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## COMPUTER SCIENCE & IT

## OBJECTIVE PRACTICE SETS VOLUME - I

CONTENTS



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# DISCRETE & ENGINEERING MATHEMATICS

## OBJECTIVE PRACTICE SETS

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# 1 CHAPTER Propositional Logic

## Multiple Choice Questions

**Q.1** Argument: $([P \to (q \vee r)] \wedge \bar{q} \wedge \bar{r}) \to \bar{P}$ is

(a) Valid argument (b) Invalid argument
(c) Unknown (d) None of these

**Q.2** $\neg \forall_x \forall_y [(x < y) \to (x^2 < y^2)]$ is equivalent to

(a) $\exists_x \exists_y [(x < y) \wedge (x^2 \geq y^2)]$

(b) $\exists_x \exists_y [\neg(x < y) \wedge \neg (x^2 < y^2)]$

(c) $\exists_x \exists_y [\neg(x < y) \vee \neg (x^2 < y^2)]$

(d) $\exists_x \exists_y [(x < y) \vee (x^2 \geq y^2)]$

**Q.3** What is the logical translation of the following statement?
"None of my friends are perfect".

(a) $\exists x(F(x) \wedge \neg P(x))$ (b) $\exists x(\neg F(x) \wedge P(x))$
(c) $\exists x(\neg F(x) \wedge \neg P(x))$ (d) $\exists x(\neg F(x) \vee \neg P(x))$

**Q.4** **Statement:** Last year, the only Book I read were adventure stories.
Logical representation of the above statement is?
(a) Adventure story $\to$ book that I read last year
(b) Book that I read last year $\to$ adventure story
(c) Not a book I read last year $\to$ not adventure story
(d) None of these

**Q.5** Consider the following statements:
**(i)** Those who like painting like flowers.
**(ii)** Those who like running like music.
**(iii)** Those who do not like music do not like flowers.
If all the above statements are true, then consider the following statements.
**1.** Those who like running do not like paintings.
**2.** Those who like painting like flowers.
**3.** Those who like running like flower.
**4.** Those who like painting like music.
Which is following is true?
(a) 2 only (b) 1, 4 only
(c) 2, 3 only (d) 4 only

**Q.6** Which of the following formulas is a formalization of the sentence:
"There is a computer which is not used by any student".
(a) $\exists x(\text{computer}(x) \wedge \forall y(\neg \text{ student } (y) \to \text{uses } (y, x)))$
(b) $\exists x(\text{computer}(x) \to \forall y(\text{student } (y) \to \neg \text{ uses } (y, x)))$
(c) $\exists x(\text{computer}(x) \wedge \forall y(\text{student } (y) \to \neg \text{ uses } (y, x)))$
(d) $\exists x(\text{computer}(x) \vee \forall y(\text{student } (y) \to \neg \text{ uses } (y, x)))$

**Q.7** $P(x, y) : x + y = x - y$
If the universe is the set of integers which of the following are true
**(i)** $P(1, 1)$ **(ii)** $P(3, 0)$
**(iii)** $\exists x P(x, 2)$ **(iv)** $\exists x \forall y P(x, y)$
**(v)** $\exists y \forall x P(x, y)$ **(vi)** $\forall x \exists x P(x, y)$
(a) (ii) and (v) only (b) (ii), (v) & (iv) only
(c) (ii) only (d) (v) and (vi) only

**Q.8** Which of the following is true?
**(i)** $\exists x\{P(x) \wedge Q(x)\} \equiv \exists x P(x) \wedge \exists x Q(x)$
**(ii)** $\exists x\{P(x) \wedge Q(x)\} \Rightarrow \exists x P(x) \wedge \exists x Q(x)$
**(iii)** $\exists x P(x) \wedge \exists x Q(x) \equiv \exists x P(x) \wedge \exists y Q(y)$
(a) (i) only (b) (ii) and (iii) only
(c) (ii) only (d) None of these

**Q.9** Which of the following is principle conjunction normal form for $[(p \vee q] \wedge \neg p \neg q]$?
(a) $p \vee \neg q$ (b) $p \vee q$
(c) $\neg p \vee q$ (d) $\neg p \vee \neg q$

**Q.10** Consider the first-order logic sentence $F : \forall x(\exists y R(x,y))$. Assuming non-empty logical domains, which of the sentences below are implied by $F$?

I. $\exists y(\exists x R(x,y))$ II. $\exists y(\forall x R(x,y))$
III. $\forall y(\exists x R(x,y))$ IV. $\neg\exists x(\forall y \neg R(x,y))$

(a) IV only (b) I and IV only
(c) II only (d) II and III only

**Q.11** Which of the following is/are tautology:
(a) $(a \vee b) \rightarrow (b \wedge c)$ (b) $(a \wedge b) \rightarrow (b \vee c)$
(c) $(a \vee b) \rightarrow (b \rightarrow c)$ (d) $(a \rightarrow b) \rightarrow (b \rightarrow c)$

**Q.12** Let $P(x)$ denote the statement "$x < = 4$". What is truth value?
(a) $P(0)$ (b) $P(6)$
(c) $P(8)$ (d) P(9)

**Q.13** Let $N(x)$ be the statements "$x$" has visited North Dakota" where domain consists of the students in your school. The qualifications are as follows with English expression.

$S(\text{I})\ \exists x \sim N(x)$: Some student has not visited North Dakota.

$S(\text{II}) \sim \forall x N(x)$: Not all student has not visited North Dakota.

$S(\text{III})\ \forall x \sim N(x)$: All students have not visited North Dakota.

Choose the correct option from above statements:
(a) S(I) true; S(II) is true
(b) Only S(III) is true
(c) S(II) is true and S(II) is true
(d) All statement S(I) S(II) and S(III) is correct.

**Q.14** Consider two well-formed formulas in propositional logic:
$F_1 : P \Rightarrow \neg P$
$F_2 : (P \Rightarrow \neg P) \vee (\neg P \Rightarrow P)$
Which of the following statements is correct?
(a) $F_1$ is satisfiable, $F_2$ is valid
(b) $F_1$ is unsatisfiable, $F_2$ is satisfiable
(c) $F_1$ is unsatisfiable, $F_2$ is valid
(d) $F_1$ and $F_2$ are both satisfiable

**Q.15** Which one of the following Boolean expresses is NOT a tautology?
(a) $((a \rightarrow b) \wedge (b \rightarrow c)) \rightarrow (a \rightarrow c)$
(b) $(a \leftrightarrow b) \rightarrow (\sim b \rightarrow (a \wedge c))$
(c) $(a \wedge b \wedge c) \rightarrow (c \vee a)$
(d) $a \rightarrow (b \rightarrow a)$

**Q.16** Let $P(x)$ be the statement "$x = x^2$". If the domain consists of the integers, then which is true value?
(a) $P(2)$ (b) $P(-1)$
(c) $\exists x P(x)$ (d) $\forall x P(x)$

**Q.17** Either everything is material or there are some things that are not material.
(a) $(\forall x)M(x) \vee (\exists x) \sim M(x)$
(b) $\forall x(M(x) \vee \sim M(x))$
(c) $(\forall x)M(x) \wedge (\exists x) \sim M(x)$
(d) $(\forall x)M(x) \vee (\exists y) \sim M(y)$

