

④ Never blindly trust anything.

If you find any mistake, kindly correct it and if possible inform in our grp too.

Thank you
18BCE120.

Plz, don't download, use directly from drive,
~~using various sources~~
So that If ~~it~~ you get most recent and updated answers.

Updates & Corrections will be
mentioned here , as well as .doc file

20/04/21 solution for extra questions added.

Question 6 updated. (mistake in textbook)

Tutorial - 10

Turing Machine

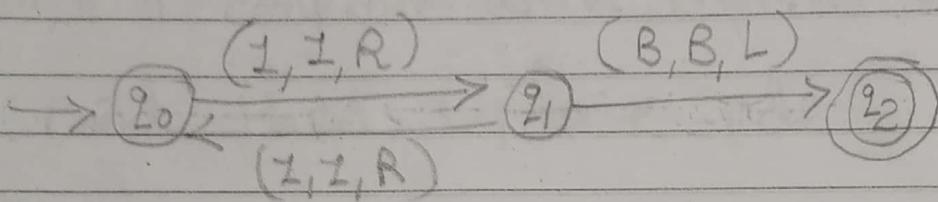
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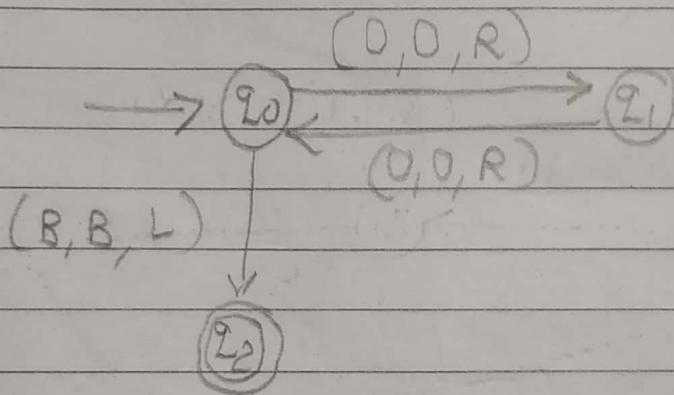
Q1

Design TM over given Language:

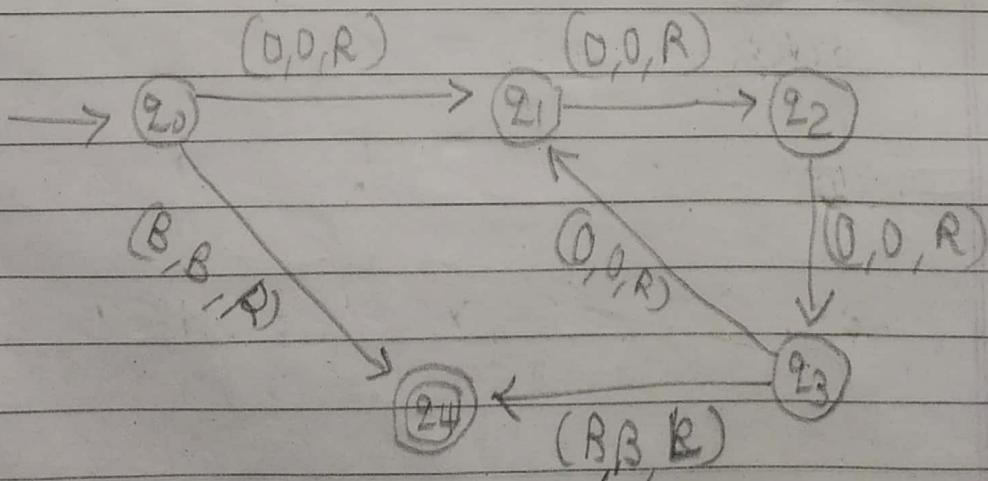
1. $L = \{ 1^m \mid m \text{ is odd} \}$



2. $L = \{ 0^m \mid m \text{ is even} \}$



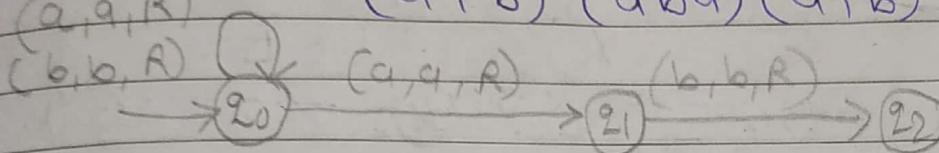
3. $L = \{ 0^m \mid m \text{ is multiple of three} \}$



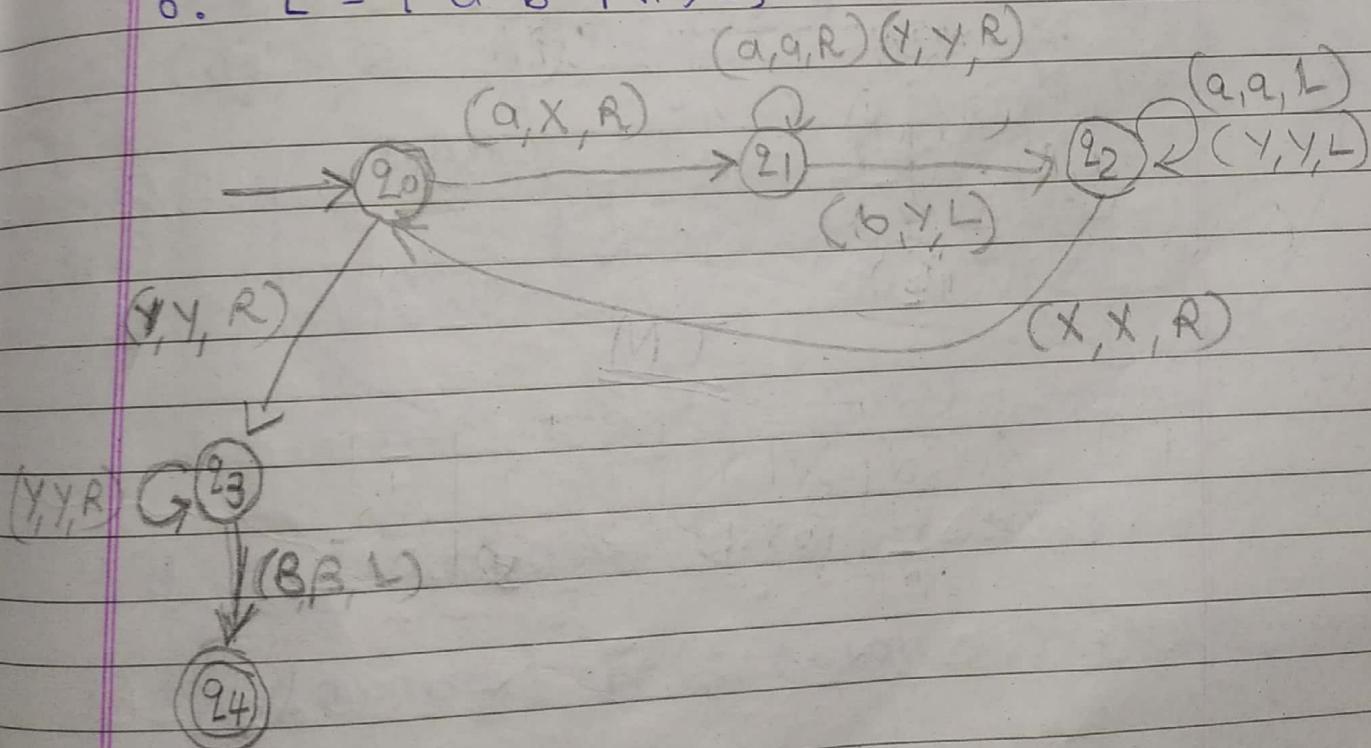
4. Same as first.

