# 11.5 Parsing

Name: _____ Class: _____ Date: _____ **Total: 24 marks**

**KEY WORDS** context-free languages • pumping lemma

## Objective

Run an LL(1) parser by table and stack, and remove left recursion.

## 1 Key knowledge and worked examples

■ **The machinery**

FIRST/FOLLOW fill the (nonterminal, lookahead) table; the stack runs the derivation; conflicts reject the grammar ✓.

■ **Worked example: the tail trick**

$E \to E + T \mid T$ becomes $E \to TE'$, $E' \to +TE' \mid \varepsilon$ – the loop becomes a tail ✓.

## 2 Practice

**2.1** What fills an LL(1) table cell? [3]

**2.2** What does a conflict in a cell mean? [3]

**2.3** Why does left recursion break LL(1) parsing? [3]



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## 3 Exam-style questions

**3.1** Grammar: $S \to \mathbf{id} = E$; $E \to TE'$; $E' \to +TE' \mid \varepsilon$; $T \to \mathbf{id}$.

Build the LL(1) table (all nonempty cells with justification). Parse `id = id + id`: give each stack snapshot with the lookahead, naming the table cell or the match at each move. State the count of moves and the final verdict. [8]

**3.2** Remove left recursion from $A \to A\mathbf{a} \mid A\mathbf{b} \mid \mathbf{c}$.

Give the transformed grammar. Derive `c a b a` under it (leftmost). State what the original grammar generated, in set notation, to show the transformation preserved the language. State the associativity cost and where it is paid. [7]