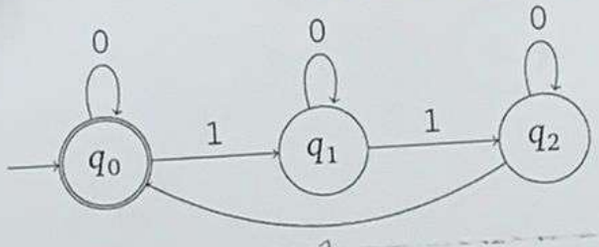
stion 1 ..... accepts with multiple of 3 numbers of 1's ... 5 points test

if 1 string exist

(a) Consider the alphabet $\Sigma = \{0, 1\}$. What is the language recognized by the following DFAs? Write your answer as a short English sentence above the DFA.

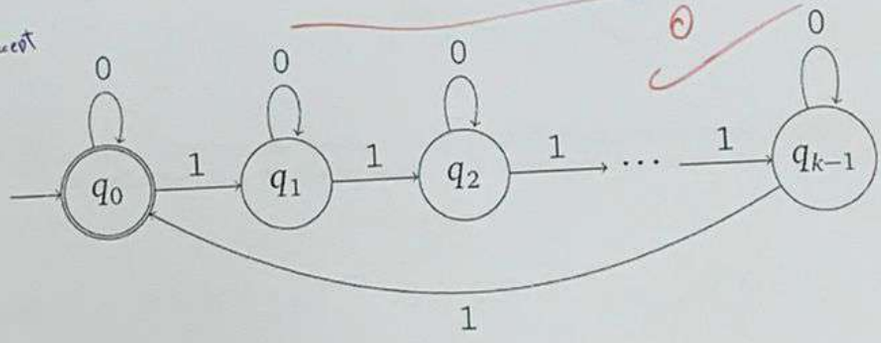
i. [1 point] ....accepts ~~with exact 1's if symbol 1 exist~~ multiple of 3 for 1's



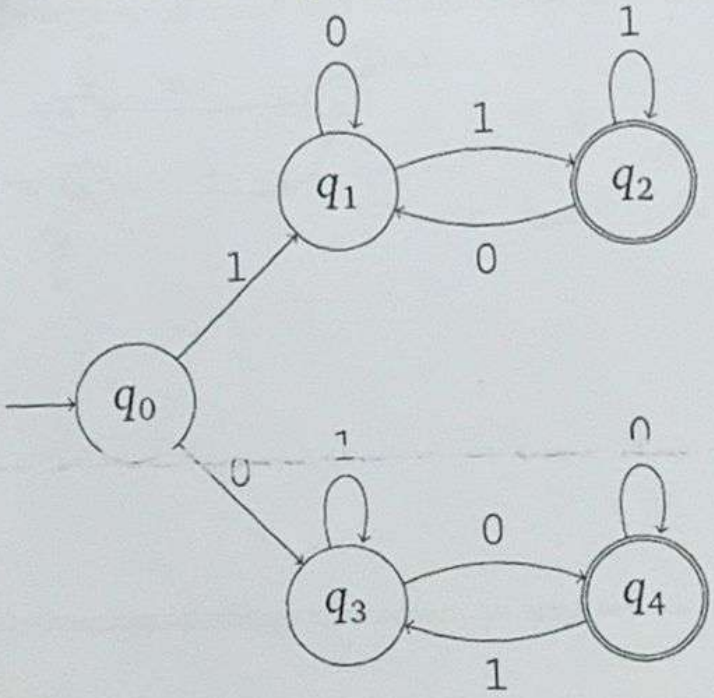
{ε, 111, 000, 0111, 01111, 111 000, 01001 1}

