

Part One Put a circle on the correct answer(8 marks)

1.
 - a. every regular language is countably infinite
 - b. some regular languages are infinite
 - c. regular languages are not decidable by DFAs
 - d. a language is not regular if there is no DFA that accepts it
2. The language ϕ^* contains
 - a. only one word.
 - b. infinite number of empty words
 - c. no word
 - b. all words containing the empty string
3. The DFA transition function maps
 - a. $\Sigma \times Q \rightarrow \Sigma$
 - b. $Q \times Q \rightarrow \Sigma$
 - c. $\Sigma \times \Sigma \rightarrow Q$
 - d. $Q \times \Sigma \rightarrow Q$
4. The number of DFA states required to accept a string containing three distinguished alphabets is
 - a. Three
 - b. Four
 - c. Five
 - d. None of the above
5. All regular languages
 - a. Do not satisfy the pumping lemma.
 - b. Can be described by regular expressions
 - c. Are not closed under complementation
 - d. All of the above
6. The language $L = \{ \text{letter}(\text{digit} + \text{letter})^* \}$ is
 - a. Regular
 - b. Not regular
 - c. May be either
 - d. None of the above

7. The regular expression $\Sigma^*11\Sigma^*$ describes a language

- a. $\{w|w \text{ has at least one } 1\}$
- b. $\{w|w \text{ have two ones}\}$
- c. $\{w|w \text{ contains the substring } 11\}$
- d. None of the above

8. the language $L = \{\epsilon\}$

- a. Recognizing only the empty string
- b. Recognizes the symbol ϵ
- c. Does not contain any string
- d. None of the above

Part II (short questions, 7 marks)

9. Describe what the Kleene star operation $*$ over the following alphabets produces. (two marks)

(i) $\Sigma = \{1\}$

$$\Sigma^* = \{\epsilon, 1, 11, \dots\}$$

(ii) $\Sigma = \emptyset$

$$\Sigma^* = \emptyset = \{\epsilon\} \text{ is empty}$$

10. Find a regular expression which represents the set of strings over $\{a, b\}$ which contains the two substrings aa and bb . (two marks)

$$\Sigma = \{aa, bb\}$$

$$\epsilon$$

$$\emptyset$$

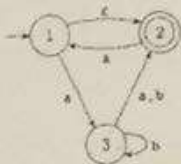
$$(aa \cup bb)$$

$$(aa \circ bb)$$

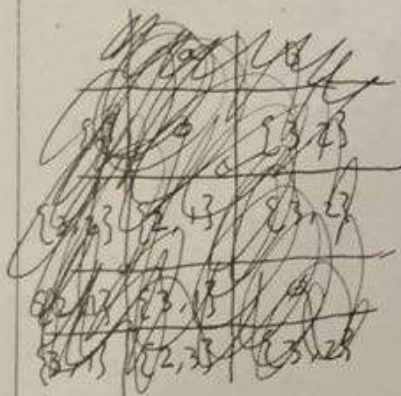
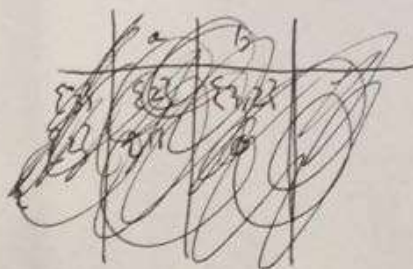
$$(aa^+)$$

Part III (fifteen marks, five marks for each)

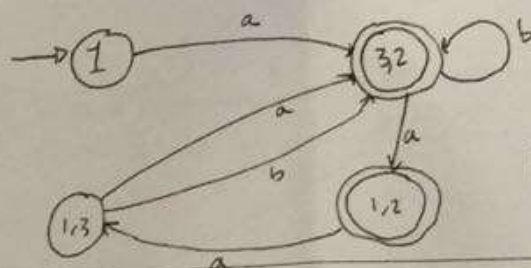
1. Convert the following NFA to a DFA.



	a	b	ε
1	3	∅	{1, 2}
2	<u>1</u>	∅	{2}
3	2	(3, 2)	

