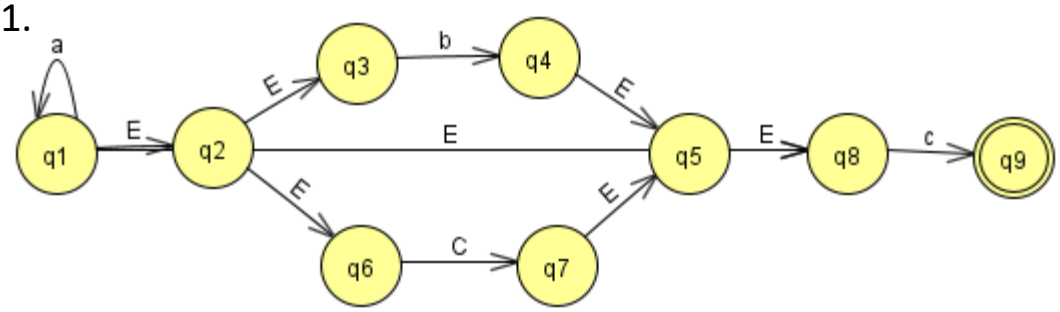
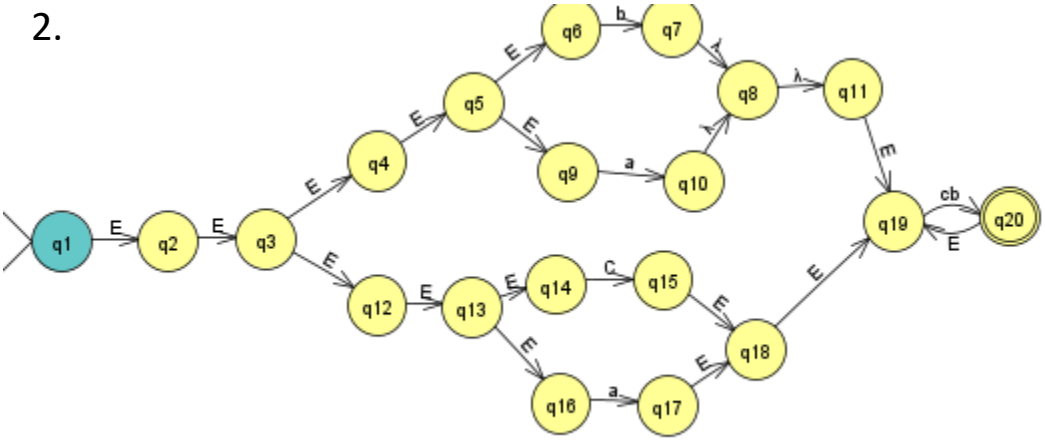
Problem 1:

1.

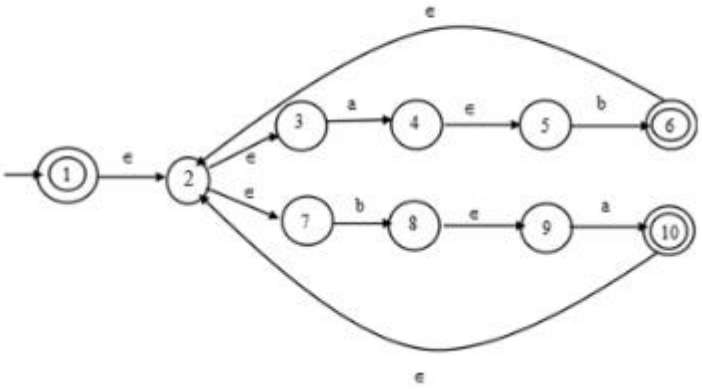

a
q1
E
q2
E
q3
b
q4
E
E
E
q5
E
q8
c
q9
E
q6
C
q7
E

2.

