Answer: 1

$\langle$float$\rangle$ $\langle$id, limited Square$\rangle$ $\langle$(> $\langle$id,x$\rangle$ $\langle$)> $\langle${}

$\langle$float$\rangle$ $\langle$id, x$\rangle$

$\langle$return$\rangle$ $\langle$(>) $\langle$id,x$\rangle$ $\langle$op, "<="$\rangle$

$\langle$num, -10.0$\rangle$ $\langle$op, "11"$\rangle$ $\langle$id,x$\rangle$ $\langle$num, +10.0$\rangle$

$\langle$)> $\langle$op, "?"$\rangle$ $\langle$num, 100$\rangle$ $\langle$op, ":"$\rangle$ $\langle$id,x$\rangle$

$\langle$op, "*"$\rangle$ $\langle$id,x$\rangle$ $\langle$}>

Answer: 2 (a)

$$S \rightarrow 0S1 | 01$$
$$S \rightarrow 0S1 \rightarrow 00S11$$
$$\rightarrow 000111$$

language generated is equal number of

0s followed by equal number of 1s

(b) $S \rightarrow + SS | - SS | a$

$S \rightarrow a$

$S \rightarrow +SS \rightarrow +aa$; $S \rightarrow +SS \rightarrow +(-SS) S \rightarrow +aaa$

Here the language generated is $(+,-)^* a^+$

(c) $S \rightarrow S(S) S | \epsilon$

$S \to \epsilon$

$S \to S(S)S \to ()$

$S \to S(S)S \to S(S(S)S)S$

$\to (())$

left Expansion

$S \to S(S)S \to S(S)S(S)S \to ()()$

Right Expansion

$S \to S(S)S \to S(S)S(S)S \to ()()$

∴ The language genrated contains same number of left and right brackets (or parenthesis).

(d) $S \to aSbS | bSaS | \epsilon$

$S \to ab;$

$S \to ba;$

$S \to aSbS$

$S \to \text{~~~~} aaSbSbS \to aabb$

$S \to bSaS \to bSaaSbS \to baab$

language generated contains equal number of a and b and can also generate empty string.

(e) $S \to a | S+S | SS | S^* | (S)$

$S \to a$ $S \to (a)$

$S \to a+a$ $S \to S+S$

$S \to aa$ $S \to SS+SS \to aa+aa$

$S \to a^*$

∴ The set of all string of +, *, 'a' and symmetric parenthesis and plus is not beginning or end of penetion, multiplication is not the begining of Penition.

$$S \rightarrow [S|s] [t|e][L|l][t|e][c|c] [T|t]$$

$$S \longrightarrow (L) \mid a$$
$$L \longrightarrow L, S \mid S$$

with string $((a,a), a, (a))$

ⓐ $S \rightarrow (L) \rightarrow (L,S) \rightarrow (L,S,S) \rightarrow (S,S,S)$
$(S,S),S,S) \leftarrow ((L,S),S,S) \leftarrow ((L),S,S)$
$\rightarrow ((a,S),S,S) \rightarrow ((a,a),S,S) \rightarrow ((a,a),a,(L))$
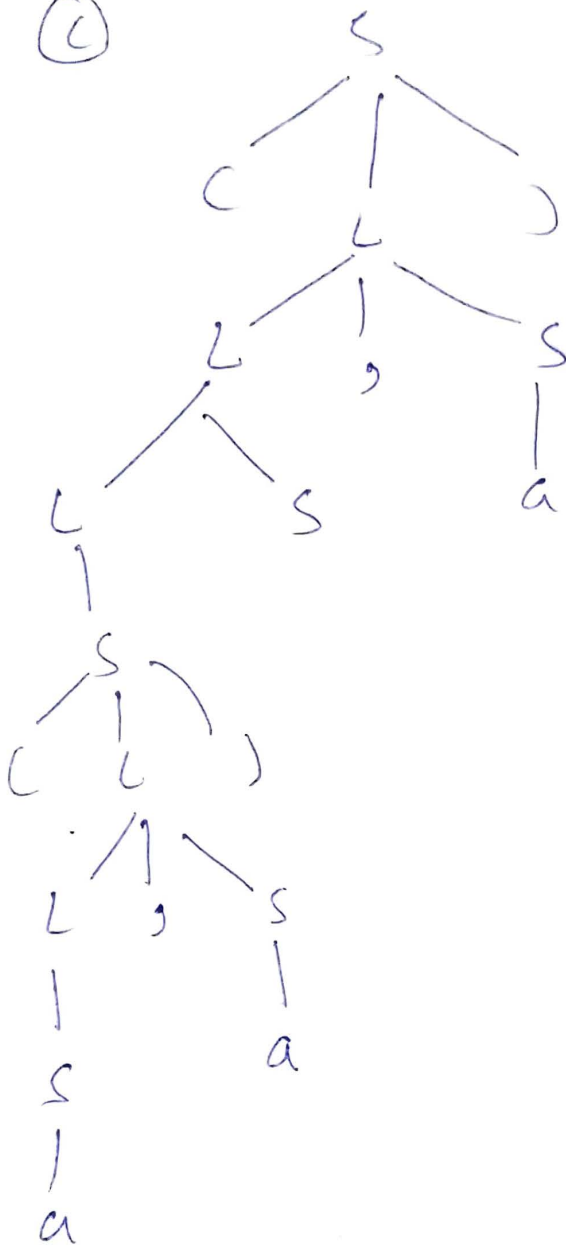$((a,a),a,(a)) \leftarrow ((a,a),a,(S))$