**Q.18** Select which quantifier is Tautology.
(a) $\sim (P \rightarrow q) \rightarrow P$
(b) $(\sim P \wedge (P \rightarrow q)) \rightarrow P$
(c) $(\sim P \wedge (P \rightarrow q)) \rightarrow \sim q$
(d) $(\sim P \wedge (P \rightarrow q)) \rightarrow q$

**Q.19** Consider the following predicates:
S($x$) : "$x$ is student"
GATE ($x$, $y$) : "$x$ has written gate in every stream".
Find the equivalent predicate logic for the following statement:
"There does not exist a student who has written a GATE in every stream."
(a) $\exists y \exists x\,[S(x) \wedge \sim \text{GATE}(x, y)]$
(b) $\forall y \exists x[\sim S(x) \vee \sim \text{GATE}(x, y)]$
(c) $\exists y \forall x[\sim S(x) \vee \sim \text{GATE}(x, y)]$
(d) $\exists y \exists x[\sim S(x) \wedge \sim \text{GATE}(x, y)]$

**Q.20** Consider the following compound proposition:
$[(A \vee B) \wedge (A \rightarrow C) \wedge (B \rightarrow D)] \rightarrow (D \vee C)$
Which of the following is true for the above proposition?
(a) Satisfiable (b) Contradiction
(c) Tautology (d) None of these

**Q.21** Consider the following well-formed formulae:
I. $\neg\forall x(P(x))$
II. $\neg\exists x(P(x))$
III. $\neg\exists x(\neg P(x))$
IV. $\exists x(\neg P(x))$

Which of the above are equivalent?
(a) I and III (b) I and IV
(c) II and III (d) II and IV

**Q.22** Which one of the following is the most appropriate logical formula to represent the statement:
"Gold and silver ornaments are precious"
The following notations are used:
$G(x)$: $x$ is a gold ornament
$S(x)$: $x$ is a silver ornament
$P(x)$: $x$ is precious
(a) $\forall x(P(x) \rightarrow (G(x) \wedge S(x)))$
(b) $\forall x(G(x) \wedge (S(x) \rightarrow P(x)))$
(c) $\exists x((G(x) \wedge S(x)) \rightarrow P(x))$
(d) $\forall x((G(x) \vee S(x)) \rightarrow P(x))$

**Q.23** Match **List-I** with **List-II**:

| List-I | List-II |
|---|---|
| A. $P \rightarrow q$ | 1. $\neg(q \rightarrow \neg P)$ |
| B. $P \vee q$ | 2. $P \wedge \neg q$ |
| C. $P \wedge q$ | 3. $\neg P \rightarrow q$ |
| D. $\neg(P \rightarrow q)$ | 4. $\neg P \vee q$ |

Choose the correct option from those given below:
(a) A-2; B-3; C-1; D-4 (b) A-2; B-1; C-3; D-4
(c) A-4; B-1; C-3; D-2 (d) A-4; B-3; C-1; D-2

**Q.24** If $x + y \geq 2$, where $x$ and $y$ are real number, then
(a) $x \geq 1$ or $y \geq 1$ (b) $x \geq 1$ or $y \geq 0$
(c) $x \geq 0$ or $y \geq 0$ (d) $x \neq 1$

**Q.25** Consider the following statement:
*"Every bird can fly"*
The negation of the above statement in simple English.
(a) No bird cannot fly
(b) There is a bird that can fly
(c) Every bird cannot fly
(d) There is a bird that cannot fly

**Q.26** $\neg(X \wedge Y) \rightarrow (\neg X \vee (\neg X \vee Y))$ is logically equivalent to
(a) $\sim(X \vee Y)$ (b) $\sim X \vee Y$
(c) $\sim X \wedge Y$ (d) $\sim(X \wedge Y)$

**Q.27** Which one of the following is NOT logically equivalent to $\neg\exists x(\forall y(\alpha) \wedge \forall z(\beta))$
(a) $\forall x(\exists z(\neg\beta) \rightarrow \forall y(\alpha))$
(b) $\forall x(\forall z(\beta) \rightarrow \exists y(\neg\alpha))$
(c) $\forall x(\forall y(\alpha) \rightarrow \exists z(\neg\beta))$
(d) $\forall x(\exists y(\neg\alpha) \vee \exists z(\neg\beta))$

**Q.28** Given that
$A(x)$ means "$x$ is an alligator",
$H(x)$ means "$x$ is an Human", and
$E(x, y)$ means "$x$ eats $y$",
Which of the given choices is the best English translation for the following first order logic statement?
$\forall x\left(H(x) \rightarrow \forall y\left[E(y,x) \rightarrow A(y)\right]\right)$
(a) All humans eat alligators.
(b) Alligators eat only humans.
(c) Every Alligators eats humans.
(d) Only alligators eat humans.

**Q.29** If the binary operation * is defined on a set of ordered pairs of real numbers as $(a, b) * (c, d) = (ad + bc, bd)$ where $b \neq 0$, then the inverse of $(a, b)$ is ______.
(a) $\left(\frac{a}{b^2}, \frac{1}{b}\right)$ (b) $\left(\frac{a}{b^2}, \frac{-1}{b}\right)$
(c) $\left(\frac{-a}{b^2}, \frac{1}{b}\right)$ (d) None of these

**Q.30** Choose the correct statement
(a) $\sim(p \leftrightarrow q)$ and $((p \wedge\sim q) \vee (q \wedge\sim p))$ is equivalent
(b) $\sim(p \leftrightarrow q)$ and $(p \rightarrow\sim q \wedge q \rightarrow \sim p)$ is equivalent
(c) Both (a) and (b)
(d) None of these

**Q.31** $(p \wedge q) \wedge\sim (p \vee q)$ is a negation of
(a) Tautology (b) Fallacy
(c) Both (a) and (b) (d) None of these

**Q.32** Which of the following set of premises is not inconsistent?
(a) $\{P \rightarrow Q, P \rightarrow R, Q \rightarrow\sim R, P\}$
(b) $\{R \cup M \sim R \cup S, \sim M \cup \sim S\}$
(c) $\{R \cup M \sim R \cup S, \sim M, \sim S\}$
(d) None of these

**Q.33** The statement formula
$\{(a \vee b) \wedge (\sim a \vee c) \wedge \sim (b \vee c)\}$ is ______,
(a) a tautology (b) a contradiction
(c) a contingency (d) None of these

**Q.73** Consider the statement, "If you will give me a cow, then I will give you magic beans." Then which of the following statement does not represent the contrapositive statement?
(a) If you will give me a cow, then I will not give you magic beans.
(b) If I will not give you magic beans, then you will not give me a cow.
(c) If I will give you magic beans, then you will give me a cow.
(d) If you will not give me a cow, then I will not give you magic beans.

**Q.74** You have discovered an old paper on graph theory that discusses the viscosity of a graph (which for all you know, is something completely made up by the author). A theorem in the paper claims that "if a graph satisfies condition (V), then the graph is viscous." Which of the following are equivalent ways of stating this claim?
(a) A graph is viscous only if it satisfies condition (V).
(b) A graph is viscous if it satisfies condition (V).
(c) For a graph to be viscous, it is necessary that it satisfies condition (V).
(d) For a graph to be viscous, it is sufficient for it to satisfy condition (V).

