

Ans. To The Q. No. 1

$$S \rightarrow (A) | a$$

There is no left recursion present.

Because, the ^{left}most S is not calling any S . Mean, there is no symbol here ^{which} match left most S .

$$A \rightarrow A, S | S$$

$$A \rightarrow S A'$$

$$A' \rightarrow ; S A' | \epsilon$$

We know,

$$A \rightarrow A\alpha | \beta$$

$$A \rightarrow \beta A'$$

$$A' \rightarrow \alpha A' | \epsilon$$

Here,

$$A = A$$

$$\alpha = , S$$

$$\beta = S$$

Ans. To The Q. No. 2

$$\text{First}(B) = \{c, a, \epsilon\}$$

$$\text{First}(C) = \{b, \epsilon\}$$

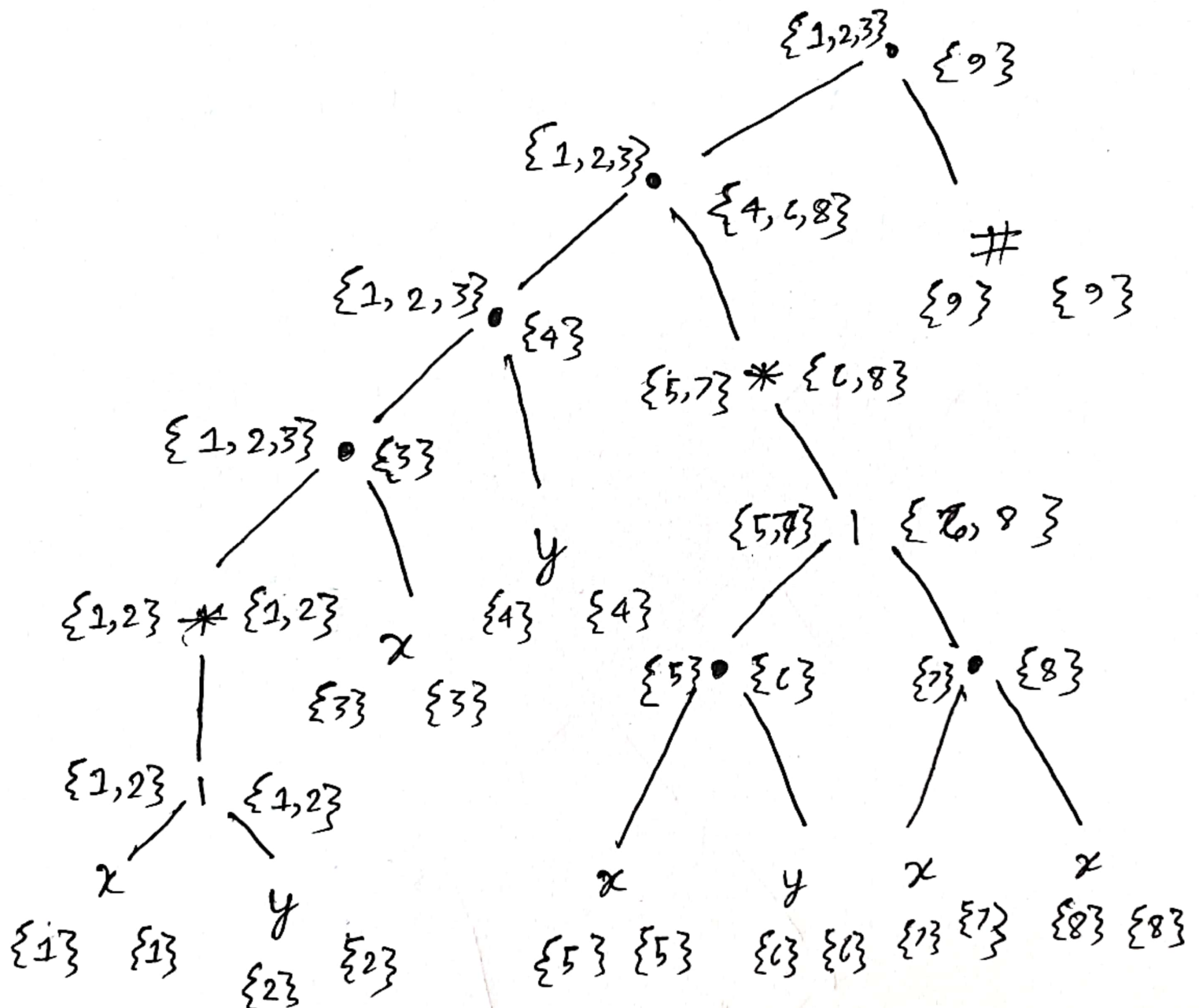
$$\text{First}(D) = \{c, c, a, \epsilon\}$$