ii. [1 point] accept multiple number of states for 1's if 1 string exist

{0} accept



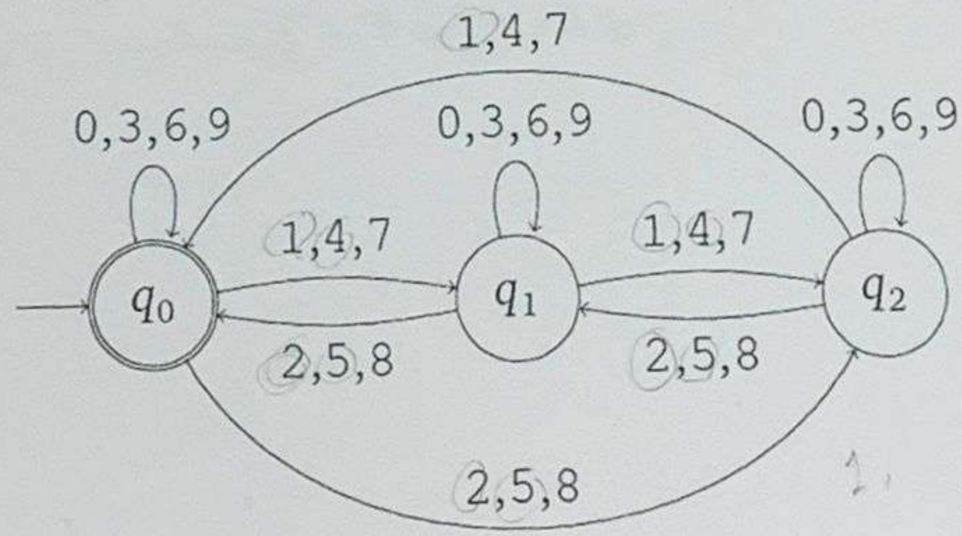
iii. [1 point] accept language Stat with string and end with the same string and its Lenght 2 at leats



1

(b) [2 points] Consider the alphabet $\Sigma = \{0, 1, \ldots 9\}$. Define the language accepted by the following DFA. Write your answer as a short English sentence below the DFA.

{0,3,6,9} accept



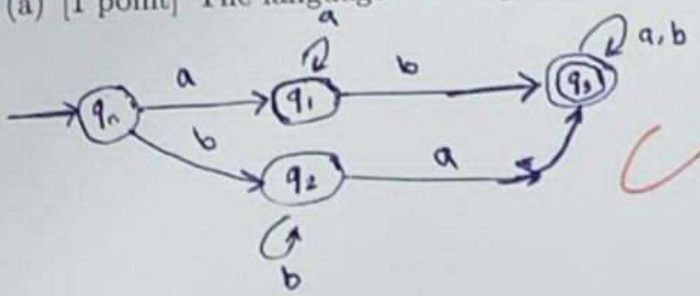
1

Langaug acceptt the out number of {1,2,4,5,7,8} mutiplue by 3 If any string of them is exist
Σ

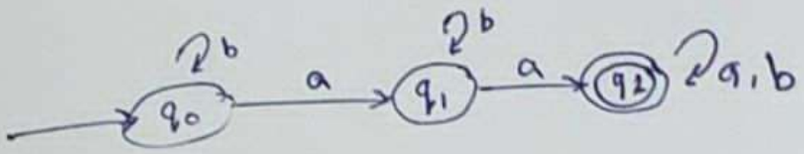
Question 2 ..... *4 points*

Give DFAs for the following languages. In all cases, the alphabet is $\Sigma = \{a, b\}$.

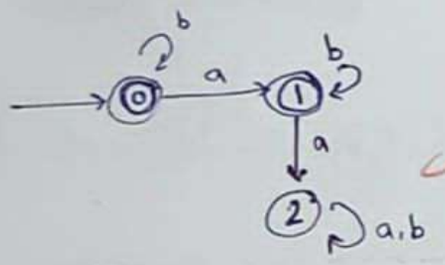
(a) [1 point] The language of strings that contain at least one a and at least one b.



(b) [1 point] The language of strings that contain at least two a's.



