Q1.a) $a^n b^m$ where $n > m$ and $n > 0$

b) aab : $\delta(q_0, a, z_0) \rightarrow \{(q_1, z_0)\}$
         $\delta(q_1, a, z_0) \rightarrow \{(q_1, a z_0)\}$
         $\delta(q_1, b, a) \rightarrow \{(q_1, e)\}$

   abb : $\delta(q_0, a, z_0) \rightarrow \{(q_1, z_0)\}$
         No further steps, string is rejected.

   aba : $\delta(q_0, a, z_0) \rightarrow \{(q_1, z_0)\}$
         No further steps, string is rejected.

c) aaa bb : $\delta(q_0, a, z_0) \rightarrow \{(q_1, z_0)\}$
         $\delta(q_1, a, z_0) \rightarrow \{(q_1, a z_0)\}$
         $\delta(q_1, a, a) \rightarrow \{(q_1, a a)\}$
         $\delta(q_1, b, a) \rightarrow \{(q_1, e)\}$
         $\delta(q_1, b, a) \rightarrow \{(q_1, e)\}$

       Accepted by state (q_1)

   aaab : $\delta(q_0, a, z_0) \rightarrow \{(q_1, z_0)\}$
         $\delta(q_1, a, z_0) \rightarrow \{(q_1, a z_0)\}$
         $\delta(q_1, a, a) \rightarrow \{(q_1, a a)\}$
         $\delta(q_1, b, a \rightarrow \{(q_1, e)\}$

       Accepted by state (q_1)

Q2

a)

$Q = \{q_0, q_1, q_2, q_3\}, \ \Sigma = \{a, b\}, \ \Gamma = \{a\}, \ F = \{q_0, q_3\}$

$$\delta(q_0, a, z_0) \rightarrow \{(q_1, a)\}$$
$$\delta(q_0, b, z_0) \rightarrow \{(q_3, \varepsilon)\}$$
$$\delta(q_1, a, a) \rightarrow \{(q_1, aa)\}$$
$$\delta(q_1, b, a) \rightarrow \{(q_2, \varepsilon)\}$$
$$\delta(q_2, b, \varepsilon) \rightarrow \{(q_3, \varepsilon)\}$$

b)

$Q = \{q_0, q_1, q_2, q_3, f\}, \ \Sigma = \{a, b, c\}, \ \Gamma = \{a, z_0\}, \ F = \{q_0, f\}$

$$\delta(q_0, a, z_0) \rightarrow \{(q_1, a)\}$$
$$\delta(q_0, c, z_0) \rightarrow \{(f, z_0)\}$$
$$\delta(q_1, a, a) \rightarrow \{(q_1, aa)\}$$
$$\delta(q_1, c, a) \rightarrow \{(q_2, a)\}$$
$$\delta(q_2, c, a) \rightarrow \{(q_2, a)\}$$
$$\delta(q_1, b, a) \rightarrow \{(q_3, \varepsilon)\}$$
$$\delta(q_2, b, a) \rightarrow \{(q_3, \varepsilon)\}$$
$$\delta(q_3, b, a) \rightarrow \{(q_3, \varepsilon)\}$$
$$\delta(q_3, e, z_0) \rightarrow \{(f, z_0)\}$$

d)

$Q = \{q_0, q_1, q_2, q_3, f\}, \ \Sigma = \{a, b, c\}, \ \Gamma \{a, b, z_0\}, \ F = \{q_0, f\}$

$$\delta(q_0, a, z_0) \rightarrow \{(q_1, a)\}$$
$$\delta(q_1, a, a) \rightarrow \{(q_1, aa)\}$$
$$\delta(q_1, b, a) \rightarrow \{(q_2, \varepsilon)\}$$
$$\delta(q_2, b, a) \rightarrow \{(q_2, \varepsilon)\}$$
$$\delta(q_2, b, z_0) \rightarrow \{(q_2, bz_0)\}$$
$$\delta(q_2, c, b) \rightarrow \{(q_3, \varepsilon)\}$$
$$\delta(q_3, c, b) \rightarrow \{(q_3, \varepsilon)\}$$
$$\delta(q_3, e, z_0) \rightarrow \{(f, z_0)\}$$

e) $Q = \{q_0, q_1, q_2, f\}$, $\Sigma = \{a, b\}$, $\Gamma = \{a, z_0\}$, $F := \{q_0, f\}$

$$\delta(q_0, a, z_0) \to (q_1, a z_0)$$
$$\delta(q_1, a, a) \to (q_1, aa)$$
$$\delta(q_1, b, a) \to (q_2, \varepsilon)$$
$$\delta(q_2, b, a) \to (q_2, \varepsilon)$$
$$\delta(q_2, b, z_0) \to (f, z_0)$$
$$\delta(f, b, z_0) \to (f, z_0)$$

f) $Q = \{q_0, q_1, q_2, q_3, f\}$, $\Sigma = \{a, b, c\}$, $\Gamma = \{a, z_0\}$, $F := \{q_0, f\}$

$$\delta(q_0, a, z_0) \to (q_1, a z_0)$$
$$\delta(q_1, a, a) \to (q_1, aa)$$
$$\delta(q_1, b, a) \to (q_2, \varepsilon)$$
$$\delta(q_2, b, a) \to (q_2, \varepsilon)$$
$$\delta(q_2, c, a) \to (q_3, \varepsilon)$$
$$\delta(q_1, c, a) \to (q_3, \varepsilon)$$
$$\delta(q_3, \varepsilon, z_0) \to (f, z_0)$$
$$\delta(q_2, \varepsilon, z_0) \to (f, z_0)$$
$$\delta(q_3, c, a) \to (q_3, \varepsilon)$$
$$\delta(q_1, c, a) \to (q_3, \varepsilon)$$

Exercise 6.3.2

$$\delta(q_0, e, Z_0) \to (q, SZ_0)$$
$$\delta(q, e, S) \to (q, aAA)$$
$$\delta(q, e, A) \to (q, aS)$$
$$\delta(q, e, A) \to (q, bS)$$
$$\delta(q, e, A) \to (q, a)$$
$$\delta(q, a, a) \to (q, \varepsilon)$$
$$\delta(q, b, b) \to (q, \varepsilon)$$
$$\delta(q, e, Z_0) \to (q, \varepsilon)$$