**Q.75** You have discovered an old paper on graph theory that discusses the viscosity of a graph (which for all you know, is something completely made up by the author). A theorem in the paper claims that "if a graph satisfies condition (V), then the graph is viscous." Which of the following are equivalent ways of stating the converse of this claim?
(a) Satisfying condition (V) is a sufficient condition for a graph to be viscous.
(b) Satisfying condition (V) is a necessary condition for a graph to be viscous.
(c) Every viscous graph satisfies condition (V).
(d) Only viscous graphs satisfy condition (V).

**Q.76** Consider the statement:
$\forall x(\forall y(x + y = y) \rightarrow \forall z(x \cdot z = 0))$
Then which of the following statement(s) is/are true?
(a) The converse of above statement is $\forall x(\forall z(x \cdot z = 0) \rightarrow \forall y(x + y = y))$
(b) The contrapositive of above statement is $\forall x(\exists z(x \cdot z$ not equals to $0) \rightarrow \exists y(x + y$ not equals to $y))$.
(c) The negation of above statement is $\exists x(\forall y(x + y = y) \wedge \exists z(x \cdot z$ not equals to $0))$.
(d) The above statement can also be represented as $\forall x\ (\forall z(x \cdot z = 0) \rightarrow \forall y\ (x + y = y))$

**Q.77** Consider the following statement:
$\forall x(x < 1 \rightarrow x^2 < 1)$
Then which of the following statement(s) is/are True with respect to given statement
(a) The negation of the statement is $\exists x(x < 1 \wedge x^2 \geq 1)$
(b) The converse of the statement is $\exists x(x < 1 \wedge x^2 \geq 1)$
(c) The contrapositive of the statement is $\forall x(x^2 \geq 1 \rightarrow x \geq 1)$
(d) The converse of the statement is $\forall x(x^2 < 1 \rightarrow x < 1)$

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## Answers — Propositional Logic

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | (a) | 2. | (a) | 3. | (d) | 4. | (b) | 5. | (d) | 6. | (c) | 7. | (b) | 8. | (b) | 9. | (a) |
| 10. | (b) | 11. | (b) | 12. | (a) | 13. | (d) | 14. | (a) | 15. | (b) | 16. | (c) | 17. | (a) | 18. | (a) |
| 19. | (c) | 20. | (c) | 21. | (b) | 22. | (d) | 23. | (d) | 24. | (a) | 25. | (d) | 26. | (b) | 27. | (a) |
| 28. | (d) | 29. | (c) | 30. | (c) | 31. | (a) | 32. | (b) | 33. | (b) | 34. | (b) | 35. | (a) | 36. | (a) |
| 37. | (d) | 38. | (b) | 39. | (c) | 40. | (a) | 41. | (c) | 42. | (b) | 43. | (b) | 44. | (c) | 45. | (b) |
| 46. | (b) | 47. | (d) | 48. | (c) | 49. | (c) | 50. | (b) | 51. | (b) | 52. | (a) | 53. | (d) | 54. | (d) |
| 55. | (c) | 56. | (d) | 57. | (c) | 58. | (a) | 59. | (a) | 60. | (c) | 61. | (c) | 62. | (d) | 63. | (c) |
| 64. | (a) | 65. | (c) | 66. | (b) | 67. | (c) | 68. | (d) | 69. | (b) | 70. | (a, c) | 71. | (a, c, d) | | | | |
| 72. | (b, c) | 73. | (a, c, d) | 74. | (b, d) | 75. | (b, c) | 76. | (a, b, c) | 77. | (a, c, d) | | | | | | |

## Explanations Propositional Logic

**1. (a)**

$([P \to (q \vee r)] \wedge \bar{q} \wedge \bar{r}) \to \bar{P}$ is tautology hence it is valid argument.

**2. (a)**

$\neg \forall x \forall y [(x < y) \to (x^2 < y^2)]$

$\cong \exists x \exists y \neg [(x < y) \to (x^2 < y^2)]$

$\cong \exists x \exists y \neg [\neg(x < y) \vee (x^2 < y^2)]$

$\cong \exists x \exists y [(x < y) \wedge \neg (x^2 < y^2)]$

$\cong \exists x \exists y [(x < y) \wedge (x^2 \geq y^2)]$

**3. (d)**

$F(x) \Rightarrow x$ is my friend.
$P(x) \Rightarrow x$ is perfect.
(d) is correct answer.
(a) There exist some friend which are not perfect.
(b) There are some people who are not my friend and are perfect.
(c) There exist some people who are not my friend and are not perfect.
(d) There does not exist any person who is my friend and perfect.
So, option (d) is correct.

**4. (b)**

This states the original accurately. If something is a book that I read last year, then it is guaranteed to be adventure story. The equivalent rule is that if a book is not an adventure story, then i definitely did not read it last year.

**5. (d)**

Let $P(x) = x$ likes paintings, $F(x) = x$ likes flowers, $R(x) = x$ likes running, $M(x) = x$ likes music
Statement (i) implies $P(x) \to F(x)$
Statement (ii) implies $R(x) \to M(x)$
Statement (iii) implies $\sim M(x) \to \sim P(x)$ can be written as $F(x) \to M(x)$
From statement 2 and 3, we can get $P(x) \to M(x)$
Only statement (4) is correct.
So, option (d) is correct.

**6. (c)**

(c) is the correct option.

**7. (b)**

$P(1, 1) : 1 + 1 = 1 - 1$ is false
$P(3, 0) : 3 + 0 = 3 - 0$ is true
$\exists x P(x, 2) : \exists x (x + 2 = x - 2)$ is false as there is no solution
$\exists x \forall y P(x,y) : \exists x \forall y (x + y = x - y)$ is false since this can be made true only if y = 0
$\exists y \forall x P(x,y) : \exists y \forall x (x + y = x - y)$ is true since for y = 0 the equation is true for all x
$\forall x \exists y P(x, y) : \forall x \exists y (x + y = x - y)$ is true since for all $x$, $y = 0$ will satisfy the equation.

**8. (b)**

III is true since once a variable is bound to a qualifier it's name does not matter.
So $\exists x Q(x)$ is same $\exists y Q(y)$ and so II is true since LHS and RHS is same.

I is false, since
LHS: some value of $x$ satisfies both $P$ and $Q$
RHS: some values satisfies $P$ and some value satisfies $Q$, but these 2 values need not be same.

II is true, since
If the same value satisfies both $P$ and $Q$ surely some value satisfies $P$ and some values satisfies $Q$.
In other words LHS of implication is stronger than RHS and hence implication will be true.

**9. (a)**

Given $[(p \vee q] \wedge \neg p \neg q]$

The precedence of the used operators are: $\wedge > \vee > \to$

Therefore, $[(p \vee q] \wedge \neg p \to \neg q]$

$\Rightarrow \quad [((p \vee q) \wedge \neg p) \to \neg q]$

$\Rightarrow \quad [((p \wedge \neg p) \vee (q \wedge \neg p)) \to \neg q]$

(using distributing law)

$\Rightarrow \quad [(0 \vee (q \wedge \neg p)) \to \neg q]$

$\Rightarrow \quad [(q \wedge \neg p) \to \neg q]$

$\Rightarrow$ $[\neg(q \wedge \neg p) \vee \neg q)]$ (using Demorgan's law)

$\Rightarrow$ $[\neg q \vee p \vee \neg q]$

$\Rightarrow$ $[p \vee \neg q]$

$\therefore$ Option (a) is correct.

