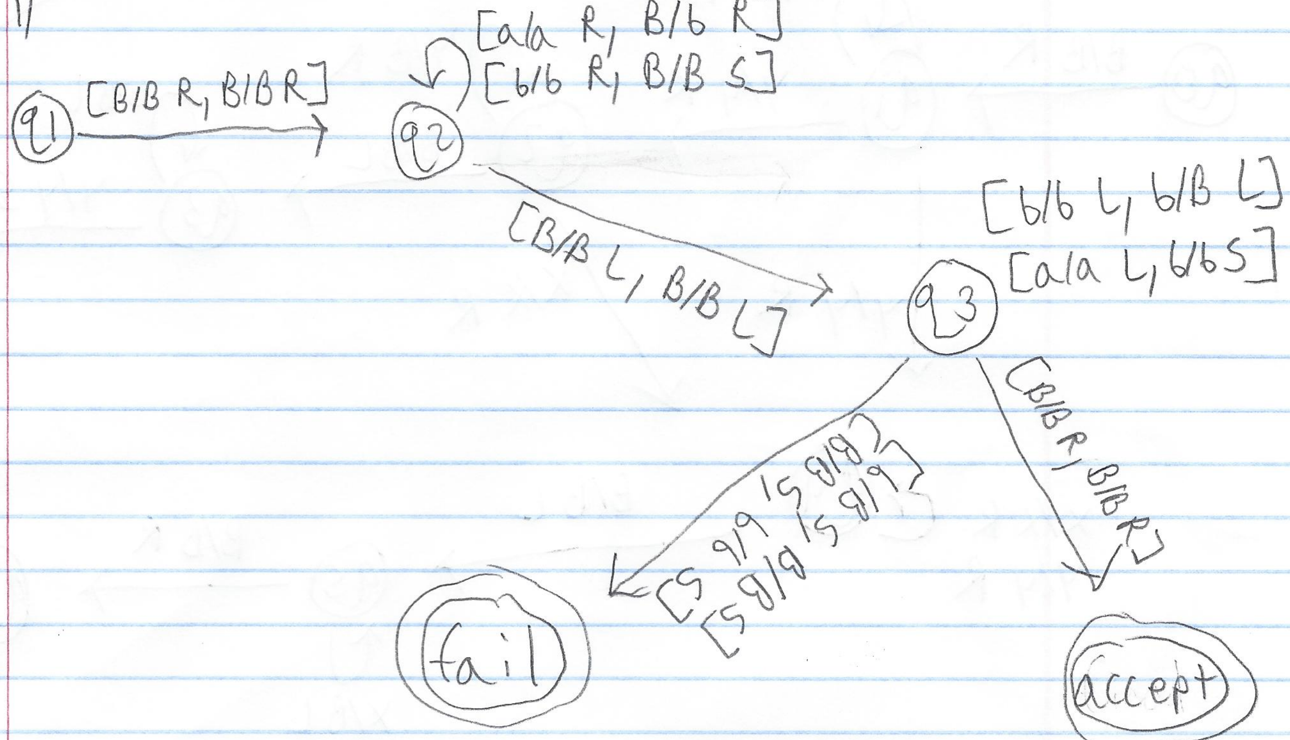
