Full Length Test
Computer Science and Information Technology

Answer Keys and Explanations

1. [Ans. *] Range: 4 to 4

LAN = Ethernet → using 1-Persistent CSMA/CD Access Control Protocol
Distance of the Cable = d = ?
Bandwidth = B = 1 Gbps = 10^9 bits/sec
Size of Frame = F = 5000 Bytes = 40,000 bits
Speed of Signal = s = 2×10^8 mts/sec
In CSMA/CD,
$F = 2 \times T_p \times B$ bits $= 2 \times d/s \times B$ bits
$40{,}000 = 2 \times d/(2 \times 10^8) \times 10^9$ bits
d = 4000 mts = 4 kilometers.

2. [Ans. B]

DNS	To find the IP address of Email recipient
FTP	To upload files to remote server
HTTP	To access data on World Wide Web
SMTP	To send E-Mail
POP	To access E-Mail form Mail Box

3. [Ans. D]

Relation is in 2NF.
Redundancy is existing because of FD: BC → D, where BC is not a key.
Redundancy will be eliminated completely by decomposing the relation into BCNF. BCNF decomposition of R(ABCD) is R1(ABC) and R2(BCD).

4. [Ans. *] Range: 16 to 16

Gantt chart

A	B	E	C	D	E	A	B	E	C	D	E	B	D	E	D

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Completion time of D is = 16 nsec

5. [Ans. A]

The given grammar is unambiguous for the given string

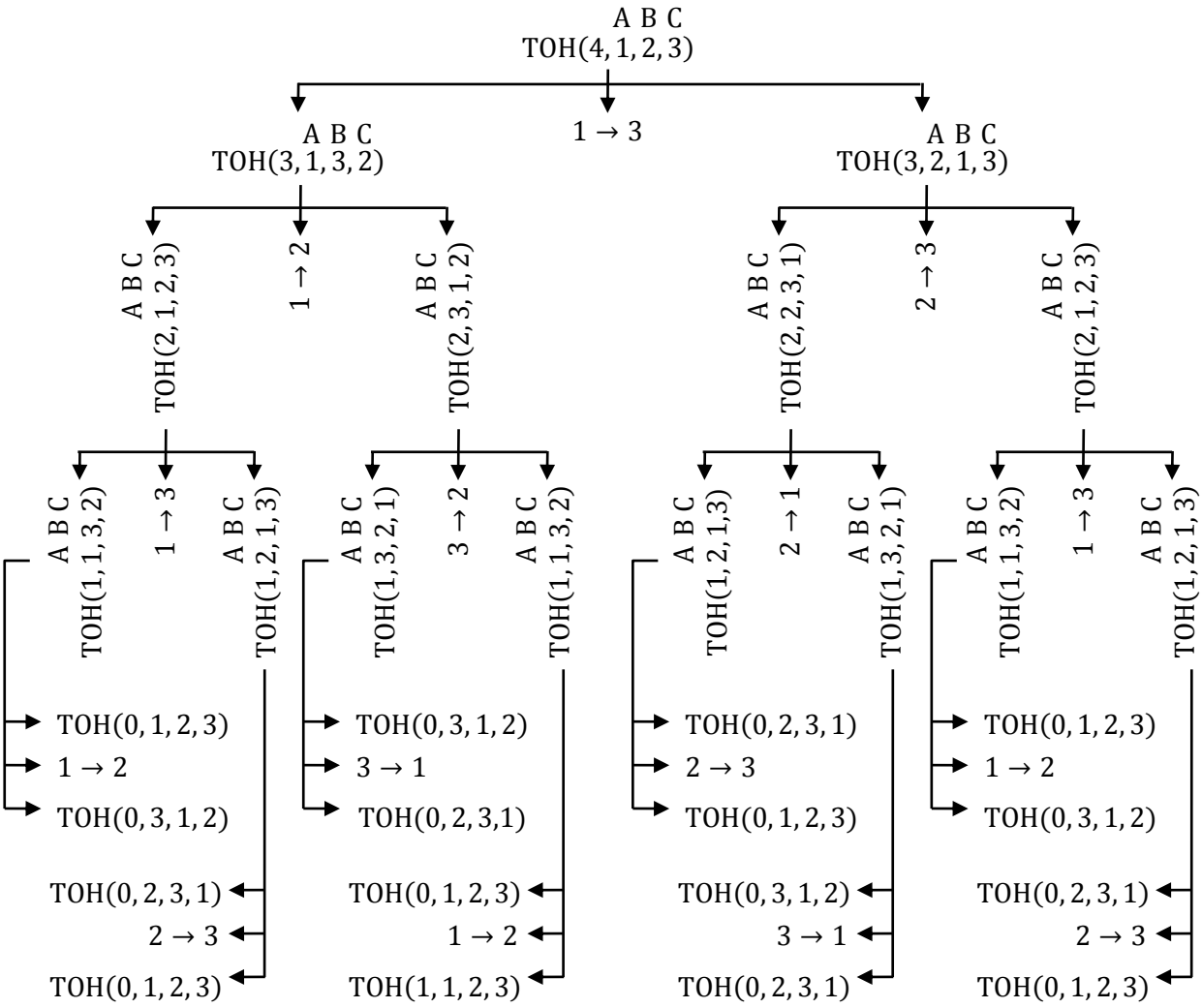
6. [Ans. D]