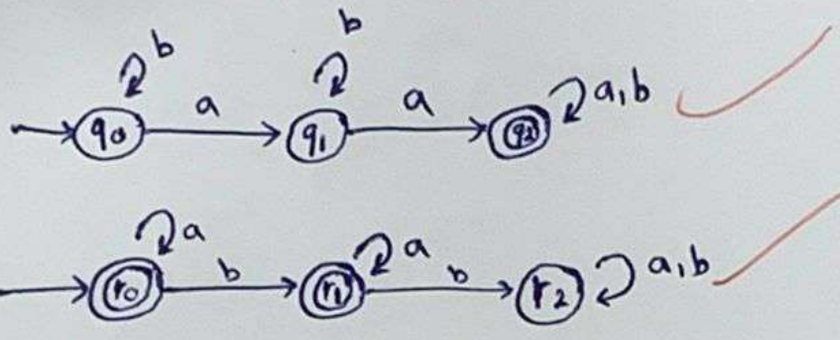
(c) [2 points] The language of strings that contain less than two a's.



2

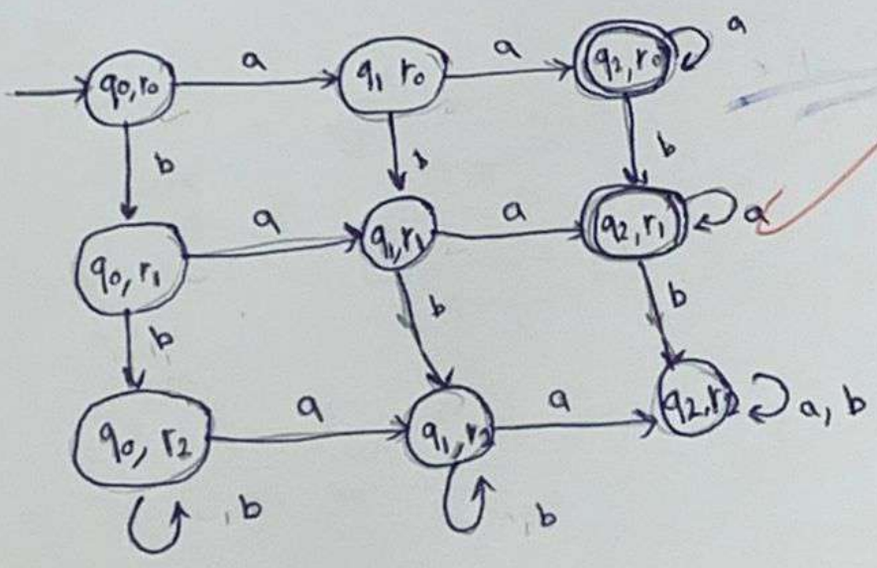
Question 3 ..... *4 points*

Consider the alphabet $\Sigma = \{a, b\}$. **Use the intersection of regular languages** to give a DFA for the language of strings that contain at least two a's and at most one b. Give the transition table and the state diagram of the obtained DFA.



