QUESTION BANK

1. Let $L_1 = \{0^{n+m} 1^n 0^m \mid n, m \geq 0\}$,
$L_2 = \{0^{n+m} 1^{n+m} 0^m \mid n, m \geq 0\}$, and
$L_3 = \{0^{n+m} 1^{n+m} 0^{n+m} \mid n, m \geq 0\}$.
Which of these languages are NOT context free?
(a) L_1 only (b) L_3 only
(c) L_1 and L_2 (d) L_2 and L_3

2. If s is a string over (0 + 1)*, then let $n_0(s)$ denote the number of 0's in s and $n_1(s)$ the number of 1's in s. Which one of the following languages is not regular?
(a) $L = \{s \in (0+1)^* \mid n_0(s) \text{ is a 3-digit prime}\}$
(b) $L = \{s \in (0+1)^* \mid \text{for every prefix } s' \text{ of } s, |n_0(s') - n_1(s')| \leq 2\}$
(c) $L = \{s \in (0+1)^* \mid |n_0(s) - n_1(s) \leq 4\}$
(d) $L = \{s \in (0+1)^* |n_0(s) \bmod 7 = n_1(s) \bmod 5 = 0\}$

3. For $s \in (0+1)^*$ let d(s) denote the decimal value of s (e. g. d (101) = 5).
Let $L = \{s \in (0+1)^* \mid d(s) \bmod 5 = 2 \text{ and } d(s) \bmod 7 \neq 4\}$
Which one of the following statements is true?
(a) L is recursively enumerable, but not recursive
(b) L is recursive, but not context-free
(c) L is context-free, but not regular
(d) L is regular

4. Consider the following statements about the context-free grammar:
$G = \{S \to SS, S \to ab, S \to ba, S \to \wedge\}$
I. G is ambiguous
II. G produces all strings with equal number of a's and b's
III. G can be accepted by a deterministic PDA.
Which combination below expresses all the true statements about G?
(a) I only (b) I and III only
(c) II and III only (d) I, II, and III

5. Let L_1 be regular language, L_2 be a deterministic context-free language and L_3 a recursively enumerable, but not recursive, language. Which one of the following statements is false?
(a) $L_1 \cap L_2$ is a deterministic CFL
(b) $L_3 \cap L_1$ is recursive
(c) $L_1 \cup L_2$ is context free
(d) $L_1 \cap L_2 \cap L_3$ is recursively enumerable

6. Which of the following problems is undecidable?
(a) Membership problem for CFGs.
(b) Ambiguity problem for CFGs.
(c) Finiteness problem for FSAs
(d) Equivalence problem for FSAs

7. Which of the following is TRUE?
(a) Every subset of a regular set is regular
(b) Every finite subset of a non-regular set is regular
(c) The union of two non-regular sets is not regular
(d) Infinite union of finite sets is regular

8. A minimum state deterministic finite automaton accepting the language.
$L = \{w \mid w \in \{0, 1\}^*$, number of 0s and 1s in w are divisible by 3 and 5, respectively$\}$ has
(a) 15 states (b) 11 states
(c) 10 states (d) 9 states

9. The language $L = \{0^i 21^i \mid i \geq 0\}$ over the alphabet {0, 1, 2} is.
(a) not recursive
(b) is recursive and is a deterministic CFL
(c) is a regular language.
(d) is not a deterministic CFL but a CFL

10. Which of the following languages is regular?

(a) $\{ww^R \mid w \in \{0, 1\}^+\}$

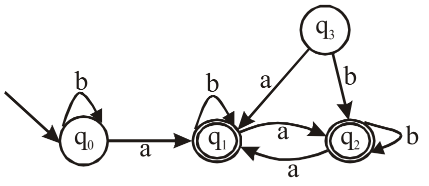
(b) $\{ww^Rx \mid x, w \in \{0,1\}^+\}$

(c) $\{wxw^R \mid x, w \in \{0,1\}^+\}$

(d) $\{xww^R \mid x, w \in \{0,1\}^+\}$

Common Data Q. 11-12

Consider the following Finite State Automaton:



