1. Consider the following Turing Machine. Its input alphabet is \{a, b\}. Transitions to the REJECT state are not shown. ("If stuck, reject.")

(a) Exhibit a non-empty string over \{a, b\} that this TM accepts.

\(aba\)

(b) Exhibit a non-empty string over \{a, b\} that this TM does not accept.

\(ab\)

(c) What language does this TM accept? (You should characterize it in terms of properties of the accepted strings.)

\(\left\{a^m b a^m \mid m \geq 0 \right\}\)
2. Exhibit a derivation of the string $a^2b^4c^2$ in the following grammar:

$$
S \rightarrow SABBC \mid X \\
CB \rightarrow BC \\
CA \rightarrow AC \\
BA \rightarrow AB \\
XA \rightarrow aX \mid aY \\
YB \rightarrow bY \mid bZ \\
ZC \rightarrow cZ \mid c
$$

What language does this grammar generate?

$$
S \Rightarrow SABBC \Rightarrow SABBCABBC \Rightarrow XABBCABBC \Rightarrow XABBCBCC \Rightarrow XABABCBBCC \Rightarrow XABABBCCBC \Rightarrow XABABBBCBC \Rightarrow XABABBCCBC \Rightarrow XABABBBCBC \Rightarrow aXABBCCBC \Rightarrow aaYBBBCBC \Rightarrow aabbYBBCC \Rightarrow aabbbYBCC \Rightarrow aabbbbZCC \Rightarrow aabbbbcZC \Rightarrow aabbbbcC
$$

The language is $\left\{ a^m b^{2m} c^m \mid m > 0 \right\}$.