**10. (b)**

I. $\forall x \exists y\ R(x,y) \rightarrow \exists y(\exists x\ R(x,y))$ is true, since $\exists y\ (\exists x\ R(x,y)) \equiv \exists x\ (\exists y\ R(x,y))$

II. $\forall x \exists y\ R(x,y) \rightarrow \exists y(\forall x\ R(x,y))$ is false

Since $\exists y$ when it is outside is stronger then when it is inside.

III. $\forall x \exists y\ R(x,y) \rightarrow \forall y \exists x\ R(x,y)$ is false

Since $R(x, y)$ may not be symmetric in $x$ and $y$.

IV. $\forall x \exists y\ R(x,y) \rightarrow \neg(\exists x \forall y\ \neg R(x,y))$ is true

Since $\neg(\exists x \forall y \neg\ R(x,y)) \equiv \forall x \exists y\ R(x,y)$

So, IV will reduce to

$\forall x \exists y\ R(x,y) \rightarrow \forall x \exists y\ R(x,y)$ which is trivially true.

So correct answer is I and IV only which is option (b).

**11. (b)**

(a) $(a \vee b) \rightarrow (b \wedge c)$

$\equiv (a + b)' + bc$

$\equiv a'\ b' + bc$

Therefore, $((a \vee b) \rightarrow (b \wedge c))$ is contingency and not tautology.

(b) $(a \wedge b) \rightarrow (b \vee c)$

$\equiv ab \rightarrow b + c$

$\equiv (ab)' + b + c$

$\equiv a' + b' + b + c$

$\equiv a' + 1 + c \equiv 1$

So $((a \wedge b) \rightarrow (b \vee c))$ is tautology.

(c) $(a \vee b) \rightarrow (b \rightarrow c)$

$\equiv (a + b) \rightarrow (b' + c)$

$\equiv (a + b)' + b' + c$

$\equiv a'\ b' + b' + c$

$\equiv b' + c$

So $((a \vee b) \rightarrow (b \rightarrow c))$ is contingency but not tautology.

(d) $(a \rightarrow b) \rightarrow (b \rightarrow c)$

$\equiv (a' + b) \rightarrow (b' + c)$

$\equiv (a' + b)' + b' + c$

$\equiv ab' + b' + c$

$\equiv b' + c$

Therefore, $((a \rightarrow b) \rightarrow (b \rightarrow c))$ is contingency but not tautology.

**12. (a)**

$P(x) : x < = 4$

(a) $P(0)$: $0 < = 4$ True

(b) $P(6)$: $6 < = 4$ False

(c) $P(8)$: $8 < = 4$ False

(d) $P(9)$: $9 < = 4$ False

So, option (a) is correct.

**13. (d)**

All statement S(I), S(II) and S(III) is correct.

**14. (a)**

$F_1 : P \rightarrow \sim P \equiv p \rightarrow p' \equiv p' + p' \equiv p'$

So $F_1$ is contingency. Hence, $F_1$ is satisfiable but not valid.

$F_2 : (P \rightarrow \sim P) \vee (\sim P \rightarrow P)$

$\equiv (p \rightarrow p') + (p' \rightarrow p)$

$\equiv (p' + p') + (p + p)$

$\equiv p' + p \equiv 1$

So $F_2$ is tautology and therefore valid.

**15. (b)**

$(a \leftrightarrow c) \rightarrow (\sim b \rightarrow (a \wedge c))$

$(a'c' + ac) \rightarrow (b + (ac))$

$(a'c + ac') + (b + ac)$

$a(c + c') + a'c + b$

$a + a'c + b$

$a + c + b$

So not tautology but contingency.

**16. (c)**

$X$ = {integer}

$X$ = {–2, –1, 0, 1, 2 ....}

$P(X) : X = X^2$

(a) $P(2)$: False, since $2 \neq 2 \wedge 2$

(b) $P(-1)$: False, since $-1 \neq (-1) \wedge 2$

(c) $\exists x P x$ : True; let $x = 0$, since $0 = 0^2$

(d) $\forall x P(x)$; False; let $x = 2$, since $2 \pm 2^2$

Hence, option (c) is correct.

**17. (a)**

"Either everything is material or there are somethings that are not material"

Either-OR means XOR.

We will define $P$ as $\forall x$ (material($x$))

$q$ as $\exists x$ ($\neg$ material ($x$))

Either $P$ or $q \equiv (\neg P \wedge q) \vee (P \wedge \neg q)$

$\Rightarrow$ $(\neg \forall x$ (material $(x)) \wedge \exists x$ ($\neg$ material $(x))) \vee$

$(\forall x$(material $(x)) \wedge \neg \exists x(\neg$ material $(x)))$

$\Rightarrow$ $(\exists x(\neg$ material $(x)) \wedge \exists x(\neg$ material $(x)))$

$(\forall x$(material $(x)) \wedge \forall x$(material $(x)))$

$\Rightarrow$ $(\exists x(\neg$ material $(x)) \vee (\forall x$ (material $(x)))$

Hence, option (a) is correct.

**18. (a)**

By truth table,

| P | q | P′ | q′ | P → q | ~(P → q) | ~(P → q) → P | let S<br>~P∧(P → q) | S → P | S → ~q | S → q |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 |
| | | | | | | (a) | | (b) | (c) | (d) |

So, from above truth table, (a) option is correct.

**19. (c)**

$\sim\left[\exists x\, S(x) \wedge \forall_y \text{GATE}(x, y)\right]$

$= \sim \forall y \exists x\, [S(x) \wedge \text{GATE}\,(x, y)]$

$= \exists y \forall x\, [\sim S(x) \vee \sim \text{GATE}\,(x, y)]$

**20. (c)**

$[(A \vee B) \wedge (A \rightarrow C) \wedge (B \rightarrow D)] \rightarrow (D \vee C)$

$= \neg\, [(A \vee B) \wedge (\neg A \vee C) \wedge (\neg B \vee D)] \vee (D \vee C)$

$= \neg\, (A \vee B) \vee \neg(\neg A \vee C) \vee \neg(\neg B \vee D) \vee D \vee C$

$= (\neg A \wedge \neg B) \vee (A \wedge \neg C) \vee (B \wedge \neg D) \vee D \vee C$

$= (\neg A \wedge \neg B) \vee (A \wedge \neg C\ ) \vee B \vee D \vee C$

$= (\neg A \wedge \neg B) \vee A \vee B \vee D \vee C$

$= \neg A \vee A \vee B \vee D \vee C$

$= T \vee B \vee D \vee C$

= true

$\therefore$ It is tautology

**21. (b)**

I $\quad \neg \forall x P(x) \equiv \exists x \neg P(x)$

and IV $\quad \exists x \neg P(x)$

Clearly, choices I and IV are equivalent.

II $\quad \neg \exists x P(x) \equiv \forall x \neg P(x)$

and III $\quad \neg \exists x\left[\neg P(x)\right] \equiv \forall x P(x)$

Clearly II and III are not equivalent to each other or to I and IV.

**22. (d)**

The correct translation of "Gold and silver ornaments are precious" is choice (d)

$$\forall x((G(x) \vee S(x)) \rightarrow P(x))$$

which is read as "if an ornament is gold or silver, then it is precious".

Now since a given ornament cannot be both gold and silver at the same time.

Choice (b) $\forall x((G(x) \wedge S(x)) \rightarrow P(x))$ is incorrect.

**23. (d)**

Option (d) is correct

$\therefore$ A-4; B-3; C-1; D-2

**24. (a)**

Let us assume the contrapositive, i.e., both $x$, $y$ are less than 1.