5. I am assuming that given language is

$$(a+b)^* (aba) (a+b)^*$$



6. $L = \{ a^n b^n \mid n \geq 1 \}$

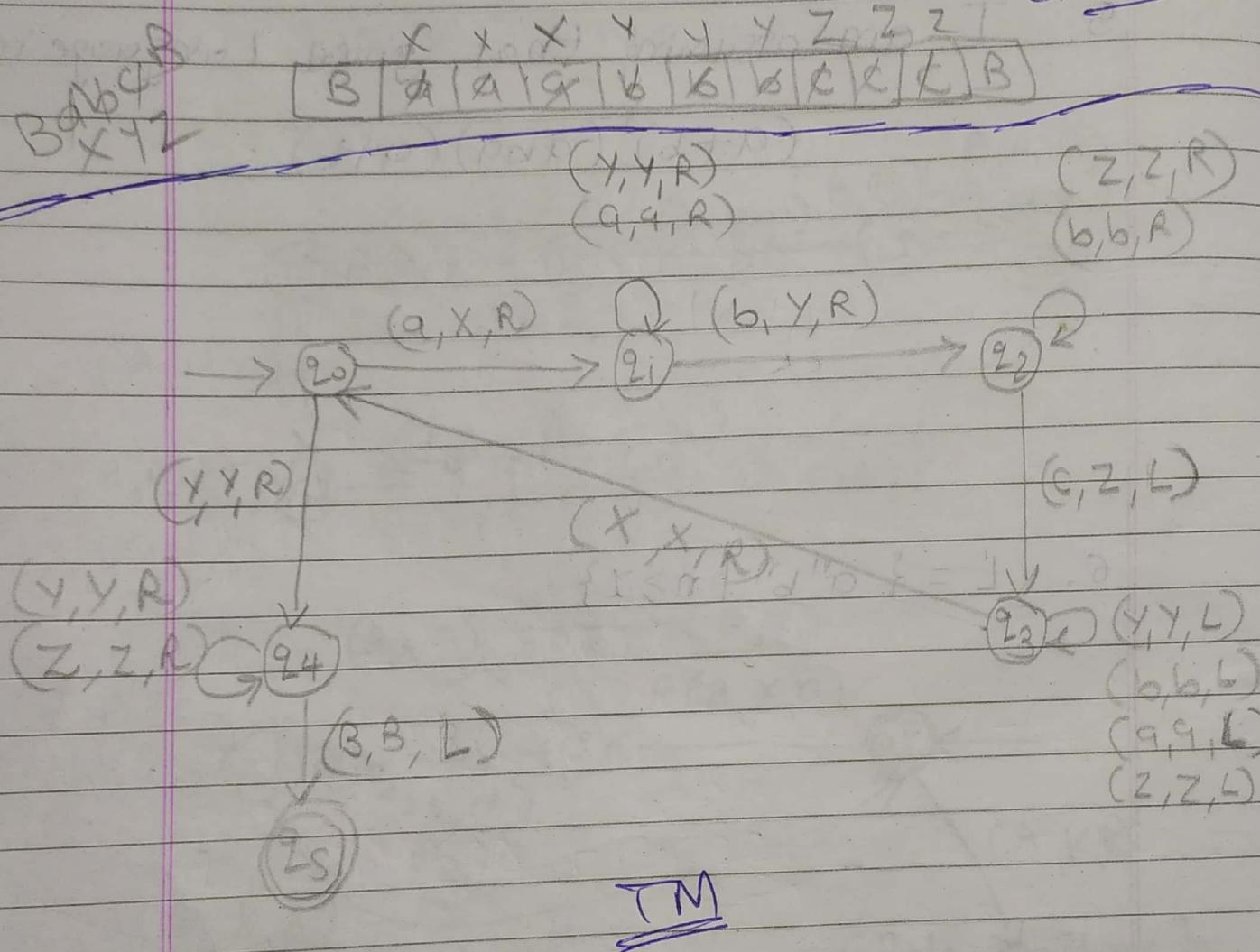


EXAMPLE $\boxed{B \ a \ \& \ a \ * \ b \ b \ | \ B}$ accepted

$\boxed{B \ a \ \& \ a \ a \ b \ b \ b \ | \ B}$ Not accepted

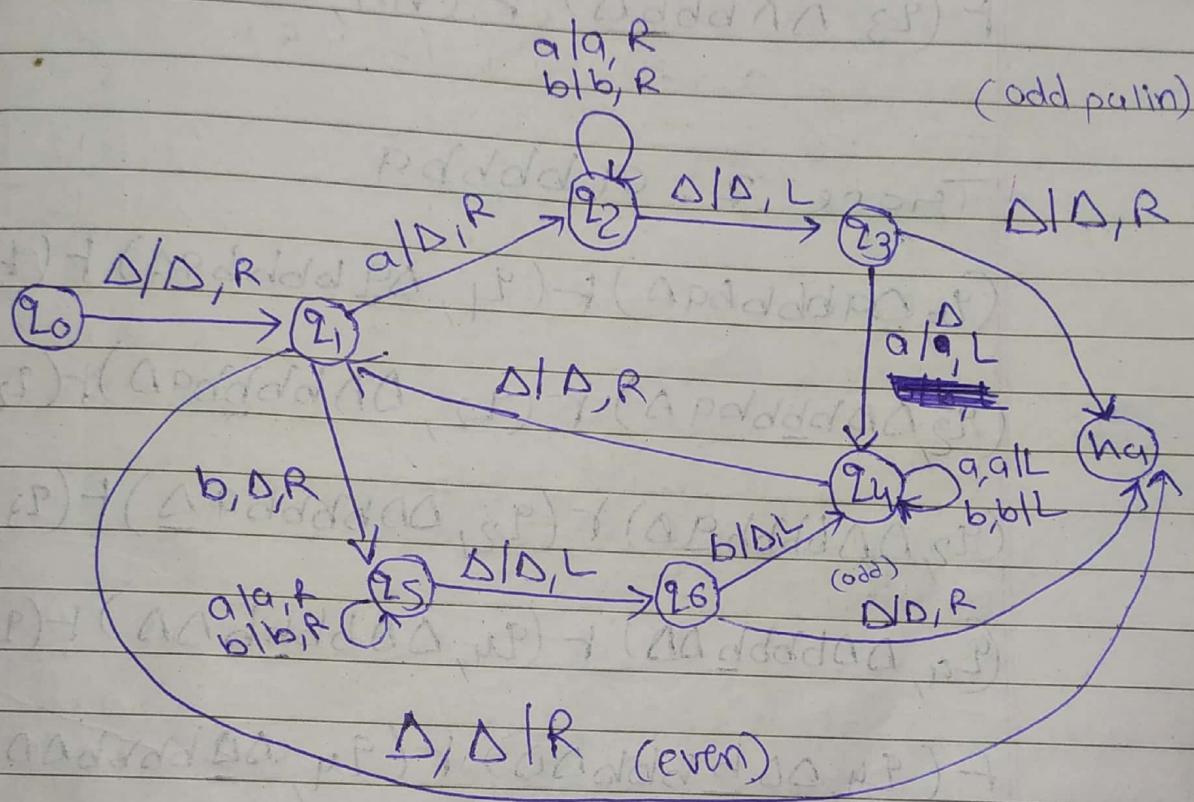
7. $L = \{a^n b^n c^n \mid n \geq 1\}$

example



Q2 TM which accepts palindrome over $\Sigma(a, b)$.

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Traces of ababa:

$(q_0, \Delta \underline{a} b a b a \Delta) \xrightarrow{\cdot} (q_1, \Delta a \underline{b} a b a \Delta) \xrightarrow{\cdot} (q_2, \Delta \Delta b \underline{a} b a \Delta)$

$\xrightarrow{\cdot} (q_2, \Delta \Delta b \underline{a} b a \Delta) \xrightarrow{\cdot} (q_3, \Delta \Delta b a \underline{b} a \Delta) \xrightarrow{\cdot} (q_4, \Delta \Delta b a \underline{b} \Delta \Delta)$
 $\xrightarrow{\cdot} (q_4, \Delta \Delta b \underline{a} b \Delta \Delta) \xrightarrow{\cdot} (q_5, \Delta \Delta \Delta \underline{a} b \Delta \Delta) \xrightarrow{\cdot} (q_5, \Delta \Delta \Delta a \underline{b} \Delta \Delta)$
 $\xrightarrow{\cdot} (q_5, \Delta \Delta \Delta a b \underline{\Delta} \Delta) \xrightarrow{\cdot} (q_5, \Delta \Delta \Delta a b \Delta \Delta) \xrightarrow{\cdot} (q_4, \Delta \Delta \Delta a \underline{b} \Delta \Delta)$
 $\xrightarrow{\cdot} (q_4, \Delta \Delta \Delta a \underline{b} \Delta \Delta) \xrightarrow{\cdot} (q_1, \Delta \Delta \Delta a \underline{b} \Delta \Delta) \xrightarrow{\cdot} (q_2, \Delta \Delta \Delta a \underline{b} \Delta \Delta)$
 $\xrightarrow{\cdot} (q_3, \Delta \Delta \Delta \underline{a} \Delta \Delta) \xrightarrow{\cdot} (ha, \Delta \Delta \Delta a \underline{\Delta} \Delta)$ Accepted (odd palin)

Trace 2: abbb.

$(q_0, \underline{\Delta abbb\Delta}) \vdash (q_1, \underline{\Delta q\ bbb\Delta}) \vdash (q_2, \underline{\Delta \Delta b\ bbb\Delta})$
