QUESTION 1

Infinite sets are uncountable

- True
- False

QUESTION 2

If a language is decidable, then its complement is not decidable.

- True
- False

QUESTION 3

If S is an infinite countable set, then the power set 2^S of S is uncountable.

- True
- False

QUESTION 4

Every decidable language is Turing-Acceptable.

- True
- False

QUESTION 5

The membership problem is undecidable.

- True
- False

QUESTION 6

The halting problem is decidable.

- True
- False

QUESTION 7

Finding the square root of a number is decidable.

- True
- False

QUESTION 8

The SAT problem is NP complete.

- True
- False

QUESTION 9

SAT is reduced in polynomial time to Hamilton path problem.

- ○ True
- ○ False

QUESTION 10

$$\varphi = (x_1 \vee x_3 \vee \overline{x_4}) \wedge (\overline{x_1} \vee \overline{x_2} \vee \overline{x_4})$$

Can the above 3CNF-SAT problem be reduced to the k-clique problem in Figure 1?

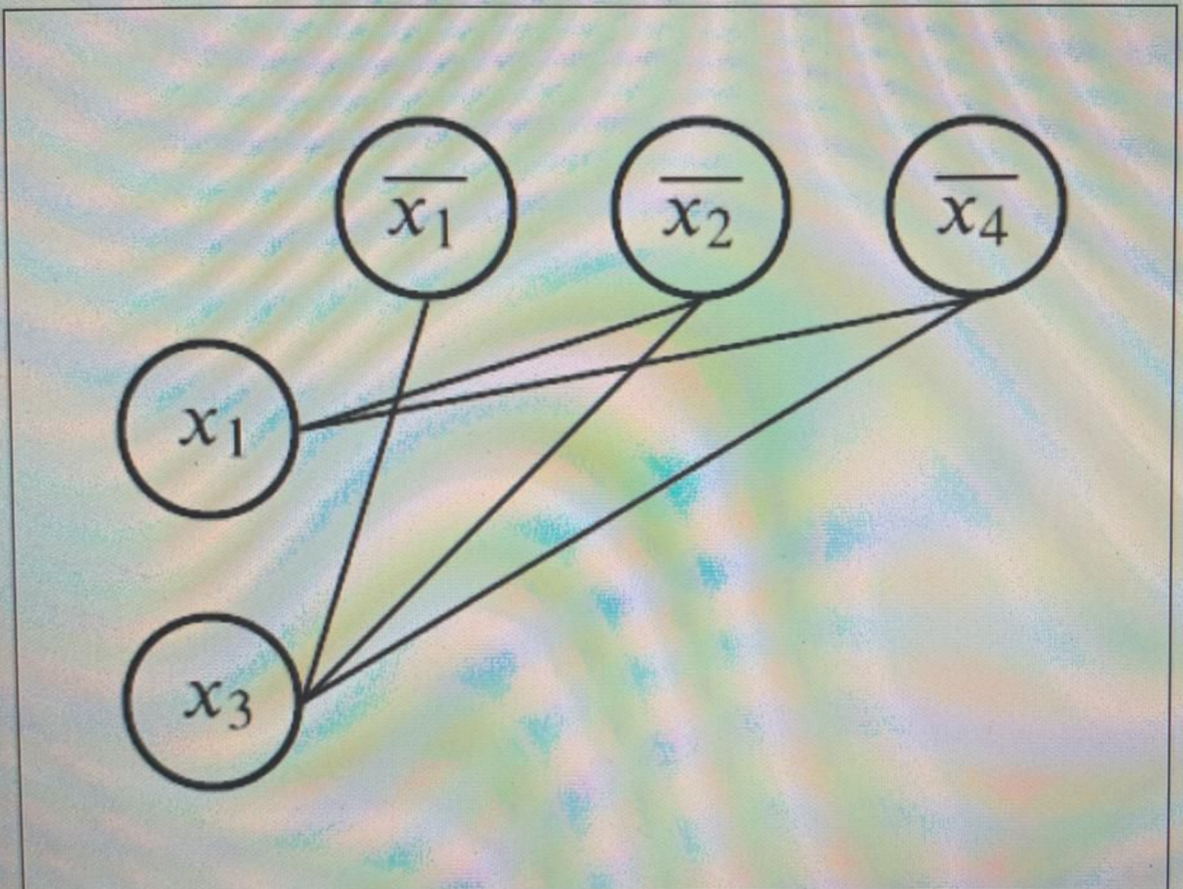

Figure 1: k-clique problem

- ○ Yes
- ○ No

QUESTION 11

$\varphi = (x_1 \vee x_3 \vee \overline{x_4}) \wedge (\overline{x_1} \vee \overline{x_2} \vee \overline{x_4})$

Can the above 3CNF-SAT problem be reduced to the k-clique problem in Figure 2?

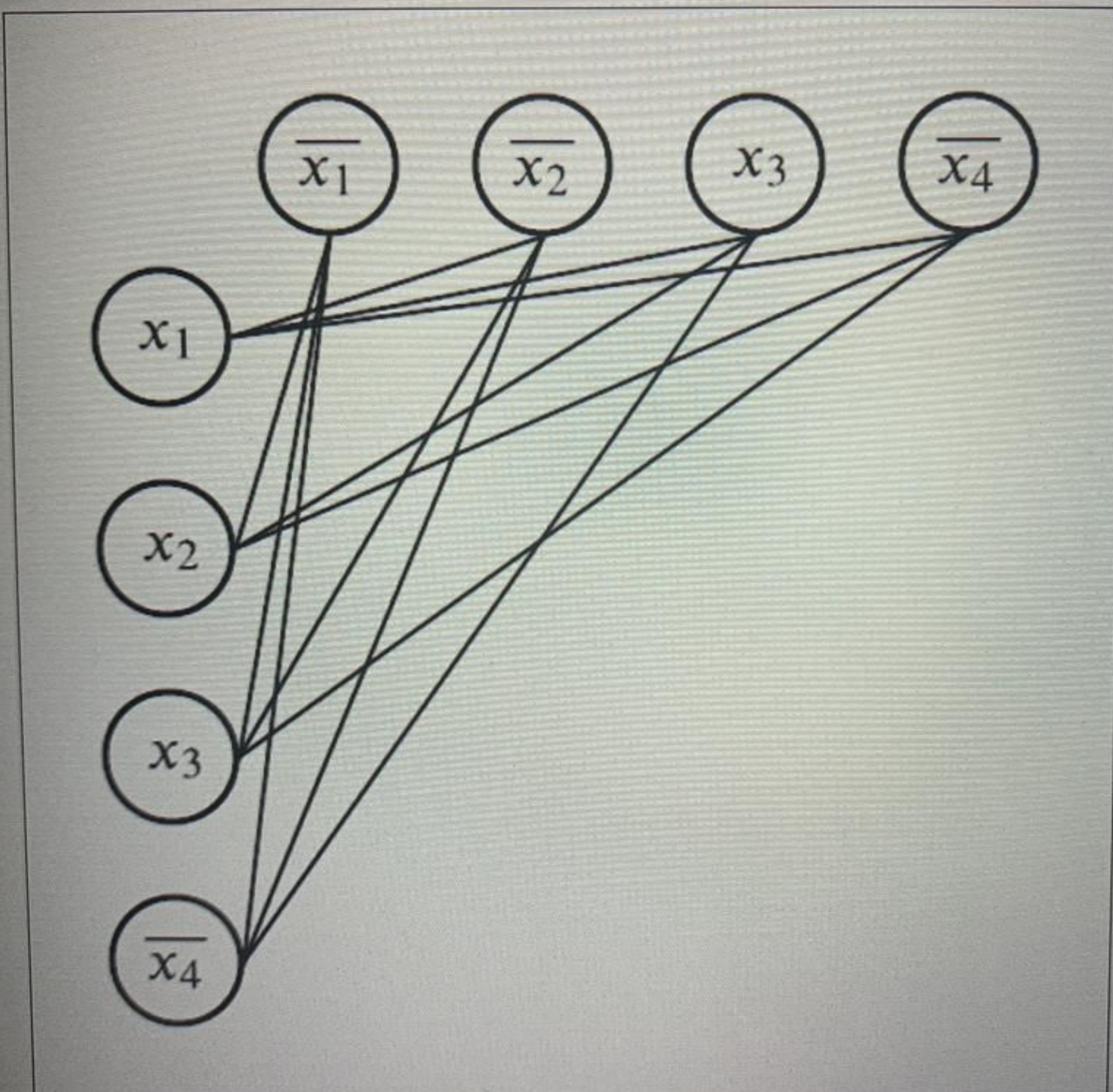

Figure 2: k-clique problem

- Yes
- No

QUESTION 12

$\varphi = (x_1 \vee x_3 \vee \overline{x_4}) \wedge (\overline{x_1} \vee \overline{x_2} \vee \overline{x_4})$

Can the above 3CNF-SAT problem be reduced to the k-clique problem in Figure 3?

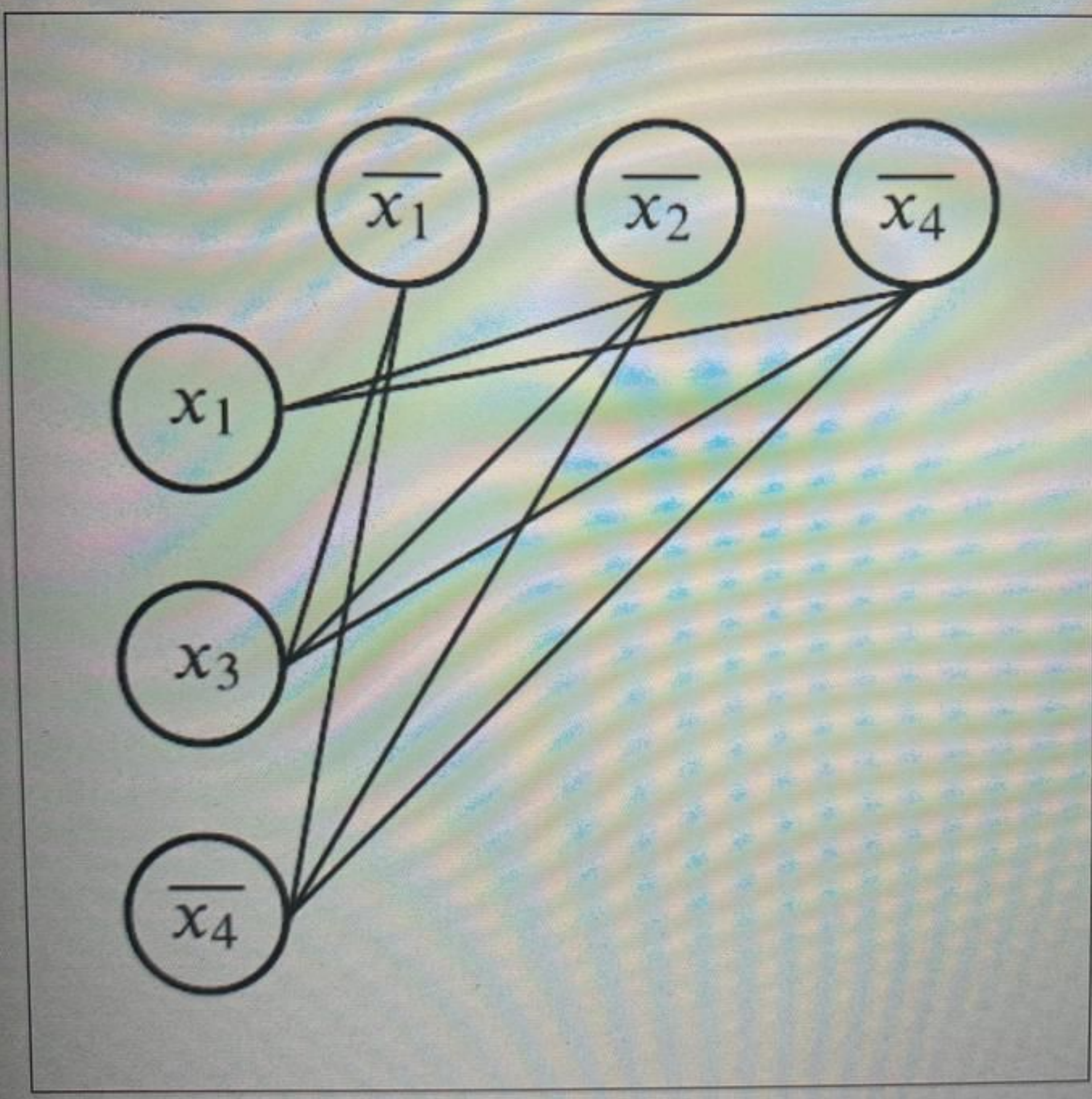

Figure 3: k-clique problem

- ○ Yes
- ○ No

QUESTION 13

Consider the following Turing machine M: $M=\{Q,\Sigma,\Gamma,\#,q0,final,\delta\}$ where $Q=\{q0,q1,q2,q3,q4,q5,q6,final\}$, and $\Sigma=\{a,b,c\}$.