$$\text{First}(A) = \{c, a, b, c, \epsilon\}$$

$$\text{First}(S) = \{c, a, b, c, d\}$$

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Firstpos and Lastpos:



Follow pos :

	Node	Follow pos
x	1	{1, 2, 3}
y	2	{1, 2, 3}
x	3	{4}
y	4	{5, 7, 9}
x	5	{6}
y	6	{5, 7, 9}
x	7	{8}
x	8	{5, 7, 9}
#	9	—

DFA for $(x|y)^* xy (xy|xx)^* \#$

$$A = \{1, 2, 3\}$$

$$(A, x)$$

$$= FP(1) \cup FP(3)$$

$$= \{1, 2, 3, 4\}$$

$$= B$$

$$(A, y)$$

$$= FP(2)$$

$$= \{1, 2, 3\}$$

$$= A$$

$$\begin{aligned}
 (B, x) \\
 &= FP(1) \cup FP(3) \\
 &= B
 \end{aligned}$$

$$\begin{aligned}
 (B, y) \\
 &= FP(2) \cup FP(4) \\
 &= \{1, 2, 3, 5, 7, 9\} \\
 &= C
 \end{aligned}$$

$$\begin{aligned}
 (C, x) \\
 &= FP(1) \cup FP(3) \cup FP(5) \cup FP(7) \\
 &\quad \cup FP(9) \\
 &= \{1, 2, 3, 4, 6, 8\} \\
 &= (D)
 \end{aligned}$$

$$\begin{aligned}
 (C, y) \\
 &= FP(2) \\
 &= A
 \end{aligned}$$

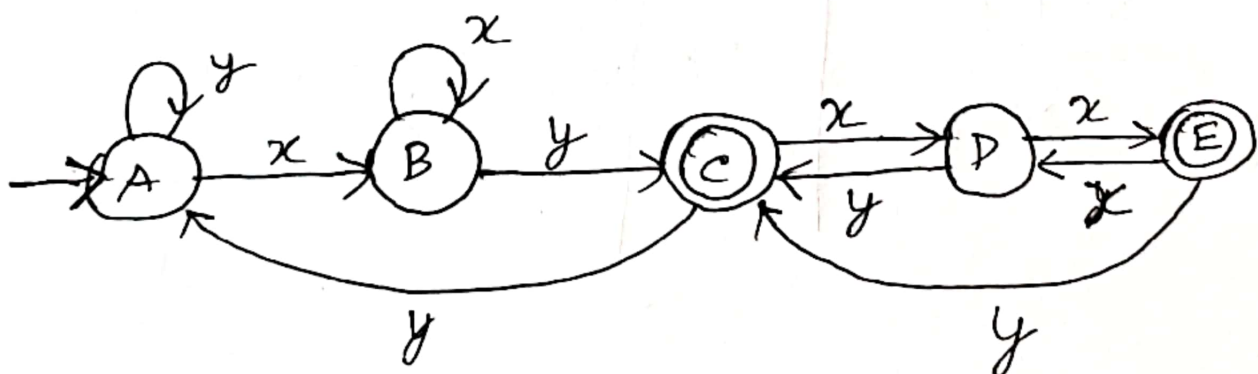
$$\begin{aligned}
 (D, x) \\
 &= FP(1) \cup FP(3) \cup FP(8) \\
 &= \{1, 2, 3, 4, 5, 7, 9\} \\
 &= (E)
 \end{aligned}$$

$$\begin{aligned}
 (D, y) \\
 &= FP(2) \cup FP(4) \\
 &\quad \cup FP(6) \\
 &= \{1, 2, 3, 5, 7, 9\} \\
 &= C
 \end{aligned}$$

$$\begin{array}{l|l}
 (E, x) & (E, y) \\
 \hline
 = FP(1) \cup FP(3) \cup FP(5) \cup FP(7) & = FP(2) \cup FP(4) \\
 = D & = C
 \end{array}$$