 $\vdash (q_2, \underline{\Delta \Delta b\ b\ b\Delta}) \vdash (q_2, \underline{\Delta \Delta b\ b\ b\Delta}) \vdash (q_2, \underline{\Delta \Delta b\ b\ b\Delta})$
 $\vdash (q_3, \underline{\Delta \Delta b\ b\ b\Delta}) \vdash (h_2, \underline{\Delta \Delta b\ b\ b\Delta}) \quad \text{reject}$

Trace 3: abbbbq

$(q_0, \underline{\Delta abbbb\Delta}) \vdash (q_1, \underline{\Delta q\ bbbb\Delta}) \vdash (q_2, \underline{\Delta \Delta bbbb\Delta})$
 $(q_2, \underline{\Delta \Delta b\ bbbb\Delta}) \vdash (q_2, \underline{\Delta \Delta b\ b\ b\ b\Delta}) \vdash (q_2, \underline{\Delta \Delta b\ b\ b\ b\Delta})$
 $(q_2, \underline{\Delta \Delta b\ b\ b\ b\Delta}) \vdash (q_2, \underline{\Delta \Delta b\ b\ b\ b\Delta}) \vdash (q_2, \underline{\Delta \Delta b\ b\ b\ b\Delta})$
 $(q_3, \underline{\Delta \Delta b\ b\ b\ b\Delta}) \vdash (q_4, \underline{\Delta \Delta b\ b\ b\ b\Delta}) \vdash (q_4, \underline{\Delta \Delta b\ b\ b\ b\Delta})$
 $\vdash (q_4, \underline{\Delta \Delta b\ b\ b\ b\Delta}) \vdash (q_4, \underline{\Delta \Delta b\ b\ b\ b\Delta})$
 $\vdash (q_1, \underline{\Delta \Delta b\ b\ b\ b\Delta}) \vdash (q_5, \underline{\Delta \Delta \Delta b\ b\ b\Delta})$
 $\vdash (q_5, \underline{\Delta \Delta \Delta b\ b\ b\Delta}) \vdash (q_5, \underline{\Delta \Delta \Delta b\ b\ b\Delta})$
 $\vdash (q_5, \underline{\Delta \Delta \Delta b\ b\ b\Delta}) \vdash (q_6, \underline{\Delta \Delta \Delta b\ b\ b\Delta})$
 $\vdash (q_6, \underline{\Delta \Delta \Delta b\ b\ b\Delta}) \vdash (q_6, \underline{\Delta \Delta \Delta b\ b\ b\Delta})$
 $\vdash (q_6, \underline{\Delta \Delta \Delta b\ b\ b\Delta}) \vdash (q_6, \underline{\Delta \Delta \Delta b\ b\ b\Delta})$
 $\vdash (q_6, \underline{\Delta \Delta \Delta b\ b\ b\Delta}) \vdash (q_6, \underline{\Delta \Delta \Delta b\ b\ b\Delta})$
 $\vdash (q_6, \underline{\Delta \Delta \Delta b\ b\ b\Delta}) \vdash (q_6, \underline{\Delta \Delta \Delta b\ b\ b\Delta})$
 $\vdash (q_6, \underline{\Delta \Delta \Delta b\ b\ b\Delta}) \vdash (q_6, \underline{\Delta \Delta \Delta b\ b\ b\Delta})$

