(24) Design a TM for multiplication of two integers (or) unary nos.

⇒ In this m & n as $0^m 1 0^n 1$ on the input tape.

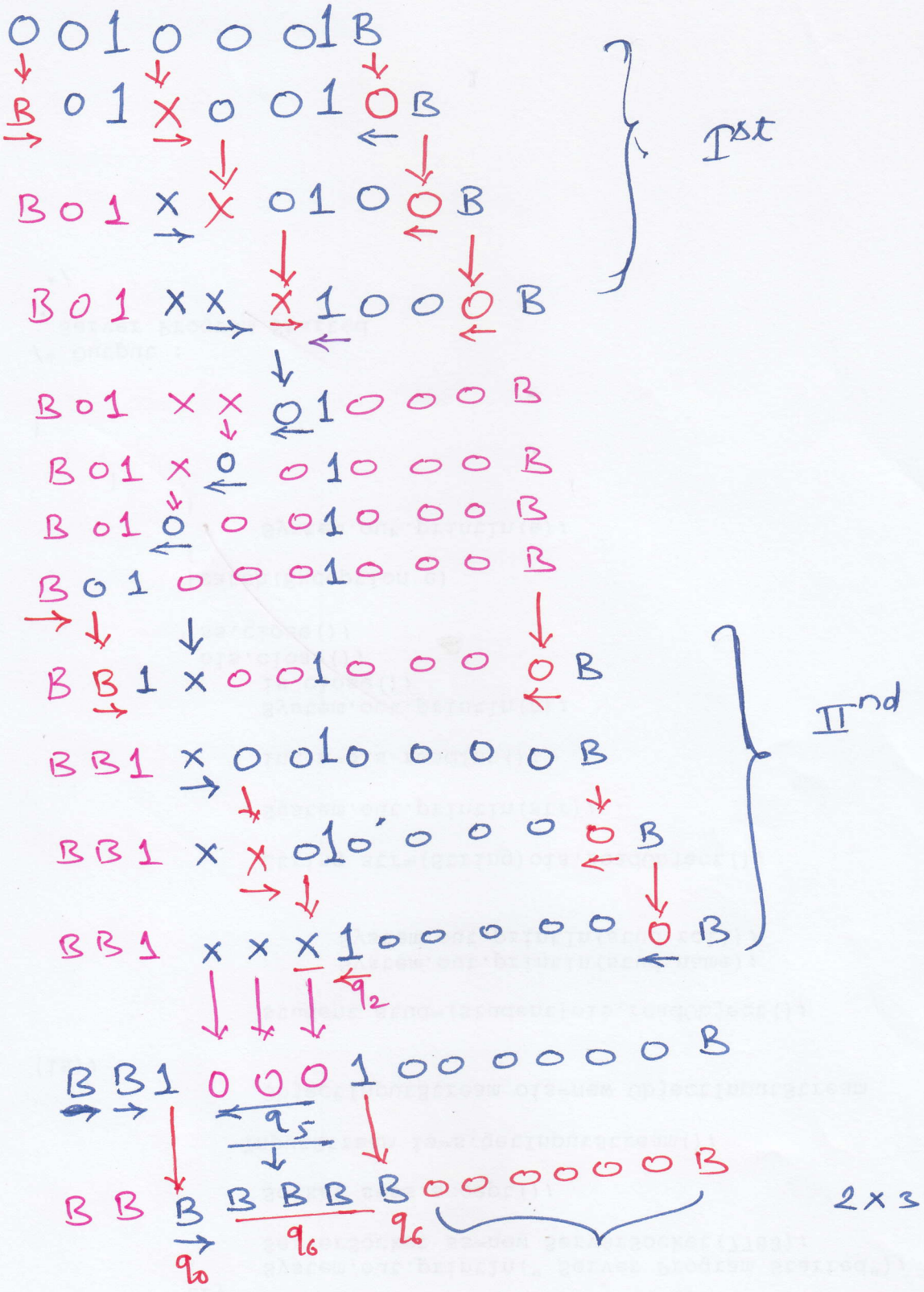
⇒ on first occurence of '0' replace it by Blank & for each occurence of '0' of second integer write '0' at the end.

