Week 1: Algebra Foundations

Lesson 1: Introduction to Index Laws

Objective: Students will recall and apply basic index laws to simplify expressions.

Materials: Whiteboard, markers, handouts with practice problems.

Lesson Outline:

1. **Introduction & Icebreaker (5 min)**
   - Teacher introduction:
   - Students volunteer one exponent rule (e.g., $a^m \times a^n = a^{m+n}$).
2. **Pronunciation Practice (5 min)**
   - Focus on key terms: "index," "base," "power."
   - Choral repetition and individual practice.
3. **Review of Index Laws (10 min)**
   - Present key laws using the textbook summary:
     - $a^m \times a^n = a^{m+n}$
     - $a^m \div a^n = a^{m-n}$
     - $(a^m)^n = a^{mn}$
     - $(ab)^n = a^n b^n$
   - Example: Simplify $x^3 \times x^4 \to x^7$.
   - Address common pitfalls:
     - "Why is $3x^3 \times 2x^2 = 6x^5$ (not $6x^6$)?"
     - Stress non-applicability to unlike bases (e.g., $a^m \times b^n$ cannot be combined).
4. **Guided Practice (10 min)**
   - Solve together:
     - Example 1
     - Example 2
     - Example 3
   - Emphasize step-by-step justification: "We used the division law: $a^m \div a^n = a^{m-n}$."
5. **Independent Practice (7 min)**
   - Handout: Simplify 3 expressions (e.g., $2x^3 \times 3x^2$, $\left(p^3\right)^2 \div p^4$).
   - Peer check: Swap papers for quick feedback.

6. **Wrap-up & Homework (3 min)**
    - Summary: "Index laws are tools for simplification. Always state the law used."
    - Homework: Textbook Exercise 1A, Q1a–i (simplification).

Lesson 2: Advanced Simplification and Polynomial Expansion

Objective: Extend index laws to complex expressions and expand single brackets.

Materials: Whiteboard, algebra tiles (optional), practice problems.

Lesson Outline:

1. **Review (5 min)**
    - Quick quiz: 3 problems from Lesson 1 homework. Address errors.
2. **Multi-variable Expressions (15 min)**
    - Example: Simplify $\frac{21a^3b^7}{7ab^4} = 3a^2b^3$.
    - Stress: "Apply laws to each variable separately."
    - Challenge: $9x^2 \times 3(x^2)^3 = 27x^8$.
3. **Expanding Brackets (15 min)**
    - Rule: $a(b \pm c) = ab \pm ac$.
    - Examples:
        - $x(x + 9) = x^2 + 9x$
        - $-3y(4 - 3y) = -12y + 9y^2$ (highlight sign change).
        - $4x(3x - 2x^2 + 5x^3) = 12x^2 - 8x^3 + 20x^4$.
4. **Practice & Feedback (5 min)**
    - Expand: $2x(5x + 3) - 5(2x + 3)$.
    - Teacher models first step, students complete independently.
5. **Homework**
    - Textbook Exercise 1A, Q1j–r and Exercise 2A, Q2a–d (expansion).

Lesson 3: Double Brackets and Factorisation Introduction

Objective: Expand double brackets and introduce factorisation.

Materials: Whiteboard, grid method templates.

Lesson Outline:

1. **Starter (5 min)**
   - Simplify $7a^4 \times (3a^4)^2$ (review indices) → $63a^{12}$.
2. **Expanding $(x + a)(x + b)$ (15 min)**
   - FOIL method: $(x + 5)(x + 2) = x^2 + 2x + 5x + 10 = x^2 + 7x + 10$.
   - Grid method visualization:
     - Example: $(x - 3)(x + 2)$.
   - Common error: Forgetting cross-terms (e.g., $x \times 2$ and $-3 \times x$).
3. **Factorisation Basics (15 min)**
   - Link to expansion: "Factorising is reversing expansion."
   - Example: $3x + 9 = 3(x + 3)$ (common factors).
   - Example: $x^2 - 5x = x(x - 5)$.
4. **Classwork**
   - Expand $(x - y)(2x + 3)$, then factorise $8x^2 + 20x$.
5. **Homework**
   - Textbook Exercise 1B, Q1a–i (double brackets).

