(1)

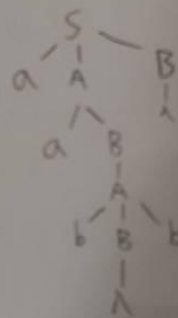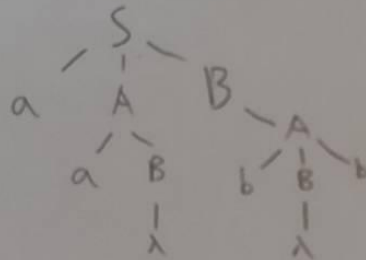(a) X (b) O (c) X (d) X (e) X (f) O (g) O (h) O (i) O (j) O

(2)

(a)

$$S \Rightarrow aAB \Rightarrow aaBB \Rightarrow aaAB$$
$$\Rightarrow aabBbB \Rightarrow aabbB \Rightarrow aabb$$

(b)

$$S \Rightarrow aAB \Rightarrow aAA \Rightarrow aAbBb$$
$$\Rightarrow aAbb \Rightarrow aaBbb \Rightarrow aabb$$

(c)

(3)

(a) set w = abab

leftmost derivation

$$S \Rightarrow aSbS \Rightarrow absaSbS \Rightarrow abab$$

rightmost derivation   兩種不同

$$S \Rightarrow aSbS \Rightarrow aSbaSbS \Rightarrow abab$$

(b)

$$L = \{ w \in \{a,b\}^* : n_a(w) = n_b(w) \}$$

(4)

(a)
$$S \rightarrow aaAbbb$$
$$A \rightarrow aaAbbb \mid \lambda$$

(b)
$$S \rightarrow aASB \mid aAB$$
$$A \rightarrow a$$
$$B \rightarrow bB'$$
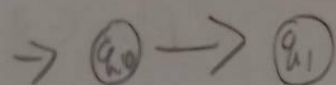$$B' \rightarrow bB''$$
$$B'' \rightarrow b$$

(5) (a)
$$S \rightarrow S'$$
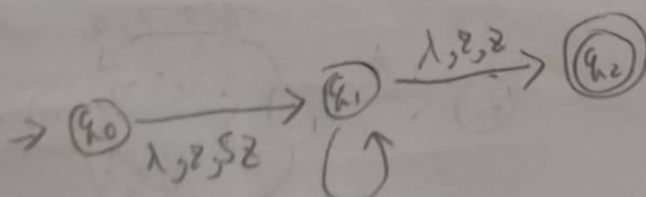$$S' \rightarrow aS'a \mid bS'b \mid x$$

(b)

$$\rightarrow \boxed{q_0} \longrightarrow \boxed{q_1}$$

(c)

(d) Yes

(6)(a)

$$\rightarrow \boxed{q_0} \xrightarrow[\lambda, S, Z]{} \boxed{q_1} \xrightarrow[]{\lambda, z, z} \boxed{q_2}$$

q_1 self-loop:

$$a, S, BSB$$
$$a, S, A$$
$$a, A, \lambda$$
$$b, B, \lambda$$

(b)

(7)

(a)

$S \rightarrow aB \mid aaB \mid a \mid aa$

$B \rightarrow bb$

(b) $S \rightarrow aBA \mid a \mid b \mid aA$

$A \rightarrow a \mid aA \mid b$

$B \rightarrow b \mid a \mid aA$

(C) $S \rightarrow$ ... a

(8)

(a)

$S \rightarrow V_a C \mid DB$

$A \rightarrow BE \mid V_b V_a$

$B \rightarrow V_b B \mid b$

$C \rightarrow AV_b$

$D \rightarrow V_b V_b$

$E \rightarrow V_a V_a$

$V_a \rightarrow a$

$V_b \rightarrow b$

(b)

$S \rightarrow aA V_b \mid b V_b B$

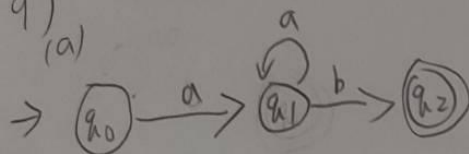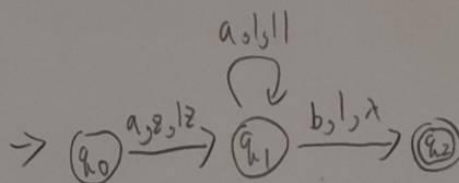$A \rightarrow b V_A V_A \mid b V_A \mid bB V_A V_A$

$B \rightarrow bB \mid b$

$V_B \rightarrow b$

$V_A \rightarrow a$

(9)

(a)

(b)

(10)

(a)