$r(26, \square \square \square b \square \square) \vdash r(\cancel{q}, \square \square \square \square \square)$

$$F(Q_1, \Delta\Delta\Delta\Delta\Delta\Delta) \vdash (R_2, \Delta\Delta\Delta\Delta\Delta\Delta)$$

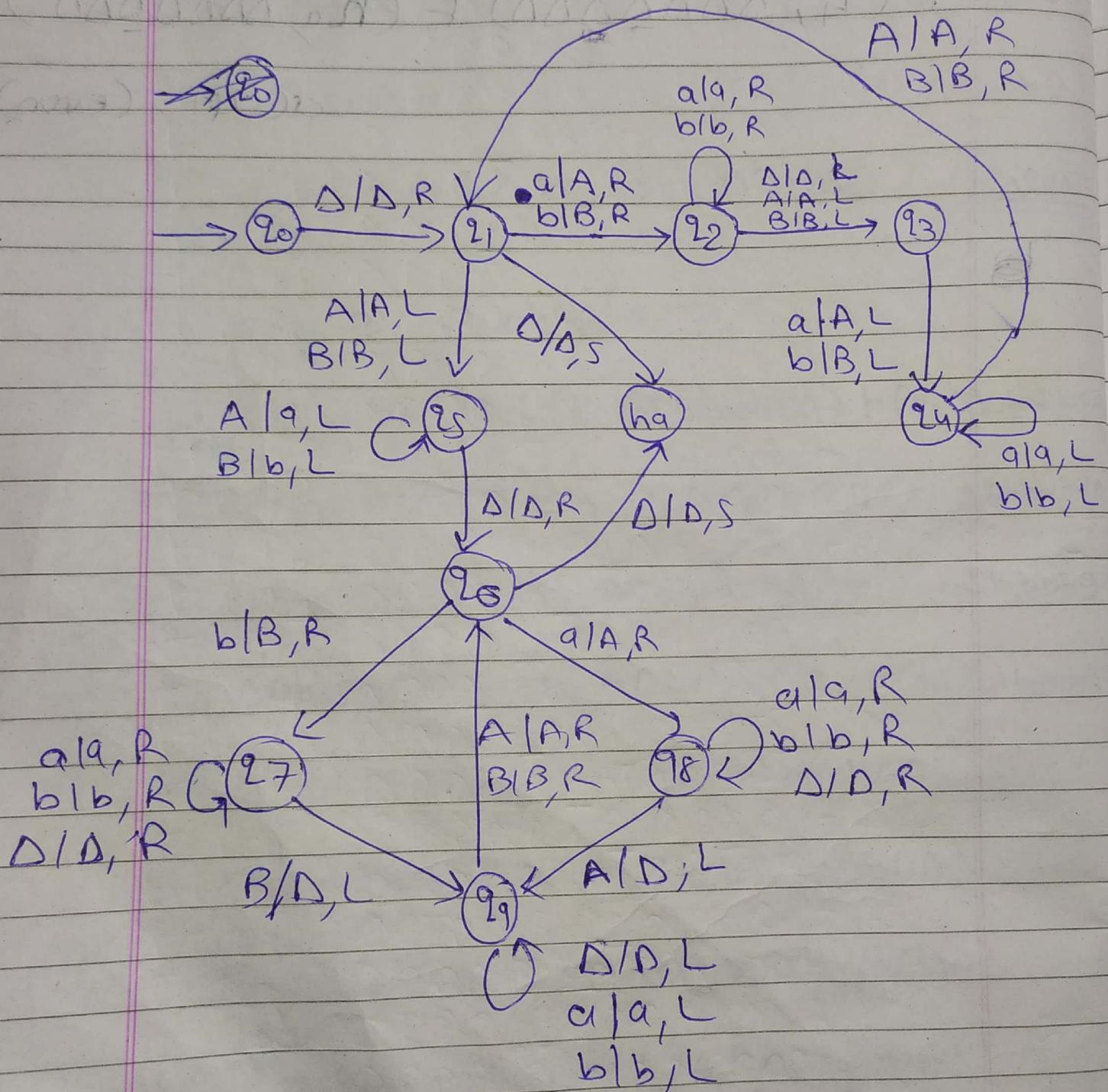
accept. (even)

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3

Tm for $\{SSA, SG(a, b)\}^*$.



Trace String L aqabbaaabbb

(20, ΔaaaabbbaaabbbΔ)

F(21, ΔaaaabbbaaabbbΔ)

F(22, ΔAaaabbbaaabbbΔ)

F(22, ΔAaaabbbaaabbbΔ)

F(22, ΔAaaabbbaaabbbΔ)

F(22, ΔAaaabbbaaabbbΔ)

F(22, ΔAaaabbbaaabbbΔ)

F(22, ΔAaaabbbaaabbbΔ) F(22, ΔAaabbbaaaaabbbbΔ)

F(22, ΔAaaabbbaaabbbΔ)

F(22, ΔAaaabbbaaabbbΔ)

F(22, ΔAaaabbbaaabbbΔ)

F(22, ΔAaaabbbaaabbbΔ)

F(22, ΔAaaabbbaaabbbΔ)

F(22, ΔAaaabbbaaabbbΔ) F(24, ΔAaabbbaaaaabbbbΔ)

F(22, ΔAaaabbbaaabbbΔ)

$\vdash (\Diamond \text{AAA} \rightarrow \text{BB} \wedge \text{AAA} \rightarrow \text{BBD})$

First phase finished

F(96, DAA q bb ΔΔABBD)
 F(98, DAAAAbb ΔΔABBD)
 F(98, DAAA b b ΔΔABBD)
 F(98, DAAA bb ΔΔABBD)
 F(98, DAAA bb ΔΔ ABBD)
 F(98, DAAA bb ΔΔA BBΔ)
 F(98, DAAA bb ΔΔABBΔ)
 F(99, DAAA bb ΔΔABBΔ)
 F(99, DAAA bb ΔΔ BBΔ)
 F(99, DAAA bb ΔΔ ΔΔ BBΔ)
 F(99, DAAA b b ΔΔΔ BBΔ)
 F(99, DAAA b b ΔΔ ΔΔ BBΔ)

