A6. i) We define a PDA M as follows

$M = (\{q_0, q_1, q_f\}, \{a, b, c\}, \{a, b, z_0\}, \delta, q_0, z_0, \{q_f\})$

where δ is defined by

$\delta(q_0, a, z_0) = \{(q_0, az_0)\}$

$\delta(q_0, b, z_0) = \{(q_0, bz_0)\}$

$\delta(q_0, b, a) = \{(q_1, \wedge)\}$

$\delta(q_0, b, b) = \{(q_1, b$

$\delta(q_1, a, z_0) = \{(q_1, az_0)\}$

$\delta(q_1, a, a) = \{(q_1, aa)\}$

$\delta(q_1, a, b) = \{(q_1, \wedge)\}$

$\delta(q_1, a, a) = \{(q_1, a)\}$

$\delta(q_1, c, b) = \{(q_1, b)\}$

$\delta(q_1, b, a) = \{q_0, a\}$

$\delta(q_1, b, b) = \{q_0, bb\}$

$\delta(q_1, b, \wedge) = \{q_0, \wedge\}$

$\delta(q_0, c, a) = \{q_0, a\}$

$\delta(q_0, c, b) = \{q_0, b\}$

$\delta(q_0, c, z_0) = \{q_0, cz_0\}$

$\delta(q_0, \epsilon, z_0) = \{q_f, z_0\}$

ii) We define a PDA M as follows

$M = (\{q_0, q_1, q_f\}, \{a, b, c\}, \{a, b, \$, z_0\}, \delta, q_0, z_0, \{q_f\})$

where δ is defined by

$\delta(q_0, a, z_0) = \{(q_0, az_0)\}$

$\delta(q_0, a, a) = \{(q_0, aa)\}$

$\delta(q_0, b, a) = \{(q_0, ba)\}$

$\delta(q_0, b, z_0) = \{(q_0, bz_0)\}$

$\delta(q_0, b, b) = \{(q_0, bb)\}$

$\delta(q_0, a, b) = \{(q_0, ab)\}$

$\delta(q_0, c, z_0) = \{(q_1, z_0)\}$

$\delta(q_0, c, a) = \{(q_1, a)\}$

$\delta(q_0, c, b) = \{(q_1, b)\}$

$\delta(q_1, b, b) = \{(q_1, \Lambda)\}$

$\delta(q_1, a, a) = \{(q_1, \Lambda)\}$

$\delta(q_1, \Lambda, z_0) = \{q_f, z_0\}$

iii) We define a PDA M as follows

$M = (\{q_0, q_1, q_2, q_3, q_f\}, \{a, b, c\}, \{a, b, c, z_0\}, \delta, q_0, z_0, \{q_f\})$

where δ is defined by

$\delta(q_0, a, z_0) = \{(q_0, az_0)\}$

$\delta(q_0, a, a) = \{(q_0, aa)\}$

$\delta(q_0, b, a) = \{(q_1, \Lambda)\}$

$\delta(q_1, b, a) = \{(q_1, ba)\}$

$\delta(q_1, \Lambda, z_0) = \{(q_2, z_0)\}$

$\delta(q_2, b, z_0) = \{(q_2, bz_0)\}$

$\delta(q_2, b, b) = \{(q_2, bb)\}$

$\delta(q_2, c, b) = \{(q_3, \Lambda)\}$

$\delta(q_3, c, b) = \{(q_3, \Lambda)\}$

$\delta(q_3, \Lambda, z_0) = \{(q_f, z_0)\}$