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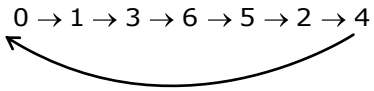
Answer Keys:

1	D	**2**	D	**3**	D	**4**	C	**5**	D	**6**	A	**7**	C
8	D	**9**	A	**10**	C	**11**	C	**12**	C	**13**	A	**14**	C
15	A	**16**	A	**17**	C	**18**	4	**19**	5.5	**20**	7	**21**	10.1
22	1.28	**23**	B	**24**	A	**25**	C	**26**	B	**27**	D	**28**	B
29	C	**30**	D	**31**	D	**32**	B	**33**	A	**34**	2500	**35**	0.7752
36	D	**37**	D	**38**	D	**39**	D	**40**	D	**41**	C	**42**	A
43	D	**44**	C	**45**	B	**46**	1.26	**47**	B	**48**	D	**49**	D
50	A	**51**	C	**52**	C	**53**	C	**54**	A	**55**	A	**56**	B
57	D	**58**	A	**59**	A	**60**	D	**61**	D	**62**	B	**63**	A
64	D	**65**	C										

Explanation:

1. a* (ba+b)* = {$\in$,a,b,aa,ab,ba,bb,……..}doesn't contain strings with 'baa' as substring

2. The state sequence diagram of the circuit is



After every 7 clock pulses we reach 0. So after 168 clock pulses we are at 0.

Five more clock pulses will take us to state 2.

3. The cycle allocation between the user process and DMA process depends on the DMA running mode but it does not depend only on DMA.

4. 2i + j + 10
As it supports 2^{i+10} bytes of memory hence 2(i+10) bits for 2 operands and j bits for one operator.

5 The characteristic equation for above recurrence is: $S-3^2=0$

Hence root '3' has multiplicity of 2.

So, Case 1: $3^n n^2$ $An+B$

Case 2: 2^n $An+B$ since '2' is not root of characteristic equation

6. Instruction immediately following the branch condition

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If the condition is false, then it is discarded and behaves like normal branch condition.

7. $k_1 = hf\ x_0, y_0 = 0.1f\ 0,1 = 0.1\ 0+1 = 0.1$

$$k_2 = hf\left(x_0 + \frac{h}{2}, y_0 + \frac{k_1}{2}\right) = 0.1f\left(0 + \frac{0.1}{2}, 1 + \frac{0.1}{2}\right)$$

$$= 0.1f\ 0.05, 1.05 = 0.1\ 0.05 + 1.05 = 0.11$$

10. The client sees what is apparently a working version of the software unaware that in the rush to develop a working model, software quality and long-term maintainability is not considered. When informed that the system must be rebuilt, most clients demand that the existing application be fixed and made a working product. Often software developers are forced to relent.

13 Number of different links may exist between each pair of communicating processes, with each corresponding to one mailbox.

14 Both the machines B and C generate ICMP port unreachable error as both the applications are not listening to the client A.

15. By reading $\in$, the output produced by moore machine is the output associated with the initial state. By reading $\in$, the output produced by mealy machine is $\in$

18 Total number of Keys = 4 {AB, AC, BD, CD }

19.

P_1	P_2	P_3	P_4	P_1	P_2

0 2 4 6 7 9 10

$$\text{Average waiting time} = \frac{5+7+4+6}{4} = \frac{22}{4} = 5.5\,\text{ms}$$

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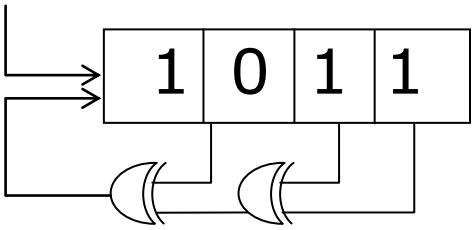
20.



clk				
0	1	0	1	1
1	0	1	0	1
2	0	0	1	0
3	1	0	0	1
4	1	1	0	0
5	1	1	1	0
6	0	1	1	1
7	1	0	1	1

21.
$$\begin{array}{l}(2.3)_4\\ +(1.2)_4\\ \hline (10.1)_4\end{array}$$

22.

$$1\,\text{Mbits data} = \frac{1024\times1024}{1024} = 1024 \text{ packets} = \frac{1024}{8} = 128 \text{ windows}$$

$$\text{RTT} = 2\times\frac{d}{v} = 2\times\frac{1000\times1000\,\text{meter}}{2\times10^8\,\text{meter/sec}} = 10\,\text{ms} = \text{time taken to send 1 window}$$

$$\text{Time taken to send 128 windows of data} = 128\times10\text{ ms} = 1.28\,\text{s}$$

23 An unambiguous grammar may or may not be regular.
Every LL(K) and LR(K) grammar is unambiguous.
A regular language can never be inherently ambiguous.
Both LMD and RMD can be written for unambiguous grammar also.

