Assignments 6

1) Which of the following statement is true in a nondeterministic halting TM $M$?

- The tape alphabet $\Gamma$ is same as the input alphabet $\Sigma$
- $x \in L(M)$ if and only if $M$ accepts $x$ on exactly one computation path
- On an input $x$, $M$ halts on all computation paths
- If $x \in L(M)$, then $M$ halts and accept on at least one computation paths but may or may not halt on other paths

**Accepted Answers:**

- On an input $x$, $M$ halts on all computation path

2) A transition is represented as $\delta(p, X) = (q, Y, L)$

Consider the following TM $M$

Which of the following are correct?

- $L(M) = \{x \mid x$ contains 000 as substring$\}$
- $L(M) = \{x \mid x$ has 000 as prefix$\}$
3) Consider the following statements:

\[ S_1 = \text{For every decidable language } L \text{ there exist a single tape deterministic halting TM } M \text{ with only five states } q_{\text{start}}, q_{\text{accept}}, q_{\text{reject}} \text{ such that } L(M) = L. \]

\[ S_2 = \text{For every decidable language } L \text{ there exist a single tape deterministic halting TM } M \text{ which doesn't write on any cell such that } L(M) = L. \]

Which of the following is correct?

- \( S_1 \) is true but \( S_2 \) is false
- \( S_1 \) is false but \( S_2 \) is true
- Both \( S_1 \) and \( S_2 \) are true
- Both \( S_1 \) and \( S_2 \) are false

Accepted Answers:
- Both \( S_1 \) and \( S_2 \) are false

4) Consider the following languages:

\[ L_1 = \{ < M > | M's \text{ head always moves to right on every transition} \} \]

\[ L_2 = \{ < M > | L(M) \text{ contains at least 5 strings} \} \]

Which of the following is correct?

- \( L_1 \) is decidable and \( L_2 \) is recognizable
- \( L_1 \) is decidable and \( L_2 \) is not recognizable
- \( L_1 \) is not decidable and \( L_2 \) is recognizable
- \( L_1 \) is not decidable and \( L_2 \) is not recognizable

Accepted Answers:
- \( L_1 \) is decidable and \( L_2 \) is recognizable

5) Let \( L_1 \) and \( L_2 \) be two decidable languages. Let \( L_3 \) and \( L_4 \) be two recognizable but not decidable languages. Which of the following statements are false?

- \( (L_1 \cup L_2) \setminus L_3 \) is a recognizable language
- \( L_1 \setminus (L_3 \cup L_4) \) is a recognizable language
- \( L_3 \setminus L_1 \) is a decidable language
- \( L_3 \setminus L_1 \)

Accepted Answers:
- \( (L_1 \cup L_2) \setminus L_3 \) is a recognizable language
- \( L_1 \setminus (L_3 \cup L_4) \) is a recognizable language
- \( L_3 \setminus L_1 \) is a decidable language
- \( L_3 \setminus L_1 \) is a recognizable but not decidable language

6) An RSTM is a deterministic Turing machine which instead of moving left and right is allowed to move only right or stay at the current cell. Similarly, an RTM is a deterministic Turing machine which instead of moving left and right is allowed to move only right. Which of the following statement is true?
RSTM and RTM both accept all and only regular languages
RSTM and RTM accept all and only CFLs and DCFLs respectively
RSTM and RTM both accept all and only DCFLs
RSTM and RTM accept all and only CFLs and regular languages respectively

Accepted Answers:
RSTM and RTM both accept all and only regular languages

7) Let $M$ be a deterministic TM. If it is known that $M$ does not halt on an input $x$, then which of the following statement is necessarily true?

- There are finitely many different configurations of $M$ with respect to $x$
- There are infinitely many different configurations of $M$ with respect to $x$
- There is exactly one configuration of $M$ with respect to $x$
- Every configuration of $M$ with respect to $x$ yield another configuration

Accepted Answers:
Every configuration of $M$ with respect to $x$ yield another configuration

8) Let $M_1$ be a deterministic TM and $M_2$ be a nondeterministic TM. Let $x_1$ be the input for $M_1$ and $x_2$ be the input for $x_2$. Which of the following statements are correct?

- One configuration can yield two different configurations with respect to $M_1$ and $x_1$
- Two different configurations can yield same configuration with respect to $M_1$ and $x_1$
- One configuration can yield two different configurations with respect to $M_2$ and $x_2$
- Two different configurations can yield same configuration with respect to $M_2$ and $x_2$

Accepted Answers:
Two different configurations can yield same configuration with respect to $M_1$ and $x_1$
One configuration can yield two different configurations with respect to $M_2$ and $x_2$
Two different configurations can yield same configuration with respect to $M_2$ and $x_2$