11. The language accepted by this automaton is given by the regular expression

(a) b * ab * ab *ab * (b) (a + b) *

(c) b * a (a + b) * (d) b * ab * ab *

12. The minimum state automaton equivalent to the above FSA has the following number of states.

(a) 1 (b) 2

(c) 3 (d) 4

13. Which of the following is true for the language $\{a^p \mid p$ is a prime$\}$?

(a) It is not accepted by a Turing Machine

(b) It is regular but not context-free

(c) It is context-free but not regular

(d) It is neither regular nor context-free, but accepted by a Turing machine

14. Which of the following are decidable?

I. Whether the intersection of two regular languages is infinite.

II. Whether a given context-free language is regular

III. Whether two push-down automata accept the same language.

IV. Whether a given a grammar is context-free.

(a) I and II (b) I and IV

(c) II and III (d) II and IV

15. If L and $\bar{L}$ are recursively enumerable, then L is

(a) regular (b) context-free

(c) context-sensitive (d) recursive

16. Which of the following statements is false?

(a) Every NFA can be convrted to an equivalent DFA

(b) Every non-deterministic Turing machine can be converted to an equivalent deterministic Turing machine

(c) Every regular language is also a context-free language

(d) Every subset of a recursively enumerable set is recursive

17. Given below are two finite state automata (→ indicates the start state and F indicates a final state)

Y:

	a	b
→1	1	2
2(F)	2	1

Z:

	a	b
→1	2	2
2(f)	1	1

Which of the following represents the product automaton Z × Y ?

(a)

	a	b
→P	S	R
Q	R	S
R(F)	Q	P
S	Q	P

(b)

	a	b
→P	S	Q
Q	R	S
R(F)	Q	P
S	P	Q

(c)

	a	b
→P	Q	S
Q	R	S
R(F)	Q	P
S	Q	P

(d)

	a	b
→P	S	Q
Q	S	R
R(F)	Q	P
A	Q	P

18. Which of the following statements are true?

I. Every left-recursive grammar can be converted to a right-recursive grammar and vice-versa

II. All ε-productions can be removed from any context-free grammar by suitable transformations.

III. The language generated by a context-free grammar all of those productions are of the form X→ w or X → w Y (where, w is a string of terminals and Y is a non-terminal), is always regular

IV. The derivation trees of strings generated by a context-free grammar in Chomsky Normal From are always binary trees.

(a) I, II, III and IV (b) II, III and IV only

(c) I, III and IV only (d) I, II and IV only

19. Match the following

List-I

A. Checking that identifiers are declared before their use

B. Number of formal para-meters in the declaration of a function agrees with the number of actual parameters in a use of that function.

C. Arithmetic expressions with matched pairs of

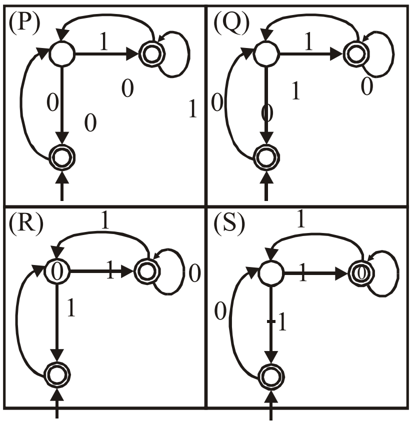
D. Palindromes

List - II

1. L = $\{a^n b^m c^n d^m \mid n \ge 1, m \ge 1\}$
2. $X \to X\ b\ X \mid X\ c\ X \mid d\ X\ f \mid g$
3. L = $\{wcw \mid w \in (a \mid b)^*\}$
4. $X \to b\ X\ b \mid c\ X\ c \mid \varepsilon$

Codes:	**A**	**B**	**C**	**D**
(a)	1	3	2	4
(b)	3	1	4	2
(c)	3	1	2	4
(d)	1	3	4	2

20. Match the following NFAs with the regular expressions they correspond to.



1. $\varepsilon + 0(01^*1 + 00)^*01^*$
2. $\varepsilon + 0(10^*1 + 00)^*0$
3. $\varepsilon + 0(10^*1 + 10)^*1$
4. $\varepsilon + 0(10^*1 + 10)^*10^*$

(a) P –2, Q – 1, R – 3, S – 4

(b) P – 1, Q – 3, R – 2, S – 4

(c) P – 1, Q – 2, R – 3, S – 4

(d) P – 3, Q – 2, R – 1, S – 4

21. Which of the following are regular sets?

I. $\{a^n b^{2m} \mid n \ge 0, m \ge 0\}$

II. $\{a^n b^m \mid n = 2m\}$

III. $\{a^n b^m \mid n \ne m\}$

IV. $\{xcy \mid x, y \in \{a, b\}^*\}$

(a) I and IV only (b) I and III only

(c) I only (d) IV only

22. $S \to aSa \mid bSb \mid a \mid b$

The language generated by the above grammar over the alphabet {a, b} is the set of

(a) all palindromes

(b) all odd length palindromes

(c) strings that begin and end with the same symbol.