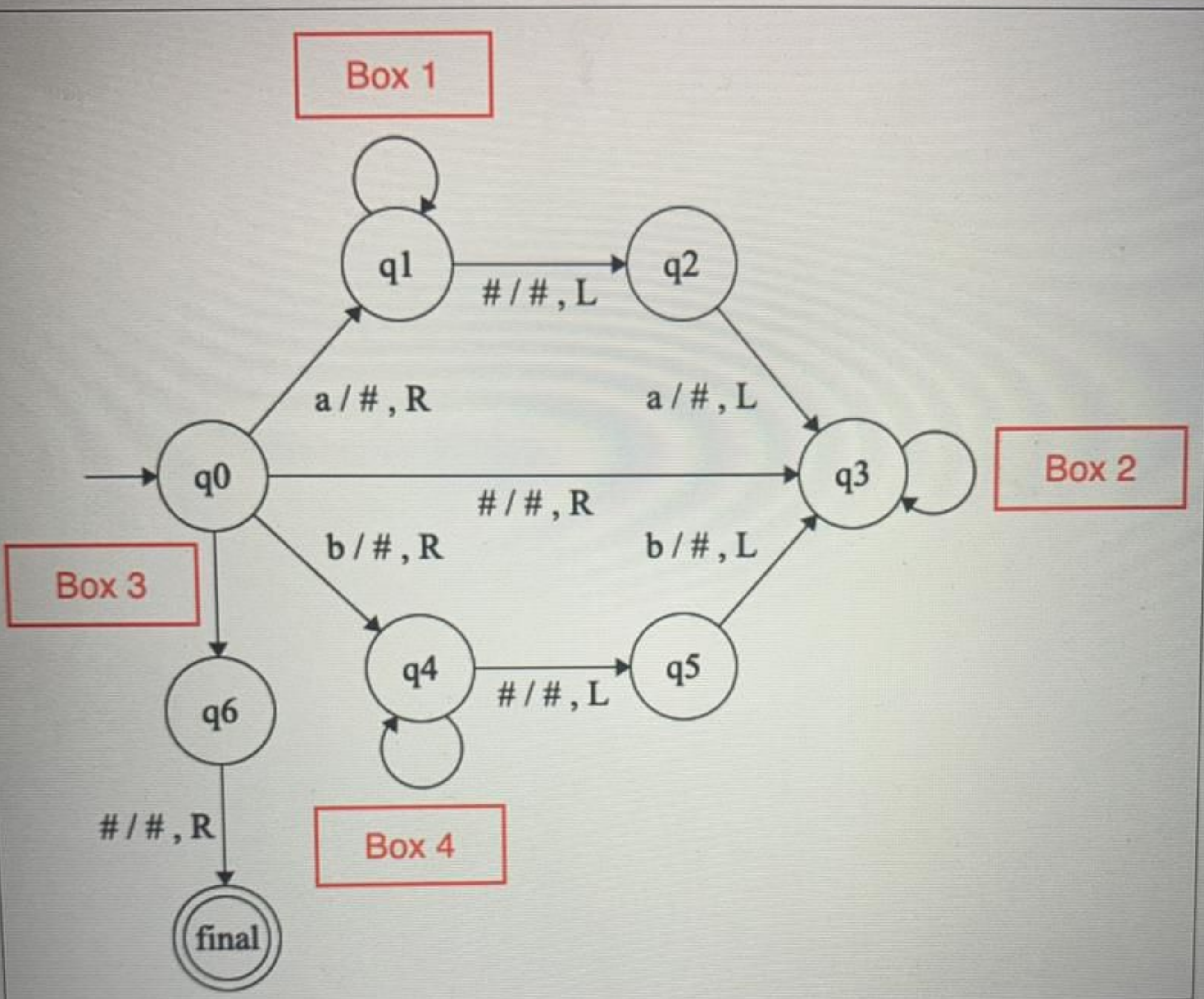

Figure 4: Turing Machine

Complete the construction of the above Turing Machine so that it accepts the language L where: $L=\{ucu^R \mid u\in\{a,b\}^*\}$. Choose the missing transition(s) inside the **Box 1**.

Note: More than one transition could be missing per box.

- a. a / a , L ; b / b , L ; c / c , L
- b. a / a , R ; b / b , R ; c / c , R
- c. a / a , R ; c / c , R
- d. a / a , L ; c / c , L

QUESTION 14

Recall **Question 13** Turing machine M: $M=\{Q,\Sigma,\Gamma,\#,q0,final,\delta\}$ where $Q=\{q0,q1,q2,q3,q4,q5,q6,final\}$, and $\Sigma=\{a,b,c\}$.

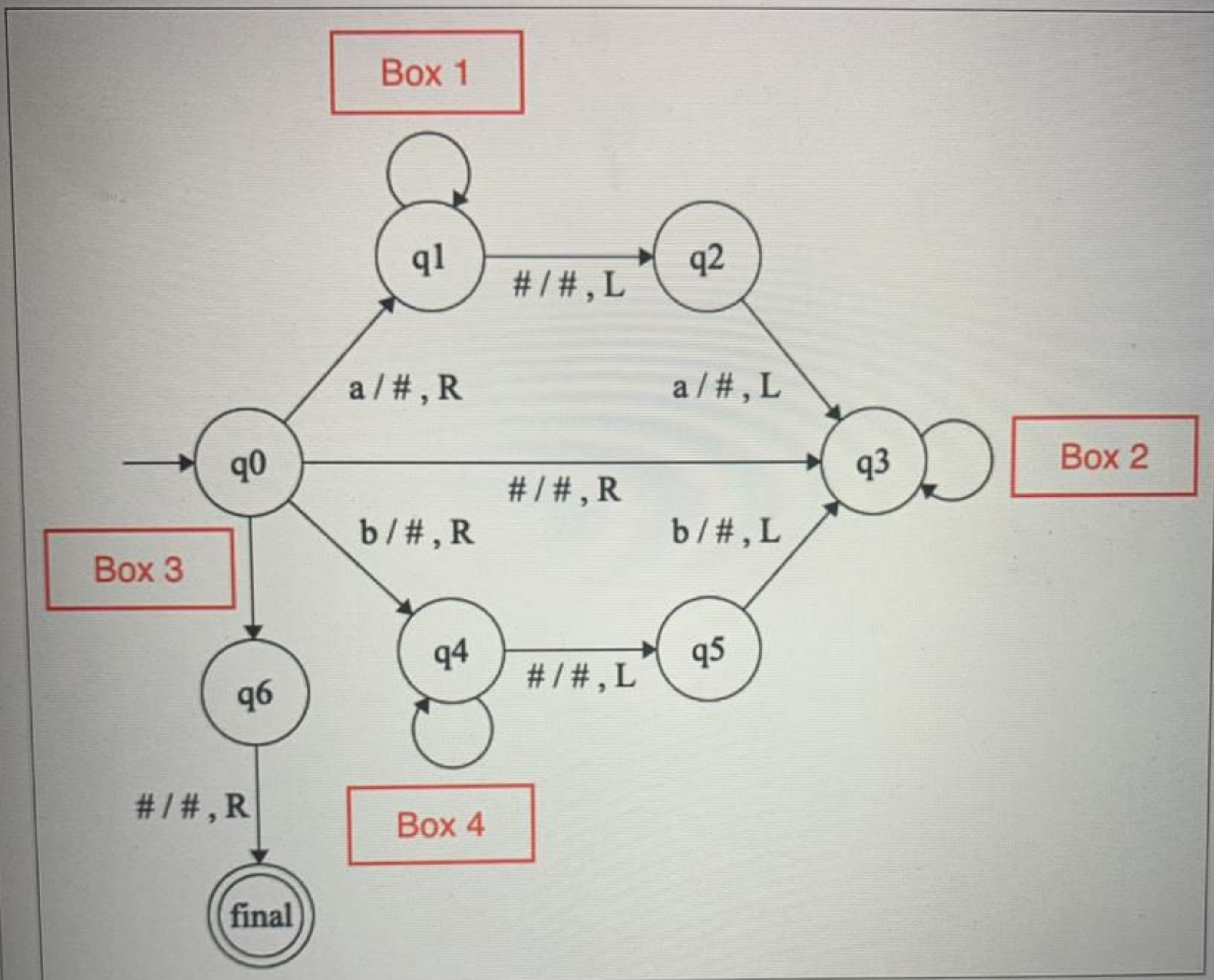

Figure 4: Turing Machine

Complete the construction of the above Turing Machine so that it accepts the language L where: $L=\{ucu^R \mid u\in\{a,b\}^*\}$. Choose the missing transition(s) inside the **Box 2.**

Note: More than one transition could be missing per box.

- a. a / a , L ; b / b , L ; c / c , L
- b. a / a , R ; b / b , R ; c / c , R
- C. a / a , L
- d. b / b , L

QUESTION 15

Recall **Question 13** Turing machine M: $M=\{Q,\Sigma,\Gamma,\#,q0,final,\delta\}$ where $Q=\{q0,q1,q2,q3,q4,q5,q6,final\}$, and $\Sigma=\{a,b,c\}$.

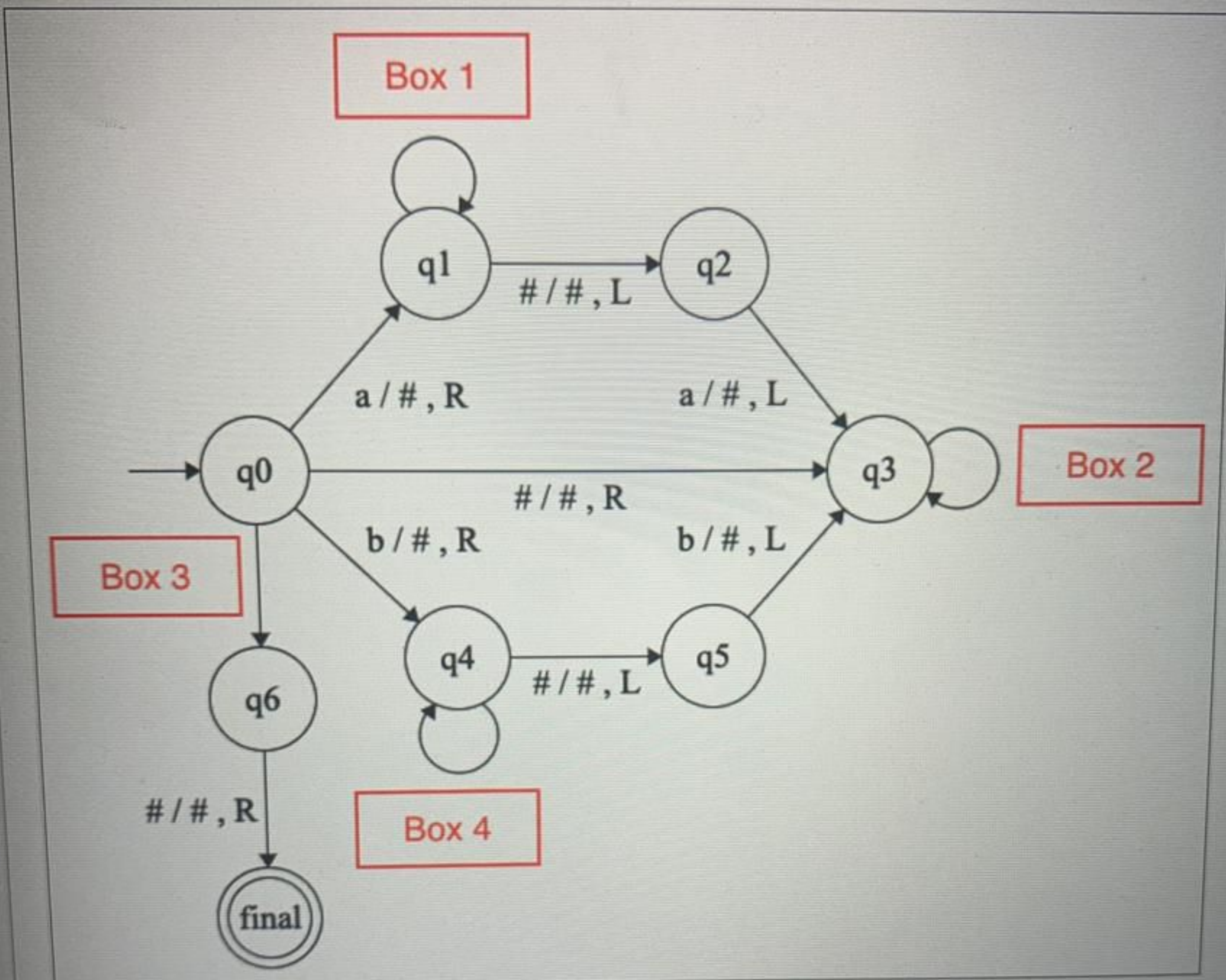

Figure 4: Turing Machine

Complete the construction of the above Turing Machine so that it accepts the language L where: $L=\{ucu^R \mid u\in\{a,b\}^*\}$. Choose the missing transition(s) inside the **Box 3**.