All are the properties of NP-complete family of problem
NP-complete problems can be solved in non-deterministic polynomial time. Travelling Selseman Problem is NP-Complete. NP-Complete is the intersection of NP and NP hard class of problems.

7. [Ans. *] Range: 5 to 5

TOH(n, A, B, C)

$\therefore n = 4$



So, After 5 function call first move will take place

8. [Ans. *] Range: 40 to 40

$R_1 \leftarrow R_1 + 100$

$= 1100$

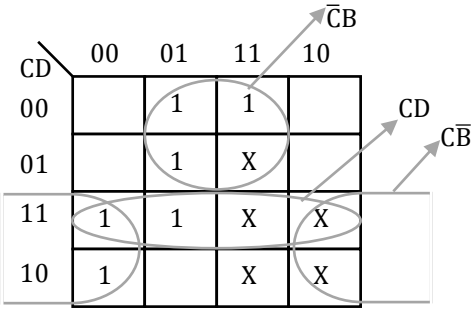
$R_2 \leftarrow R_2 + M[100 + R_1]$

$= 30$

$R_2 \leftarrow R_2 + M[1000]$

$= 40$

9. [Ans. D]



$\therefore$ Minimised form is $\bar{C}B + CD + C\bar{B}$

10. [Ans. A]

$PQRS = I$

$P^{-1}\,PQRSS^{-1} = P^{-1}IS^{-1}$

$QR = P^{-1}S^{-1}$

$Q^{-1}QR = Q^{-1}P^{-1}S^{-1}$

$R = Q^{-1}P^{-1}S^{-1}$

$R^{-1} = (Q^{-1}P^{-1}S^{-1})^{-1}$

$= SPQ$

11. [Ans. A]

Green's theorem and stokes theorem convert line integral to surface integral and vice versa. Whereas Gauss's Divergence theorem converts from surface to volume and vice versa.