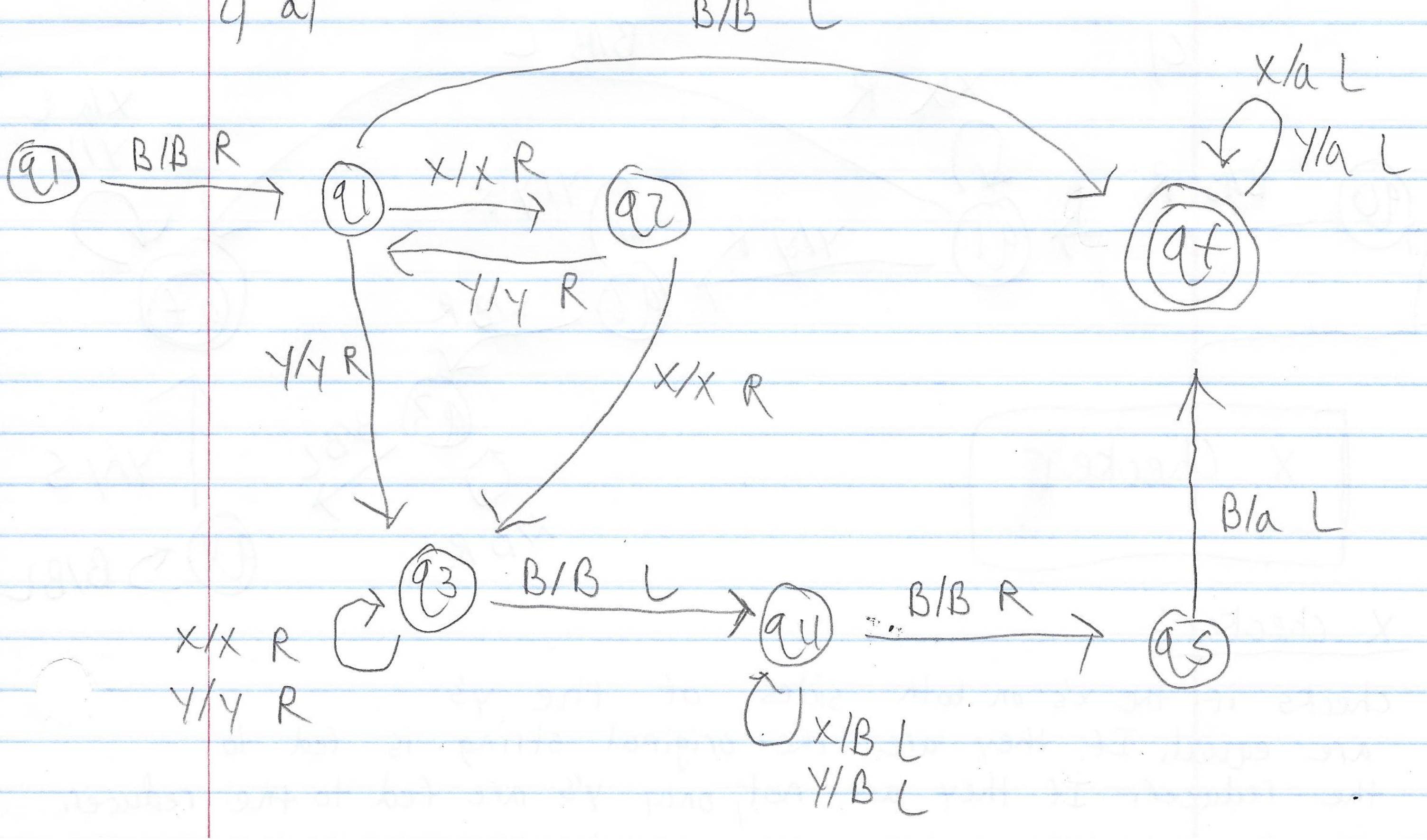
Final