Note: More than one transition could be missing per box.

- a. a / a , R
- b. b / b , R
- c. b / b , L
- d. c / c , R

QUESTION 16

Recall **Question 13** Turing machine M: $M=\{Q,\Sigma,\Gamma,\#,q0,final,\delta\}$ where $Q=\{q0,q1,q2,q3,q4,q5,q6,final\}$, and $\Sigma=\{a,b,c\}$.

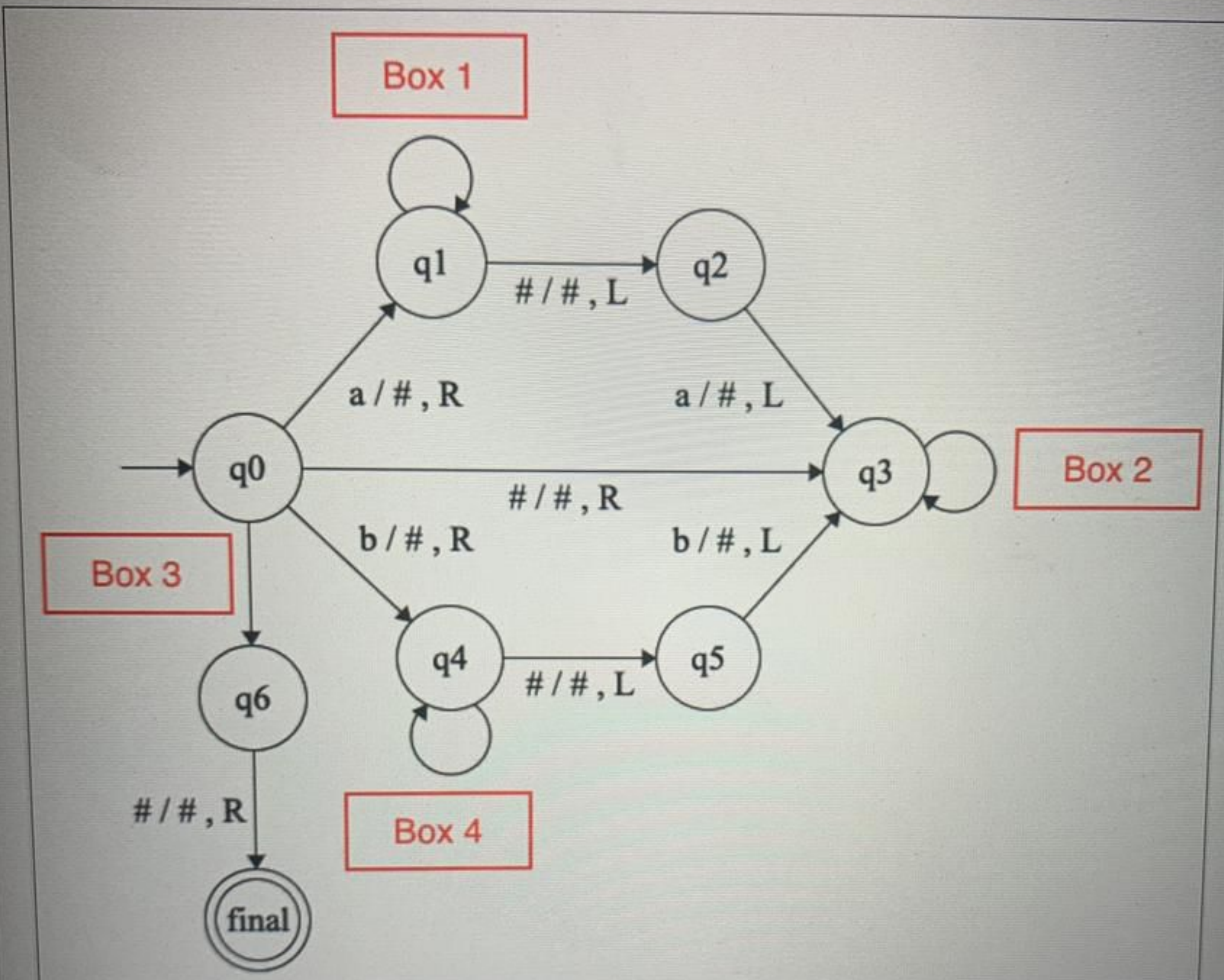

Figure 4: Turing Machine

Complete the construction of the above Turing Machine so that it accepts the language L where: $L=\{ucu^R \mid u\in\{a,b\}^*\}$. Choose the missing transition(s) inside the **Box 4.**

Note: More than one transition could be missing per box.

- a. a / a , R ; b / b , R ; c / c , R
- b. a / a , R ; b / b , R
- c. a / a , R ; c / c , R
- d. b / b , R ; c / c , R

QUESTION 17

Consider the following Turing machine M: $M=\{Q,\Sigma,\Gamma,\#,q0,final,\delta\}$ where $Q=\{q0,q1,q2,q3,q4,final\}$, and $\Sigma=\{a,b\}$.

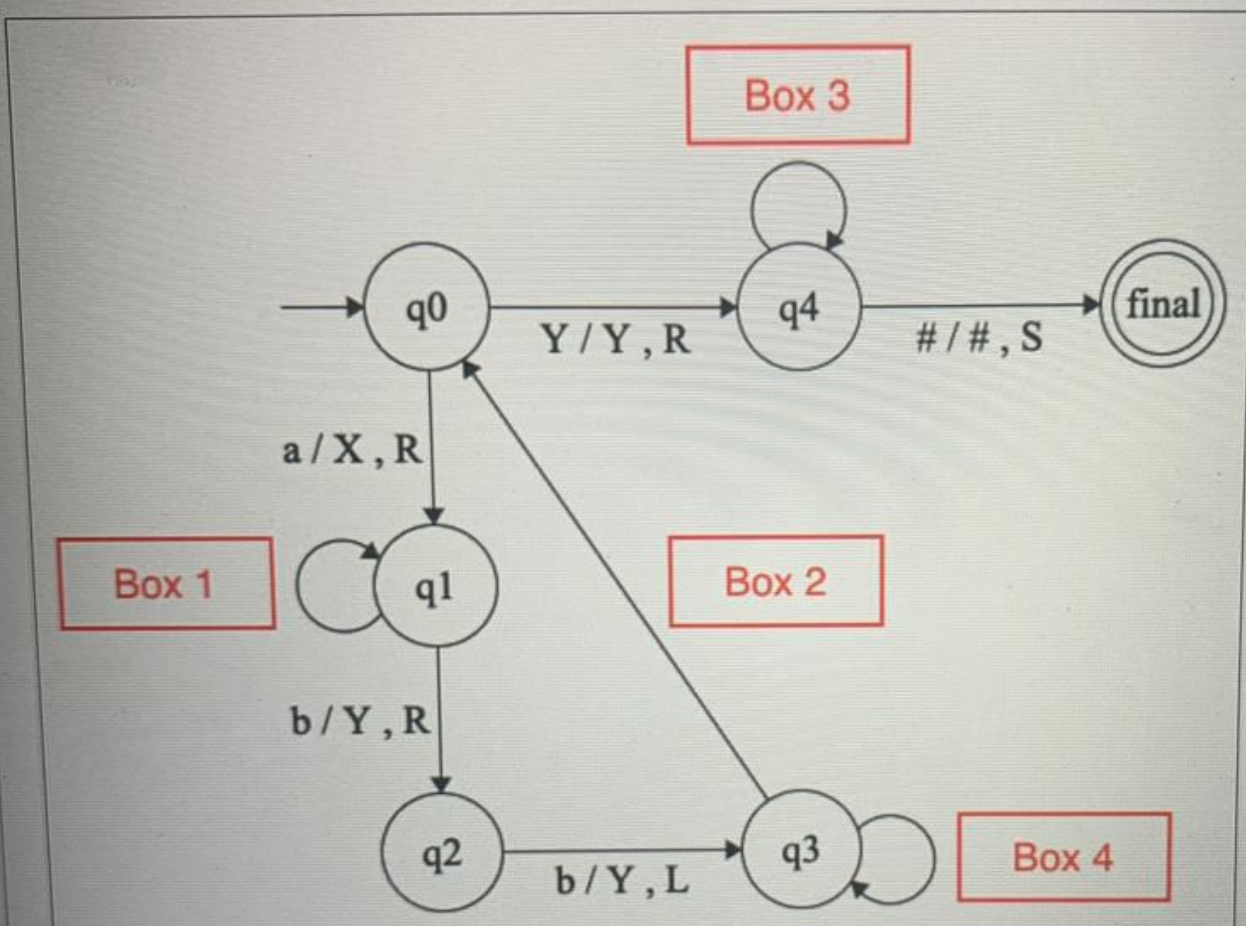

Figure 5: Turing Machine

Complete the construction of the above Turing Machine so that it accepts the language L where: $L=\{a^n b^{2n} \mid n \geq 1\}$

. Choose the missing transition(s) inside the **Box 1**.

Note: More than one transition could be missing per box.

Hint: *a* is replaced by *X* and two *b's* are replaced by one *Y*.

- a. a / a , R ; X / X , R ; Y / Y , R
- b. a / a , R ; X / X , R
- c. a / a , R ; Y / Y , R
- d. a / a , R

QUESTION 18

Recall **Question 17** Turing machine M: $M=\{Q,\Sigma,\Gamma,\#,q0,final,\delta\}$ where $Q=\{q0,q1,q2,q3,q4,final\}$, and $\Sigma=\{a,b\}$.

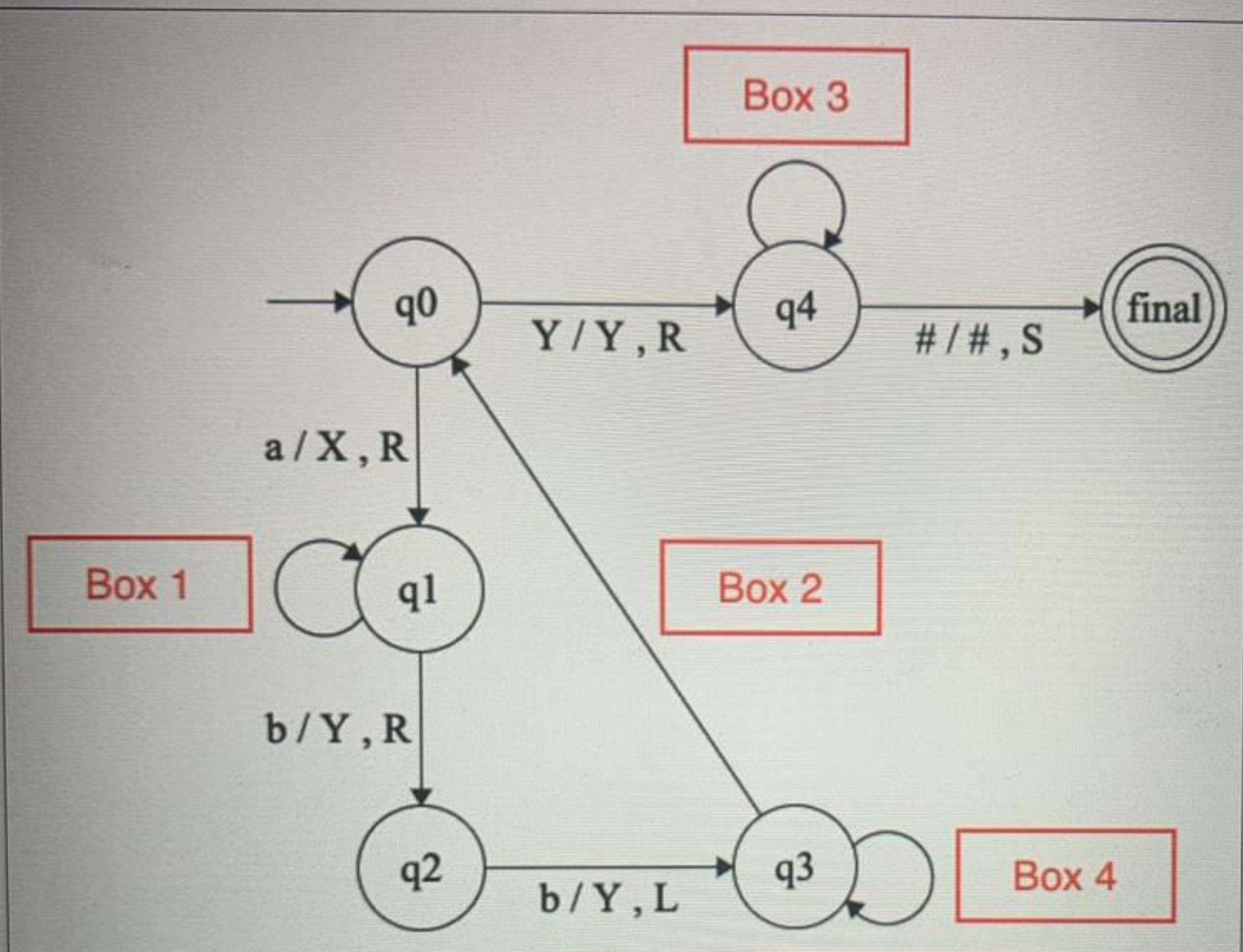

Figure 5: Turing Machine

Complete the construction of the above Turing Machine so that it accepts the language L where: $L=\{a^n b^{2n} \mid n \geq 1\}$

. Choose the missing transition(s) inside the **Box 2**.