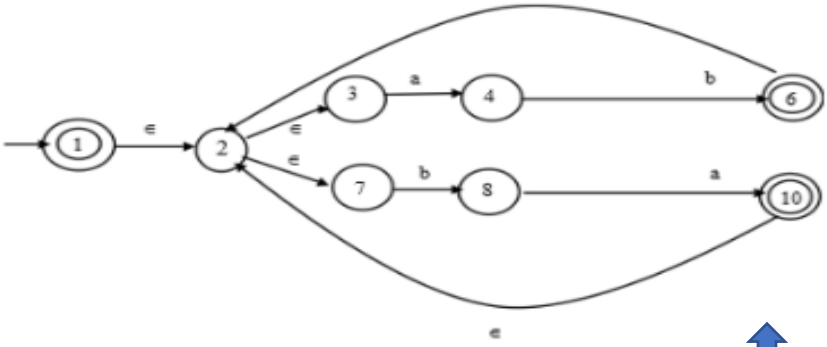

q1
E
q2
E
q3
E
E
q4
E
q5
E
q6
b
q7
λ
q8
λ
q11
E
E
q9
a
q10
λ
q19
cb
E
q20
E
q12
E
q13
E
q14
C
q15
E
q18
E
E
q16
a
q17
E

Problem 2: 1.

(a)

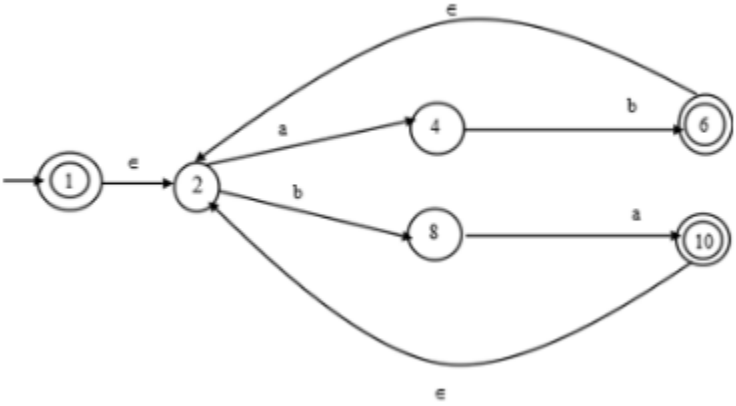


Step 1: Remove the NULL state between the states 4 and 5,8 and 9 and redraw the NFA as follows.



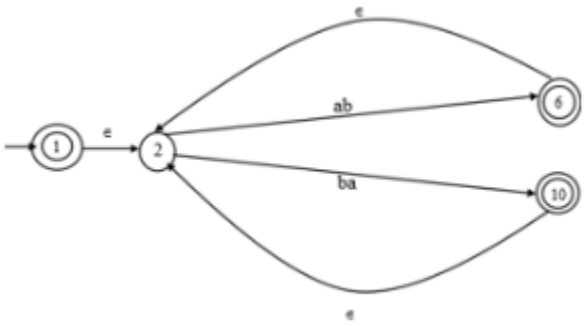
Step 2: In this NFA, one state from each end is eliminated. Here, the states 5 and 9 are deleted.

Remove the Null state (E) between the states 2 and 3, 2 and 7 and redraw the NFA as follows:

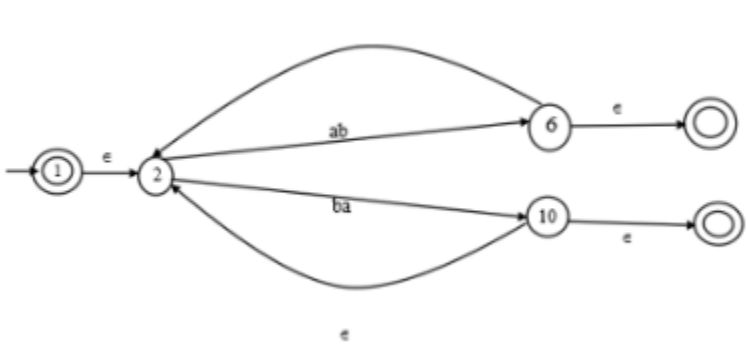


Step 3: In this NFA, states 3 and 7 are eliminated.

