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# NTIN071 A&G: Sample test

*Each problem is worth 20 points, totaling 120 points.*

1. Construct a context-free grammar generating the language $L = \{a^n b^k a^{3n} \mid n, k \geq 0\}$. Write down a derivation for the word $w = abbaaa$.

2. Convert the grammar from the previous problem to Chomsky normal form.

3. Prove that the language $L = \{a^{n^5} \mid n \geq 0\}$ is not regular.

4. Construct a pushdown automaton accepting, by empty stack, the language $L = \{w \in \{0,1\}^* \mid |w|_0 \geq |w|_1 + 1\}$. Write down a sequence of configurations for the word $w = 10001$.

5. Prove that the language $L = \{0^i 1^j 2^k 3^\ell \mid i = j = k \text{ or } \ell = 0\}$ is not context-free.

6. Construct a deterministic finite automaton that accepts exactly those words over the alphabet $\{0,1\}$ which end with the sequence 010.