The answers must be the original work of the author. While discussion with others is permitted and encouraged, the final work should be done individually. You are not allowed to work in groups. You are allowed to build on the material supplied in the class. Any other source must be specified clearly.

1. *(10 points)* Give a formal description (in the form of a 5-tuple) of the DFA shown below. The DFA accepts the strings with the symbol 'a' in the second position from the end.
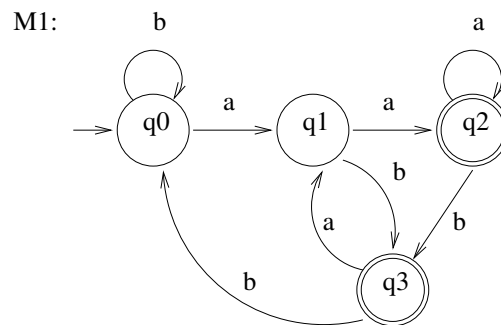
2. *(90 points)* Build a DFA that accepts the described language. Explain how the machine works. No points will be given to machines without accompanying "comments".

(a) The empty set (over $\{a, b\}$).

(b) The empty string (over $\{a, b\}$).

(c) The set of strings over $\{a, b, c\}$ in which every 'b' is immediately followed by at least one 'c'.

(d) $(ab)^*ba$

(e) $\{w \mid w \in \{a, b\}^* \text{ and the length of } w \text{ is at least 5 }\}$

(f) The set of strings over $\{a, b\}$ that end with 'b' and do not contain the substring 'aa'.