners what the various answers represent. Allow time for discussion but prompt if required, e.g., "If Dev is given some extra money in addition to his ten pounds, how could that be expressed?" For Dev and Ruby's expression game, use mini whiteboards to complete the activity. This can be done individually, in pairs or in small groups.	Slides 5–9 Mini whiteboards

Activity	Purpose of this activity	Time (min)	Guidance	Materials
	Address fundamental mathematical ideas/concepts.		Remind learners that unknown quantities can be named and used with mathematical operations.	
			Confirm BIDMAS knowledge and the importance of following BIDMAS structure.	
	Highlight mathematical structure using context.		Demonstrate that variables do not have to be named "x."	
Discuss 2	Introduce substitution. Use familiar examples to build learners' confidence. Address fundamental mathematical ideas/concepts. Highlight mathematical structure using context.	10	Work through the two examples on the PowerPoint. Example 1 $A = L \times W$ ties to prior knowledge and demonstrates simple substitution. Confirm that the answer should be m² and the ongoing importance of units. Example 2 Scientific calculation: Speed = distance ÷ time The scenario is familiar to the learners but can be tailored to the college. After the worked example, Dev makes an incorrect statement. Support the discussion so that learners understand what Dev did wrong.	Slides 10–11

| Explore 2 | The substantial task of the lesson is to demonstrate the relationship between formulae as expressions and in sentence form, before introducing number tables.

Opportunity for learners to discuss and collaborate.

Task can be extended depending on the level of the class. | 25 | Distribute card match up exercise.
Distribute the envelope containing the cut-up formulae and expressions first.
The tutor to support and discuss with learners through activities.
Once checked and confirmed correct, the tutor can follow up with the number tables, which learners not only match to the other cards, but also complete, by working out the missing numbers.

Card matching confirms knowledge of the order of operations and formulae construction.

Extension opportunity:
Learners can be challenged to develop their own examples of expressions, sentences and number tables.
Tutor should judge class confidence when deciding whether to do this. | Slide 12
Slide 13 (Ans)

Explore 2 formula cards

Explore 2 expression cards

Explore 2 number tables

Explore 2 answers

Card match handouts to be cut up and placed in envelopes prior to the lesson.

Number tables to be distributed after the cards have been matched by learners. |

Discuss and Explore 3	Complex example with tutor support. Confirms understanding of order of operations. Highlight mathematical structure using context.	10	Converting Fahrenheit to Celsius is a more complex example but still relevant, and accessible to learners. Emphasise order of operations and substitution in action. Learners discuss whether Dev is correct in telling Ruby to take warm clothes because December is always cold. Potential for individual or pair work.	Slides 14–15 Mini whiteboards Pens Calculators
Review	Summary of activities completed to this point in the lesson	5	Review key knowledge and confirm understanding of examples given through discussion and presentation. Allow for Q&A before linking to exam questions.	Slide 16
Practice questions	To demonstrate the relevance of substitution and formulae by showcasing examples from exam papers.	10	Exam questions increase in complexity. Opportunity for tutors to add additional questions if necessary. Support learners to complete questions. Learners can complete the activity on mini whiteboards or on paper.	Slides 17–19 Mini whiteboard kits Pens Calculators Exam questions handout and answers

| Review | Conclude lesson, reviewing objectives | 5 | Reinforce key language and the order of operations knowledge in order to complete substitution and formulae related questions.

Review the objectives from the start of the lesson. | Slide 18 |