(d) all even length palindromes.

23. Which one of the following languages over the alphabet {0, 1} is described by the regular expression $(0 + 1)^*0(0 + 1)^*0(0 + 1)^*$?

(a) The set of all strings containing the substring 00

(b) The set of all strings containing at most two 0's.

(c) The set of all strings containing at least two 0's.

(d) The set of all strings that begin and end with either 0 or 1.

24. Which one of the following is FALSE?

(a) There is a unique minimal DFA for every regular language.

(b) Every NFA can be converted to an equivalent PDA.

(c) Complement of every context-free language is recursive.

(d) Every nondeterministic PDA can be converted to an equivalent deterministic PDA.

25. Math all items in Group I with correct options from those given in Group II.

Group 1

A. Regular expression

B. Pushdown automata

C. Dataflow analysis

D. Register allocation

Group 2
1. Syntax analysis
2. Code generation
3. Lexical analysis
4. Code Optimization

Codes:	**A**	**B**	**C**	**D**
(a)	4	1	2	3
(b)	3	1	4	2
(c)	3	4	1	2
(d)	2	1	4	3

26. Given the following state table of an FSM with two states A and B, one input and one output:

Present State A	Present State B	Input State B	Next State B	Next State B	Output
0	0	0	0	0	1
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	1	0	0
0	0	1	0	1	0
0	1	1	0	0	1
1	0	1	0	1	1
1	1	1	0	0	1

If the initial state is A = 0, B = 0, what is the minimum length of an input string which will take the machine to the state A = 0, B = 1 with Output = 1?

(a) 3 (b) 4
(c) 5 (d) 6

27. Let = $L_1 \cap L_2$, where L_1 and L_2 are language as defined below:

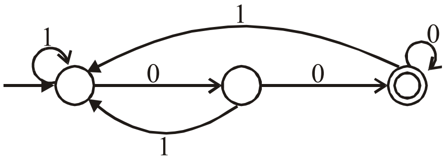
$L_1 = \{a^m b^m c a^n b^n \mid m, n^3 \geq 0\}$

$L_2 = \{a^i b^i c^k \backslash i, j, k \geq 0\}$

The L is

(a) not recursive (b) regular
(c) context-free but not regular
(d) recursively enumerable but not context-free.

28. In the following figure, DFA accepts the set of all strings over [0, 1] that



(a) begin either with 0 or 1.
(b) end with 0
(c) end with 00.
(d) contain the substring 00.

29. Let L1 be a recursive language. Let L2 and L3 be languages that are recursively enumerable but not recursive. Which of the following statements is not necessarily true?

(a) L2 – L1 is recursively enumerable
(b) L1 – L3 is recursively enumerable
(c) L2 $\cap$ L3 is recursively enumerable
(d) L2 $\cup$ L3 is recursively enumerable

30. Let L = {w $\in$ (0 +1)*| w has even number of 1s}, i.e., L is the set of all bit strings with even number of 1s. Which one of the regular expressions below represents l?

(a) (0* 10*1)* (b) 0* (10*10*)*
(c) 0* (10*1)*0* (d) 0* 1(10*1)*10*

31. Consider the languages

$L1 = \{0^i 1\backslash j \mid i \neq j\}$,
$L2 = \{0^i 1^j \mid i = j\}$,
$L3 = \{0^i 1^j \mid i = 2j + 1\}$,
$L4 = \{0^i 1^j \mid i \neq 2j\}$.

Which one of the following statements is true?

(a) Only L2 is context free
(b) Only L2 and L3 are context free
(c) Only L1 and L2 are context free
(d) All are context free

32. Let w be any string of length n in {0, 1}*.
Let L be the set of all substrings of w.
What is the minimum number of states in a nondeterministic finite automaton that accepts L?

