

Name: _____

1. (1 pt.)

- **Read all material carefully.**
- You may refer to your books, papers, and notes during this test.
- No computer or network access of any kind is allowed (or needed).
- Write, and draw, carefully. Ambiguous or cryptic answers receive zero credit.
- Use textbook and classroom conventions for notation, algorithmic options, etc.
- Ask for clarifications on the above if needed.

Write your name in the space provided above.

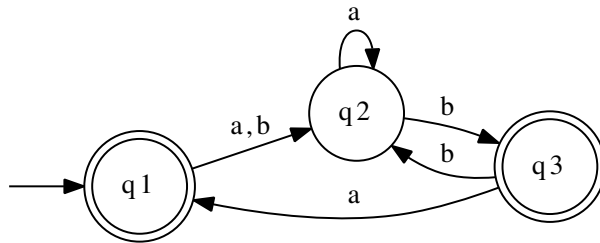
2. (14 pts.) Convert the following grammar to Chomsky normal form. Upper-case letters denote variables and lower-case letters denote terminals. *Show enough intermediate results and include brief explanations* to make it clear that the method described in the textbook is being followed.

$$\begin{aligned} A &\rightarrow BCDE \mid \epsilon \\ B &\rightarrow bBC \\ C &\rightarrow ABE \\ D &\rightarrow \epsilon \mid dd \mid DD \mid E \\ E &\rightarrow A \mid e \end{aligned}$$

[additional space for answering the earlier question]

3. (15 pts.) Provide a pushdown automaton that is equivalent to the original grammar of Question 2. *Depict* the automaton using the textbook's graphical conventions. *Briefly explain* why your answer is correct.

4. (15 pts.) Generate a regular expression that is equivalent to the following finite-state automaton. *Show enough intermediate results and include brief explanations* to make it clear that the method described in the textbook is being followed.



[additional space for answering the earlier question]

5. (15 pts.) Prove or disprove: The language $L = \{a^i b^{2^i} c^j \mid i, j \geq 0\}$ is context-free.