12. [Ans. *] Range: 70 to 70

${}^{n+r-1}C_{r-1} = {}^{5+4-1}C_4$

${}^{8}C_4 = \dfrac{8!}{4! \times 4!} = \dfrac{8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1}{4 \times 3 \times 2 \times 1 \times 4 \times 3 \times 2 \times 1}$

$= 70$

13. [Ans. *] Range: 32 to 32

Hand shaking theorem

$\Sigma \deg(v_i) = 2 \times E$

$2 \times |v| = 2 \times E$

$|v| = E$

So, the number of vertex is 32

14. [Ans. *] Range: 55 to 55

$n(A^C \cap B^C) = n[(A \cup B)^C]$

$n(A \cup B) = n(A) + n(B) - n(A \cap B)$

$= 60 + 45 - 20$

$= 85$

$\therefore n[(A \cup B)^C] = 140 - 85$

$= 55$

15. [Ans. A]

We know that for matrix if λ is Eigenvalue and x is Eigenvector then $Ax = \lambda x$ and $A^m x = \lambda^m x$

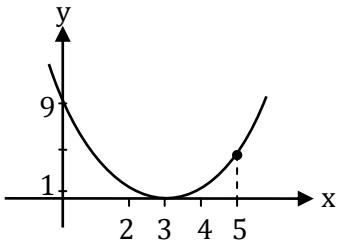
i.e., x is also Eigenvector of A^m corresponding to Eigenvalue λ^m

16. [Ans. *] Range: 5 to 5

$y = x^2 - 6x + 9 = (x-3)^2$

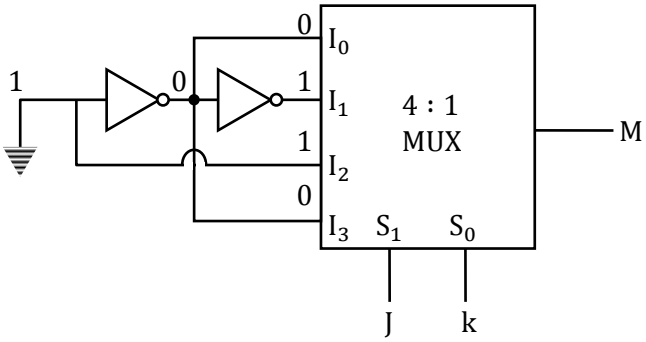
$y(2) = 1$

$y(5) = 4$



$\therefore$ Maximum value of y over the interval 2 to 5 will be at $x = 5$

17. [Ans. D]



$M = J \oplus K$

$= XOR\ (J, K)$

18. [Ans. D]

If $x = 1$

	X	y_{in}	y_{out}
$1^{st} \rightarrow$	1	0	0
$2^{nd} \rightarrow$	1	0	0
$3^{rd} \rightarrow$	1	0	0
⋮	⋮	⋮	⋮
15^{th}	1	0	0

$\therefore$ If $X = 1, y_{out} = 0$

And If $X = 0, y_{out} = 1$ ater 15^{th} clock $= \overline{X}$

19. [Ans. *] Range 2.6 to 2.67

External nodes = n! = 3! = 6

D = 3 (depth of tree)

$$\bar{E} = \frac{1}{6}(2+3+3+3+3+2)$$

$$= 2.667$$

20. [Ans. A]

X = m/n. Then avg. number of elements in any list is X. Thus, $\theta(1)$ time to find the particular list and $\theta(X)$ time to search an element in that list

21. [Ans. A]

Option (A) have the regular expression which is corresponding to the language.

22. [Ans. D]

First (S) = {e, F, i, g, j}

Follow (E) = {F, i, g, j}

∴ First (S) ∩ Follow (E) = {F, i, g, j }

23. [Ans. *] Range: 3613 to 3613

Base=3300 [for segment 1]

So address = 3300 + 313

= 3613

24. [Ans. A]

$$\text{Let } S = \sum_{r=0}^{n-1} \frac{1}{\sqrt{4n^2 - r^2}} = \frac{1}{n}\sum_{r=0}^{n-1} \frac{1}{\sqrt{4 - \left(\frac{r}{n}\right)^2}}$$