(a) n – 1 (b) n
(c) n + 1 (d) 2^{n-1}

33. Let P be a regular language and Q be a contextfree languare such that Q $\subseteq$ P. (For example, let P be the language represented by the regular expression p*q* and Q be [$p^n q^n$ | n $\in$ N]. Then which of the following is ALWAYS regular?

(a) P $\cap$ Q (b) P – Q
(c) Σ^* – P (d) Σ^* – Q

34. The lexical analysis for a modern computer language such as Java needs the power of which one of the following machine models in a necessary and sufficient sense?

(a) Finite state automata
(b) Deterministic pushdown automata
(c) Non-deterministic pushdown automata
(d) Turing machine

35. Which of the following pairs have DIFFERENT expressive power?

(a) Deterministic finite automata (DFA) and Non-deterministic finite automata (NFA)

(b) Deterministic push down automata (DPDA) and Non-deterministic push down automata (NPDA)

(c) Deterministic single-tape Turing machine and Non-deterministic single-tape Turing machine

(d) Single-tape Turing machine and multi-tape Turing machine.

36. A company needs to develop a strategy for software product development for which it has a choice of two programming languages L1 and L2. The number of lines of code (LOC) developed using L2 is estimated to be twice the LOC developed with L1. The product will have to be maintained for five years. Various parameters for the company are given in the table below.

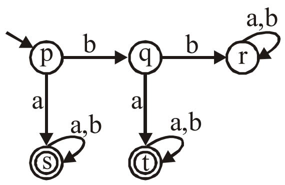
Parameter	**Language L1**	**Language L2**
Man years needed for development	Loc/10,000	LOC/10,000
Development Cost per man year	Rs. 10,00,000	Rs. 7,50,000
Maintenance time	5 years	5 years
Cost of maintenance per year.	Rs. 10,00,000	Rs. 50,000

Total cost of the project includes cost of development and maintenance. What is the LOC for L1 for which the cost of the project using L1 is equal to the project using L2?

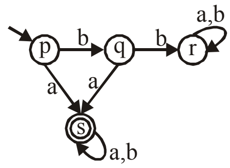
(a) 4000 (b) 5000

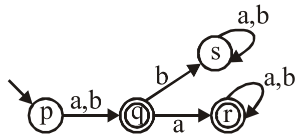
(c) 4333 (d) 4667

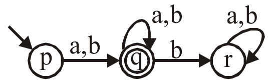
37. A deterministic finite automaton (DFA) D with alphabet $\Sigma = \{a, b\}$ is given below.

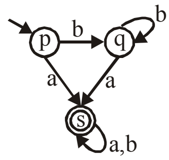


Which of the following finite state machines is a valid minimal DFA which accepts the same language as D?

(a)


(b)


(c)


(d)


38. Definition of a language L with alphabet {a} is given as following.

$L = \{a^{nk} \mid k < 0$, and n is a positive integer constant$\}$

What is the minimum number of states needed in a DFA to recognize L?

(a) $k + 1$ (b) $n + 1$

(c) 2^{n+1} (d) 2^{k+1}

39. Consider the languages L1, L2 and L3 as given below.

$L1 = \{0^p 1^q \mid p, q \in N\}$

$L2 = \{0^p 1^q \mid p, q \in N$ and $p = q\}$ and

$L3 = \{0^p 1^q 0^r \mid p, q, r \in N$ and $p = q = r\}$ Which of the following statements is NOT TRUE?

(a) Push Down Automate (PDA) can be used to recognize L1 and L2.

(b) L1 is a regular language

(c) All the three language are context free

(d) Turing machines can be used to recognize all the languages

40. Given the language L = {ab, aa, baa}, which of the following strings are in L*?

1. abaabaaabaa 2. aaaabaaaa

3. baaaaabaaaab 3. baaaaaba

(a) 1, 2 and 3 (b) 2, 3 and 4

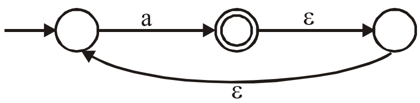
(c) 1, 2 and 4 (d) 1, 3 and 4

41. Consider a random variable X that takes values + 1 and –1 with probability 0.5 each. The values of the cumulative distribution function F(x) at x = – 1 and + 1 are.

(a) 0 and 0.5 (b) 0 and 1
(c) 0.5 and 1 (d) 0.25 and 0.75

42. What is the complement of the language accepted by the NFA shown below?

Assume $\Sigma = \{a\}$ and ε is the empty string.