Now, we are given that fact that $x + y \geq 2$, but from our assumption that $x < 1$ and $y < 1$, we get that $x + y < 2$ which defines the given fact.

Hence, option (a) is correct option.

# THEORY OF COMPUTATION

OBJECTIVE PRACTICE SETS

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# 1 CHAPTER

# Grammars, Languages and Automata

## Multiple Choice Questions & NAT Questions

**Q.1** Suppose $L_1$ = {10, 1} and $L_2$ = {011, 11}. How many distinct elements are there in $L = L_1 L_2$.

(a) 4 (b) 3
(c) 2 (d) None of these

**Q.2** In a string of length $n$, how many proper prefixes can be generated

(a) $2^n$ (b) $n$
(c) $\frac{n(n+1)}{2}$ (d) $n - 1$

**Q.3** Let $u$, $v$, $\in \Sigma^*$ where $\Sigma = \{0, 1\}$. Which of the following are TRUE?

1. $|u.v| = |v.u|$
2. $u.v = v.u$
3. $|u.v| = |u| + |v|$
4. $|u.v| = |u|\,|v|$

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

**Q.4** How many odd palindromes of length 11 are possible with alphabet $S = \{a, b, c\}$

(a) $3^6$ (b) $2^5$
(c) $2^6$ (d) $3^5$

**Q.5** The number of distinct subwords present in 'MADEEASY' are ________.

**Q.6** Consider the following statements:

1. Type 0 grammars generate all languages which can be accepted by a Turing machine.
2. Type 1 grammars generate the languages which can all be recognized by a push down automata.
3. Type 3 grammars have one to one correspondence with the set of all regular expressions.
4. There are some languages which are not accepted by a Turing machine.

Which of the above statements are TRUE?

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

**Q.7** Consider the following table of an FA:

| δ | $a$ | $b$ |
|---|---|---|
| start | $q_1$ | $q_0$ |
| $q_0$ | $q_1$ | $q_0$ |
| $q_1$ | $q_2$ | $q_1$ |
| $q_2$ | $q_3$ | $q_2$ |
| $q_3$ | $q_4$ | $q_3$ |
| $q_4$ | $q_4$ | $q_4$ |

If the final state is $q_4$, the which of the following strings will be accepted?

1. *aaaaa*
2. *aabbaabbbbb*
3. *bbababababbb*

(a) 1 and 2 (b) 2 and 3
(c) 3 and 1 (d) All of these

**Q.8** Which of the following statements is correct?

(a) Some finite automata accept non regular languages.
(b) A grammar with recursion always generates infinite languages.
(c) An infinite language can be generated by a non recursive grammar.
(d) A deterministic push down automata cannot generate all context free languages.

**Q.9** The grammar with start symbol $S$ over $\Sigma = \{a, b\}$ $S \rightarrow aSbb \mid abb$ belongs to the class

(a) Type 0 (b) Type 1
(c) Type 2 (d) Type 3

**Q.10** What is the language generated by the grammar where S is the start symbol and the set of terminals and non terminals is {$a$} and {A, B} respectively?

$S \rightarrow Aa$
$A \rightarrow B$
$B \rightarrow Aa$

(a) Set of strings with atleast one $a$
(b) Set of strings with even number of $a$'s
(c) Set of strings with odd number of $a$'s
(d) Empty language

**Q.11** How many even palindromes of length atmost 10 are possible with alphabet $\Sigma = \{0, 1, 2\}$?

(a) $\frac{3^5 - 1}{2}$ (b) $3^5 - 1$

(c) $\frac{3^6 - 1}{2}$ (d) $3^6 - 1$

**Q.12** Consider the languages $L_1 = \phi$ and $L_2 = \{1\}$. Which one of the following represents $L_1^* \cup L_2^* L_1^*$?

(a) $\{\lambda\}$ (b) $\{\lambda, 1\}$

(c) $\phi$ (d) $1^*$

**Q.13** Given language, $L_1 = \{a^n b^n\}$ and $L_2 = \{a^{2n} b^{2n}\}$. Identify the statements which are TRUE.

1. The language obtained by intersection of languages $L_1$ and $L_2$ is same as $L_2$.
2. The language obtained by performing $L_1 - L_2$ is given by $L_3 = \{a^{2n+1} b^{2n+1}\}$
3. The language obtained by union of $L_1$ and $L_2$ is same as $L_1$.
4. The language obtained by performing $L_2 - L_1$ is empty.

Which of the above statements are correct?

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

(c) 3 and 4 (d) All are correct

**Q.14** Let, $L_1 = \{a^n b^n c^n \mid n \geq 0\}$

$L_2 = \{a^{2n} b^{2n} c^{2n} \mid n \geq 0\}$

$L_3 = \{a^{2n} b^{2n} c^n \mid n \geq 0\}$

(a) $L_1 \subseteq L_2$ and $L_3 \subseteq L_2$

(b) $L_2 \subseteq L_1$ and $L_2 \subseteq L_3$

(c) $L_2 \subseteq L_1$ but $L_2 \not\subset L_3$

(d) $L_1 \subseteq L_2$ and $L_2 \subseteq L_3$

**Q.15** Let $L = \{ab, aa, baa\}$. How many of the following strings are in $L^*$?

(a) abaabaaabaa (b) baaaaabaa

(c) baaaaabaaaab (d) aaaabaaaa

**Q.16** The prefix of a language is defined as

prefix $(L) = \{x : xy \in L$ for some $y \in \Sigma^*\}$

and the suffix is defined as

suffix $(L) = \{y : xy \in L$ for some $x \in \Sigma^*\}$

Which of the following statements is always correct?

(a) prefix(L) $\cap$ suffix (L) $= \phi$

(b) prefix(L) $\cap$ suffix (L) $\supseteq (\Sigma, L)$

(c) prefix(L) $\cap$ suffix (L) $\subseteq (\Sigma, L)$

(d) prefix(L) $\cap$ suffix (L) $= (\Sigma, L)$

**Q.17** Let, $L_1$ = (Strings with any number of $a$'s followed by any number of $b$'s) and $L_2 = (ba)$. $L_3$ = Prefix $(L_1^* \cap L_2)$. The number of strings in $L_3$. will be ________.

**Q.18** What language does the grammar with these productions generate?

$S \rightarrow aaA$

$A \rightarrow aA|\varepsilon$

(a) strings with even number of $a$' s

(b) strings with odd number of $a$' s

(c) strings with atmost 2 $a$' s

(d) strings with atmost 2 $a$' s

**Q.19** Let, $L_1 = \{a^* b^*\}$ and $L_2 = \{b^* a^*\}$. The language $L = L_1 \, n \, L_2$ is represented by

(a) $\phi$ (b) $a^* + b^*$

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

**Q.20** Let $L_1 = \{a^n | \, n \geq 0$ and $L_2 = \{b^n | \, n \geq 0\}$. Then L is given by $L_1 L_2$. Which of the following statement(s) is/are true about $L$?