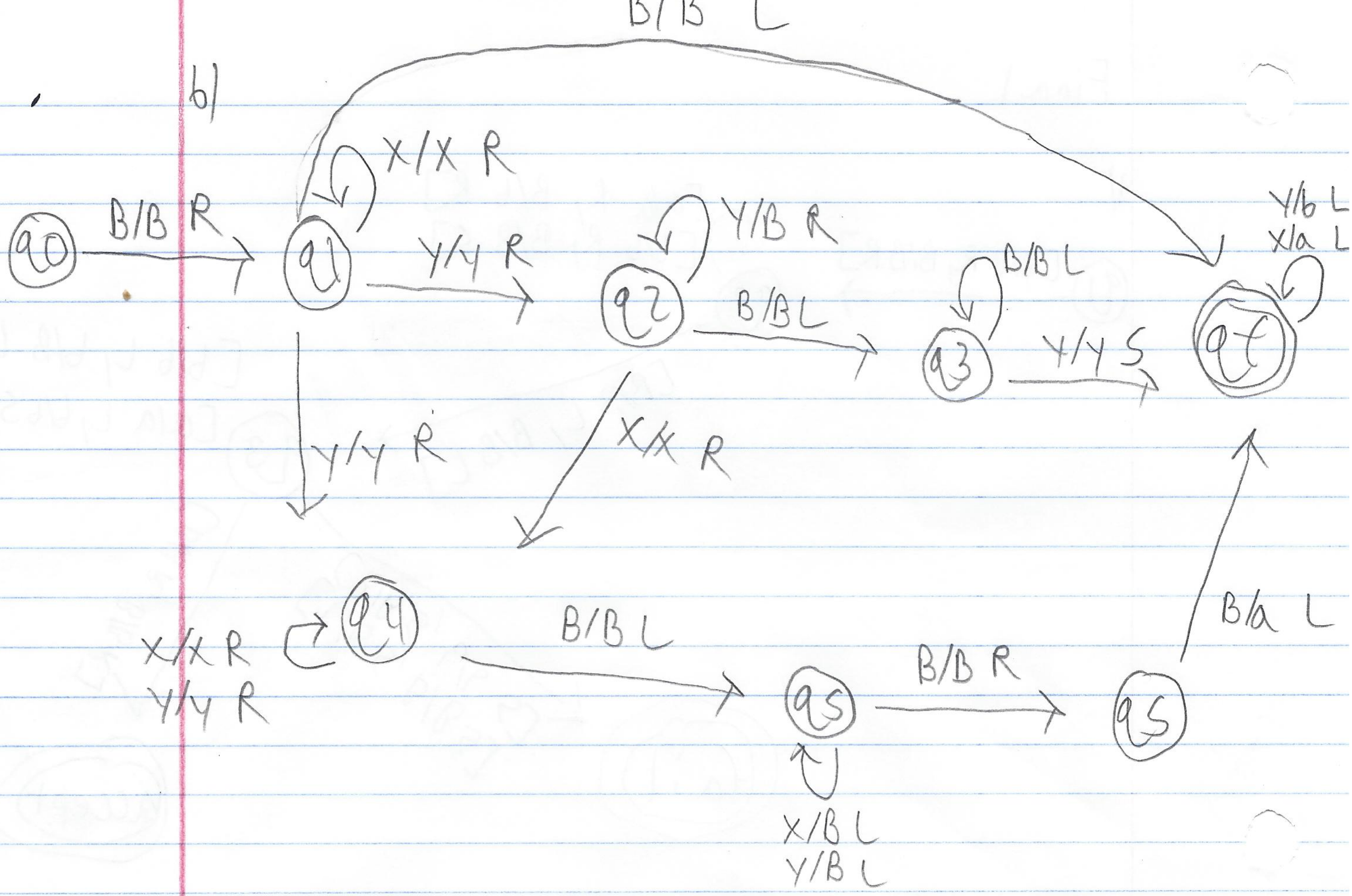
1)