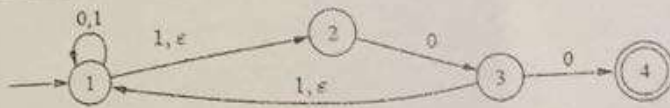


	a	b
{1}	{3, 2}	∅
{3, 2}	{1, 2}	{3, 2}
{1, 2}	{1, 3}	∅
{1, 3}	{3, 2}	{3, 2}



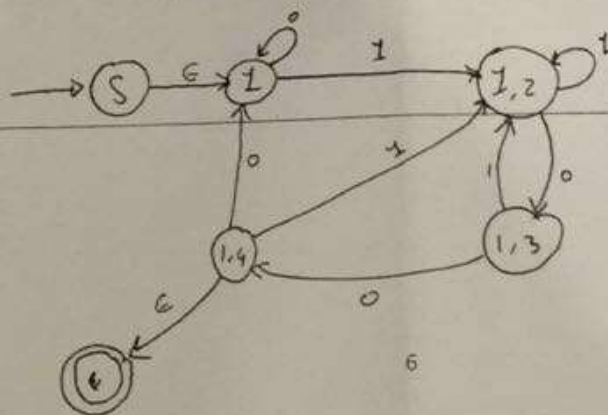
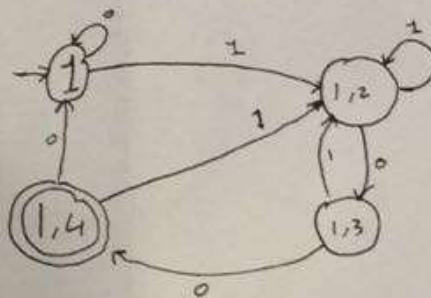
DFA

2. Convert the following finite automata to a Generalized NFA (GNFA)



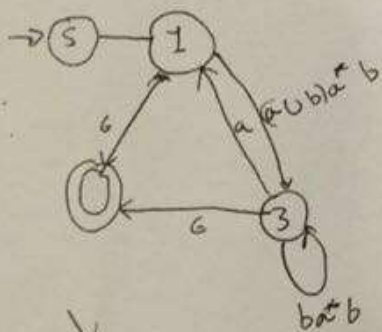
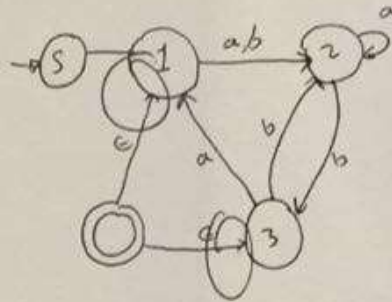
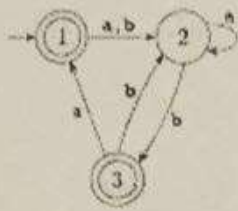
	0	1
1	1	{1,2,3}
2	3	∅
3	4	1
4	∅	∅

1,2	0	1
{1,3}	1	{1,2,3}
{1,2}	{1,3}	{1,2,3}
{1,3,3}	{1,4}	{1,2,3}
{1,4}	1	{1,2,3}

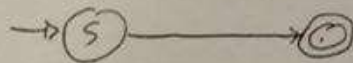
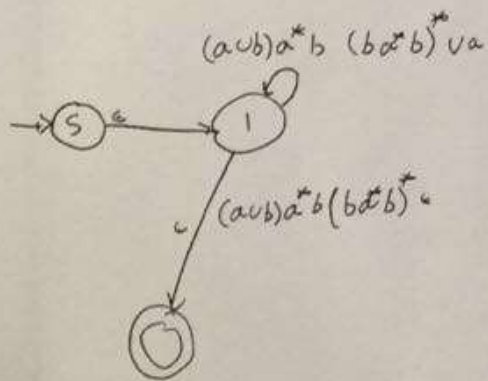


GNFA

3. convert the following automata into regular expression



X



$(\epsilon a \cup b) a^* b (ba^* b)^* \cup a) (a \cup b) a^* b (ba^* b)^*$

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