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26 $2x + 4y = 7, \quad x + 2y = 0$

$\begin{pmatrix} 2 & 4 & 7 \\ 1 & 2 & 0 \end{pmatrix}$

$R_2 \to 2R_2 - R_1$

$\begin{pmatrix} 2 & 4 & 7 \\ 1 & 0 & -7 \end{pmatrix}$

$\rho\ A \neq \rho\ A:B \quad \therefore$ No solution

28. 64bit, 32bit

The multiplier needs to shift left after each operation and there needs to be 32 shifts.

29

$+_5$	0	1	2	3	4
0	(0)	1	2	3	4
1	1	2	3	4	(0)
2	2	3	4	(0)	1
3	3	4	(0)	1	2
4	4	(0)	1	2	3

$1 \leftrightarrow 4$
$2 \leftrightarrow 3$
inverse of each other

Now : $2^{-3} = 2^{-1^{3}} = 3^{3} = 3 +_5 3 +_5 3 = 4$

$3^{-2} = 3^{-1^{2}} = 2^{2} = 2 +_5 2 = 4$

30. UPDATE on EMP is not always successful; it will fail when we try to insert a dno which is not in department table.

31. In plan-I, first we are checking the birth date irrespective of the project in which a particular employee is working and all such employees are combined with tuples of works_on, where as in Plan-II, first we are filtering the employees who are working on the project name "Database updation" to get the employees and then for those employees we are checking birth date. Hence plan 2 works faster than plan 1 as it involves less number of operations (Cartesian product, Join).

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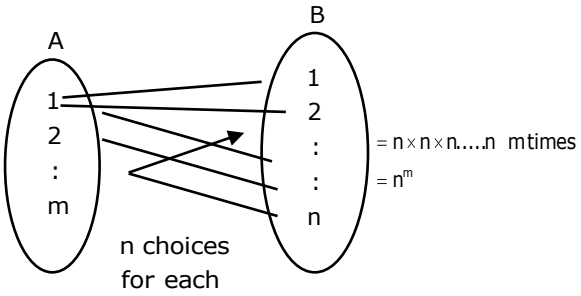
32. Total functions possible



$$\text{Many} - \text{one functions} = \text{Total} - \text{one} - \text{one functions}$$

Choices

$$\text{One} - \text{one functions} = 1 \to n$$

$$2 \to n-1$$

$$3 \to n-2 \quad = {}^{n}P_{m}$$

$$\vdots$$

$$m \to n-m-1$$

$$\text{hence, number of many} - \text{one functions} = \boxed{n^m - {}^{n}P_{m}}$$

33. A is the event of getting infrastructure contract

B is the event of getting welfare contract given that

$P(A) = 0.2, P(B)=0.4, P(A \cup B) = 0.1$

Required probability = $P(A \cap B)$

$= P(A)+ P(B) - P(A \cup B)$

$=0.2+0.4-0.1 = 0.5$

34. **Worst case** occurs when we try to make a complete graph into 2-colorable graph by deleting minimum number of edges(k). This can be achieved by reducing the complete graph with n vertices into most balanced bipartite graph with n vertices(which is 2-colorable).
{Here "most balanced" means difference between no. of nodes in two sets of bipartite graph should be minimum.}
k = Number of edges in K_n – number of edges in most balanced bipartite graph.

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$k = {}^{n}C_2 - \frac{n-1}{2} \times \frac{n+1}{2}$ [as we have to divide 101 into two partitions with 50 and 51 vertices]

$= n-1^2/4$

For n=101, k = 2500.

35. $1-\left[5/6^{10} + 10 \times 5/6^{9} \times 1/6 + 45 \times 5/6^{8} \times 1/6^{2} \right]$

38. Presence or absence of left recursion and left factor property cannot decide ambiguity or unambiguity of a grammar.

40. $S2 = 1+011^* \approx 1^*+011^* \approx 1+011^{**} \approx 1^*+011^{**} \approx 1^*(011)^{**}$

S3: Every regular language is also a context free language, so we can have CFG for every regular language but vice –versa is not true.

S4: A subset of regular language need not necessarily be regular language.

Eg : $L = \{\omega / \omega \in a^*b^*\}$; $L_1 = \{\omega / \omega \in a^m b^m; m \geq 0\}$; $L_1 \subset L$ but L_1 is not regular.