$$= \int_0^1 \frac{dx}{\sqrt{4 - x^2}}$$

$$= \sin^{-1}\frac{x}{2}\Big|_0^1 = \frac{\pi}{6}$$

25. [Ans. *] Range: 9 to 9

Initial cwnd = 4 MSS
Threshold = 16 MSS

Round	Congestion Window [cwnd]	Threshold	Phase
1	4 MSS	16 MSS	Slow Start Phase
2	8 MSS	16 MSS	Slow Start Phase
3	16 MSS	16 MSS	Slow Start Phase
4	17 MSS	16 MSS	Congestion Avoidance Phase
5	18 MSS	16 MSS	Congestion Avoidance Phase
Event = Time Out Current Phase = Congestion Detection Phase Threshold = cwnd/2 = 18 MSS/2 = 9 MSS cwnd = initial cwnd = 4 MSS Next Phase = Slow Start Phase			
6	4 MSS	9 MSS	Slow Start Phase
7	8 MSS	9 MSS	Slow Start Phase
8	9 MSS	9 MSS	Congestion Avoidance Phase

26. [Ans. B]

By observing the first octet of IP address [192.x.x.x], both networks belong to Class "C".
Default Subnet Mask for Class C Network = 255.255.255.0
Given Mask = 255.255.255.224 = 255.255.255.11100000 → 3-bits used for Subnetting.
Let us try to identify the subnet to which the given IP addresses belong to?
System "A" = 192.168.1.140 = 192.168.1.10001100
System "B" = 192.168.1.226 = 192.168.1.11100010
Port: 1 of Router = 192.168.1.246 = 192.168.1.11110110
Port: 2 of Router = 192.168.1.156 = 192.168.1.10011100
By observing the subnet bits, System "A" and Port: 2 of Router belongs to subnet "100" and System "B" and Port: 1 of Router belongs to subnet "111".
Obviously, system "A" must be connected to Port: 2 of Router and system "B" must be connected to Port: 1 of Router.

27. [Ans. *] Range: 0.19 to 0.2

At 15000 rpm

$$1 \text{ rotation time} = \frac{60}{15000}\text{sec}$$
$$= 4 \text{ msec}$$

Access time = Seek time + Rotational latency + Transfer time
Access time = 8 + 2 + (2KB/262144B) msec = 10.0078125 msec
Data rate ⇒ 10.0078125 msec → 2KB

$$1 \text{ msec} \rightarrow \frac{2\text{KB}}{10.0078125}$$

$$1 \text{ sec} = \frac{2\text{KB} \times 10^3}{10.0078125}$$
$$= 0.195 \text{ KB/sec}$$

28. [Ans. C]

Minimum cover $= \{X_1, X_4, Y_1, Y_3\}$

Maximum matching $= \{X_1\ Y_2, X_2\ Y_1, X_3\ Y_3, X_4\ Y_4\}$

Both have size 4, in a bipartite graph the size of maximum matching equals the size of minimum cover.

29. [Ans. A]

Here note that C produces terminal c, not $\in$. So, first (S) will stop there

$\text{First (S)} = (\text{First(A)} - \{\in\}) \cup (\text{First (B)} - \{\in\}) \cup \{\text{First(C)}\}$

$= \{a\} \cup \{b\} \cup \{c\}$

$= \{a, b, c\}$

30. [Ans. *] Range: 2 to 2

The expression accepted by the TM is

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

Minimum string accepted by the TM is $= bb$

So, minimum number of b's in a string that is accepted by TM $= 2$

31. [Ans. B]

First let us calculate the size of the routing table. Information is 32 – bit and there are in total 100 routers

Thus total memory of the routing table $= 32 \times 100 = 3200$ bits

The information is exchanged 6 times in a minute $= \frac{60}{6}$

$= 10$ sec

Then, the band width consumed is in one direction is $= \frac{3200}{10}$

$= 320$ bits per second

Since links are bidirectional

The total bandwidth consumption $= 640$ bps

32. [Ans. *] Range: 9 to 9

Postfix notation: $562 + * 12\ 4/-$

Symbol scanned	STACK (Last element top)
(1) 5	5
(2) 6	5, 6
(3) 2	5, 6, 2
(4) +	5, 8
(5) *	40
(6) 12	40, 12
(7) 4	40, 12, 4
(8) /	40, 3
(9) −	37