(a) Ø (b) {ε}
(c) a (d) {a, ε}

43. Consider the following logical inferences.

I_1 : If it rains then the cricket match will not be played.
The cricket match was played.
Inference : There was no rain.

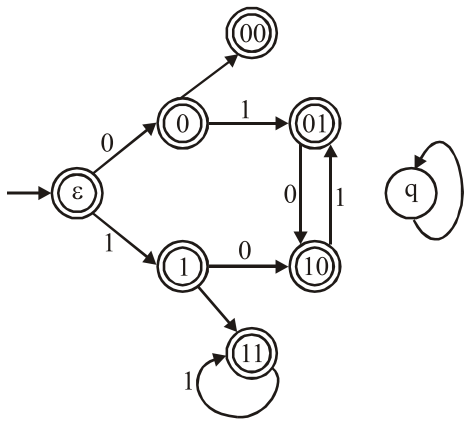
I_2 : If it rains then the cricket match will not be played.
It did not rain.

Inference: The cricket match was played.

Which of the following is TRUE?

(a) Both I_1 and I_2 are correct inferences
(b) I_1 is correct but I_2 is not a correct inference
(c) I_1 is not correct but I_2 is a correct inference
(d) Both I_1 and I_2 are not correct inferences.

44. Consider the set of strings on {0, 1} in which, every substring of 3 symbols has at most two zeros. For example, 001110 and 011001 are in the language, but 1000010 is not. All strings of length less than 3 are also in the language. A partially completed DFA that accept this language is shown below.



The missing arcs in the DFA are:

(a)

	00	01	10	11	q
00	1	0			
01				1	
10	0				
11			0		

(b)

	00	01	10	11	q
00		0			1
01		1			
10				0	
11		0			

(c)

	00	01	10	11	q
00		1			0
01		1			
10			0		
11		0			

(d)

	00	01	10	11	q
00		1			0
01				1	
10	0				
11			0		

45. The major difference between a moore and mealy machine is that.

(a) output of the former depends on the present state and present input.
(b) output of the former depends only on the present state.
(c) output of former depends only on the present input
(d) all of these

46. Any given transition graph has an equivalent

(a) regular expression (b) DFSM
(c) NDFSM (d) all of these

47. For which of the following application, regular expressions can not be used?

(a) Designing computers (b) Designing compilers
(c) Both (a) and (b) (d) Developing computers

48. If S be an infinite set and S_1..........., S_n be sets such that $S_1 \cup S_2 \cup ...... \cup S_n = S$, then

(a) atleast one of the set S_i is a finite set
(b) not more than one of the sets S_i can be finite
(c) atleast one of the sets S_i is an infinite set
(d) not more than one of the sets S_i can be infinite

49. Vienna Definition Language is an example of language definition facility based on

(a) Mathematical semantics

(b) Interpretative semantics

(c) Translational semantics

(d) Axiomatic semantics

50. Which of the following regular expressions denotes a language comprising all posible strings over the alphabet {a, b}?

(a) a* b*
(b) (a | b)*
(c) $(ab)^+$
(d) (a | b*)

❑❑❑

ANSWERS AND EXPLANATIONS

1. ***Ans. (d)***
2. ***Ans. (b)***
3. ***Ans. (b)***

By observation, all the numbers of the form 5x + 2, $x \in N$ except of the form 7 (5n + 4) + 4n $\in$N, belong to the language, Since we have an algorithm to check whether a given number belongs to L or not. It is recursive.

4. ***Ans. (d)***
5. ***Ans. (d)***

Since L_1 may or may not be content – free, hence options (a) and (c) are ruled out.

Since L_3 is not recursive, hence option (b) is also ruled out.

6. ***Ans. (b)***

As we know that Ambiguity problem for CFGs is undecidable.

7. ***Ans. (b)***

Every finite subset of a non-regular set is regular.

8. ***Ans. (a)***

The minimum state deterministic finite automata accepting specified language will have 15 states.

9. ***Ans. (b)***

Language $L = \{0^i\, 21^i \mid i \geq 0\}$

over alphabet {0, 1, 2} is recursive and is a deterministic CFL (every CFL is recursive)

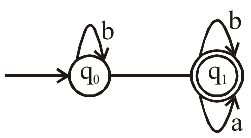
10. ***Ans. (c)***

Language $L = \{wxw^R \mid x_1\ w \in \{0, 1\}^+\}$ is a regular language.