Note: More than one transition could be missing per box.

Hint: *a* is replaced by *X* and two *b's* are replaced by one *Y*.

- a. X / X , R
- b. X / X , L
- c. Y / Y , R
- d. Y / Y , L

QUESTION 19

Recall **Question 17** Turing machine M: $M=\{Q,\Sigma,\Gamma,\#,q0,final,\delta\}$ where $Q=\{q0,q1,q2,q3,q4,final\}$, and $\Sigma=\{a,b\}$.

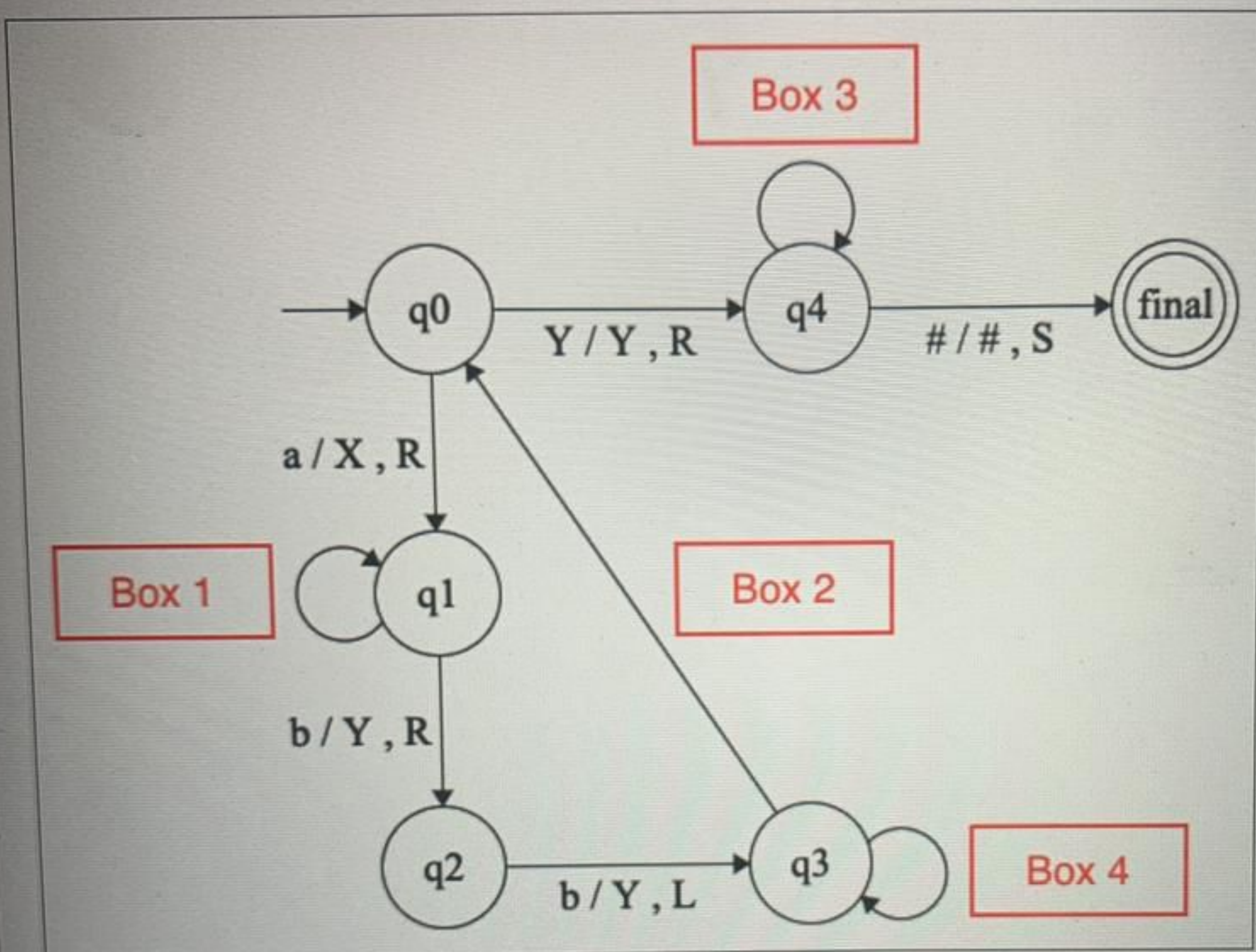

Figure 5: Turing Machine

Complete the construction of the above Turing Machine so that it accepts the language L where: $L=\{a^n b^{2n} \mid n \geq 1\}$

. Choose the missing transition(s) inside the **Box 3**.

Note: More than one transition could be missing per box.

Hint: *a* is replaced by *X* and two *b's* are replaced by one *Y*.

- a. X / X , R
- b. X / X , L
- c. Y / Y , R
- d. Y / Y , L

QUESTION 20

Recall **Question 17** Turing machine M: $M=\{Q,\Sigma,\Gamma,\#,q0,final,\delta\}$ where $Q=\{q0,q1,q2,q3,q4,final\}$, and $\Sigma=\{a,b\}$.

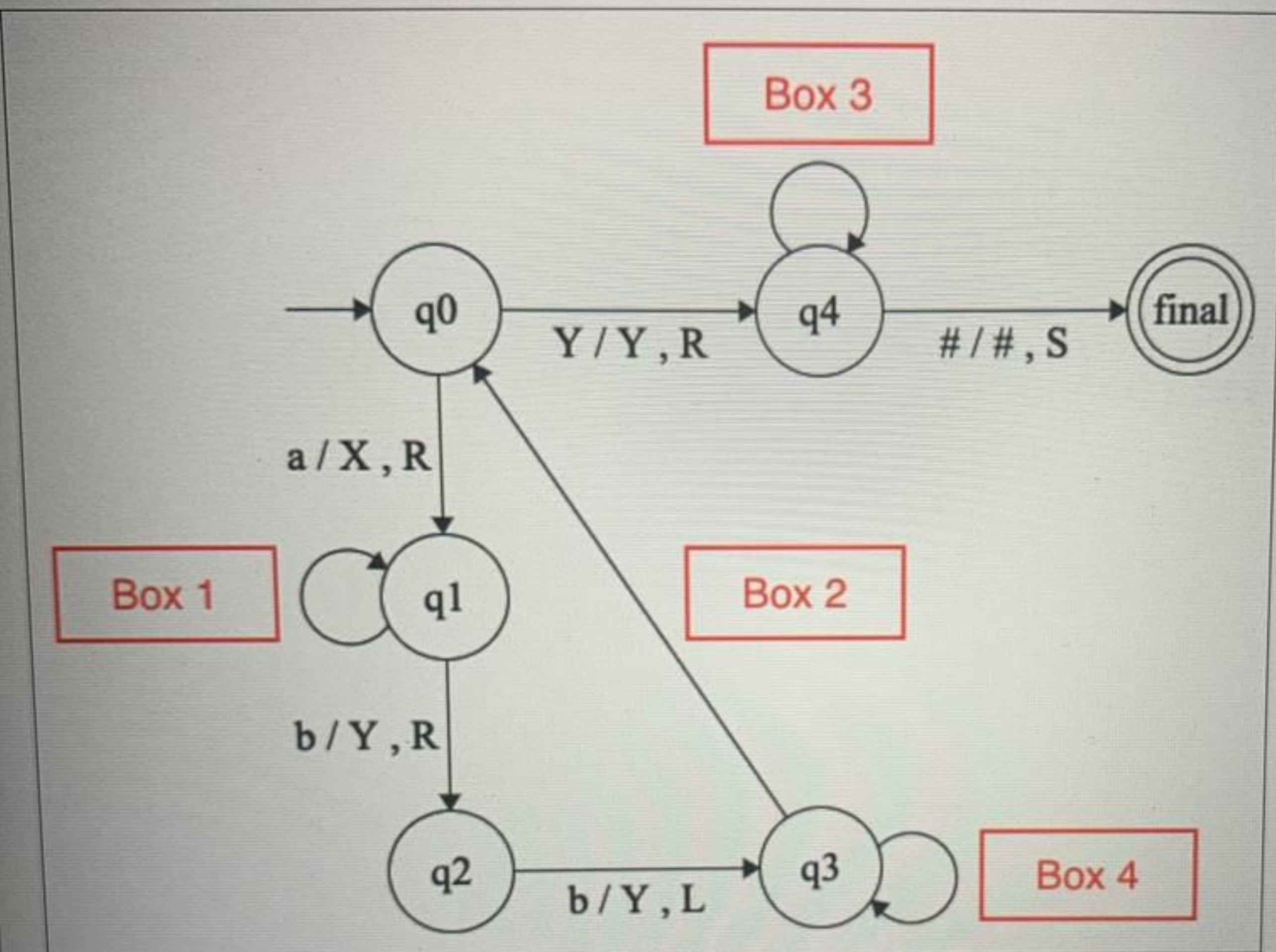

Figure 5: Turing Machine

Complete the construction of the above Turing Machine so that it accepts the language L where: $L=\{a^n b^{2n} \mid n \geq 1\}$

. Choose the missing transition(s) inside the **Box 4.**

Note: More than one transition could be missing per box.

Hint: *a* is replaced by *X* and two *b's* are replaced by one *Y*.

- a. a / a , L ; Y / Y , L
- b. a / a , L ; X / X , L
- c. b / b , L ; Y / Y , L
- d. b / b , L ; X / X , L

QUESTION 21

Consider the following Turing machine M: $M = \{Q, \Sigma, \Gamma, \#, 0, 8, \delta\}$ where $Q = \{0,1,2,3,4,5,6,7,8\}$, and $\Sigma = \{a,b,c\}$.

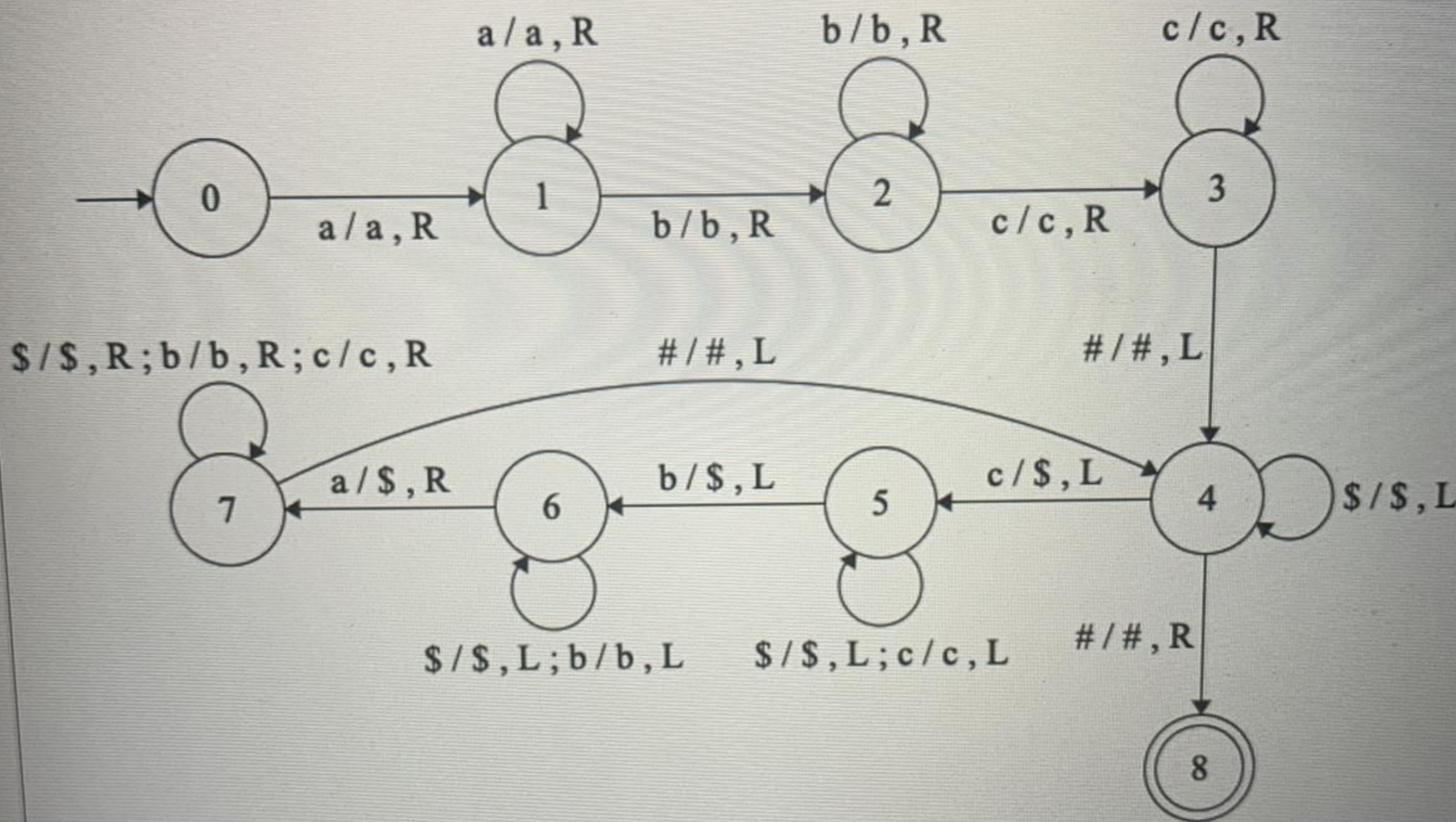

Figure 6: Turing Machine

The string ***abc*** is accepted by the above Turing Machine.