F(9A, DAAA B b ΔΔΔ BBΔ)

F(9A, DAAA B b ΔΔ ΔΔ BBΔ)

F(9A, DAAA Bb ΔΔ ΔΔ BΔ)
 F(9A, DAAA B b ΔΔ ΔΔ BΔ)

F(9B, DAAA B b ΔΔ ΔΔ BΔ)

F(97, DAAA B B ΔΔ ΔΔ BΔ)

F(97, DAAA B B ΔΔ ΔΔ BΔ)

F(97, DAAA BB ΔΔ ΔΔ BΔ)

F(9A, DAAA BB ΔΔ ΔΔ BΔ)

F(27, AAAAABBD~~DDDD~~BD)

F(29, AAAAABBD~~DDDD~~DD)

F(29, AAAAABBDDDDDD~~DD~~)

F(29, DAAAABBDDDDD~~DD~~)

F(29, DAAA BBDDDDDD)

F(29, AAAABBDDDDDD)

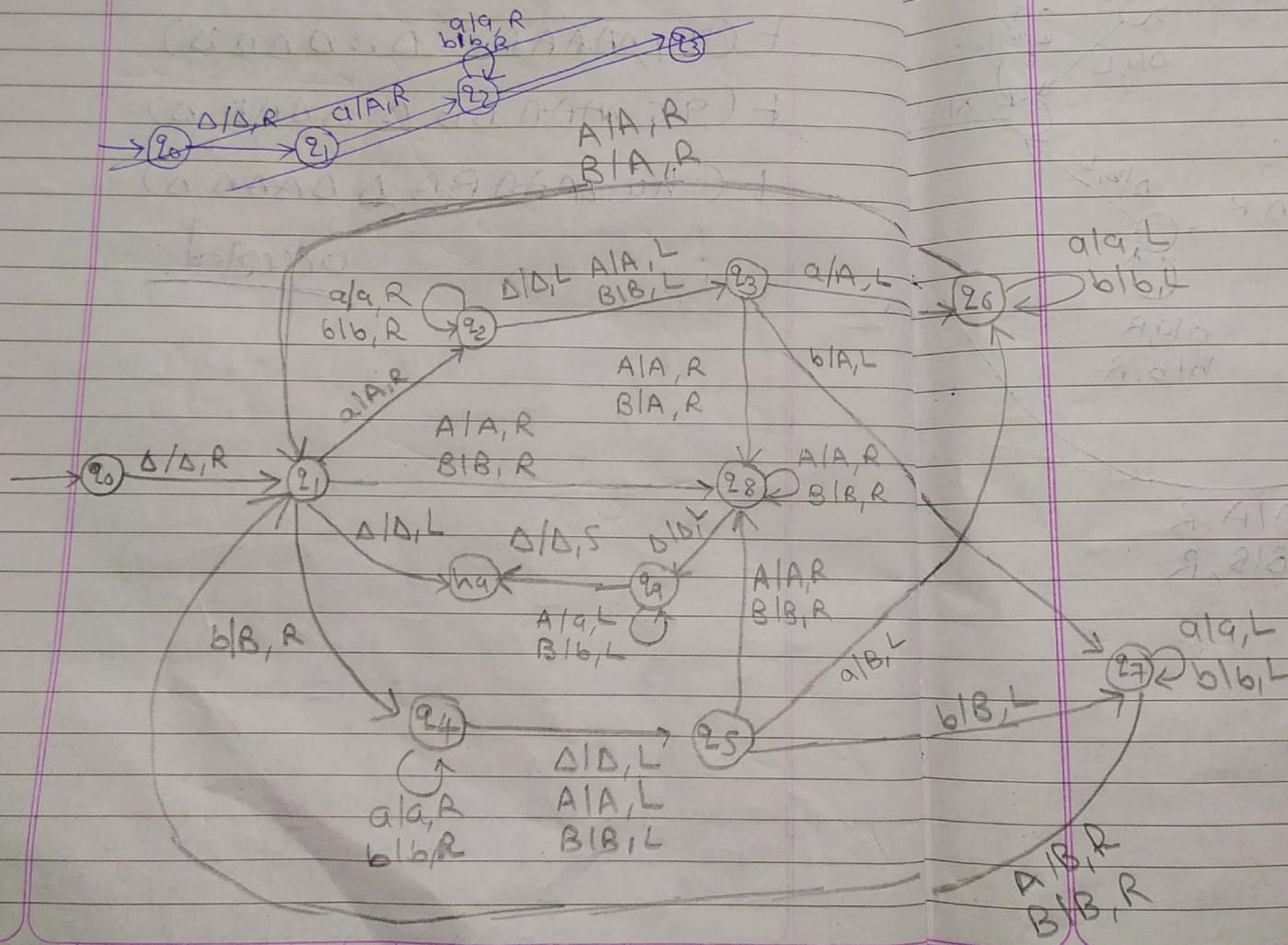
F(26, AAAA BBDDDDDD)

F(ha, AAAA BBDDDDDD)