41. 0, 1, 8, 9, 100, 101, 110, 111

$010 \rightarrow$ is a octal number format

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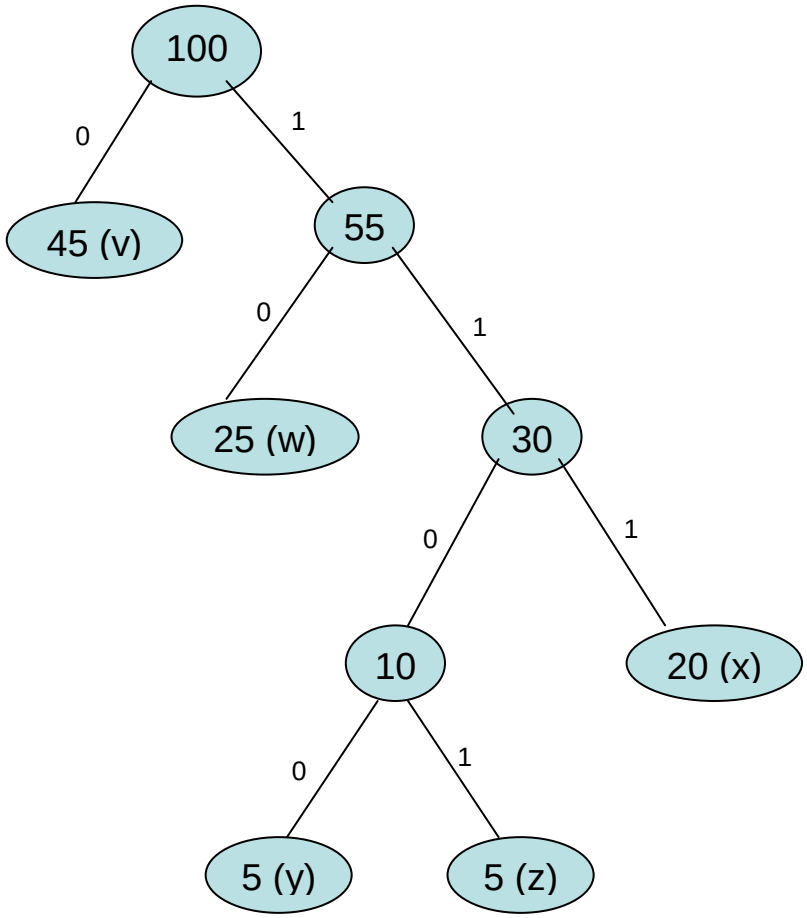
42 This is the Huffman Tree



The message is decrypted as
0 1101 111 10 0 0 1100 0 10 10
v zxwvvyvww

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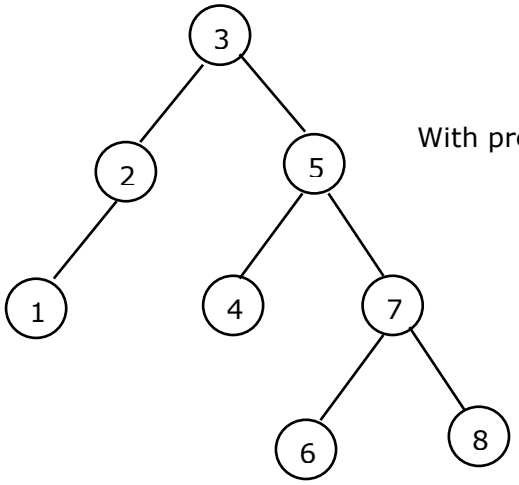
43 represents a valid BST.
Inorder = 1 2 3 4 5 6 7 8



With preorder = 3 2 1 5 4 7 6 8

44. Pass 1 Bubble sort

120 231 417 343 542 998 675 196
120 231 417 343 542 998 675 196
120 231 417 343 542 998 675 196
120 231 343 417 542 998 675 196
120 231 343 417 542 998 675 196
120 231 343 417 542 998 675 196
120 231 343 417 542 675 998 196
120 231 343 417 542 675 196 998

Pass 1: Radix sort (Sort by least significant digit)

120 231 542 343 675 196 417 998

Pass 2: Radix sort (Sort by 10's place digit)

417 120 231 542 343 675 196 998

46. Given window size 32KB = 262144 bits
Transmission time = window size / channel capacity
= 262144b/512Mbps
= 0.512 msec
Total time = transmission time + 2(one way delay) = 40.512msec
Efficiency = Throughput / channel capacity
Throughput = Amount of data sent / total time
= 262144b/40.512msec
= 6.47Mbps

Efficiency = 6.47Mbps / 512Mbps = 0.01263 = 1.26%

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47. T1 will be rolled back in basic timestamp protocol because of $W_2(A)$-$W_1(A)$ conflict as the equivalent serial schedule is T1->T2, where as in Thomas write rule $W_1(A)$ is just ignored and T_1 continues with its execution.