[B/B R, B/B R]
[a/a R, B/b R]
[b/b R, B/B S]
[B/B L, B/B L]
[b/b L, b/B L]
[a/a L, b/b S]
[B/B S, a/a S, b/b S, B/B S]
[B/B R, B/B R]
q1
q2
q3
fail
accept

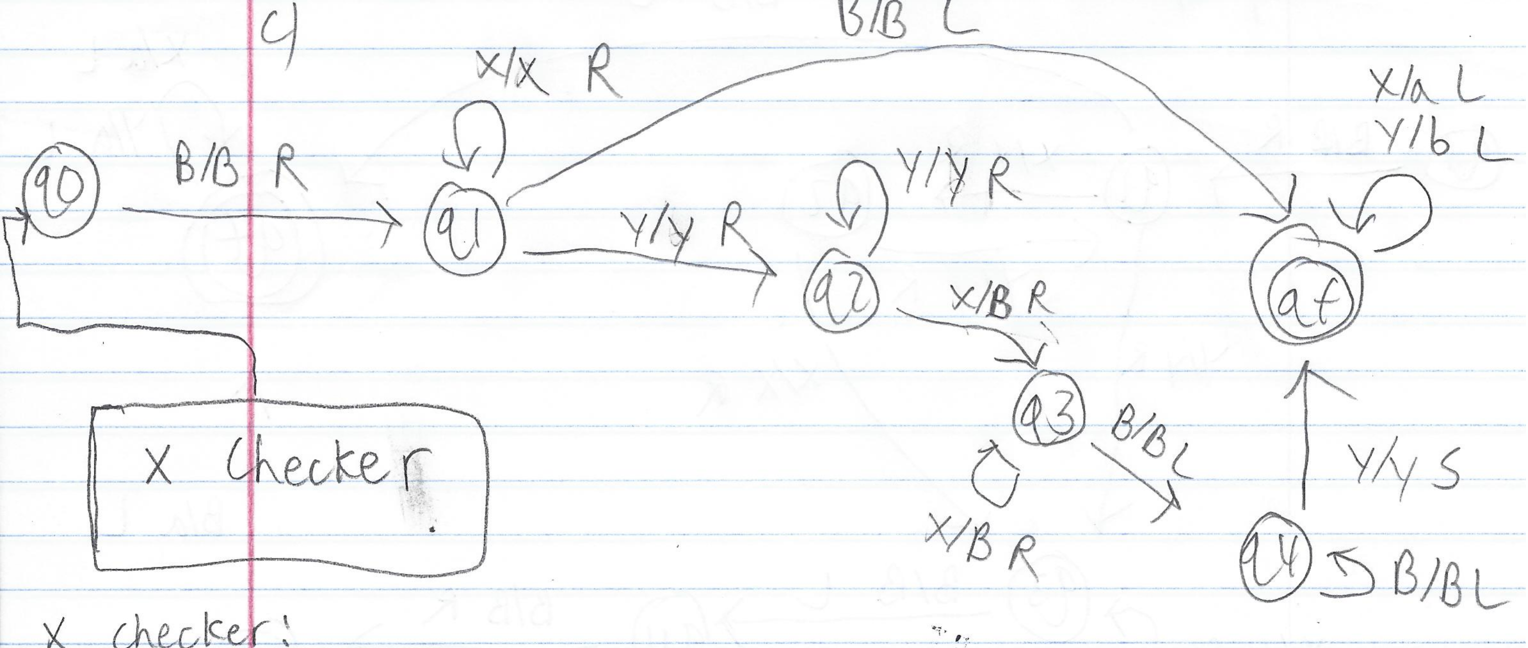
2) a)


B/B L
X/a L
Y/a L
B/B R
X/X R
Y/Y R
Y/Y R
X/X R
X/X R
Y/Y R
B/B L
B/B R
X/B L
Y/B L
B/a L
qI
q1
q2
q3
q4
q5
qf

b)



c)



X checker:

checks if the x's on both sides of the y's are equal. If they are the original string is fed to the reducer. If they are not, only y's are fed to the reducer.

5) The fundamental difference is that you are putting a limit on the number of transitions you can step through without halting. Therefore, you are taking the infinite loop out of the halting problem with the "nth transition" problem.

8) $f(3,0) = g(3) = 3$

$f(3,1) = h(3,0,f(3,0))$
$h(3,0,3)$
$3+3$
6

$f(3,2) = h(3,1,f(3,1))$
$h(3,0,6)$
$3+6$
9

6) $f(m,n) = m(n+1)$

9) a) $f(x,y) = g(x,y,x)$
$f(x,y) = g(x,y,P_1^{(2)}) = g_0(P_1^{(2)}, P_2^{(2)}, P_1^{(2)})$

b) $f(x,y,z,z) = g(x,y,x)$
$g(x,y,P_1^{(4)}) = g_0(P_1^{(4)}, P_2^{(4)}, P_1^{(4)})$

c) $f(x) = g(1,2,x)$
$g_0(1,2,P_1^{(1)})$

10) divides $(x,x) \cdot$ divides(y,x)
divides$(x,x-1) \cdot$ divides$(y,x-1)$
...

$$gcd(x,y) = \overset{x}{\mu} z[\text{divides}(x, x-z) \cdot \text{divides}(y, x-z)]$$