2 pop for each operator (2*4) = 8
One for last final result = 1
Total = 9

33. **[Ans. *] Range: 2 to 2**

$$\text{Speedup} = \frac{\text{delay}_n}{\text{delay}_p}$$
$$= \frac{1+2+4+3}{1+\max(1,2,4,3)}$$
$$= \frac{10}{5} = 2$$

34. [Ans. *] Range: 9 to 9

Postfix expression = $893 * 2 * 6/+5 -$

Remaining expression	Picked symbol	Action	Stack status (top element first)	No. of push	No. of pop
$8\ 9\ 3 * 2 * 6/+5 -$	8	push(8)	8	1	0
$9\ 3 * 2 * 6/+5 -$	9	push(9)	9 8	2	0
$3 * 2 * 6/+5 -$	3	push(3)	3 9 8	3	0
$* 2 * 6/+5 -$	*	pop(3), pop(9) res = evaluate (9*3) push (res)	27 8	4	2
$2 * 6/+5 -$	2	push(2)	2 27 8	5	2
$* 6/+5 -$	*	pop(2),pop(27) res = evaluate (27*2) push(res)	54 8	6	4
$6/+5 -$	6	push(6)	6 54 8	7	4
$1 + 5 -$	/	pop(6), pop(54) res = evaluate(54/6) push(res)	9 8	8	6

35. [Ans. *] Range: 1408 to 1408

Number of blocks in cache $= \frac{2^{14}\text{B}}{2^{8}\text{B}} = 2^{6}$

Number of sets $= \frac{2^{6}}{2^{2}} = 2^{4}$

Number of blocks in memory $= \frac{2^{32}}{2^{8}} = 2^{24}$

$\therefore$ Tag length $= \log_2\left(\frac{2^{24}}{2^{4}}\right) = 20$ bits

$\therefore$ Metadata size $= 2^{6} \times (20 + 1 + 1)$

$= 1408$ bits

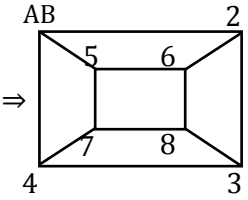
36. [Ans. B]

37. [Ans. C]

i) The chromatic number of graph G is 2 and a graph with chromatic number 2 is bipartite graph

ii) Isomorphic of G is planar

Isomorphic (G) $\Rightarrow$



iii) Independence no. = Cardinality of longest maximal independent set of a graph
So {1, 6, 7, 3} is LMIS of graph. So it should be 4
{1, 6, 7, 3} cover all the edge of a graph. So it is vertex covering

38. [Ans. B]

Graph iii and iv both are isomorphic to $K_{4,4}$ because there exists one to one correspondence between

1. Number of vertex
2. Number of edges
3. Degree of each vertex

And after deleting same degree vertex from the (iii) & (iv) & $K_{4,4}$ one to one correspondence is still maintain

39. [Ans. A]

Here, size of instruction $= 32/8 = 4$ bytes.

Program Counter can shift 4 bytes at a time to jump to next instruction.

So the given options must be divisible by 4. Only 420 is satisfied.

40. [Ans. *] Range: 12 to 12

Disk block size = 256 Bytes

Disk block Address = 8 Bytes

Use 16 direct = 16×256

$= 2^4 \times 2^8$

$= 2^{12}$ Bytes

Use 1 Indirect = $\frac{256}{8} \times 2^8$

$= 2^{13}$ Bytes

$\therefore$ The maximum possible file size = $2^{12} + 2^{13}$ Bytes

$= 4\text{KB} + 8\text{KB}$

$= 12\text{KB}$

41. [Ans. *] Range: 1.2 to 1.4

Memory related operations are only 2 (Fetch and store)