ⓑ $S \rightarrow (L) \rightarrow (L,S) \rightarrow (L,(L)) \rightarrow (L,(a)) \rightarrow (L,S,(a))$
$((L),a,a) \leftarrow (S,a,a) \leftarrow (L,a,(a))$
$\rightarrow ((L,S),a,(a)) \rightarrow ((S,S),a,(a)) \rightarrow ((a,a),a,(a))$

∴

(c)

S
├── C
├── L
│   ├── L
│   │   ├── L
│   │   │   └── S
│   │   │   ├── C
│   │   │   ├── L
│   │   │   │   ├── L
│   │   │   │   │   └── S
│   │   │   │   │   └── a
│   │   │   │   ├── ,
│   │   │   │   └── S
│   │   │   │   └── a
│   │   │   └──)
│   │   └── S
│   ├── ,
│   └── S
│   └── a
└──)

(d) Unambiguous.

(e) Like a tuple in Python.

s

|

⑤ (1)

$$S \longrightarrow S+S \mid SS \mid (S) \mid S* \mid a$$

$$\downarrow \text{left factoring}$$

$$S \longrightarrow SA \mid (S) \mid a$$
$$A \longrightarrow +S \mid s \mid *$$

$$\downarrow \text{further extraction}$$

$$S \longrightarrow SA \mid T$$
$$A \longrightarrow +S \mid s \mid *$$
$$T \longrightarrow (S) \mid a$$

$$\downarrow \text{eliminate left Recursion}$$

$$S \longrightarrow TB$$
$$B \longrightarrow AB \mid \varepsilon$$
$$A \longrightarrow +S \mid TB) \mid *$$
$$T \longrightarrow (S) \mid a$$

First $(S) = $ First $(T) = \{ (, a \}$

First $(B) = \{ $ First $(A), \varepsilon \} = \{ +, (, a, *, \varepsilon \}$

First $(A) = \{ +, $ First $(T) , * \} = \{ +, (, a, * \}$

Follow $(S) = \{ \$,), +, (, a, * \}$

Follow $(B) = \{ \$,) \}$

Follow $(A) = \{ +, (, a, *,), \$ \}$

Follow $(T) = \{ +, (, a, *, \$ \}$

Parse Table

	(	)	+	*	a	$
S	S→TB			S→TB		
B	B→AB	↑	B→AB	B→AB	B→AB	B→E
A	A→SB		A→+S	A→*	A→TB	
T	T→(S)				T→a	

(2)

$$S \longrightarrow (L) \mid a$$
$$L \rightarrow L,S \mid S$$

eliminate] left recursion
↓

$$S \rightarrow (L) \mid a$$
$$L \rightarrow SA$$
$$A \rightarrow ,SA \mid \epsilon$$

first (S) = {(, a}
first (L) = {(, a}
first (A) = {, , ε}

follow (S) = {$, ,)}
follow (L) = {)}
follow (A) = {)}

Parse Table

	(	)	a	,	$
S	S→(L)		S→a		
L	L→SA		L→SA		
A		A→ε		A→,SA	