11. ***Ans. (c)***

b*a (a + b)* is regular expression which gives language accepted by automata.

12. ***Ans. (b)***



Since state q_3 is isolated and q_1 and q_2 are indistinguishable.

13. ***Ans. (d)***

$L = a^p \mid p$ is prime.

L is not be regular, can be proved by pumping Lemma, so it cannot be context free language.

14. ***Ans. (c)***

Intersection of two regular languages can be determined by a given algorithm, it can be determined whether a given grammer is context free. Context free grammar should have all productions of the type

$A \rightarrow x$

where, $A \in V_N$ {set of varibale}

$a \in (V_N\ U_z)^*$ {z = set of terminal}

15. ***Ans. (d)***

If a language is recursively enumerable, and its complement is also, then the language is recursive.

16. ***Ans. (d)***

I, II and III are true

Instead true statement is, "every recursive set is recursively enumerable."

17. ***Ans. (b)***
18. ***Ans. (d)***

Statement III is false. In a context free grammar, right side of the productions should either have single terminal or none non-terminal followed by terminal or λ.

19. ***Ans. (a)***

Here $X \rightarrow b\,x\,b \mid c\,x\,c \mid \varepsilon$ surely repesent palindrome and $x \rightarrow x\ b\ x \mid \mid x\ c\ x \mid d\ x\ f \mid g$ Arithmetic expressions with match pair are simple & L = {wcw\we(a/b)*} checking that identifier are declared before their use.

20. ***Ans. (b)***
21. ***Ans. (*)***
22. ***Ans. (b)***
23. ***Ans. (c)***

R.E. = (0 + 1) * 0 (0 + 1)* 0(0 + 1)*

Accepting Language will be

L = {00, 000, 100, 001, 010, 0000, 0001, 1000, 1001, 0100, 1100, 0010, 0011, 0110, 0101, 1010,.....} atleast two zeros.

24. ***Ans. (d)***
25. ***Ans. (b)***

Regular expression denote structure of data specially text string-lexical analyser break input text into logical unit such as identifiers.

Push down automater- Syntax analysis. Study with the help of syntax.

Data flow analysis – Code optimization

Register allocation – Lexical analysis

26. ***Ans. (a)***

27. ***Ans. (c)***

Intersection of two regular language is regular

Given : $L_1 = \{a^m b^m c a^n b^n \mid m, n \geq 0\}$

If n = 1 {a, b, c, a, b} not regular
m = 1

If n/1 a^m, $b^m c a^n b^n$ is regular.

28. ***Ans. (c)***

29. ***Ans. (b)***

L1 is recursive and L2, L3 are recursively enumerable, So L1 $\cap$ L3 and L2 $\cup$ L3 can recursively enumerable and also L2 – L1 can recursively enumerable. But we can't say that L1– L3 is also recursively enumerable.

30. ***Ans. (d)***

31. ***Ans. (d)***

Since L1, L2, L3, L4 can be recognised by push down automata, so these all are context-free grammer.

32. ***Ans. (c)***

33. ***Ans. (c)***

$\Sigma^* - P$ is the complement of P so it is always regular, Since regular language are closed under complementation.

34. ***Ans. (a)***

Lexical Analysis is implemented by finite automata

35. ***Ans. (b)***

NPDA is more powerful than DPDA.

Hence answer is (b).

36. ***Ans. (b)***

37. ***Ans. (a)***

Options (b) and (c) will accept the string b

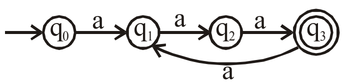
Option (d) will accept the string "bba"

Both are invalid strings.

So minized DFA is option a.

38. ***Ans. (b)***

Let n = 3 and k = 1



39. ***Ans. (c)***

40. ***Ans. (c)***

41. ***Ans. (c)***

42. ***Ans. (b)***

Language accepted by NFA is a^+, so complement of this language is $\{\varepsilon\}$.

43. ***Ans. (b)*** **44.** ***Ans. (d)***

45. ***Ans.(b)*** **46.** ***Ans.(d)***

47. ***Ans.(c)*** **48.** ***Ans.(c)***

49. ***Ans.(a)*** **50.** ***Ans.(b)***

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