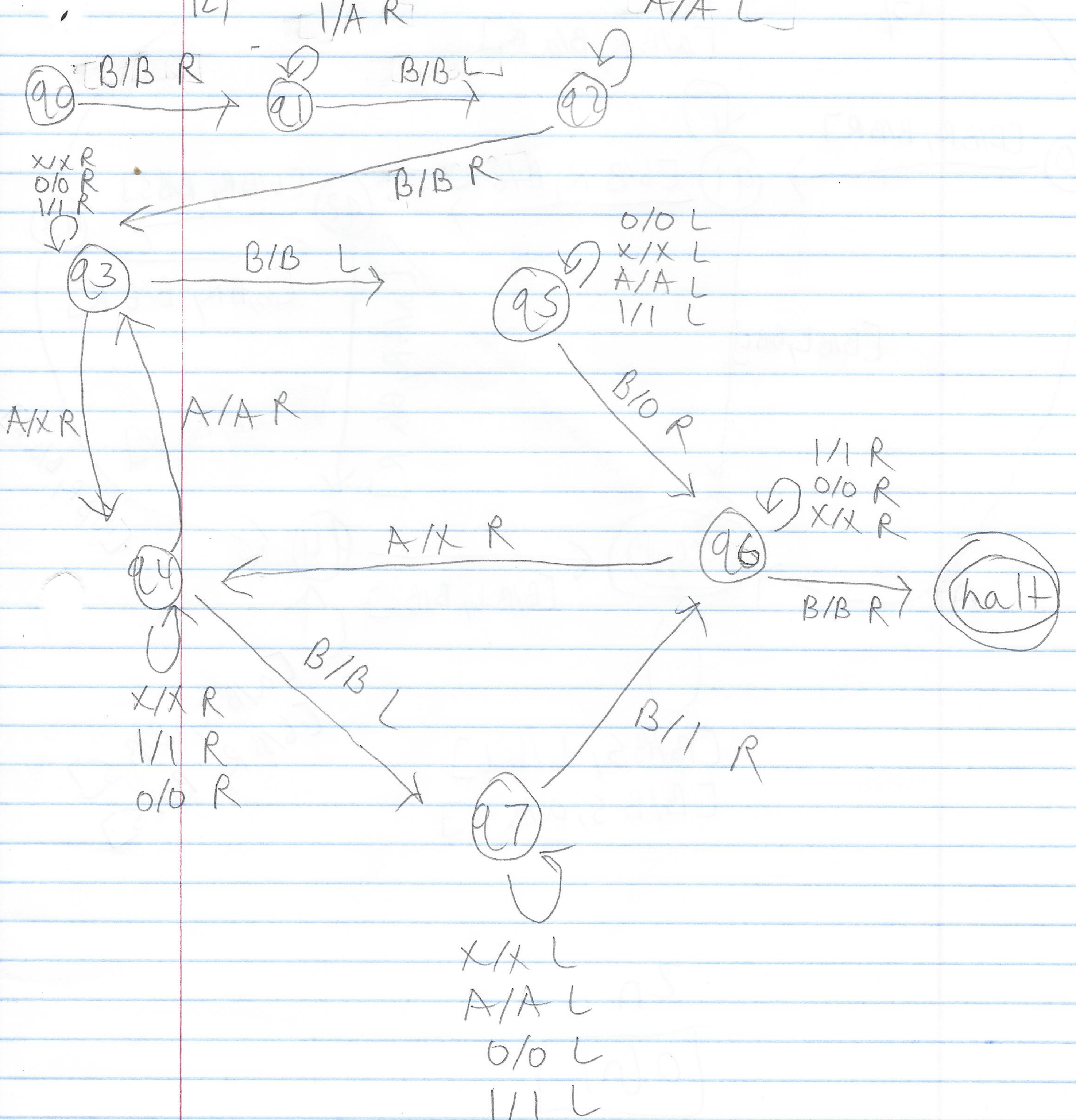
11)