1. $L$ is the language of strings with equal number of $a$'s followed by an equal number of $b$'s.
2. $L$ is a context free language but not regular.
3. $L$ is regular.
4. $L = \{a^n b^n \mid n \geq 0\}$

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

(c) 1 and 4 (d) 3 only

**Q.21** How many of the following statements are correct?

1. Both $L$ and $\overline{L}$ can be finite
2. $(\overline{L^*}) = (\overline{L})^*$
3. $(L_1 L_2)^R = (L_2)^R (L_1)^R$
4. $(L^*)^* = L^*$

(a) Only 1 (b) Only 2

(c) 1 and 2 (d) All of the above

**Q.22** Given $L = \{a^n | n \geq 0\}$ over $\Sigma = \{a\}$. What is the language represented by $L^2$?

(a) Set of all strings over $\Sigma$ with odd length

(b) Set of all strings over $\Sigma$ with even length

(c) Set of all strings over $\Sigma$

(d) None of these

**Q.23** Let, $L = \{\lambda, 0, 01, 10\}$. Which of the following strings does not belong to $L^5$?

(a) 110 010 (b) 101001001

(c) 100100 (d) 01101001

**Q.24** Which of the following conversions is not possible?
(a) Regular grammar to context free grammar
(b) NFA to DFA
(c) Non deterministic PDA to deterministic PDA
(d) Non deterministic Turing machine to deterministic Turing machine

**Q.25** If $S = \{ab, ba\}$, which of the following is true?
(a) $S^*$ contains finite no of strings of infinite length.
(b) $S^*$ has no strings having '*aaa*' or '*bbb*' as substring.
(c) $S^*$ has no strings having aa as substring.
(d) If $T = \{a, b\}$, then $S^* \not\subseteq T^*$,

## Multiple Select Questions (MSQ)

**26.** Given the language $L$ = {ab, aa, baa}, which of the following strings are in $L^*$?
(a) abaabaaabaa
(b) aaaabaaaa
(c) baaaaabaaaab
(d) baaaaabaa

## Answers — Grammars, Languages & Automata

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1. (b) | 2. (b) | 3. (a) | 4. (a) | 5. (34) | 6. (c) | 7. (a) | 8. (d) | 9. (c) |
| 10. (d) | 11. (c) | 12. (d) | 13. (d) | 14. (c) | 15. (c) | 16. (b) | 17. (3) | 18. (d) |
| 19. (b) | 20. (d) | 21. (b) | 22. (c) | 23. (a) | 24. (c) | 25. (b) | 26. (a, b, d) | |

## Explanations — Grammars, Languages & Automata

**1. (b)**

$L_1 = \{10, 1\}$,
$L_2 = \{011, 11\}$

By concatenation of $L_1$ and $L_2$ we get

$L_1 \cdot L_2 = \{10011, 1011, 1011, 111\}$

Hence, 3 distinct elements are there.

**2. (b)**

Suppose, $S = aaab$, $|s| = 4$. The prefixes are $S_p = \{\lambda, a, aa, aaa, aaab\}$. Here aaab is not a proper prefix.

**Note:** The proper prefix of string $S$ is a prefix, which is not same as string $S$.

A string of length 4 has 4 proper prefixes. A string of length 5 has 5 proper prefixes. For a string of length $n$, therefore we can have '$n$' proper prefixes.

**3. (a)**

Let, $u = 1001$ and $v = 001$

$u.v = 1001001$ and $v.u = 001\,1001$

$|u, v| = |v, u| = |u| + |v|$

But, $u.v \neq v.u$

**4. (a)**

Palindromes can be represented by

$\{ww^R \mid w \in \{a, b, c\}^*\} \cup$

$\{wxw^R \mid w \in (a, b, c)^*,\ x \in (a, b, c)\}$

Since, we need to count the number of odd palindromes of length 11, the number of possible $w$'s of length 5 are $|\Sigma|^5$ i.e. $3^5$

Number of possible ways for $x = 3$

$\therefore$ Number of odd palindromes of length

$11 = 3^5 \times 3 = 3^6$

Number of odd palindromes of length,

$$n = |\Sigma|^{\frac{n-1}{2}} \times |\Sigma| = |\Sigma|^{\frac{n+1}{2}}$$

**5. (34)**

Distinct subwords of

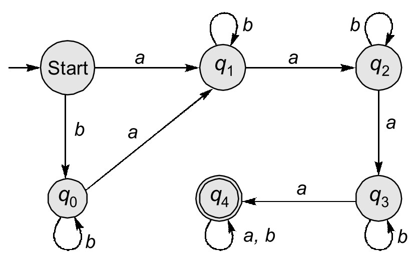
| | |
|---|---|
| Length 1 = 6 | Length 5 = 4 |
| Length 2 = 7 | Length 6 = 3 |
| Length 3 = 6 | Length 7 = 2 |
| Length 4 = 5 | Length 8 = 1 |

$\therefore$ Total = 34

**6. (c)**

See Chomsky Hierarchy languages, which are not recursively enumerable are not recognized by any machine.

**7. (a)**




Drawing the FA we have

we can clearly see that only (i) *aaaaa* and (ii) *aabbaabbbbb* are accepted.

**8. (d)**

(a) Is false since a FA can accept only regular languages as it has finite memory only.

(b) Is false consider the grammar $\{S \to Sa\}$ which a recursive. It generates the empty languages i.e. $\phi$ which is finite.

(c) Is false. To generate an infinite language, the grammar must have recursion.

(d) True DPDA cannot generate all CFLs. It generates a subset of CFLs called DCFLs. DPDA has less recognition power than a PDA.

**9. (c)**

The given grammar is Type 2 as every rule is restricted as:

$V \to (V \cup T)^*$

where $V$ is the set of non-terminals and T is set of terminals.

**10. (d)**

Since there is no string which can be generated from the grammar in finite number of steps as there is no termination, (d) is true.

**11. (c)**

If the sequence has even length say, $n = 2k$, selecting the first $k$ characters completely determines the palindrome since the remaining $k$ characters can be found by repeating the sequence in the reverse order. Number of palindromes of even length atmost $n$ in alphabet with $x$ characters is

$$x^0 + x^1 + x^2 + \ldots x^k = \frac{-1 + x^{k+1}}{x-1}.$$

Here, $x = 3$ and $k = 5$

$\therefore \frac{3^6 - 1}{2}$ is the number of palindromes of length atmost 10.

**12. (d)**

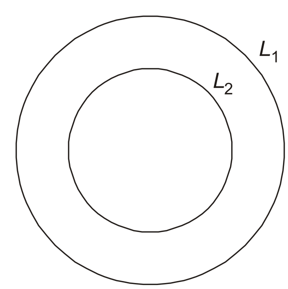
$$L_1^* = \{\phi\}^* = \{\lambda\}$$

$$L_2^* = \{1\}^* = 1^*$$

$$L_1^* \cup L_2^* L_1^* = \{\lambda\} \cup \{\lambda\}.1^* = 1^*$$

**13. (d)**

$L_1$ is the set of all strings where any number of $a$'s is followed by an equal number of $b$'s.




$L_2$ is the set of all strings where an even number of $a$'s is followed by an equal number of $b$'s.

$$\therefore \quad L_2 \subseteq L_1$$

$$L_2 \cap L_1 = L_2$$

$$L_2 \cup L_1 = L_1$$

$L_1 - L_2$ = (Set of all strings where an odd number of $a$'s is followed by an equal number of $b$'s)

$$L_2 - L_1 = \phi$$

**14. (c)**

$$L_1 = \{a^n b^n c^n, n \geq 0\}$$
$$= \{\lambda, abc, a^2b^2c^2, \ldots\}$$
$$L_2 = \{a^{2n} b^{2n} c^{2n}, n \geq 0\}$$
$$= \{\lambda, a^2b^2c^2, a^4b^4c^4, \ldots\}$$
$$L_3 = \{a^{2n} b^{2n} c^n, n \geq 0\}$$
$$= \{\lambda, a^2b^2c, a^4b^4c^2, \ldots\}$$

as we can easily see that

(i) $L_1$ contains all the words generated by $L_2$ and also it contains some extra strings.