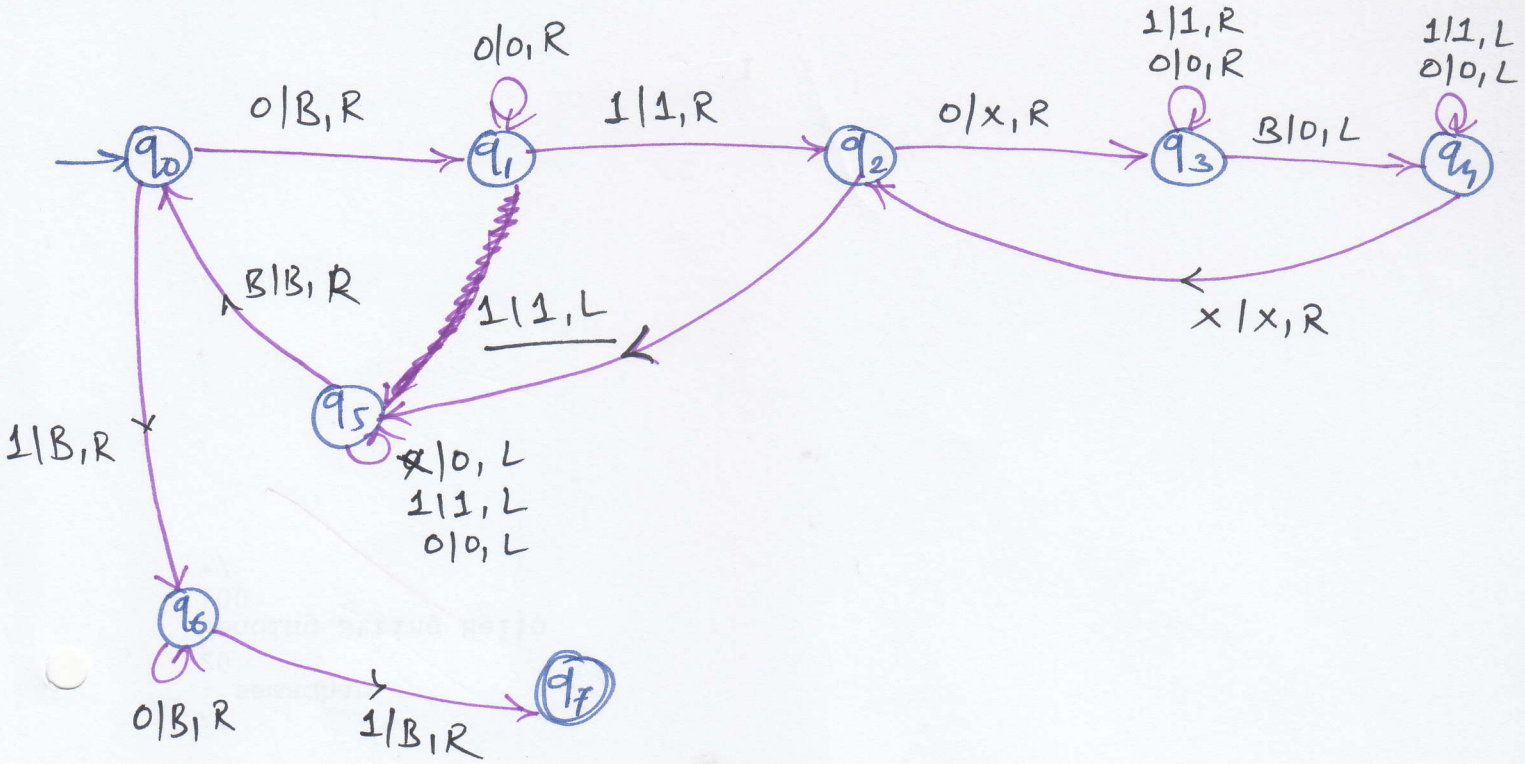
⇒ once all 0's of second integer are replaced with 'X'. Now remodify all X's to 0's & move extreme left to find B.

⇒ Repeat this process until all 0's of first integer are replaced with B.

⇒ Now replace all 0's of second integer by Blank & Halt.