4

$\{q_2, r_0, r_1\}$

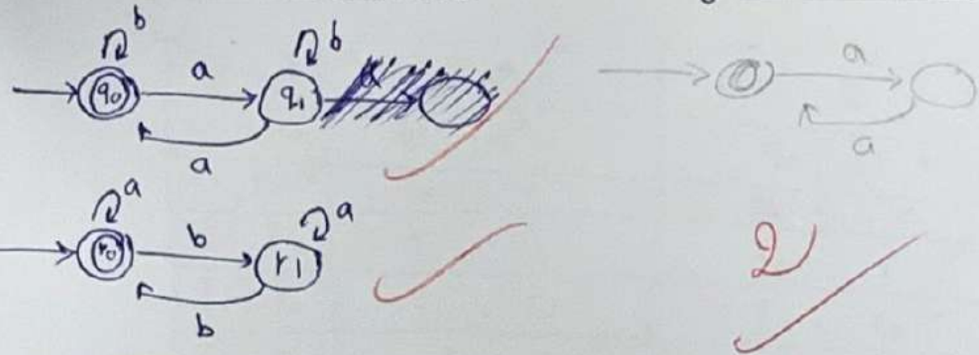


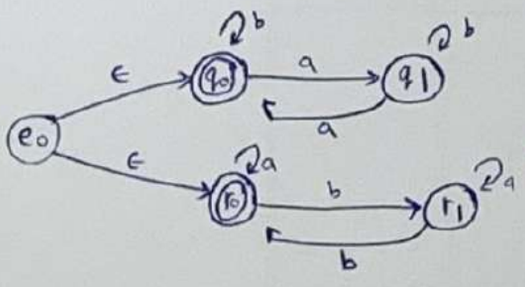
δ	a	b
q_0, r_0	q_1, r_0	q_0, r_1
q_1, r_0	q_2^*, r_0	q_1, r_1
q_0, r_1	q_1, r_1	q_0, r_1
q_2, r_0^*	q_2^*, r_0	q_2^*, r_1
q_1, r_1	q_2, r_1	q_1, r_2
q_2, r_1^*	q_2^*, r_1	q_2, r_2
q_1, r_2	q_2, r_2	q_1, r_2
q_2, r_2	q_2, r_2	q_2, r_2
$q_0 r_2$	$q_1 r_2$	$q_0 r_2$

q_0, r_2

Question 4 ..... *4 points*

(a) [2 points] Consider the alphabet $\Sigma = \{a, b\}$. Give an NFA for the language of strings that contain either an even number of a's or an even number of b's. Include the transition table of the NFA.



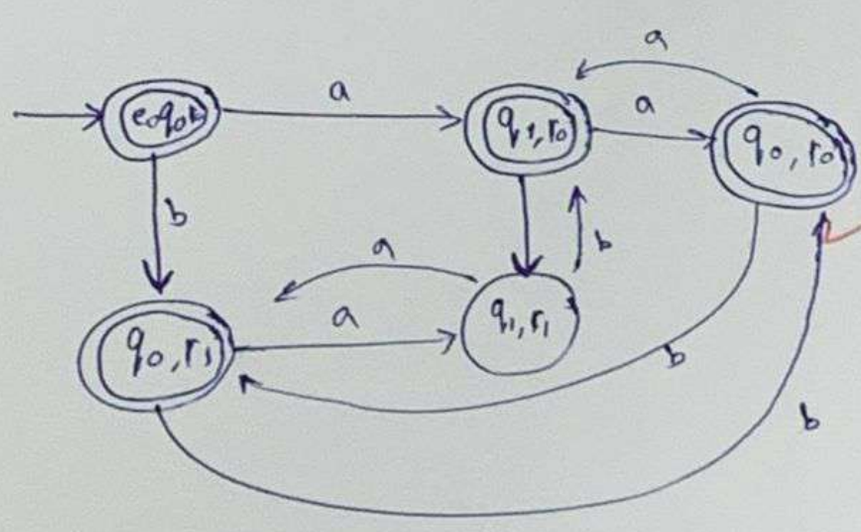


δ \ Σ	a	b	ε
~~e_0, r_0~~	~~q_1, r_0~~ *	~~q_0, r_1~~ *	
q_0	q_1	q_0 *	
~~q_1~~	q_0 *	q_1	
r_0	r_0 *	r_1	
r_1	r_1	r_0 *	

(b) [2 points] Convert the NFA of the previous question to a DFA. Include the transition table of the DFA. Draw the state diagram of the DFA.

δ / Σ	a	b
e_0, q_0, r_0	q_1, r_0 *	q_0, r_1 *
q_1, r_0 *	q_0, r_0 *	q_1, r_1
q_0, r_1 *	q_1, r_1	q_0, r_0 *
q_0, r_0 *	q_1, r_0 *	q_0, r_1 *
q_1, r_1	q_0, r_1 *	q_1, r_0 *

2



Question 5 ..... *3 points*

Consider the alphabet $\Sigma = \{a, b, c\}$. Give a regular expression for each of the following languages.

(a) [1.5 points] The language of strings that begin and end with the same symbol.

$a\Sigma^*a + b\Sigma^*b + c\Sigma^*c + a + b + c$ ✓ 1.5

(b) [1.5 points] The language of strings that contain at least one a, at least one b, and at least one c.

$\Sigma^*a\Sigma^*b\Sigma^*c\Sigma^*$ ✓ 1.5