accepted

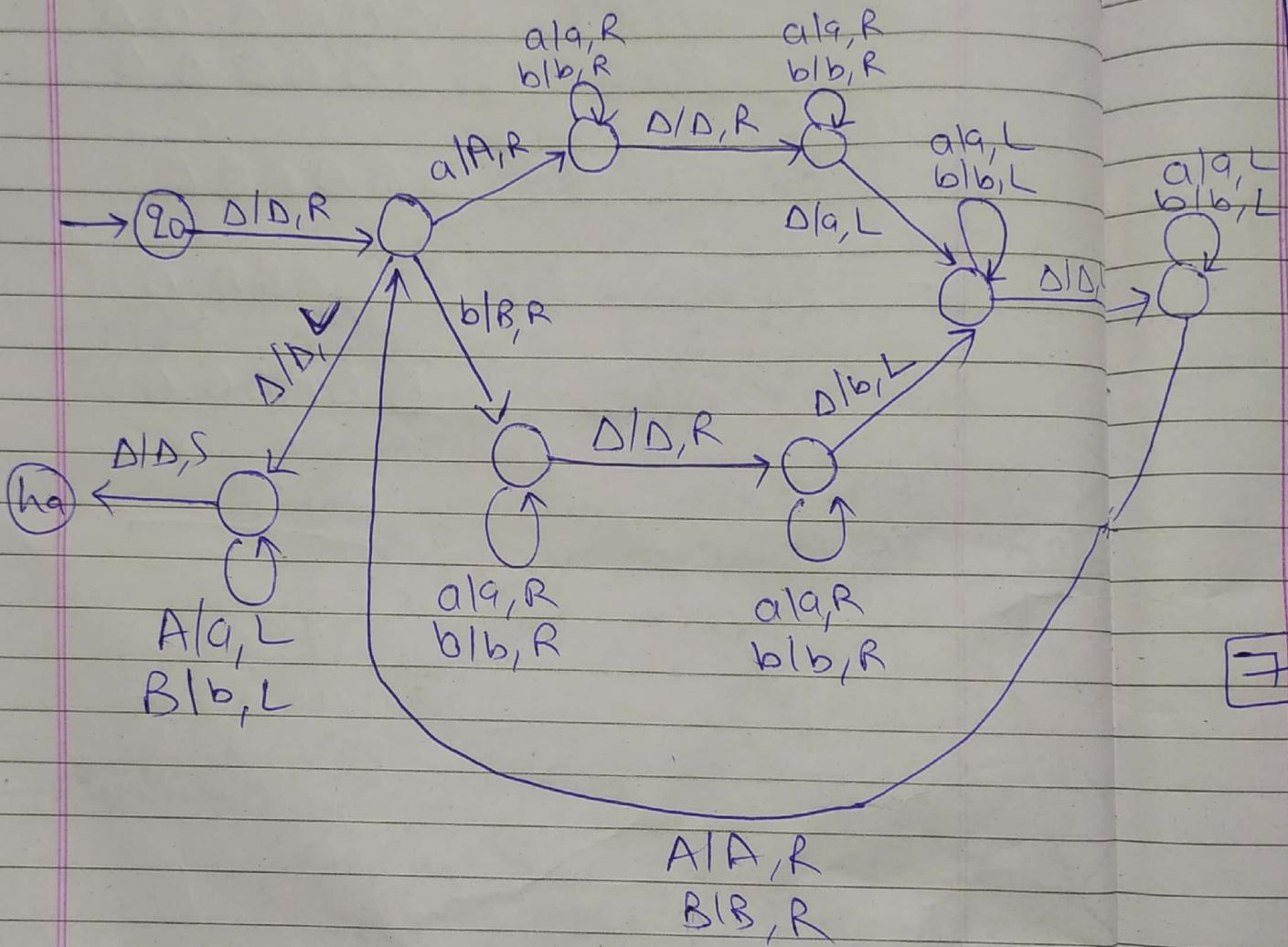
4) TM for reverse a string:

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pdf page no. 243)



5 TM for copying a string

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[Pdf page no. 245]



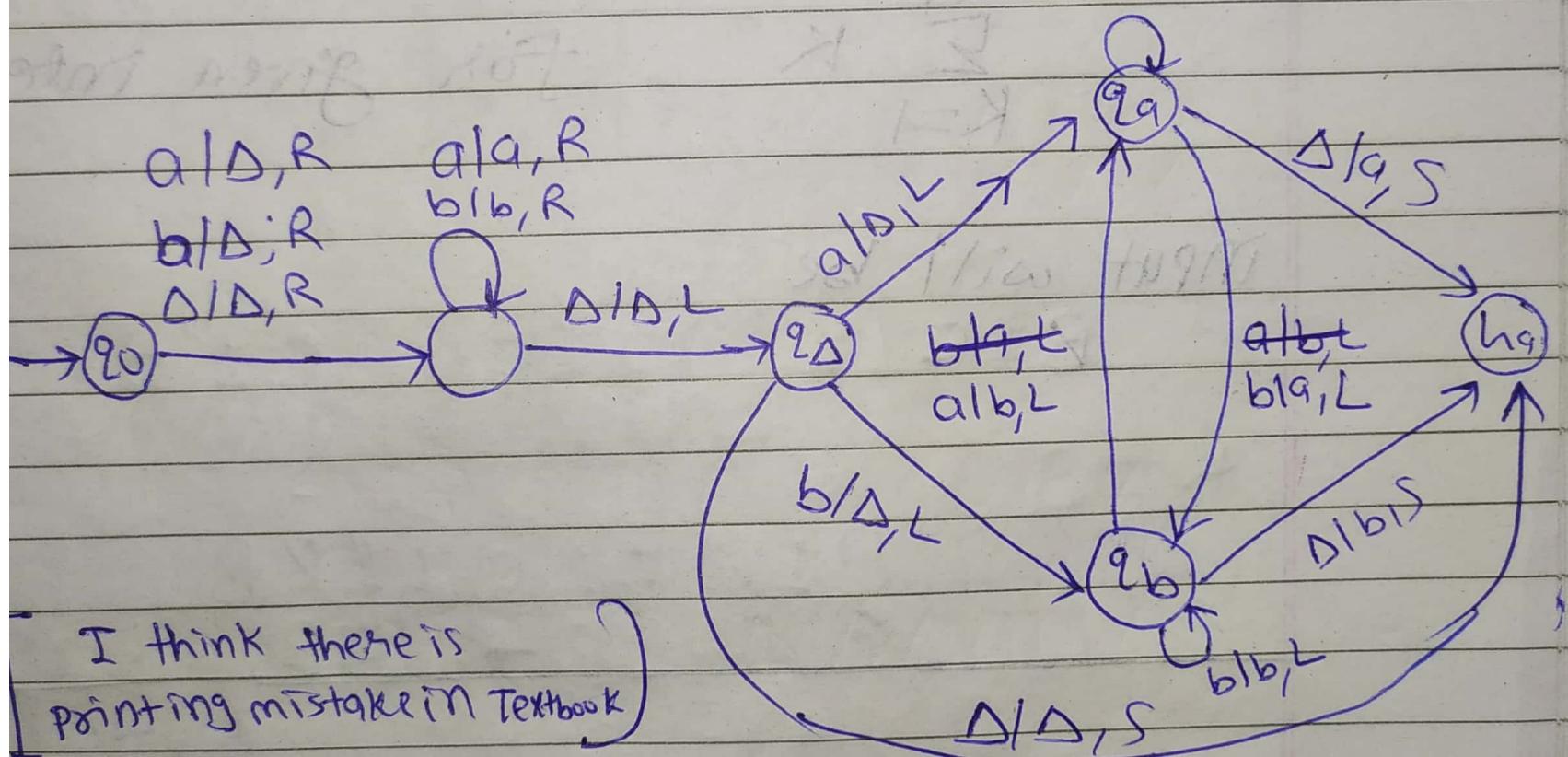
Book Pg. no. 336

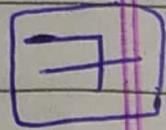
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Q6

Q. TM for deleting a symbol [8]





MCQ

- 1) d. ✓
- 2) b ✓
- 3) c
- 4) ←
- 5) a

[confirm
Kar lena]

After reading
about post machine
on internet.

