Syntax Exercises: Using the Formation Rules from the online handout, determine whether the strings of symbols given below are sentences of FOL. Take each string as given—there are no “typos” to be “corrected”. Give step-by-step explanations with numbered lines. Start with the smallest, most "internal" parts of the strings that count as FOL sentences (if any), citing a Formation Rule that justifies labeling them as FOL sentences. Then try to build up to the full string by application and reapplication of the relevant Formation Rules. Explain each step in the process by citing the rule applied to construct the string you declare a sentence of FOL at that step, along with the line numbers of the steps in your explanation that declared the input to the rule to be sentences (or a sentence) of FOL. Do this until either you reach the full string or you hit a point at which no rule can get you closer to the full string (i.e., build up as much as you can, and as many pieces as you can, then state “No Formation Rule will take us any further towards the string”). If the former happens you will have a numbered line that says the string is a sentence of FOL, so make that conclusion explicitly; if the latter happens, explicitly conclude that the string is not a sentence of FOL.

Example:  \(((F \lor \neg G) \land H)\)
  i. \(F, G, \text{ and } H\) are all atomic sentences of FOL by Rule 0/Atomic Sentence Rule.
  ii. \(\neg G\) is a sentence of FOL by Rule 1/Negation Rule and Line i.
  iii. \((F \lor \neg G)\) is a sentence of FOL by Rule 3/Disjunction Rule and Lines i and ii.
  iv. \(((F \lor \neg G) \land H)\) is a sentence of FOL by Rule 2/Conjunction Rule and Lines i and iii.

Thus, \(((F \lor \neg G) \land H)\) is a sentence of FOL!

1. \((\neg B \lor (\neg C \land A))\)

2. \(A \land (B \lor (\neg C))\)

3. \(F \lor (D \land (B \lor (\neg C \lor H)))\)

4. \(A \lor (\neg A \land (A' \lor (\neg A' \land (A'' \lor \neg A''))))\)

5. \((\neg ((\neg A \lor B) \land (C \land B)) \lor (B \lor (\neg C \land \neg A))))\)