P_B has 2-port memory $\Rightarrow$ no stall cycles

	Stages	Memory	Stall cycles	Stall Frequency
P_A	K	Single – port	1	30%
P_B	K	Two – port	0	30%

$$S = \frac{S_{ideal}}{\left(1 + \frac{\text{stall}}{\text{cycle}} \times \frac{\text{stall}}{\text{freq}}\right)}$$

$$S_A = \frac{K}{(1 + 1 \times 30\%)} = \frac{K}{1.3}$$

$$S_B = \frac{K}{(1 + 0 \times 30\%)} = K$$

$$\frac{S_B}{S_A} = \frac{K}{K/1.3}$$

$$\frac{S_B}{S_A} = 1.3$$

42. [Ans. A]

Each head of multitape TM can move at most n cells left or right, in n steps. So the heads are at most 2n cells apart

To simulate 1 step, the 1 – tape TM needs to read at most 2n cells to find the K heads, and then change at most 2n cells to simulate writing and moving the heads

So, total times taken = $O(n^2)$

43. [Ans. A]

Strings accepted by the PDA are

abb, aabbbb, aaabbbbbb, ----------

So, $L = \{a^n b^{2n} | n \geq 1\}$

44. [Ans. A]

Set of binary numbers accepted by the Finite automata are
0, 101, 1100, 1111, …
⇒ 0, 5, 10, 15, …
From the accepted sets it is clear that option A is correct

45. [Ans. D]

Primary index is defined on an ordered data file and includes one index entry for each block in the data file. Clustered index is also defined on an ordered data file and includes one index entry for each distinct value of the field. Secondary index, if defined on key field, includes one entry for each record in the data file, hence it is a dense index

46. [Ans. C]

It's a correlated sub query.
Outer Query → computing the average salary of male employees in each department.
Inner Query → computing the average salary of female employees in the department selected by the outer query

47. [Ans. B]

Sliding Window Protocol = Selective Repeat
Bandwidth = B = 2 Mbps = 2×10^6 bits/sec
Propagation Delay = T_p = 3 milliseconds = 3×10^{-3} seconds
Size of Frame = 100 Bytes = 800 bits
Utilization = U = 50% = 1/2
Minimum Number of bits required = b = ?
$U = n \times F/F + 2 \times T_p \times B$
$1/2 = (n \times 800)/(800 + 2 \times 3 \times 10^{-3} \times 2 \times 10^6)$
$1/2 = n \times 800/12800$
$n = 8$
$n = 2^b = 8$
$b = 3$ bits

48. [Ans. *] Range: 220 to 220

$$\text{count}(n) = \sum_{i=1}^{n}\sum_{j=1}^{i}\sum_{k=1}^{j} 1$$

$$= \sum_{i=1}^{n}\sum_{j=1}^{i} j$$

$$= \sum_{i=1}^{n} \frac{i(i+1)}{2}$$

$$= \frac{1}{2}\left[\sum_{i=1}^{n} i^2 + \sum_{i=1}^{n} i\right]$$

$$= \frac{1}{2}\left[\frac{n(n+1)(2n+1)}{6} + \frac{n(n+1)}{2}\right]$$

$$= \frac{n(n+1)}{4}\left[\frac{2n+1}{3} + 1\right]$$

$$= \frac{n(n+1)}{4} \times \left[\frac{2n+4}{3}\right]$$

$$= \frac{n(n+1)(n+2)}{6}$$

If $n = 10$ answer is $= 220$

49. [Ans. C]

We know that, in distance-vector routing updates it information with the help of neighbours information only. Let us first look at the first update of all the router nodes