→ Post machine has
bi-directional movements

→ so, I think answer
can be b

4

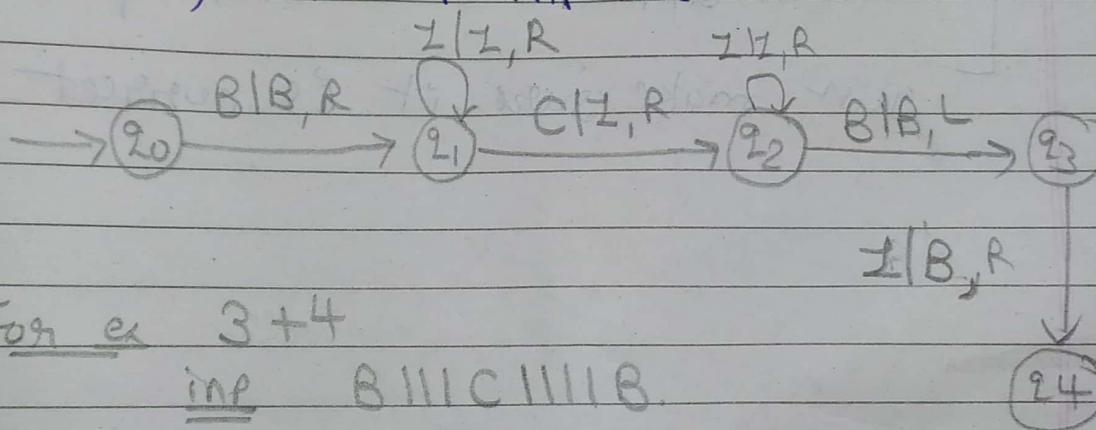
~~for Q. 2 and 5 (Extra note)~~ watch video
TM as adder on Knowledge gate (youtube)
Addition of two numbers

→ We are considering operation in unary system.

integer n in unary will be 1^n .

→ numbers, n, m .

so, on tap input will be $B1^n C1^m B$.



For ex $3+4$

in $B111C1111B$.