- True
- False

UESTION 22

ecall **Question 21** Turing machine M: $M = \{Q, \Sigma, \Gamma, \#, 0, 8, \delta\}$ where $Q = \{0,1,2,3,4,5,6,7,8\}$, and $\Sigma = \{a,b,c\}$.

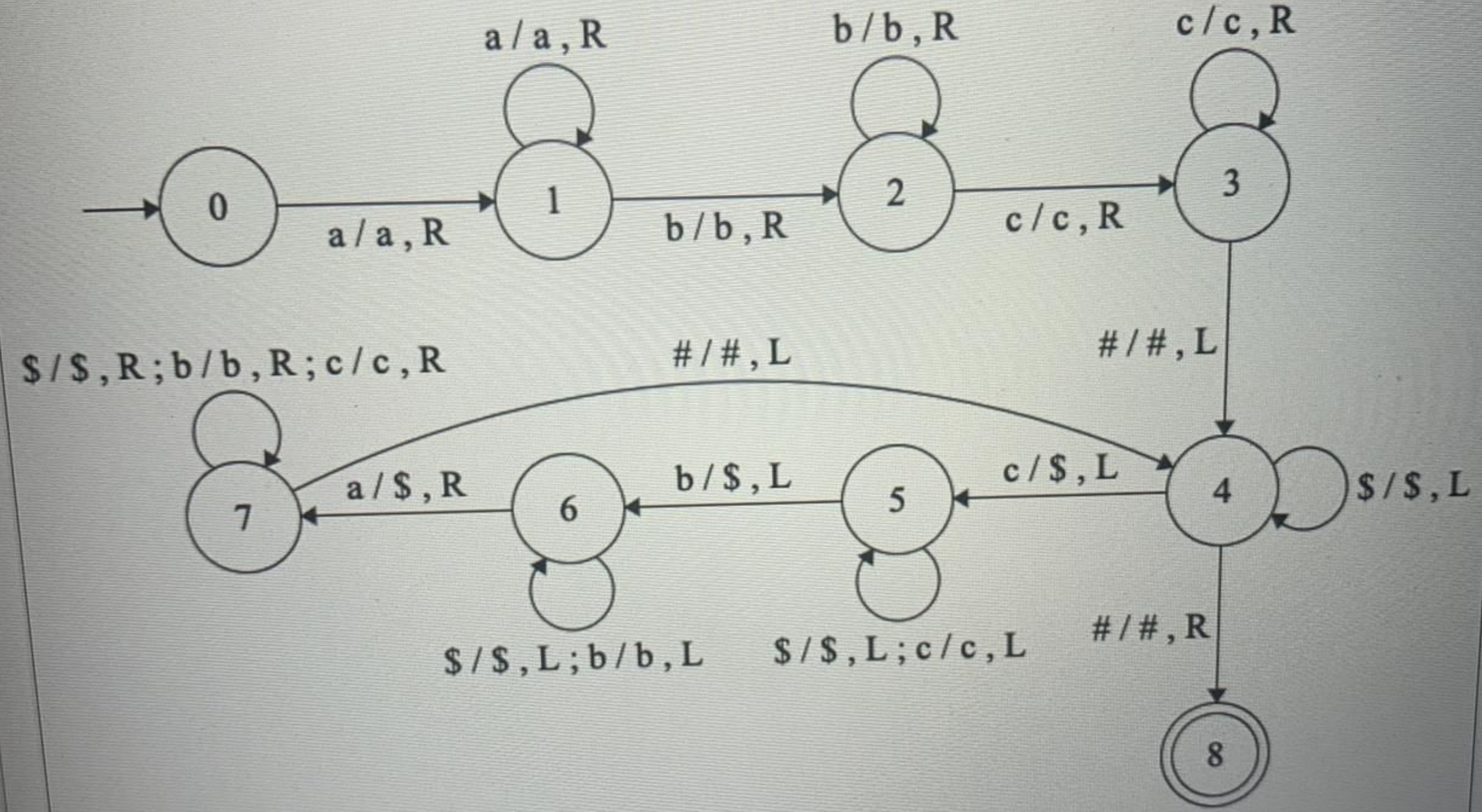

Figure 6: Turing Machine

The string ***aabcc*** is accepted by the above Turing Machine.

- True
- False

QUESTION 23

Recall **Question 21** Turing machine M: $M = \{Q, \Sigma, \Gamma, \#, 0, 8, \delta\}$ where $Q = \{0,1,2,3,4,5,6,7,8\}$, and $\Sigma = \{a,b,c\}$.

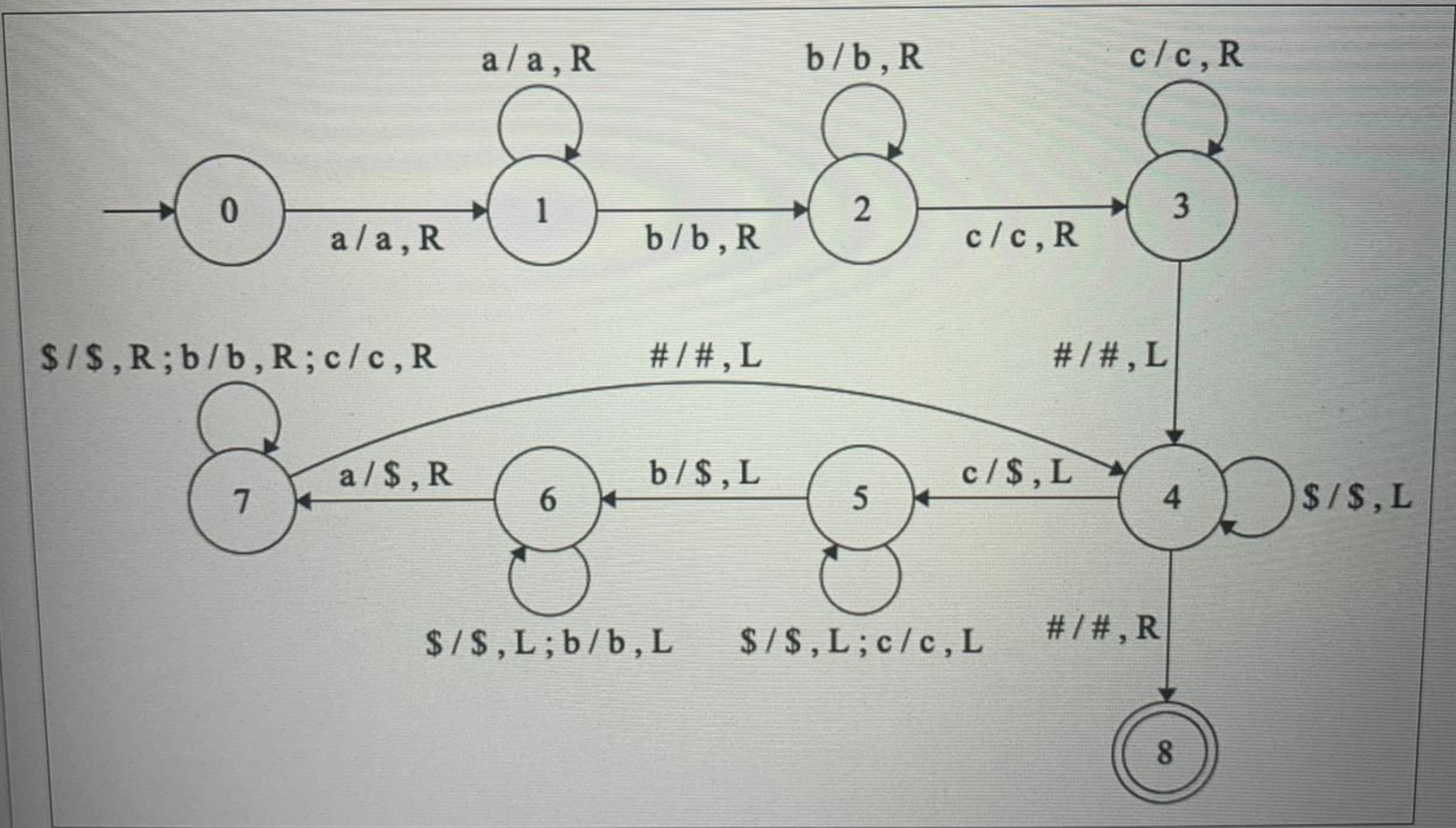

Figure 6: Turing Machine

The string ***aaaabbbbcccc*** is accepted by the above Turing Machine.

- True
- False

QUESTION 24

Recall **Question 21** Turing machine M: $M = \{Q, \Sigma, \Gamma, \#, 0, 8, \delta\}$ where $Q = \{0,1,2,3,4,5,6,7,8\}$, and $\Sigma = \{a, b, c\}$.

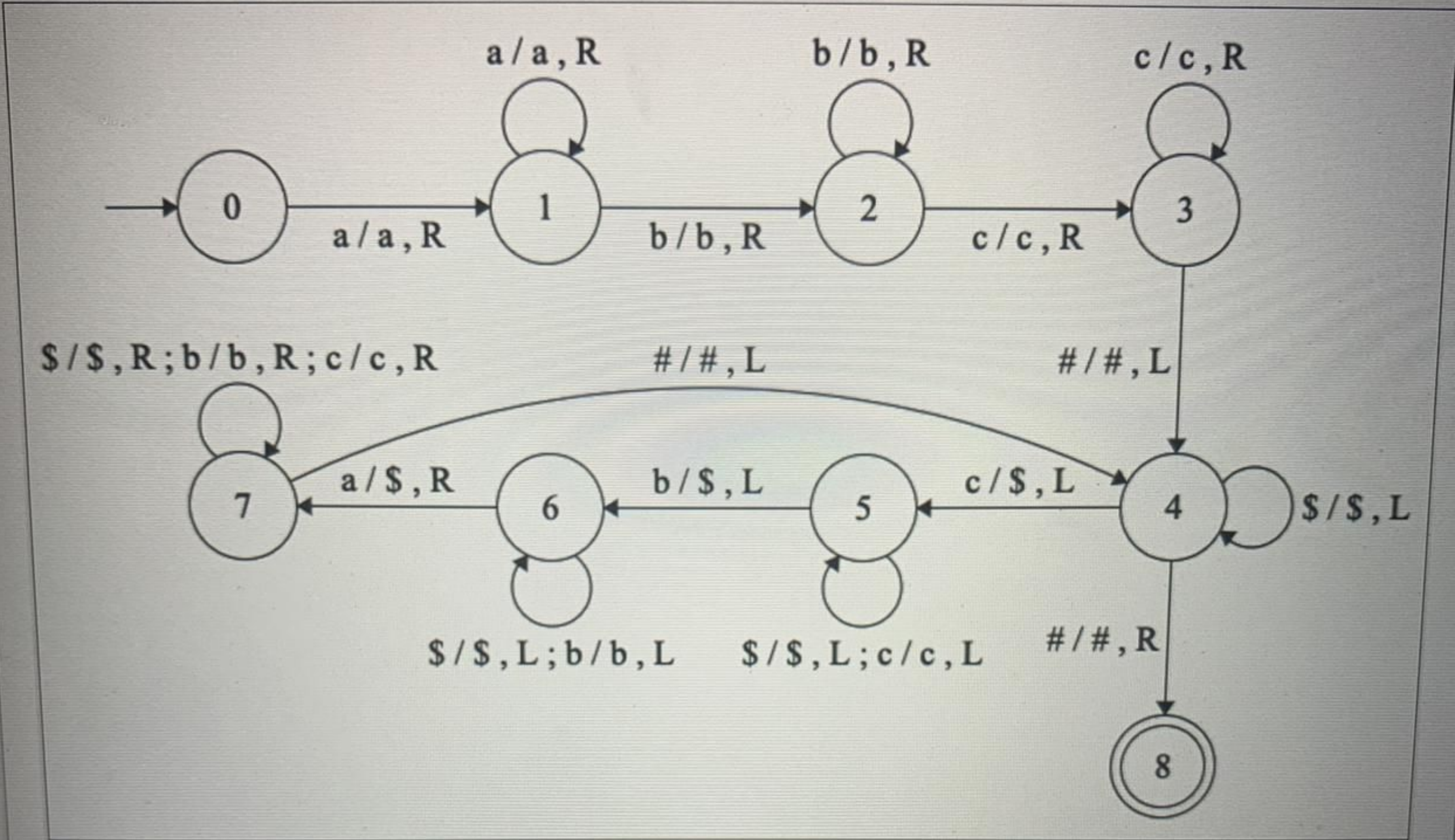

Figure 6: Turing Machine

The string ***aaabbbc*** is accepted by the above Turing Machine.