Ex:- 2 × 3


I st
II nd
2 x 3


0|0,R
0|B,R
1|1,R
0|x,R
1|1,R
0|0,R
1|1,L
0|0,L
B|0,L
B|B,R
1|1,L
x|x,R
1|B,R
x|0,L
1|1,L
0|0,L
0|B,R
1|B,R
q0
q1
q2
q3
q4
q5
q6
q7

(25) Design a TM to recognize an arbitary string divisble by 4 $\Sigma = \{0, 1, 2\}$.

→ input string is $\Sigma = \{0,1,2\}$, any arbitary string of i/p should be a ternary string & we have to check such ternary input is divisible by 4 (or) not.

$(121)_3 = 1\times3^2 + 2\times3^1 + 1\times3^0$

$= 9 + 6 + 1 = (16)_{10}$ $\Rightarrow 16/4 = 0$

$(120)_3 = 1\times3^2 + 2\times3^1 + 0\times3^0$

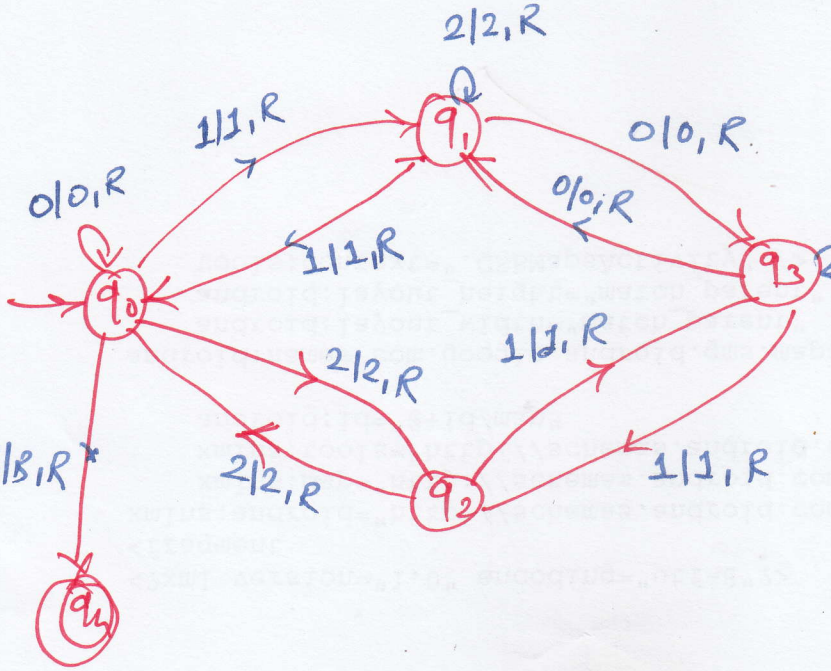
$= 9 + 6 + 0 = (15)_{10}$ $\Rightarrow 15/4 = 3$

q_0 - Remainder '0'

q_1 - Remainder '1'

q_2 - Remainder '2'

q_3 - Remainder '3'