output $B111111BB$ which is 7

Practice Problems

8

1. TM to complete

1173

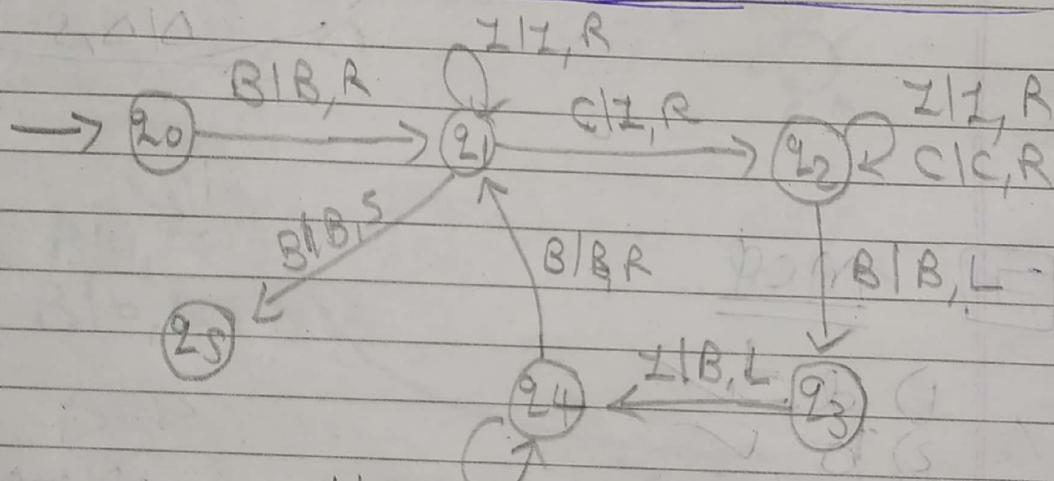
for given integer n

input will be

BICIZCIZC_n - CZB

大 (1) w

~~BIG ZIG ZAG B~~



~~17 Dec~~

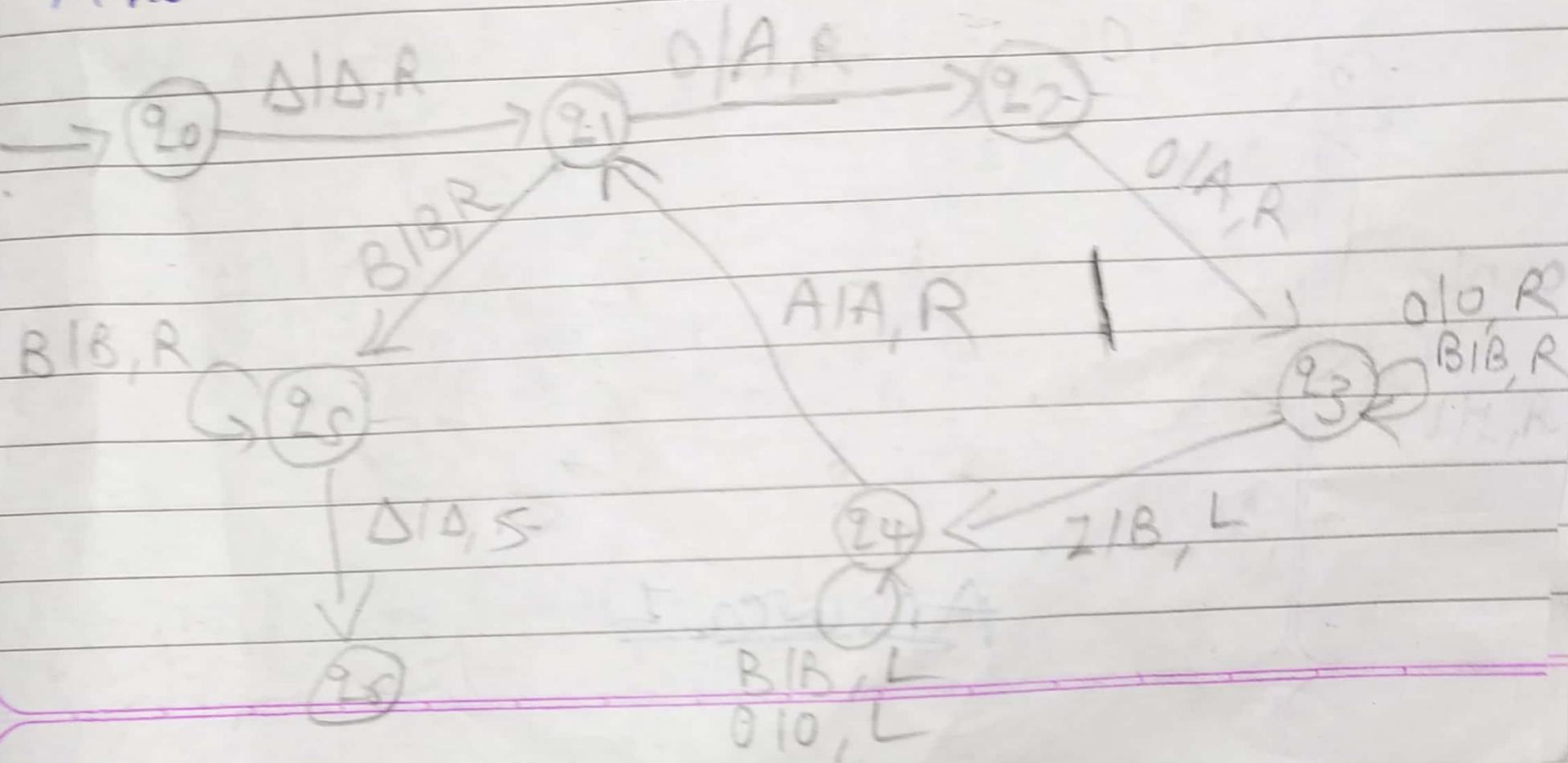
~~one~~ ~~one~~ ~~one~~ BICZ1C772C7771B

~~ask~~ borib - B I I I I I Z Z Z Z Z Z B B B B

$$[6] \quad \text{ad} \quad 1+2+3+4 = \underline{\underline{10}} \quad (10 \text{ Zg})$$

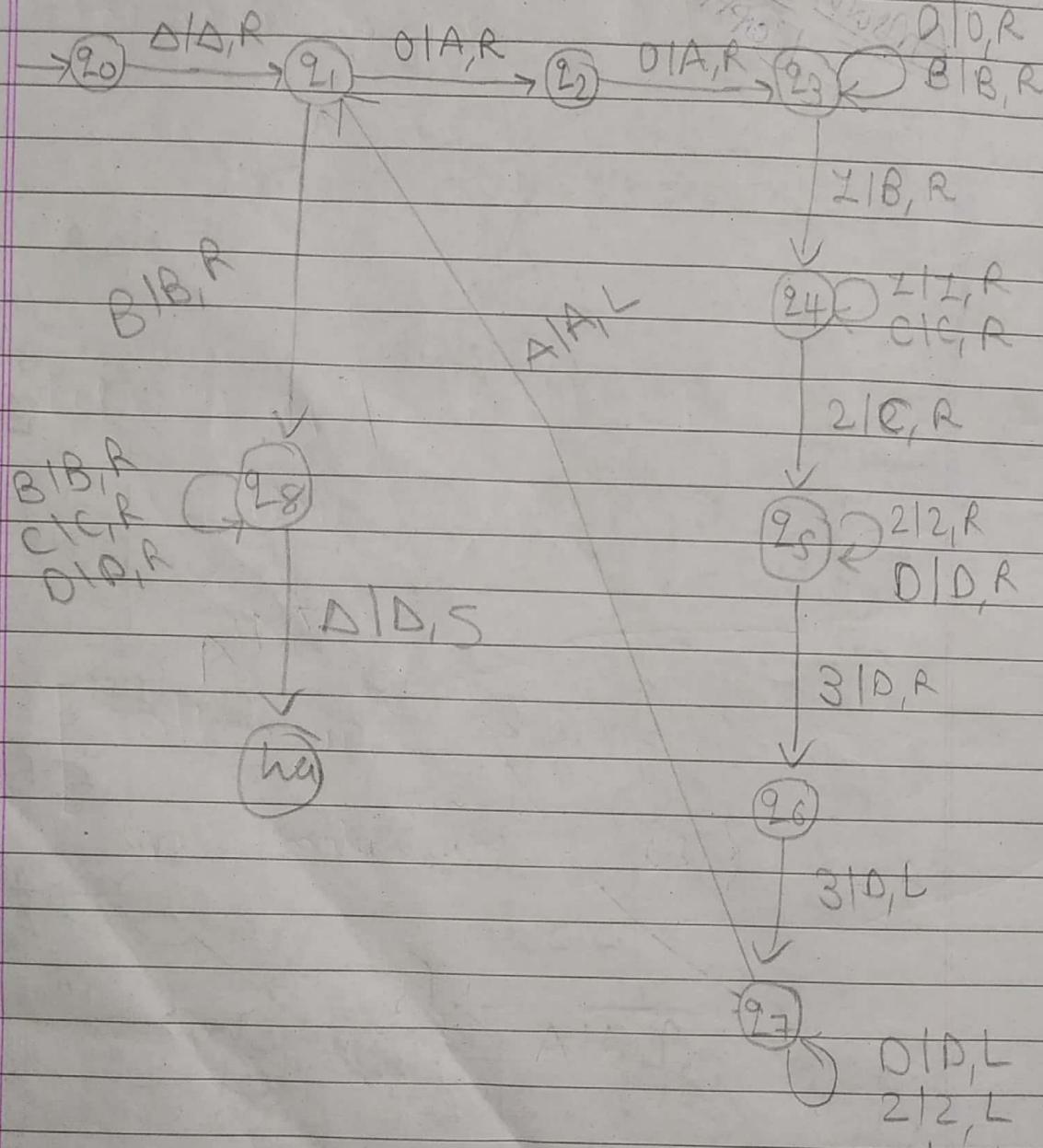
$$2 \cdot 0^{2n} - 2^n \quad n \geq 2$$

Answer



$$3. \quad T_m \text{ for } 0 \leq n \leq m, \quad n \geq 1.$$

D 0012 333 A X
PFB C DD



XΔΔ
1898.5100

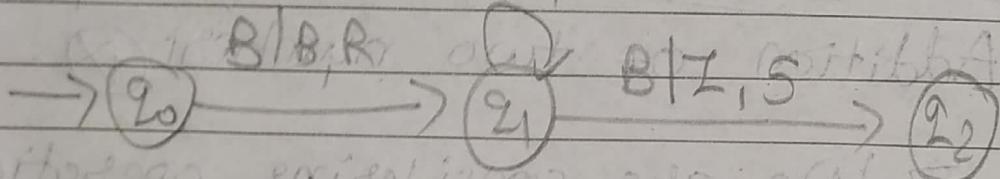
X 08888100000

D1D,L
212,L
C1G,L
212,L
B1B,L
010,L

5. TM for successor of integer n

so, here addition will be $n+1$.

The input will be $B1^n BB$



Let's say if $B1111 BB$ which is 4.

output $B11111 B$ which is 5

or maximum

other approaches are also possible

just make sure it is correct