$\therefore$ $L_1 \supseteq L_2$. (or $L_2 \subseteq L_1$)

(ii) Since only $\lambda$ is common in $L_2$ and $L_3$

Hence $L_2 \not\subset L_3$.

**15. (c)**

$L^*$ is a combination of strings in $L$.

1. abaabaaabaa = ab aa baa ab aa belongs to $L^*$.
2. baaaaabaa = baa aa ab aa belongs to $L^*$.
3. baaaaabaaaab = baa aa ab aa aa b does not belong to $L^*$.
4. aaaabaaaa = aa aa baa aa belongs to $L^*$.

**16. (b)**

Both prefix and suffix consists of ε and $L$.
However in case of binary alphabet, for instance,
prefix ($L$) = suffix($L$)
∴ Prefix ($L$) ∩ suffix ($L$) ⊇ {Σ, $L$}

**17. (3)**

$L_1$ can be represented by $a^*b^*$

$$L_1^* = (a^*b^*)^* = (a+b)^*$$
$$L_2 = (ba)$$
$$L_1^* \cap L_2 = [(a+b)^*] \cap (ba)$$
$$= (ba)$$
$$\text{Prefix}, (L_3) = (\varepsilon, b, ba)$$

**18. (d)**

(a) is false as 'aaa' is generated by the grammar.
(b) is false as 'aa' is generated.
(c) is false as 'aaa' is generated.
A generates the language represented by $a^*$ {0 or more $a$'s}
$S$ generate aaa*

**19. (b)**

$L_1$ is the set of strings where zero or more $a$'s is followed by zero or more $b$'s.
$L_2$ is the set of strings where zero or more $b$'s is followed by zero or more $a$'s.
$L_1$ $n$ $L_2$ - Set of strings of only $a$'s or only $b$'s including the NULL string λ.

∴ $L_1 \cap L_2 = \{a^* + b^*\}$

Note: $a^*b^* = a^+b^+ + a^* + b^*$
$b^*a^* = b^+a^+ + a^* + b^*$

**20. (d)**

$L = \{a^nb^m \mid n, m \geq 0\}$ i.e. the number of $a$'s and number of $b$'s are independent.
∴ $L$ is a regular language.

$$L_1 = \{\varepsilon, a, aa, aaa, ...\}$$
$$L_2 = \{\varepsilon, b, bb, bbb, ...\}$$
$$L = L_1L_2 = \{\varepsilon, ab, abb, abbb, aab, ...\}$$

**21. (b)**

1. False

Case (i) $L$ is finite
We know that Σ* is infinite

$$\overline{L} = \Sigma^* - L$$

∴ $\overline{L}$ must be infinite as it is obtained by removing a finite number of string from an infinite set.

Case (ii) $L$ is infinite
Σ* is infinite

$$\overline{L} = \Sigma^* - L$$

∴ $\overline{L}$ may be finite or infinite

From above, in any case, both $L$ and $\overline{L}$ cannot be finite.

2. False

$$\lambda \in L^*$$
$$\Rightarrow \quad \lambda \notin \left(\overline{L^*}\right)$$

But $\left(\overline{L}\right)^*$ must contain λ.

∴ No language satisfies $\left(\overline{L^*}\right) = \left(\overline{L}\right)^*$

3. True

Let $u \in L_1$, $v \in L_2$
$$L_1L_2 = \{uv\}$$
$$(L_1L_2)^R = (uv)^R = v^Ru^R$$
$$= (L_2)^R(L_1)^R \;\forall u, v$$

4. True

For all Σ
(i) $L^* \subseteq (L^*)^*$. This is because $L^* = \{w_1, w_2, ...\}$ and therefore $\{w_1, w_2, ...\} \subseteq \{w_1, w_2, ...\}^*$.
(ii) $(L^*)^* \subseteq (L^*)$. For every $w \notin (L^*)^*$, we can decompose it as
$w = w_1w_2w_3... w_n$ such that each $w_i \in L^*$. Similarly we can decompose $w_i$ such that $w_i = w_{1i}w_{2i}w_{3i}... w_{iNi}$ where $W_iN_i \in L$. So, $w \in L^*$
Now, $w = w_{11}w_{21}w_{31}....w_1NW_{12}....w_2N_2.....$
where $w_{ij} \notin L$
So $w \in L^*$
From (i) and (ii) $L^* = (L^*)^*$
[$L^*$ is the combination of strings in $L$]

**22. (c)**

$$L = \{\lambda, a, aa, aaa, ...\}$$
$$L^2 = L.L = \{\lambda, a, aa, aaa, aaaa, ...\ a^n\}$$
∴ $L^2$ is the set of all strings over Σ

# COMPILER DESIGN

**OBJECTIVE PRACTICE SETS**

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# 1 CHAPTER Introduction to Compiler

## Multiple Choice Questions

Q.1 Which translator program converts assembly language program to object program?
(a) Assembler (b) Compiler
(c) Microprocessor (d) Linker

Q.2 Which one is a phase of a compilation process?
(a) Lexical analysis (b) Code generation
(c) Both (a) and (b) (d) None of these

Q.3 Choose the correct sequence of occurrence during compilation process.
(a) Character stream → Parse Tree → Optimized code
(b) Parse tree → Token stream → Intermediate code
(c) SDT tree → Parse tree → Optimized code
(d) Parse tree → 3 address code → Character stream

Q.4 Assembly language
(a) is usually the primary user interface
(b) requires fixed format commands
(c) is a mnemonic form of machine language
(d) is quite different from the SCL interpreter

Q.5 For which of the following reasons compiler is preferable to an interpreter?
(a) It can generate stand-alone programs that often take less time for execution.
(b) It is much helpful in the initial stages of program development.
(c) Debugging can be faster and easier
(d) It needs less computer resources

Q.6 In a context-free grammar
(a) ε can't be the right-hand side of any production
(b) terminal symbols can't be present i the left-hand side of any production.
(c) the number of grammar symbols in the left-hand side is not greater than the number of grammar symbols in the right hand side.
(d) All of the above

Q.7 The cost of developing a compiler is proportional to the
(a) complexity of the source language
(b) complexity of the architecture of the target machine
(c) flexibility of the available instruction set
(d) All of the above

Q.8 Semantic errors can be detected by the system
(a) At compile time only
(b) At run time only
(c) Both at compile and run time
(d) None of these

Q.9 Undeclared name is _______ error.
(a) Syntax (b) Lexical
(c) Semantic (d) No

Q.10 A simple two-pass assembler does not do which of the following in the first pass?
(a) It allocates space for the literals.
(b) It computes the total length of the program.
(c) It builds the symbol table for the symbols and their values.
(d) It generates code for all the load and stores register instructions.