48 We have to count i and nodes having 3 children in left, middle and right subtree.

49 For each node the function is called.

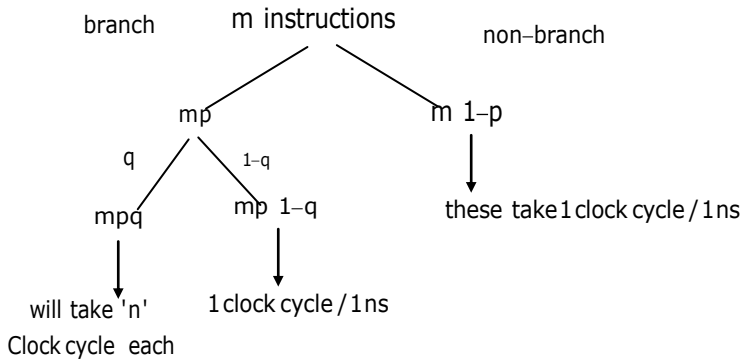
50. Given address is Class B, we need 512 subnets so we require 9 bits to be borrowed from host id i.e., 8bits from 3rd octet and 1bit from 4th octet. so the subnet mask is 255.255.255.128/25.

51. Given 150.36.0.0/16 and we need to create 512 subnets. So we require 9 bits to be borrowed from host id and we are left with 7 bits in host part. So, practically we have

2^7-2 = 126 hosts per subnet.

The first subnet is 150.36.0.0. So the first host in first subnet is 150.36.0.1 and last host is 150.36.0.126.

52.



$$\text{CPI} = \frac{n\ mpq\ + mp\ 1-q\ + m\ 1-p}{m} = 1 - pq + npq\ = 1 + pq\ n-1$$

53. If all the branches are unsuccessful , then q = 0.

Hence average CPI = $\frac{m(1-p)+mp}{m} = \frac{m}{m} = 1$

$$\text{Factor by which it is reduced} = \frac{1 + pq\ n-1}{1}\ \ \frac{\text{Previous}}{\text{new}}$$

$$= 1 + pq\ n-1\ = 1 - pq + npq$$

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54.

1	5	5	1	6	3	1	3	2	4	5	1
1	1	1	1	1	1	1	1	1	1	1	1
	4	4	4	4	4	4	4	4	4	5	5
		5	5	6	3	3	3	2	2	2	2
F	F	F	H	F	F	H	H	F	H	F	H

55.

1	4	5	1	6	3	1	3	2	4	5	1
1	1	1	1	1	1	1	1	1	4	4	4
	4	4	4	6	6	6	6	2	2	2	1
		5	5	5	3	3	3	3	3	5	5
F	F	F	H	F	F	H	H	F	F	F	H

60. $Q = T - 5$

$S = P - 10 = Q - 8$

Putting the value of T, $Q = 15$ years

$S = Q - 8 = 7$ years

$P - 10 = Q$

$P = 17$ years

But there is no data provided about R. So we cannot find R's age.

62. 4 men can go in five hotels in 5^4 ways.

Number of ways in which 4 men can go into different hotel = $5_{P4} = \frac{5!}{5-4\ !} = 5!$

$\therefore$ Required proability $= \frac{5!}{5^4} = \frac{120}{625} = \frac{24}{125}$

63. Let the distance is d & speed of the river is x.

$\frac{d}{50+x} = 25$..... i

$\frac{d}{2\ 40+x} = 15$..... ii

$\frac{i}{ii} = \frac{80+2x}{50+x} = \frac{5}{3} \Rightarrow 240+6x = 250+5x \Rightarrow x = 10\,km/hr.$

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64. C done the work half of $A+B$

$C's\ one\ day's\ work = \frac{A+B}{2}$ 1

But given C alone work = $\frac{1}{80}$

2C is the 1 day's work of $A+B$

$\therefore\ A+B\ 's\ one\ day\ work = \frac{1}{40}$

$\therefore\ A+B+C\ 's\ one\ day\ work = \frac{1}{80}+\frac{1}{40}=\frac{3}{80}$

65. Required % $\left[\frac{288+98+3.00+23.4+83}{420+142+3.96+49.4+98}\times 100\right]\%$

$\left[\frac{495.4}{713.36}\times 100\right]\% = 69.45\%$

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