- True
- False

QUESTION 25

Recall **Question 21** Turing machine M: $M = \{Q,\Sigma,\Gamma,\#,0,8,\delta\}$ where $Q = \{0,1,2,3,4,5,6,7,8\}$, and $\Sigma = \{a,b,c\}$.

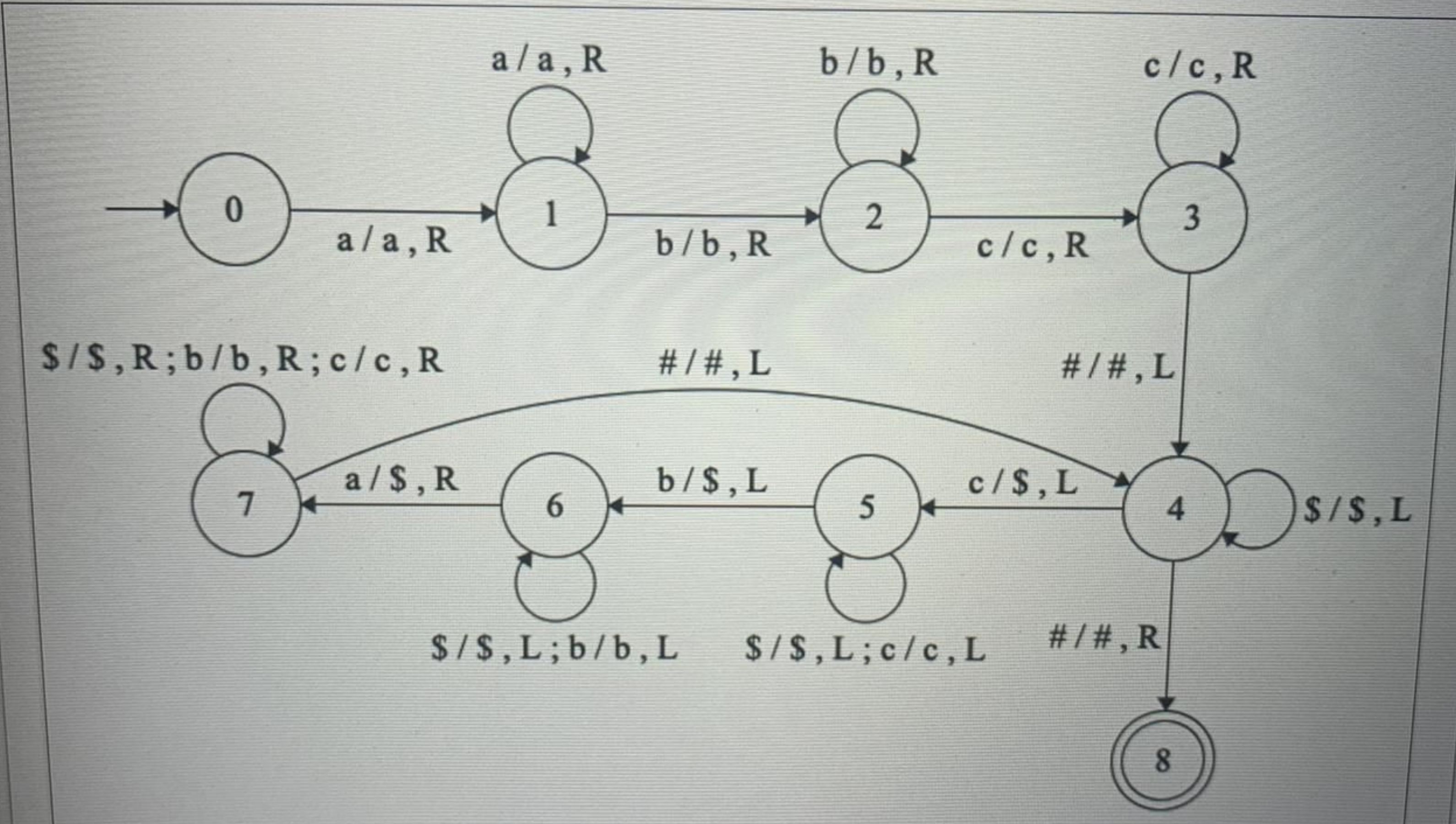

Figure 6: Turing Machine

The string ***aaabbbc*** is accepted by the above Turing Machine.

- True
- False

QUESTION 26

Recall **Question 21** Turing machine M: $M = \{Q, \Sigma, \Gamma, \#, 0, 8, \delta\}$ where $Q = \{0,1,2,3,4,5,6,7,8\}$, and $\Sigma = \{a,b,c\}$.

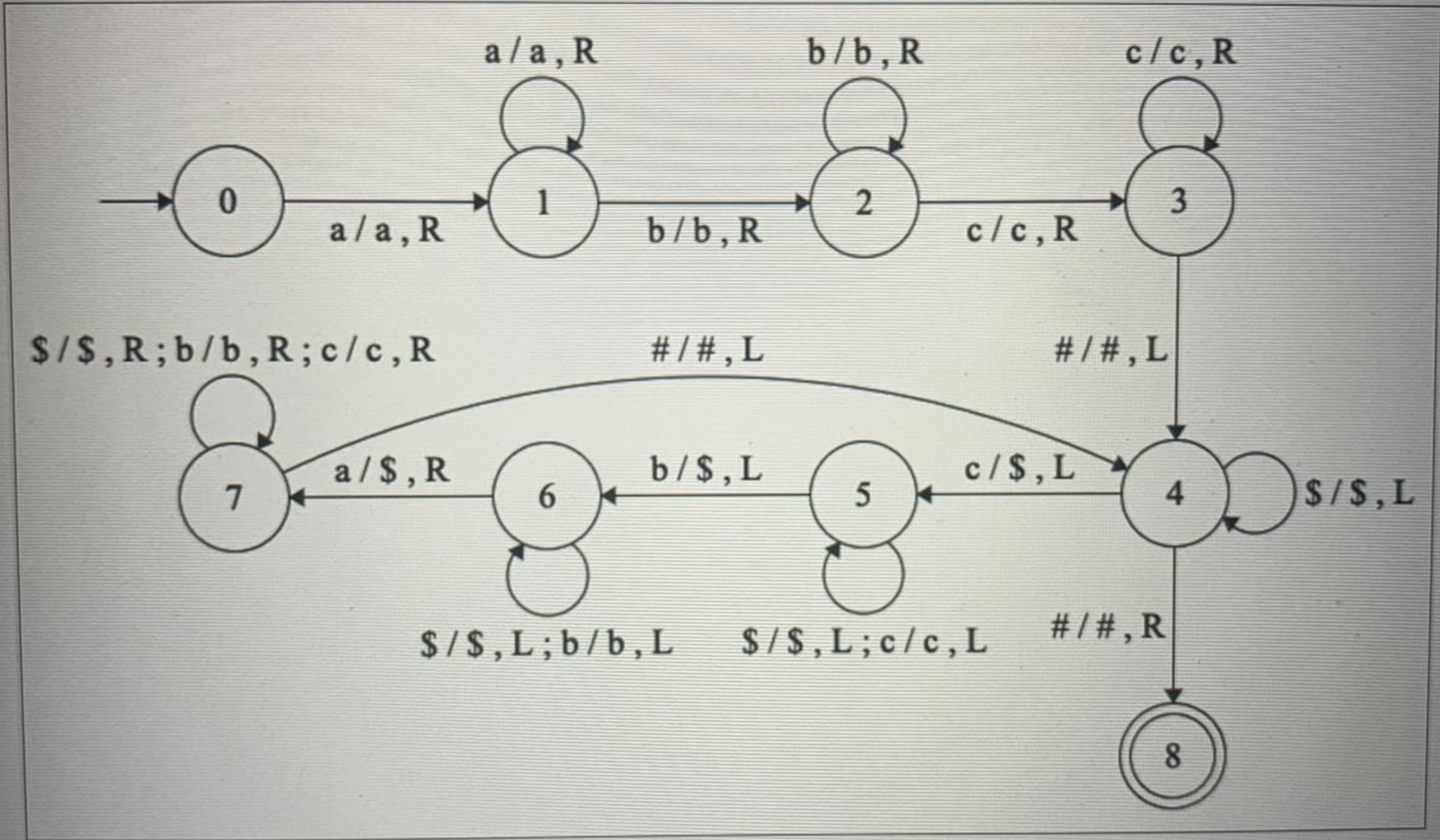

Figure 6: Turing Machine

The string ***aaabbb*** is accepted by the above Turing Machine.

- ○ True
- ○ False

QUESTION 27

Recall **Question 21** Turing machine M: $M = \{Q, \Sigma, \Gamma, \#, 0, 8, \delta\}$ where $Q = \{0,1,2,3,4,5,6,7,8\}$, and $\Sigma = \{a,b,c\}$.

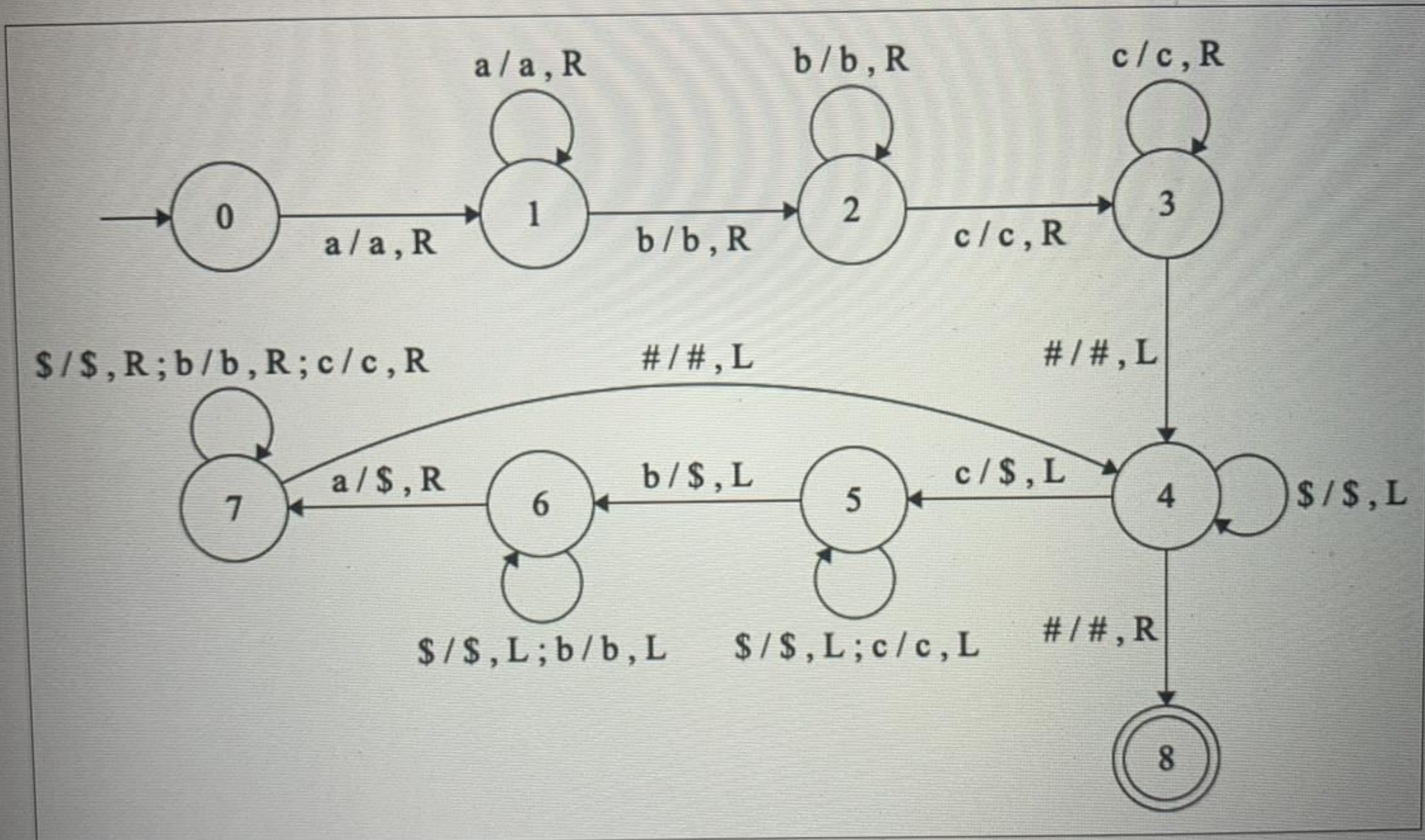

Figure 6: Turing Machine

Which language is accepted by the above Turing Machine?