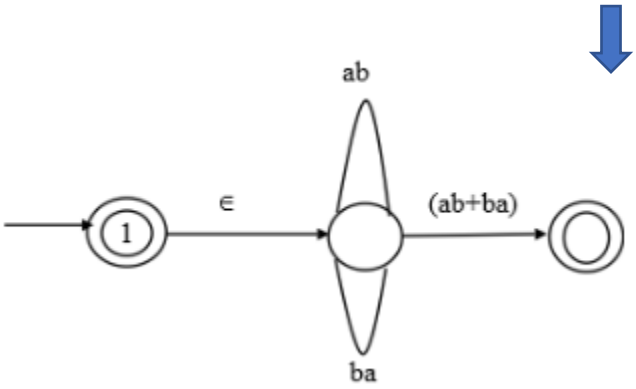
Now, remove the states 4 and 8 and merge the characters as ‘ab’ and ‘ba’ respectively.



Introduce two states, which will act as the final states originating from state 6 and 10 as follows:



Now, eliminate the states 6 and 10 and redraw the NFA as follows:

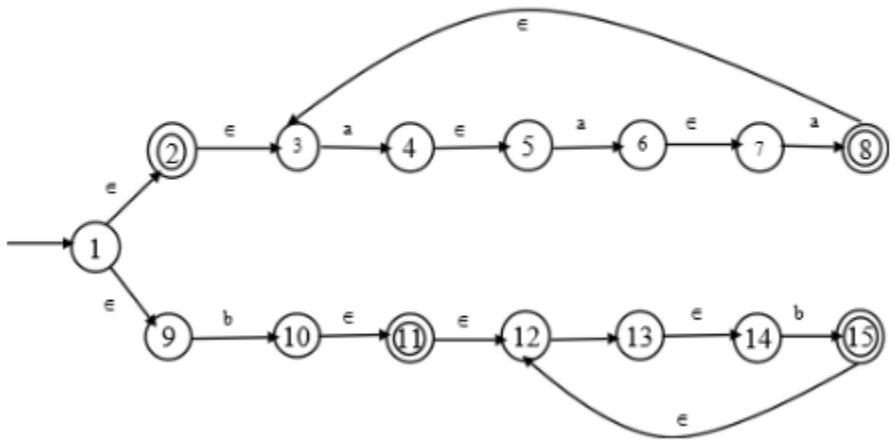


- The regular expression will be as follows:

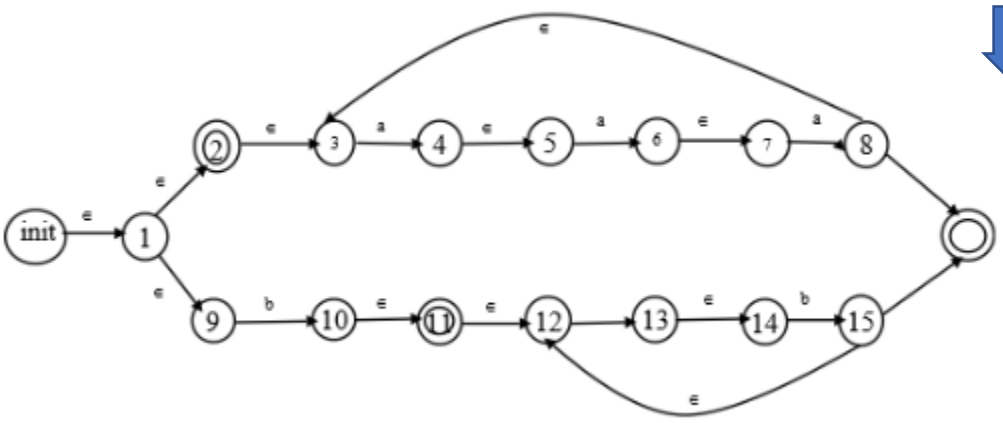
$$(\in+(ab)^*+(ba)^*+(ab+ba)+\in) \Rightarrow ((ab)^*+(ba)^*+(ab+ba))$$

2.

