True/False

1. True/False: $S_{tm}$ is defined as the set of representations of TMs that do not halt on their own representation.

   False

2. True/False: If a language is the output of some Printer-TM, then it must be r.e.

   True

3. True/False: The set of r.e. languages is closed under sampling.

   True

4. True/False: To show that a standard TM has the same power as a crippled TM, we show that the standard TM can emulate the crippled one.

   False. Other way around.

5. The complement of $A_{tm}$ is also r.e.

   False

Multiple Choice

1. Which of the following problems is decidable for a regular language?
   (a) Is it infinite?
   (b) Does it contain the string "tiger"?
   (c) Is it equal to its complement?
   (d) All of the above

   D
2. Diagonalization was invented by
   (a) Cantor
   (b) Deacon
   (c) Priestley
   (d) Pope

3. Assume that language $A$ reduces to language $B$ and language $B$ reduces to language $C$. Assume that $A$ is recursive and $C$ is r.e. What can we say about language $B$
   (a) It is recursive
   (b) It is r.e. but not recursive
   (c) It is r.e. and might or might not be recursive
   (d) The given situation is impossible

4. When we say two models of computation have the same power, we mean that they have the same set of
   (a) Alphabets
   (b) Bases
   (c) Languages
   (d) Reductions

5. Which of the following is true about the language $A_{tm}$?
   (a) It is recursive
   (b) It is r.e.
   (c) It is finite
   (d) It consists of the encodings $\langle M \rangle$ such that $M$ accepts $\langle M \rangle$

6. Which of the following is generated by a context-sensitive grammar but not by any unrestricted grammar?
   (a) $0^n1^n$
   (b) $A_{tm}$
   (c) $S_{tm}$
   (d) None of the above

D. Does not exist.
7. What is the best description of the following grammar?

\[ S \rightarrow abS \]
\[ bS \rightarrow Sc \]
\[ SS \rightarrow a \]

(a) Regular grammar
(b) Context-sensitive grammar
(c) Kelsey grammar
(d) Unrestricted grammar

8. When one performs diagonalization on the following grid, what is the result?

\[
\begin{array}{cccc}
P & O & N & Y \\
U & T & A & H \\
A & C & H & E \\
N & A & V & Y \\
\end{array}
\]

(a) TEST
(b) ROFL
(c) QUIZ
(d) GAGA

9. Which of the following is true?

(a) There is a language \( A \) accepted by some standard TM but not by any nondeterministic TM
(b) There is a language \( B \) accepted by some standard TM but not by any NFA
(c) There is a language \( C \) accepted by some nondeterministic TM but not by any standard TM
(d) There is a language \( D \) accepted by some NFA but not by any standard TM

10. In which of the following is it essential that we use parallelism?

(a) The proof that recursive languages are closed under star
(b) The proof that recursive languages are closed under intersection
(c) The proof that r.e. languages are closed under star
(d) The proof that r.e. languages are closed under intersection
11. Which of the following problems is decidable for context-free grammars?
(a) Does the grammar generate the string ORANGE?
(b) Does the grammar generate everything?
(c) Do two grammars generate the same language?
(d) All of the above

12. Which of the following statements is true about the proof that $S_{tm}$ is not r.e.
(a) It relies on the fact that a TM cannot recognize its own representation
(b) It relies on the fact that a TM can simulate another TM
(c) It relies on the fact that the sky is green
(d) All the above

13. Which of the following sets is NOT countable?
(a) Binary strings
(b) CFGs
(c) Languages
(d) REs

14. Which of the following decision problems is decidable?
(a) The halting problem for TMs
(b) The halting problem for nondeterministic TMs
(c) The halting problem for DFAs
(d) The halting problem for 2-PDAs

15. Which of the following has the same power as a standard TM?
(a) A twice-change Turing Machine (TCTM)
(b) A multi-tape Turing Machine
(c) A TM with a one-way infinite tape
(d) All of the above