Lesson 4: Factorising Quadratics (40 minutes)

Objective: Factorise quadratic expressions using the ac-method.

Materials: Whiteboard, factorisation puzzles.

Lesson Outline:

1. **Recap (5 min)**
   - Expand $(x + 3y)(4x - y) \rightarrow 4x^2 + 11xy - 3y^2$.
2. **Factorising $ax^2 + bx + c$ (20 min)**

- Steps:
    a. Find two numbers multiplying to ac, adding to b.
    b. Split middle term, then factorise by grouping.
- Example: $x^2 - 5x - 6 \rightarrow (x - 6)(x + 1)$.
- Example: $6x^2 - 11x - 10 \rightarrow (3x + 2)(2x - 5)$.

3. **Practice (10 min)**
    - Factorise $x^2 + 6x + 8 \rightarrow (x + 2)(x + 4)$.
    - Spot errors in incorrect solutions (e.g., $(x + 1)(x + 8)$).
4. **Homework**
    - Textbook Exercise 1C, Q2a–l (quadratic factorisation).

Lesson 5: Negative and Fractional Indices

Objective: Simplify expressions with negative/fractional indices.

Materials: Whiteboard, scientific calculators.

Lesson Outline:

1. **Starter (5 min)**
    - Why is $a^{-m} = \frac{1}{a^m}$? Discuss using division law.
2. **Negative Indices (10 min)**
    - Examples:
        - $x^{-3} = \frac{1}{x^3}$
        - $\frac{2x^2 - x}{x^5} = 2x^{-3} - x^{-4} = \frac{2}{x^3} - \frac{1}{x^4}$.
3. **Fractional Indices (15 min)**
    - Link to roots: $a^{\frac{1}{n}} = \sqrt[n]{a}$, $a^{\frac{m}{n}} = (\sqrt[n]{a})^m$.
    - Examples:
        - $49^{\frac{1}{2}} = 7$
        - $8^{\frac{2}{3}} = 4$
        - Simplify $\sqrt[3]{125x^6} = 5x^2$.
4. **Application (7 min)**
    - Simplify $2x^{1.5} \div 4x^{-0.25} = \frac{1}{2}x^{1.75}$.
5. **Homework**
    - Textbook Exercise 1D (negative/fractional indices).

Lesson 6: Surds and Rationalising Denominators

Objective: Simplify surds and rationalise denominators.

Materials: Whiteboard, surds puzzles.

Lesson Outline:

1. **Recap (5 min)**
   - Convert $16^{-\frac{3}{2}}$ to fraction → $\frac{1}{64}$.
2. **Surd Simplification (15 min)**
   - Rules: $\sqrt{ab} = \sqrt{a} \times \sqrt{b}$, $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$.
   - Examples:
     - $\sqrt{12} = 2\sqrt{3}$
     - $\frac{\sqrt{20}}{2} = \sqrt{5}$.
3. **Rationalising Denominators (15 min)**
   - Case 1: $\frac{1}{\sqrt{a}}$ → multiply by $\frac{\sqrt{a}}{\sqrt{a}}$.
   - Case 2: $\frac{1}{a \pm \sqrt{b}}$ → multiply by conjugate.
   - Example: $\frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{3}$.
   - Example: $\frac{1}{3+\sqrt{2}} \times \frac{3-\sqrt{2}}{3-\sqrt{2}} = \frac{3-\sqrt{2}}{7}$.
4. **Summary & Preview (5 min)**
   - Week 1 recap: "We've built a foundation in algebra. Next week: quadratic equations!"
   - Exit ticket: Simplify $\frac{\sqrt{75}-\sqrt{12}}{3}$.

Weekly Assessment:

- **Formative:** Daily exit tickets, homework checks.
- **Summative:** End-of-week quiz (20 min) covering all topics.

Adaptations:

- **Support:** Step-by-step scaffolds for factorisation; visual aids for surds.
- **Challenge:** Problem-solving tasks (e.g., simplify $(x + y)^4$ using index laws).