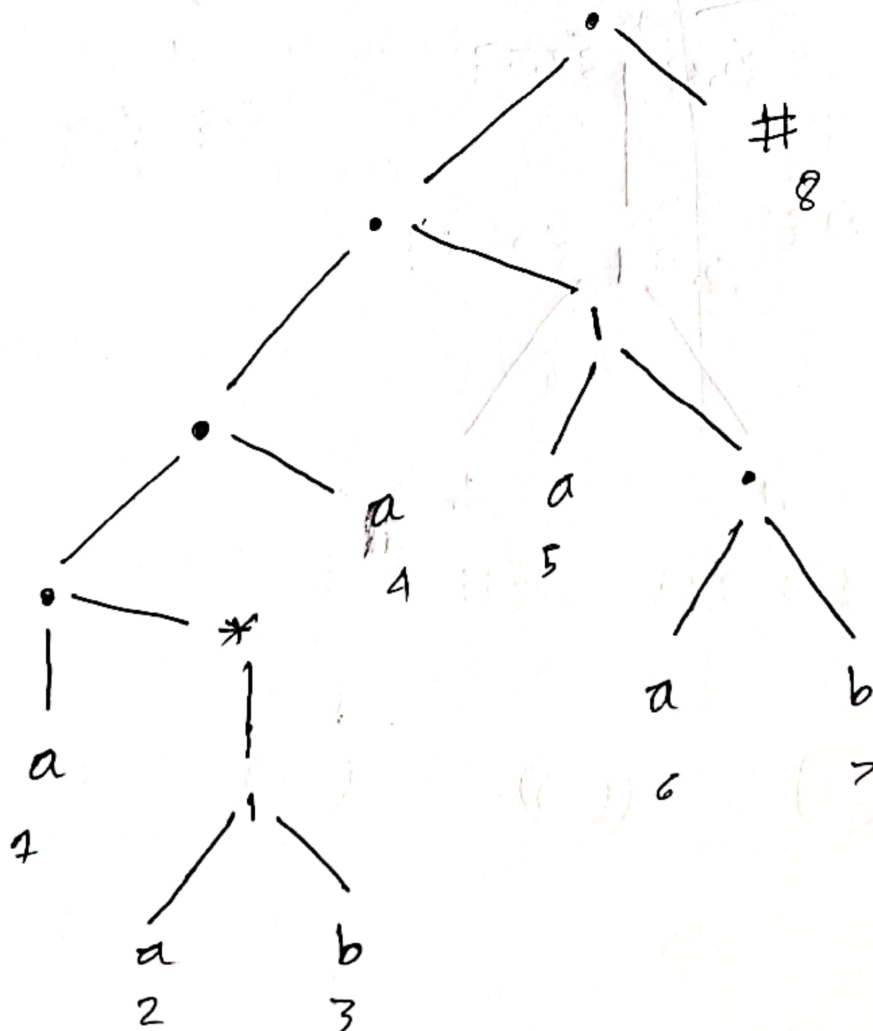
States	x	y
$\{1, 2, 3\} = A$	B	A
$\{1, 2, 3, 4\} = B$	B	C
$\{1, 2, 3, 5, 7, 9\} = C$	D	A
$\{1, 2, 3, 4, 6, 8\} = D$	E	C
$\{1, 2, 3, 4, 5, 7, 9\} = E$	D	C