$q_0 = (121)_3 = (16)_{10} \Rightarrow R = 0$

$q_3 = (120)_3 = (15)_{10} \Rightarrow R = 3$

$q_3 (12021)_3 = (142)_{10}$

$R = 2$

$(120211)_3 = (427)_{10}$

$R = 3$

$q_0 (110)_3 = (12)_{10} = 0$

$q_2 = (112)_3 = (14)_{10} = 2$

$q_2 (1122)_3 = (44)_{10} = 2$

(26) Design a TM to recognize the divisibility

5/2 ⇒ B 00 # 00000 # BBB

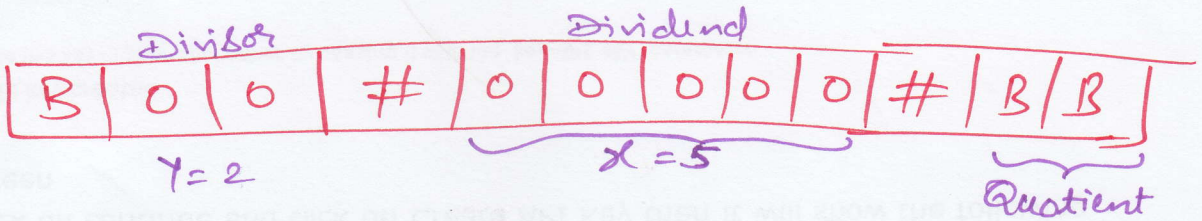
m/n

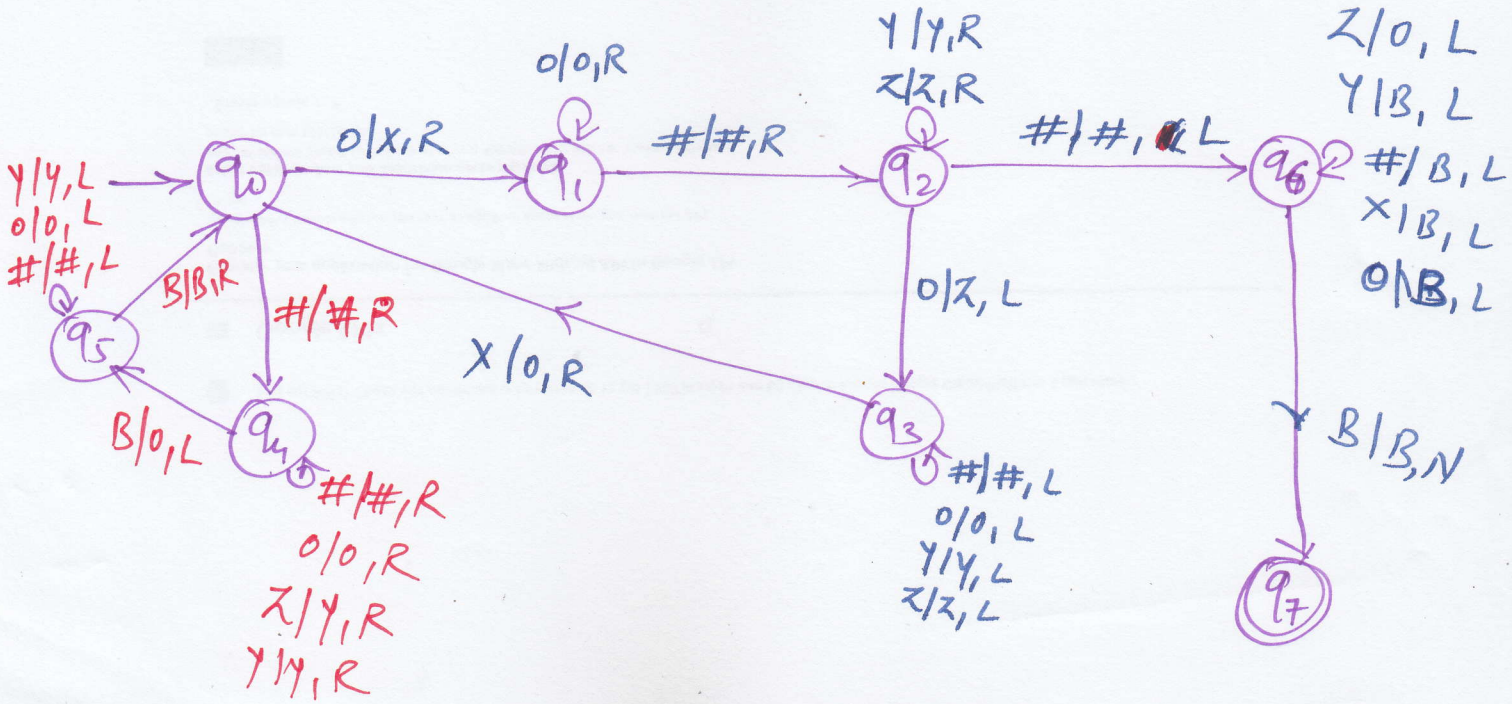
Remainder Quotient

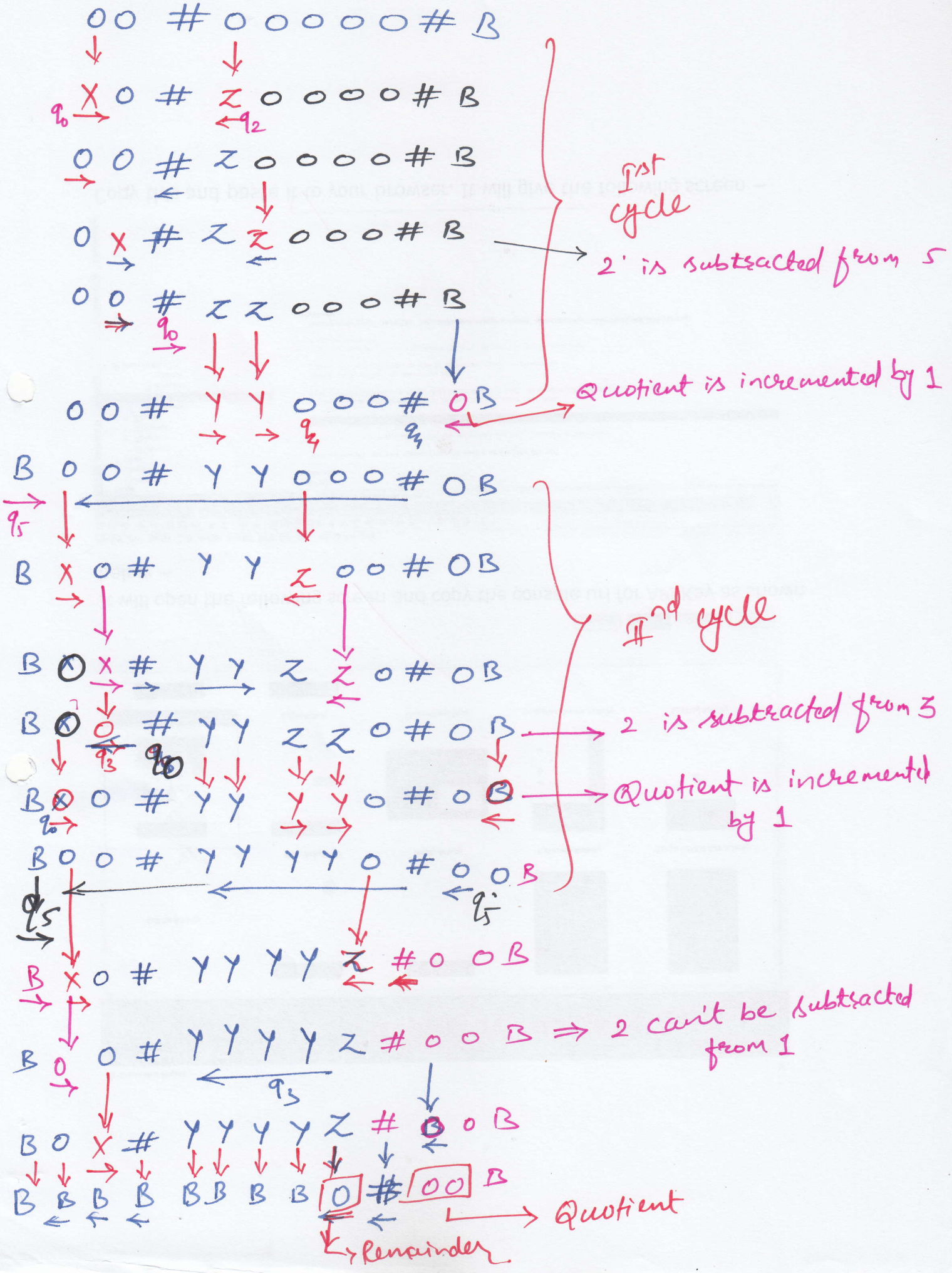
⇒ Division can be performed through repeated subtractions.

⇒ To perform x/y both x & y are represented in unary system y is divisor & x is dividend.

⇒ y is repeatedly subtracted from x as long as $x \geq y$ each time y is subtracted from x, quotient is incremented by 1.






I^st cycle
2' is subtracted from 5
Quotient is incremented by 1
II^nd cycle
2 is subtracted from 3
Quotient is incremented by 1
2 can't be subtracted from 1
Quotient
Remainder