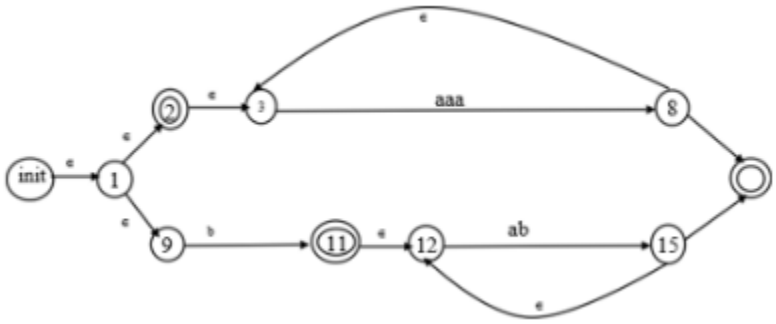
(b)



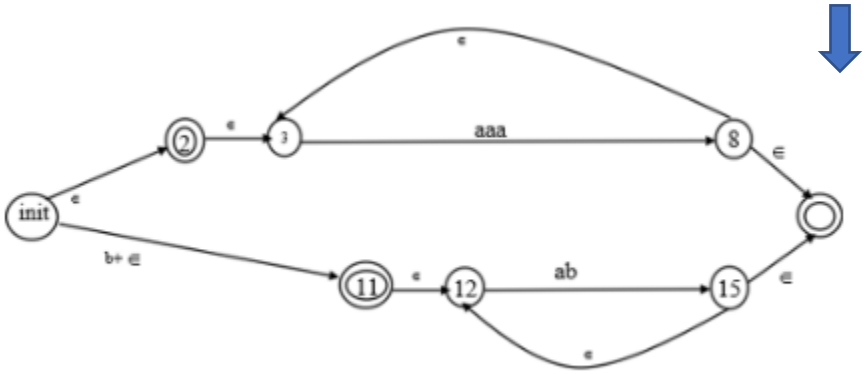
Steps: Redraw the NFA by introducing more states as follows:



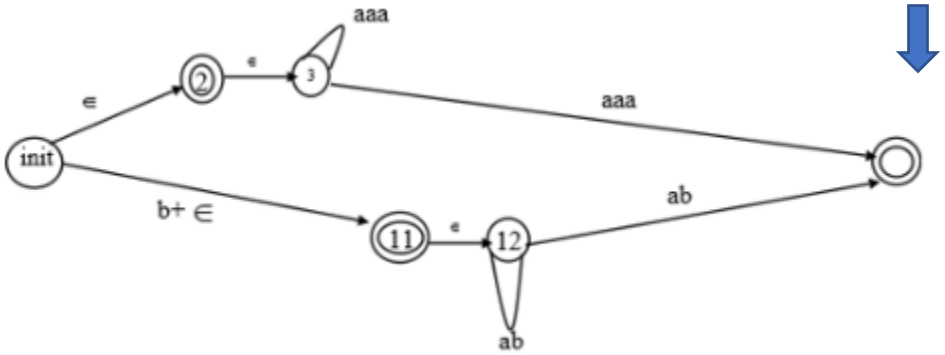
Now, remove the states 4,5,6,7 and 10,13,14 and redraw the NFA as follows:



Also, remove the states 1 and 9 as follows:



Now, remove the states 8 and 15 and redraw the NFA as follows:



The regular expression will be:

$$(\epsilon+(aaa)^*aaa+b+(ab)^*ab) \Rightarrow ((aaa)^*aaa+b+(ab)^*ab)$$