DFA

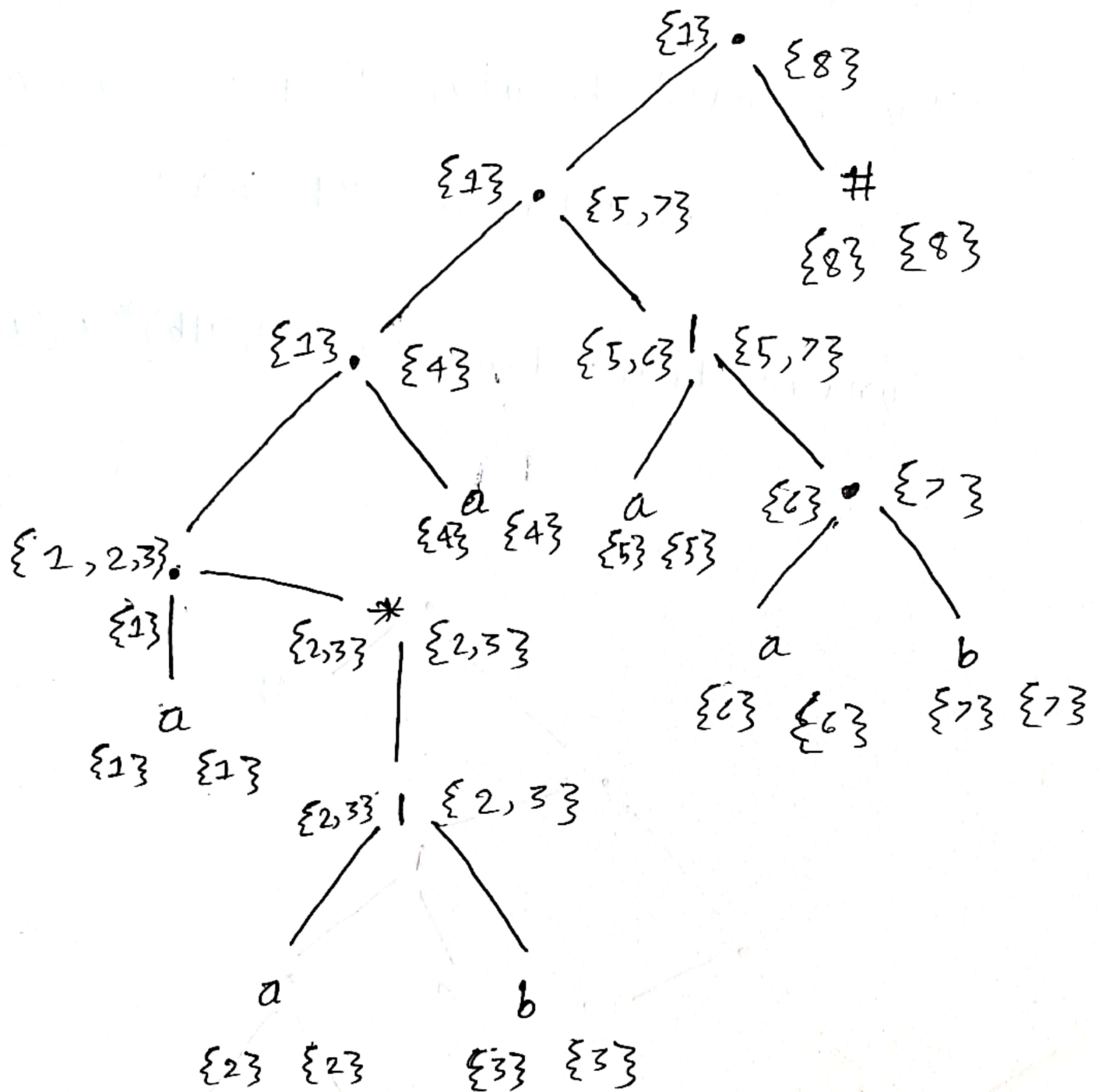


Ans. To The Q. No. 4 $a(a|b)^*a(a|ab)$

Augmented Regular Expression

 $r\# = a(a|b)^*a(a|ab)\#$ Syntax tree for $r\# = a(a|b)^*a(a|ab)\#$ 

Firstpos and Lastpos :



Follow pos:

	Node	Follow pos
a	1	$\{2, 3, 4\}$
a	2	$\{2, 3, 4\}$
b	3	$\{2, 3, 4\}$
a	4	$\{5, 6\}$
a	5	$\{8\}$
a	6	$\{7\}$
b	7	$\{8\}$
#	8	—

DFA states for $a(a|b)^*a(a|ab)\#$

D states	a	b
$\{1\} = A$	B	\emptyset
$\{2, 3, 4\} = B$	C	B
$\{2, 3, 4, 5, 6\} = C$	D	B
$\{2, 3, 4, 5, 6, 7, 8\} = D$	D	E
$\{2, 3, 4, 8\} = E$	C	B

DFA:

