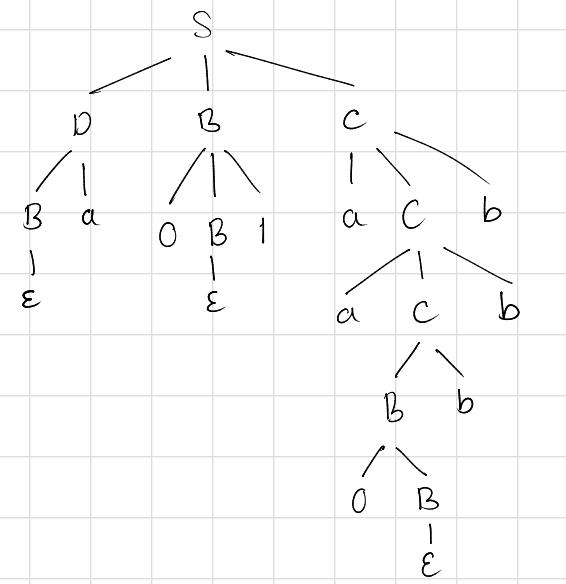


1. a) $\alpha 0 | \alpha a 0 b b b$



b) SWITCH \rightarrow switch (EXPR) : CASE

\rightarrow switch (INT) : CASE

\rightarrow switch (5) : CASE

\rightarrow switch (5) : case EXPR : STMT CASE

\rightarrow switch (5) : case INT : STMT CASE

\rightarrow switch (5) : case 1 : STMT CASE

\rightarrow switch (5) : case 1 : a+b CASE

\rightarrow switch (5) : case 1 : a+b case EXPR : STMT CASE

\rightarrow switch (5) : case 1 : a+b case INT : STMT CASE

\rightarrow switch (5) : case 1 : a+b case 2 : a++ CASE

\rightarrow switch (5) : case 1 : a+b case 2 : a++ DF

\rightarrow switch (5) : case 1 : a+b case 2 : a++ df : STMT

\rightarrow switch (5) : case 1 : a+b case 2 : a++ df : a*b

2. a) $S \rightarrow aSc | aAc$

$A \rightarrow bAb | bb$

b) $S \rightarrow aSa | bSb | a | b$

c) $S \rightarrow L | BA$

$A \rightarrow i | ii | iii | iv | v | vi | vii | viii | ix | \epsilon$

$B \rightarrow x | xx | xxx | XL | \epsilon$

3. a) $S \rightarrow BAC | B$

$B \rightarrow OB1 | O1$

$A \rightarrow aAb | \epsilon$

$C \rightarrow Bc$

$S \rightarrow BAC | B | BC$

$B \rightarrow OB1 | O1$

$A \rightarrow aAb | ab$

$C \rightarrow Bc$

$S \rightarrow BAC | B | BC$

$B \rightarrow PBQ | PQ$

$A \rightarrow RAS | RS$

$C \rightarrow BT$

$P \rightarrow O | Q \rightarrow 1 | R \rightarrow a | S \rightarrow b$

$T \rightarrow c$

$S \rightarrow xc | B | BC$

$B \rightarrow YQ | PQ$

$A \rightarrow ZS | RS$

$C \rightarrow BT$

$P \rightarrow O | Q \rightarrow 1 | R \rightarrow a | S \rightarrow b$

$X \rightarrow BA | S \rightarrow b$

$Y \rightarrow PB | T \rightarrow c$

$Z \rightarrow RA |)$

$S \rightarrow xc | YQ | PQ | BC$

$B \rightarrow YQ | PQ$

$A \rightarrow ZS | RS$

$C \rightarrow BT$

$P \rightarrow O | Q \rightarrow 1 | R \rightarrow a | S \rightarrow b$

$X \rightarrow BA | T \rightarrow c$

$Y \rightarrow PB | Z \rightarrow RA$

b) $S \rightarrow ABA$

$A \rightarrow aA | \epsilon$

$B \rightarrow bBc | \epsilon$

$S \rightarrowABA | BA | AB | B | AA | A | \epsilon$

$A \rightarrow aA | a$

$B \rightarrow bBc | bc$

$S \rightarrowABA | BA | AB | B | AA | A | \epsilon$

$A \rightarrow XA | a$

$B \rightarrow YBZ | YZ$

$X \rightarrow a | Y \rightarrow b | Z \rightarrow c$

$S \rightarrow PA | BA | AB | B | AA | A | \epsilon$

$A \rightarrow XA | a$

$B \rightarrow QB | YZ$

$X \rightarrow a | Y \rightarrow b | Z \rightarrow c$

$P \rightarrow AB | Q \rightarrow YB$

$S \rightarrow PA | BA | AB | QZ | YZ | AA | XA | a | \epsilon$

$A \rightarrow XA | a$

$B \rightarrow QB | YZ$

$X \rightarrow a | Y \rightarrow b | Z \rightarrow c$

$P \rightarrow AB | Q \rightarrow YB$

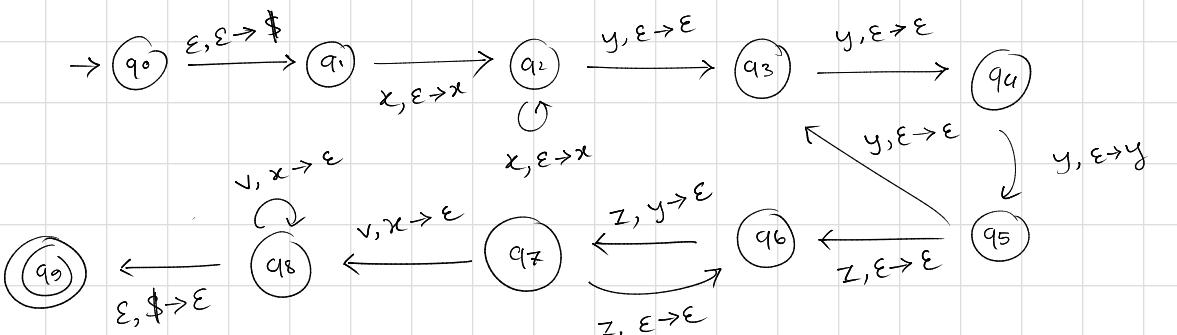
d) $p^{2m} a^m n^o s^{20}$

$S \rightarrow AB$

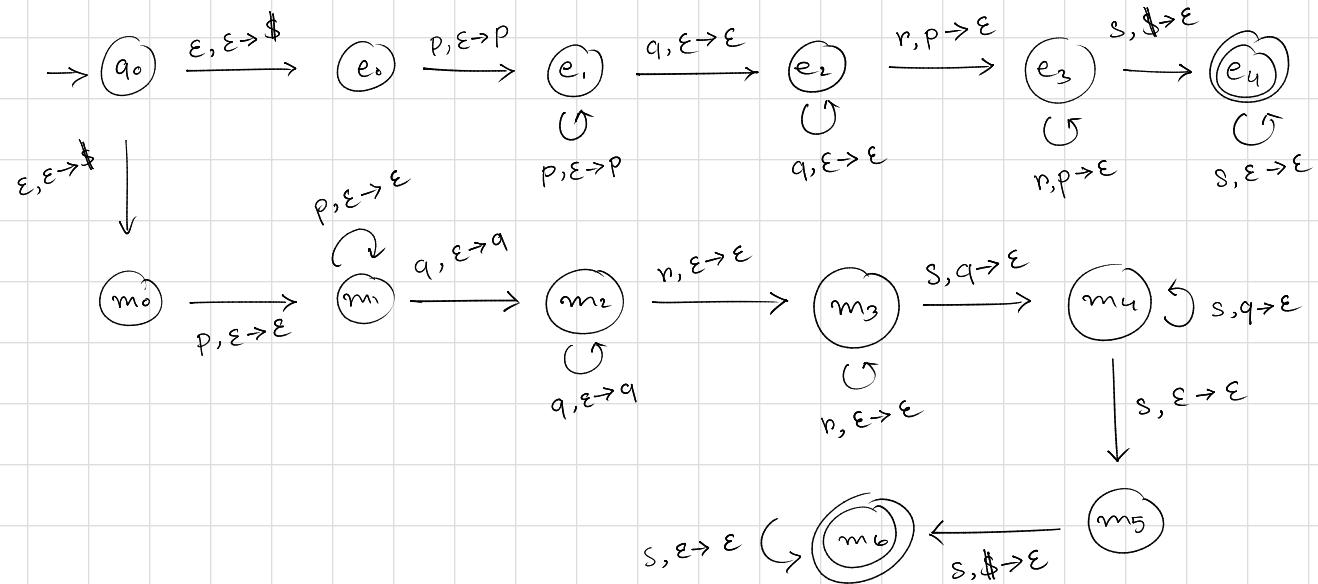
$A \rightarrow ppAa | \epsilon$

$B \rightarrow nBss | \epsilon$

4. a) $x^n y^{3m} z^{2m} v^n \quad n, m \geq 1$

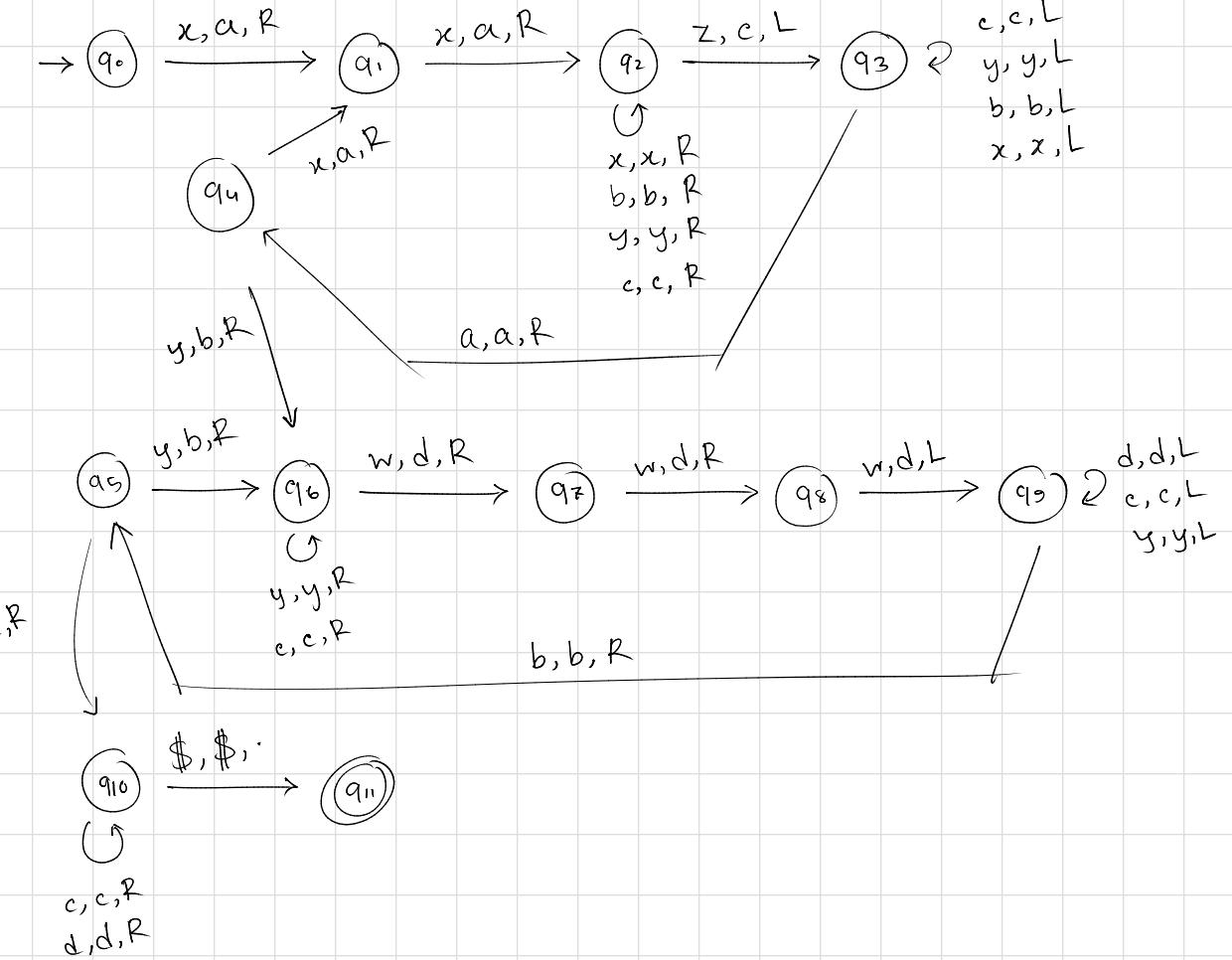


b) $p^i q^j r^k s^m \quad i = k \text{ or } m \geq j+2 \text{ all } \geq 1$



5. $L = x^{2^i} y^j z^i w^{3^j} \quad i, j \geq 1$

cross 2 x then cross 1 z
cross 1 y then cross 3 w



$xx\alpha x \alpha y \beta z z \gamma \gamma \gamma \gamma \gamma \gamma$

c, c, L
 y, y, L
 b, b, L
 x, x, L