- a. $L = \{a^n b^n c^n \mid n \geq 1\}$
- b. $L = \{a^n b c^n \mid n \geq 1\}$
- c. $L = \{a^n b^n c^m \mid n \geq 1, m \geq 0\}$
- d. $L = \{a^n b^m c^k \mid n \geq 1, m \geq 1, k \geq 1\}$

QUESTION 28

Consider the following Turing machine M: $M = \{Q, \Sigma, \Gamma, \#, 0, 9, \delta\}$ where $Q = \{0,1,2,3,4,5,6,7,8,9\}$, and $\Sigma = \{a, b, c\}$. It is a function which takes a string as input and gives a string as output.

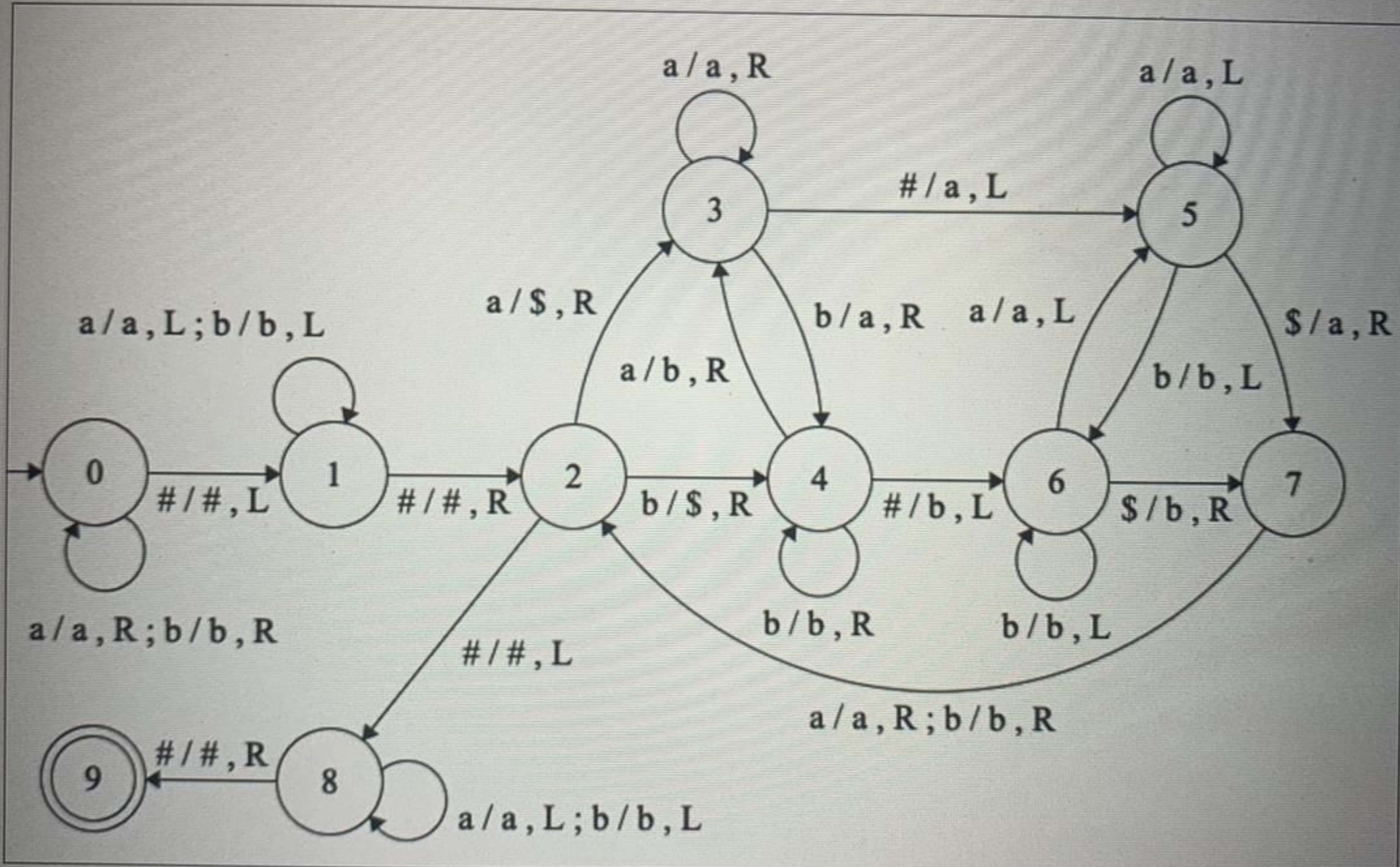

Figure 7: Turing Machine

What is the output of the input string ***abc***?

- a. *abc*
- b. *aabbcc*
- c. aacc
- d. None

QUESTION 29

Recall **Question 28** Turing machine M: $M=\{Q,\Sigma,\Gamma,\#,0,9,\delta\}$ where $Q=\{0,1,2,3,4,5,6,7,8,9\}$, and $\Sigma=\{a,b,c\}$. It is a function which takes a string as input and gives a string as output.

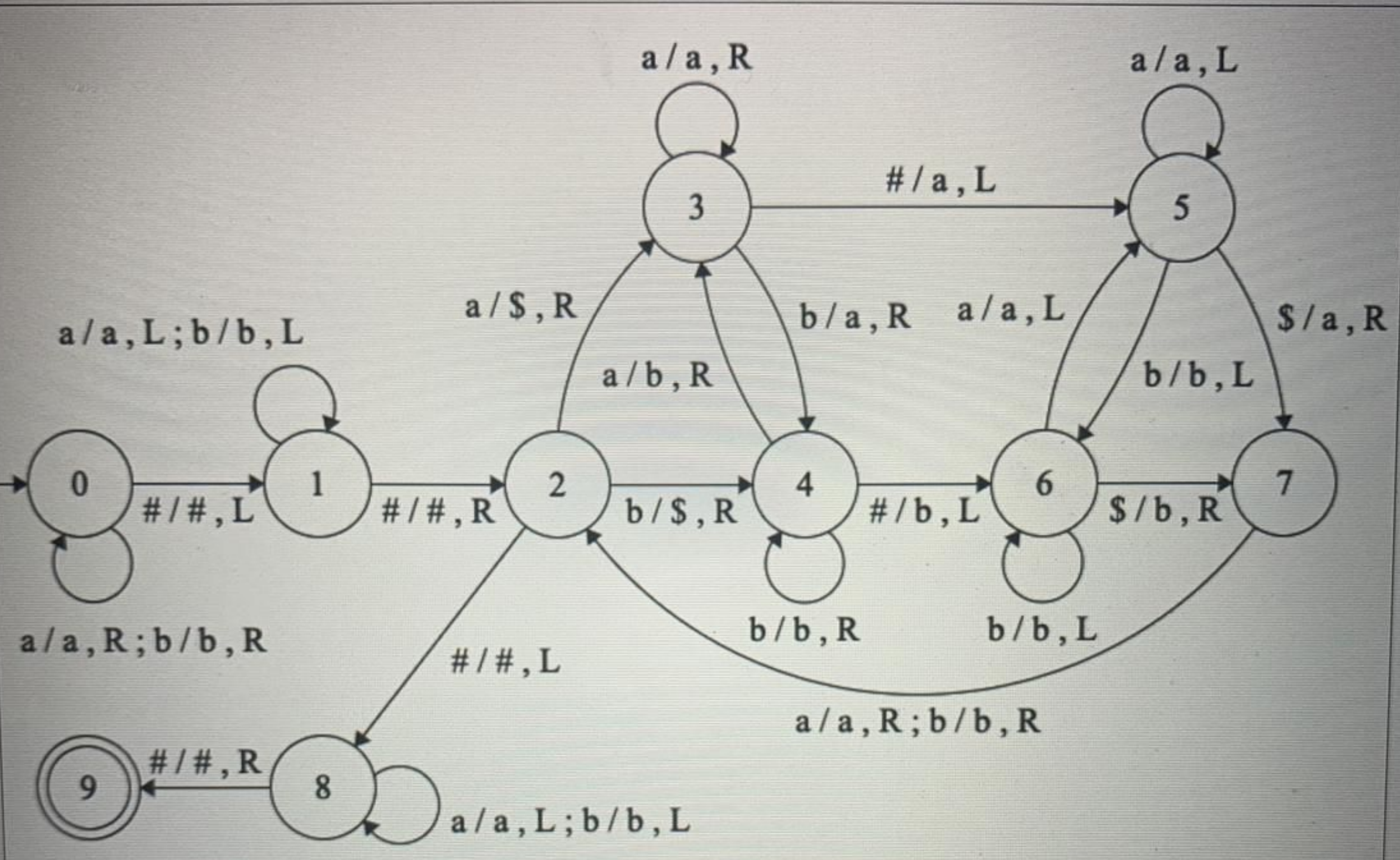

Figure 7: Turing Machine

What is the output of the input string ***aabccc***?

- a. *aaaabbcccccc*
- b. *aabccc*
- c. *aaaacccccc*
- d. None

QUESTION 30

Recall **Question 28** Turing machine M: $M=\{Q,\Sigma,\Gamma,\#,0,9,\delta\}$ where $Q=\{0,1,2,3,4,5,6,7,8,9\}$, and $\Sigma=\{a,b,c\}$. It is a function which takes a string as input and gives a string as output.

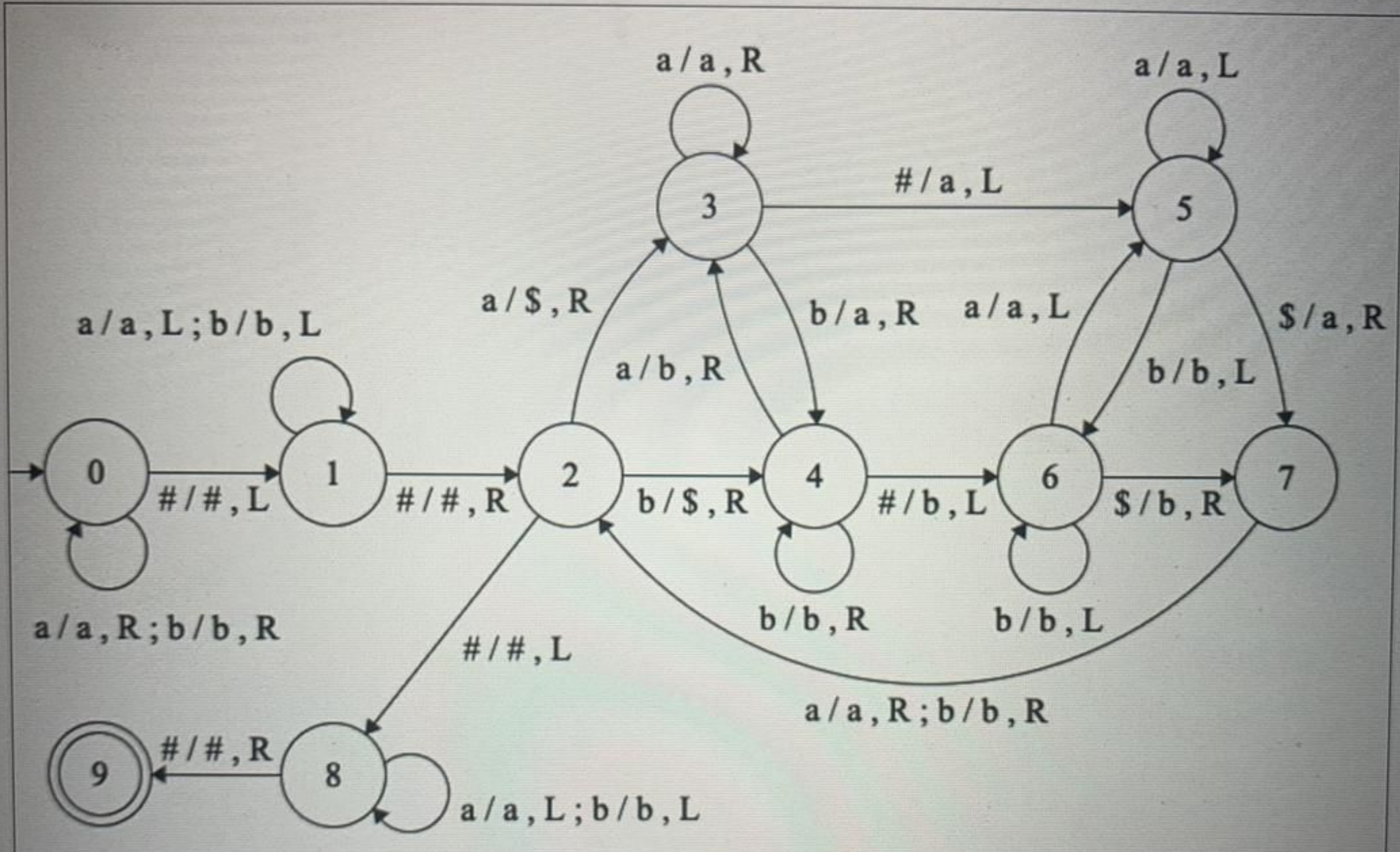

Figure 7: Turing Machine

What is the output of $a^n b^q c^r$?