Q.11 Consider the following statement:
$S_1$: Analysis phase of compiler includes code optimization stages.
$S_2$: Synthesis phase of compiler is followed by analysis phase.
(a) $S_1$ is correct, $S_2$ is not
(b) $S_2$ is correct, $S_1$ is not
(c) $S_1$ and $S_2$ are correct
(d) $S_1$ and $S_2$ are incorrect

Q.12 Match the following groups:
**List-I**
A. Lexical analyzer
B. Syntax analyzer
C. Type checking
D. Intermediate code generation

List-II
1. Checks the structure of the program.
2. Analysis of entire program by reading each character.
3. High level language is translated to simple machine independent language.
4. Checks the consistency requirements in a context of the program.

Codes:

| | A | B | C | D |
|---|---|---|---|---|
| (a) | 1 | 2 | 4 | 3 |
| (b) | 2 | 1 | 4 | 3 |
| (c) | 2 | 4 | 3 | 1 |
| (d) | 1 | 4 | 3 | 2 |

**Q.13** An optimizing compiler
(a) is optimized to occupy less space
(b) is optimized to take less time for execution
(c) optimized the code
(d) None of the above

**Q.14** Which of the following is not a functionality of C compiler?
(a) Identifying syntax error
(b) Identifying tokens
(c) Linking
(d) None of these

**Q.15** Which of the following grammars are not phase structured?
(a) Regular (b) Context-free
(c) Context-sensitive (d) None of the above

**Q.16** Cross-compiler is a compiler
(a) which is written is a language that a different from the source language.
(b) that generates object code for its last machine.
(c) which is written in a language that is same as the source language.
(d) that runs on one machine but produces object code for another machine.

**Q.17** Match **List-I** with **List-II** and select the correct answer using the code given below:

| List-I | List-II |
|---|---|
| A. Load time | 1. Relocation |
| B. Compile time | 2. Token recognition |
| C. Link time | 3. Resolving reference |
| D. Run time | 4. Activation record |

Code:

| | A | B | C | D |
|---|---|---|---|---|
| (a) | 1 | 4 | 3 | 2 |
| (b) | 1 | 2 | 3 | 4 |
| (c) | 1 | 3 | 2 | 4 |
| (d) | 4 | 1 | 3 | 2 |

**Q.18** If *w* is a string of terminal and A, B are two non-terminals, then which of the following are right-linear are grammars?
(a) A → B W
(b) A → B W/W
(c) A → WB/W
(d) None of the above

**Q.19** CSG can be recognized by
(a) pushdown automata
(b) 2-way linear bounded automata
(c) finite state-automata
(d) None of the above

**Q.20** A Top-down parser generates
(a) left-most derivation
(b) right-most derivation
(c) right-most derivation in reverse
(d) left-most derivation in reverse

**Q.21** A programming language is to be designed to run on a machine that does not have a big memory. The language should
(a) prefer a 2 pass compiler to a 1 pass compiler
(b) prefer an interpreter to a compiler
(c) not support recursion
(d) All of the above

**Q.22** A loader is
(a) a program that place programs into memory and prepares them for execution
(b) a program that automates the translations of assembly language into machine language
(c) a program that accepts a program written in a high level language and produces an object program
(d) a program that appears to execute a source program as if it were machine language

**Q.23** Which of the following is the most general phase-structured grammar?
(a) Regular (b) Context-free
(c) Context-sensitive (d) None of the above

**Q.35** Choose the correct statements:
(a) Sentence of a grammar is a sequential form without any terminals.
(b) Sentence of a grammar should be derivable from the start state.
(c) Sentence of a grammar should be frontier of a derivation tree, in which the root node has the start state as the label.
(d) None of the above

**Q.36** Representing the syntax by a grammar is advantageous because
(a) It is concise
(b) It is accurate
(c) Automation becomes easy
(d) All of the above

**Q.37** CFG can be recognized by a
(a) push down automata
(b) finite state automata
(c) 2-way linear bounded automata
(d) Non finite state automata

## Multiple Select Questions (MSQ)

**Q.38** For which of the following reasons, an interpreter is preferred to a compiler?
(a) It takes less time to execute
(b) It is much helpful in the initial stages of program development.
(c) Debugging is easier.
(d) It needs less computer resources.

**Q.39** Storage mapping is done by
(a) Operating system (b) Compiler
(c) Linker (d) Loader

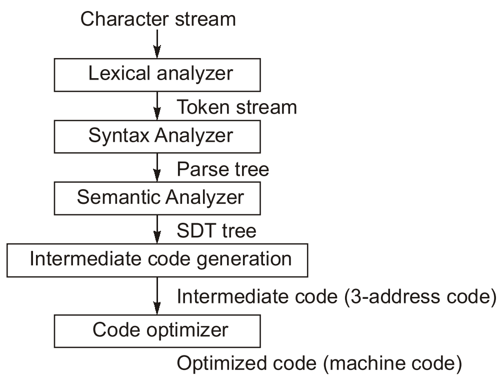
■■■■

## Answers: Introduction to Compiler

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | (a) | 2. | (c) | 3. | (a) | 4. | (c) | 5. | (a) | 6. | (b) | 7. | (d) | 8. | (a) | 9. | (c) |
| 10. | (d) | 11. | (d) | 12. | (b) | 13. | (c) | 14. | (c) | 15. | (d) | 16. | (d) | 17. | (b) | 18. | (c) |
| 19. | (b) | 20. | (a) | 21. | (d) | 22. | (a) | 23. | (c) | 24. | (d) | 25. | (c) | 26. | (a) | 27. | (d) |
| 28. | (b) | 29. | (b) | 30. | (b) | 31. | (b) | 32. | (d) | 33. | (d) | 34. | (b) | 35. | (b) | 36. | (d) |
| 37. | (a) | 38. | (b, c) | 39. | (a, d) | | | | | | | | | | | | |

## Explanations Introduction to Compiler

**3. (a)**




**9. (c)**

It is a semantic error (run-time error).

**11. (d)**

Analysis phase {lexical analysis, syntax analysis, semantic analysis} is followed by synthesis phase {intermediate code generation, code optimizer, machine code generation}

**12. (b)**

**Lexical analyzer:** Reads every character of the program to identify the tokens.
**Syntax analyzer:** Analyzes the syntax or structure of the program.
**Type checking:** It determines violation of consistency requirements.
**ICG:** Translates the program into intermediate language.

**14. (c)**

Linking is done by a linker after compilation process.
Compilation can identify token generates compilation error which can be lexical, syntax or semantic.

**17. (b)**

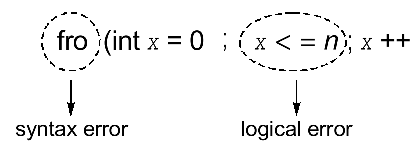
Load time relocation is done on load time:
**Compile time :** Token recognition during complication
**Line time :** Reference can be resolved
**Run time :** Activation record created during run time

**21. (d)**

Since the programming language is to be designed to run on a machine that does not have a big memory. Therefore pass-2 (multi phase), which uses less space is preferred also instead of using a compiler we use an interpreter, which scans the program line by line hence uses less memory at compiler time for each instance. Also it does not support recursion.

**28. (b)**

Although the statement




Has both syntax and logical error
But, it will result in syntax error.
Hence, (b) is correct option.

**30. (b)**

The compiler is divided into two phase all the compiler modules from lexical analysis till ICG are in front end and alter that back end.

**31. (b)**

The preprocessor expand macros, into source language statements and generate modified source program as the output.
The assembly language is processed by a program called an assembles that produces relocatable machine code.
Loader puts together all of the executable object files into memory for execution.

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