Iteration	Direction	Transitions
1	Right	n+1
2	Left	n+1
3	Right	n/2

$2(n+1) + n/2$

$\boxed{O(n)}$

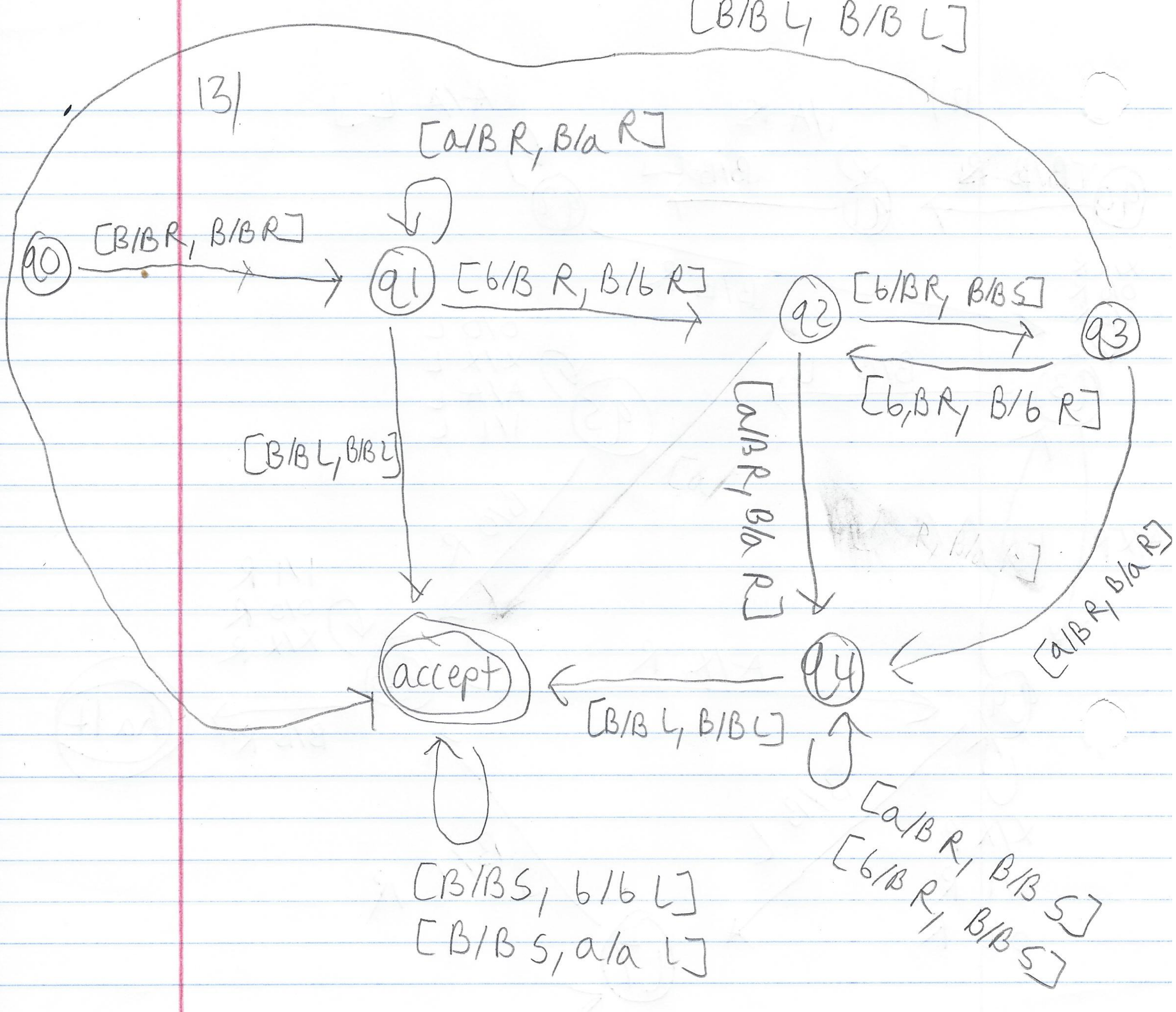
12)



$3n + n/2 + n/4 + n/\ldots$

$\boxed{O(n \log n)}$

13)



2n

$\boxed{O(n)}$