- a. $a^n b^q c^r$
- b. $a^{2n} c^{2r}$
- c. $a^{2n} b^{2q} c^{2r}$
- d. None

QUESTION 31

Which of the following statements is incorrect?

- a. P is the class of all languages that are decidable by deterministic Turing machines in polynomial time.
- b. NP is the class of languages that cannot be decided in polynomial time using a deterministic Turing machine.
- c. P is included in NP.
- d. All of the above.

QUESTION 32

Consider the following Turing machine M that replaces all ***0s*** of a binary string with ***1s*** : $M=\{Q,\Sigma,\Gamma,\#,q0,q2,\delta\}$ where $Q=\{q0,q1,q2\}$, and $\Sigma=\{0,1\}$.

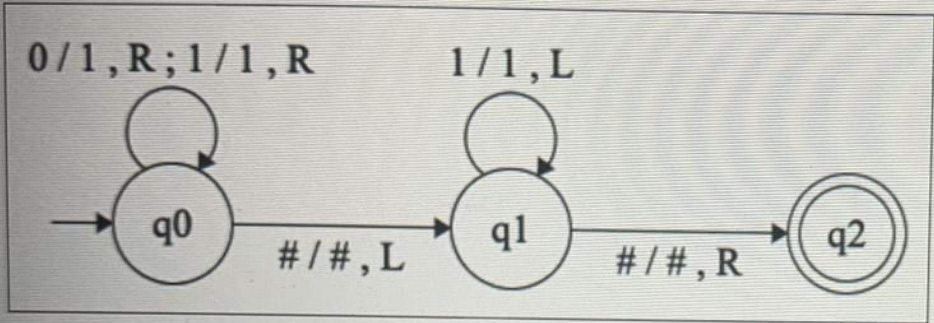

Figure 8: Turing Machine

What is the time complexity?

- ○ $O(n)$
- ○ $O(n^2)$
- ○ $O(2^n)$
- ○ $O(n!)$

QUESTION 33

Recall **Question 32** Turing machine M that replaces all ***0s*** of a binary string with ***1s***: $M=\{Q,\Sigma,\Gamma,\#,q0,q2,\delta\}$ where $Q=\{q0,q1,q2\}$, and $\Sigma=\{0,1\}$.

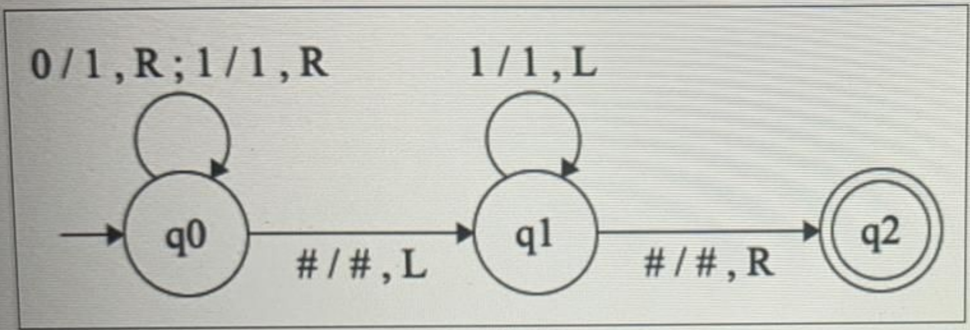

Figure 8: Turing Machine

What is the space complexity?

- ○ O(1)
- ○ $O(n)$
- ○ $O(n^2)$
- ○ $O(2^n)$

QUESTION 34

Consider the following Turing machine M: $M = \{Q, \Sigma, \Gamma, \#, q0, q6, \delta\}$ where $Q = \{q0, q1, q2, q3, q4, q5, q6, q6\}$, and $\Sigma = \{0\}$.

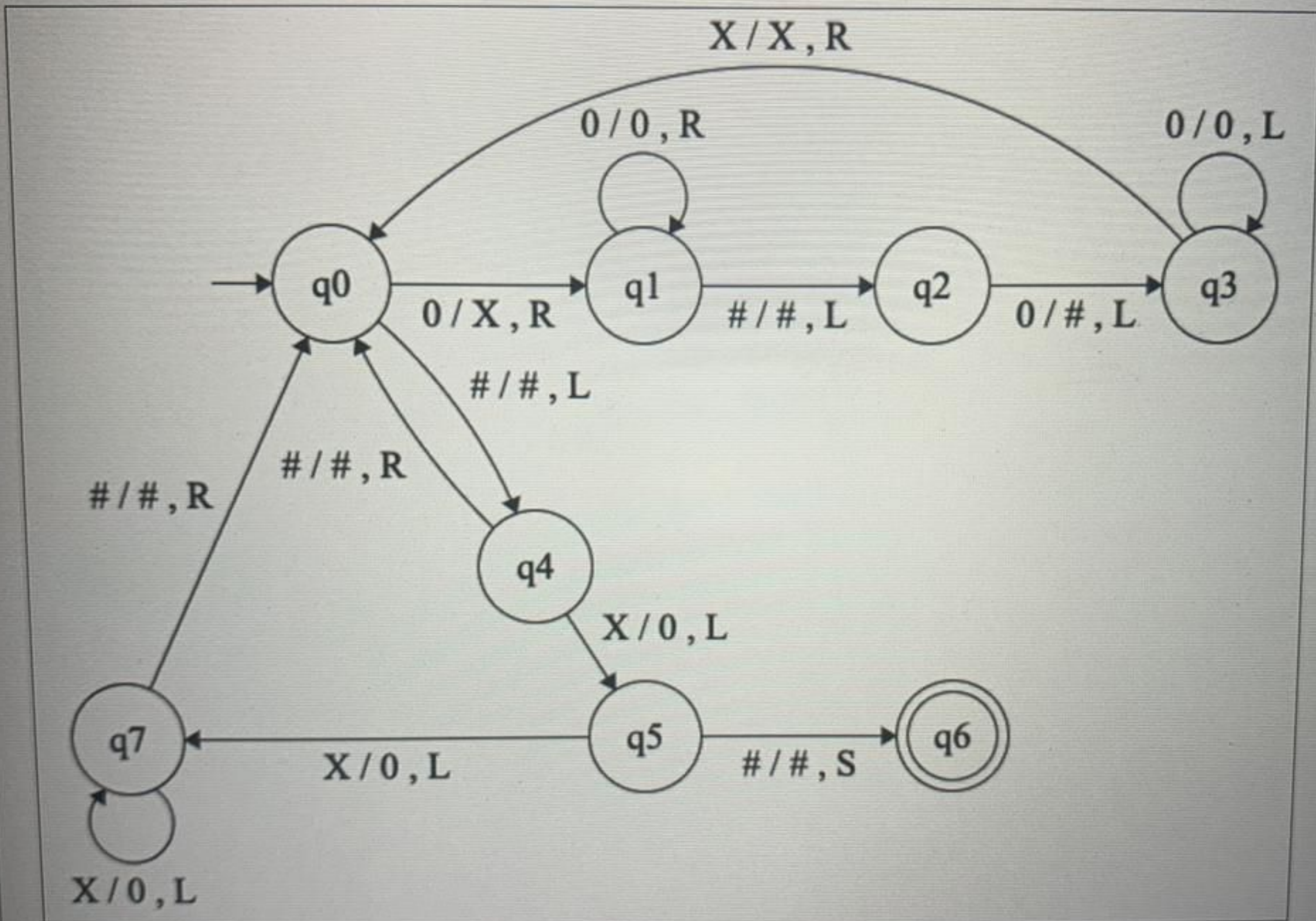

Figure 9: Turing Machine

The above Turing Machine accepts the language $L = \{0^n \mid n = 2^p\}$. What is the time complexity?

- ○ $O(n)$
- ○ $O(n^2)$
- ○ $O(2^n)$
- ○ $O(n!)$

QUESTION 35

Recall **Question 34** Turing machine M: $M = \{Q, \Sigma, \Gamma, \#, q0, q6, \delta\}$ where $Q = \{q0, q1, q2, q3, q4, q5, q6, q6\}$, and $\Sigma = \{0\}$.

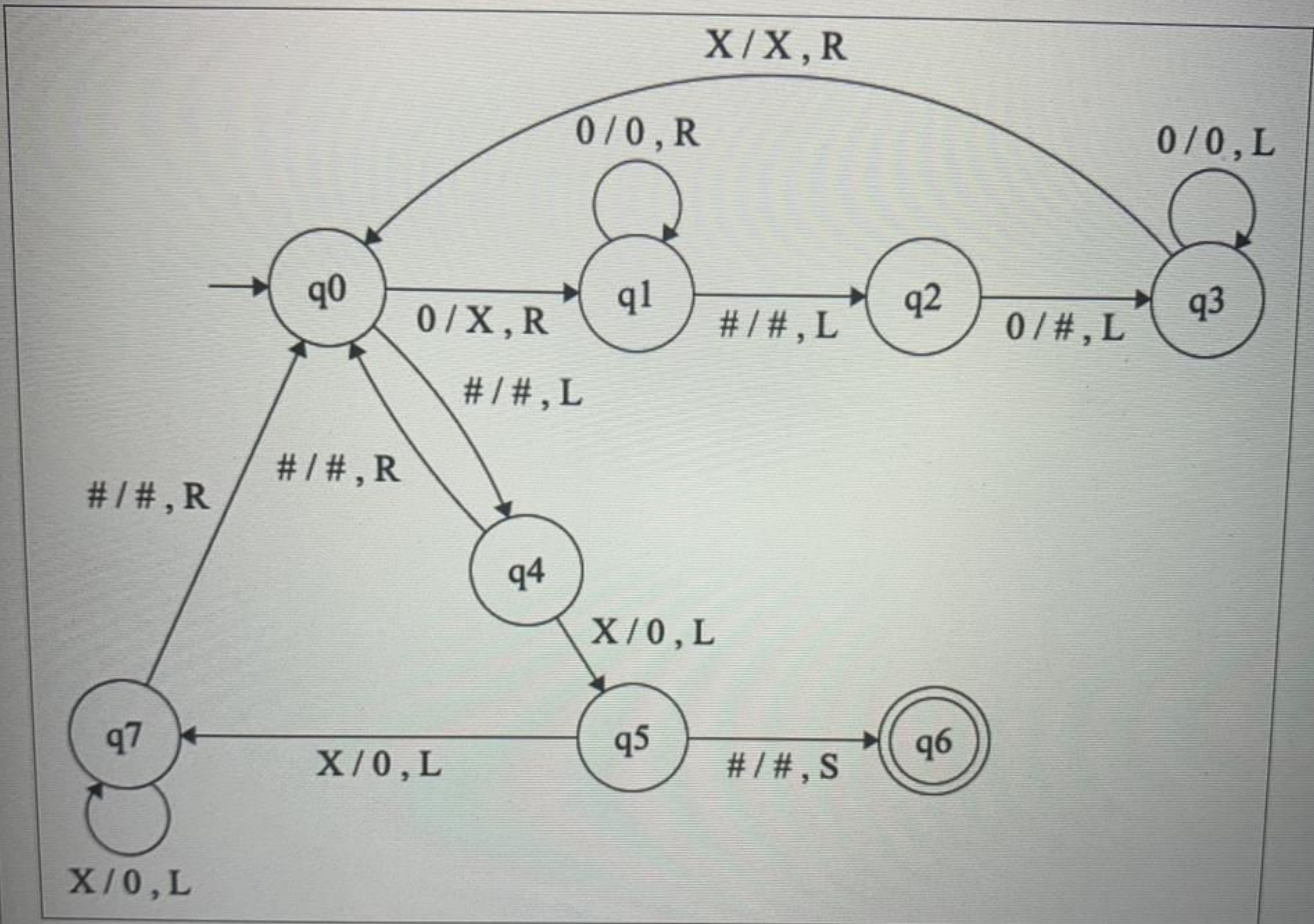

Figure 9: Turing Machine

The above Turing Machine accepts the language $L = \{0^n \mid n = 2^p\}$. What is the space complexity?

- O(n)
- O(n^2)
- O(2^n)
- O(n!)