At $t = 0$

1	2	3	4	5
0	30	-	20	-

Router 1

2	1	3	4	5
0	30	26	10	-

R-2

3	1	2	4	5
0	-	26	15	2

R-3

4	1	2	3	5
0	20	10	15	40

R-4

5	1	2	3	4
0	-	-	2	40

R-5

This information will be exchanged between each other's neighbours

From then At $t = 10$ sec, the table are updates as follows

1	2	3	4	5
0	30	35	20	60

R-1 From 4

2	1	3	4	5
0	30	26	10	50

R-2 From 4

3	1	2	4	5
0	35	26	15	2

From 4 R-3

4	1	2	3	5
0	20	10	15	17

R-4 From 3

5	4	3	2	1
0	60	50	2	17

R-5 From 4 From 3

At $t = 20$

1	2	3	4	5
0	30	35	20	3

From 4's table

At $t = 30$ sec, when next update takes place, router 1 table remains inundated further. Therefore it takes at least 30 sec for router 1 to converge with routing information

50. **[Ans. *] Range: 90 to 90**

$T_1 = 10ns, T_2 = 20ns, T_3 = 100ns$

Average access time = 42 ns

$H_1 = 80\%$

$H_3 = 100\%$ (Level-3 having all blocks; no miss)

$H_2 = ?$

$T_{B1} = 20 \times 4 = 80ns, T_{B2} = 100 \times 8 = 800ns$

Average access time $= H_1T_1 + (1 - H_1)[H_2(T_{B1} + T_1) + (1 - H_2)(T_{B2} + T_{B1} + T_1)]$

$42 = 0.8 \times 10 + (1 - 0.8)[H_2(80 + 10) + (1 - H_2)(800 + 80 + 10)]$

$34 = 18H_2 + 178 - 178H_2$

$H_2 = 0.9 = 90\%$

51. [Ans. *] Range: 36 to 36

$$\frac{\text{Byte address}}{\text{Block size}} = \frac{1600}{16} = 100$$

Block number $= 100 \bmod 64$

$= 36$

52. [Ans. A]

Initialization: $\{P \to Q, P \to R, Q \to R, PQ \to R\}$

Consider $P \to R$

$G: \{P \to R\} = \{P \to R, Q \to R, PQ \to R\} = G'$ since $P \to Q \in G', P \to Q$ stays.

53. [Ans. A]

$\{AB\}^+ = \{ABC\}$ $[\because AB \to C]$

$= \{ABCD\}$ $[\because AB \to D]$

So, AB is a candidate Key

AD is a candidate Key $[\because D \to B]$

So, BC & CD are also candidate keys $[\because C \to A]$.

Not in BCNF.

Because of FD: $C \to A$

So, highest normal form is 3NF.

54. [Ans. A]

See the code carefully; here we are calculating two things,

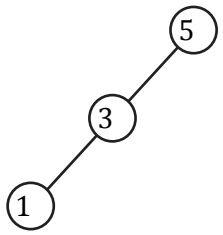
(i) $a = preorder[i] - preorder[i+1]$

(ii) $b = preorder[i] - preorder[n-1]$

If root of the tree is having 2 children then b would be negative because it is BST and value of RST node would be > value of LST node.

Same logic can be applied to both LST and RST. So, tape an example

(i)



Preorder - 1

0	1	2
5	3	1

$i = 0; n - 1 = 2$

$a = pre[0] - pre[1]$

$a = 5 - 3 = 2$

$b = pre[0] - pre[2]$

$= 5 - 1 = 4$

$a.b > 0 \Rightarrow 8 > 0$ so, move to next

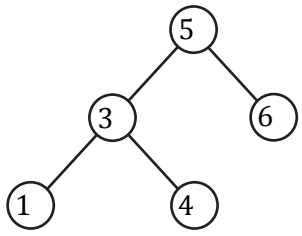
$i = 1, n - 1 = 2$

$a = pre[1] - pre[2] = 3 - 1 = 2$

$b = 3 - 1 = 2$

So, $a.b > 0 = 4 > 0$ return 1;

(ii)



Preorder → 5 3 1 4 6

$i = 0; n - 1 = 6$

$a = 5 - 3 = 2$

$b = 5 - 6 = -1$

So, $a.b < 0$ return 0;

So, it shows that function will return 1 only when each internal node is having exactly one child.

55. [Ans. *] Range: 8 to 8

Reference string according to the given references will be

1 4 2 6 1 6 1 6 1 2 4 5 6 1 3 6

1	1	1	1	1	6	6	6
	4	4	4	4	4	4	3
		2	2	2	2	1	1
			6	5	5	5	5

Number of page Faults = 8

56. [Ans. D]

They will chime together after the time in minutes equal to LCM of 18, 24, 32.

$18 = 2 \times 3 \times 3$

$24 = 2 \times 2 \times 2 \times 3$

$32 = 2 \times 2 \times 2 \times 2 \times 2$

$\therefore$ LCM $= 2 \times 2 \times 2 \times 3 \times 3 \times 2 \times 2 = 288$

288 min = 4 hrs 48 min.

57. [Ans. C]

According to the statement, 80% of the total runs were made by spinners. So, conclusion I does not follow. Nothing about the opening batsmen is mentioned in the statement. So, conclusion II also does not follow

58. [Ans. D]

1 km = 1000 meter

1 min = 60 second

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time}}$$

Total distance = 12 km = 12000 meter

Total time = 6 + 6 +12 minute = $24 \times 60 = 1440$ seconds

$$\text{Average speed} = \frac{12000}{1440} = 8.33 \text{ m/s}$$

59. [Ans. A]

60. [Ans. C]

CEPQS - E cannot go with S.

AEPQS - C and P have to be together. E cannot go with S.

ACPRS -It satisfies all the conditions and also there are two boys in the team.

BDPRS - C and P have to be together.

Hence, C

61. [Ans. A]

Number of males in U. P $= \left[\frac{3}{5} \text{ of } (15\% \text{ of N})\right] = \frac{3}{5} \times \frac{15}{100} \times N = \frac{9N}{100}$

Total population, N $= 3276000$

Number of males in M. P $= \left[\frac{3}{4} \text{ of } (20\% \text{ of N})\right] = \frac{3}{4} \times \frac{20}{100} \times N = \frac{15N}{100}$

Number of males in Goa $\left[\frac{3}{8} \text{ of } (12\% \text{ of N})\right] = \frac{3}{8} \times \frac{12}{100} \times N = \frac{4.5N}{100}$

Total males in these 3 states $= \frac{(9 + 15 + 4.5)N}{100} = \frac{28.5N}{100}$

Required % $= \left(\frac{28.5 \times \frac{N}{100} \times 100}{N}\right)\% = 28.5\%$

62. [Ans. C]

A cube is cut into 125 smaller cubes.

$\therefore$ Length of cube $= \sqrt[3]{125}$

$\therefore l = 5$ unit

Let upper face be coloured red.

Then bottom face will be coloured green, two adjacent faces are coloured yellow and blue respectively.

Two faces are uncoloured.

Number of cubes uncoloured on all faces $= (n-2)^3 = (5-2)^3 = 27$

Now there are two surfaces which are not coloured.

$\therefore$ There will be 9 cubes at centre on both the uncoloured surfaces each.

3 cubes at the common edge of both uncoloured surfaces.

$\therefore$ Total number of uncoloured cubes $= 27 + 9 + 9 + 3 = 48$

63. [Ans. C]

64. [Ans. B]

The passage clearly states the unawareness of teachers regarding population education. Thus, the teachers should be given a proper orientation on the same.

65. [Ans. C]

In statement I nothing is given about c. Hence it is not enough to answer the question.

In statement II nothing is mentioned about a. Hence this statement alone cannot answer the question.

Combining both the statements we get

$a : b : c = 3 : 15 : 10$

$\therefore a : c = 3 : 10$

$$\frac{a}{c} = \frac{3}{10}$$

$$\frac{a+c}{c} = \frac{3+10}{10} = \frac{13}{10}$$

$\therefore$ Question can be answered using both the statements.

Hence, C.