## Solutions

1. Ans. B.

$$
\begin{aligned}
\sim((\mathrm{p} \Rightarrow \mathrm{q}) \wedge(\sim r & \vee \vee \sim s)) \\
& =\sim(p \Rightarrow q) \vee(\sim r \wedge \sim s) \\
& =\sim(p \Rightarrow q) \vee(r \wedge s) \\
& =\sim(\sim p \vee q) \wedge(r \wedge s) \\
& =(p \wedge \sim q) \vee(r \wedge s)
\end{aligned}
$$

For $\mathrm{x}=11$ only the above compound preposition is true.
2. Ans. B.

Case I First bit is ' 0 '


Case II First bit is ' 1 '

$\therefore \quad a_{n}=a_{n-1}+a_{n-2}$
3. Ans. B.
$\lim _{x \rightarrow 4} \frac{\sin (x-4)}{x-4}$
$=\lim _{x-4 \rightarrow 0} \frac{\sin (x-4)}{x-4}$
$=\lim _{x \rightarrow y} \frac{\sin y}{y} \quad(B y$ taking $y=x-4)$
$=1$
4. Ans. A.

Given $f(x)=\frac{1}{x^{2}} x \in[a, 1]$

$$
=0 \text { other wise }
$$

We know that $\int_{a}^{1} f(x) d x=1$
$\Rightarrow \int_{a} \frac{1}{x^{2}} \mathrm{dx}=1 \Rightarrow\left(\frac{-1}{\mathrm{x}}\right)_{\mathrm{a}}^{1}=1$
$\Rightarrow \frac{1}{a}-1=1$
$\Rightarrow a=0.5$
5. Ans. B.

Given that $2+\sqrt{-1}$ and 3 are two Eigen values of $3 \times 3$ real matrix is, $2+i$ and 3 are Eigen values.
But 2-i also Eigen values (complex roots occurs in pair only)
det $=$ Product of Eigen values
$=(2+i) \times(2-i) \times 3=5 \times 3=15$
6. Ans. A
\# has the property of xor operation.
So $x \# y=x y^{\prime}+x^{\prime} y$
7. Ans. D.

1111111111110101
2's complement 0000000000001011
11 and 1 st bit is 1 .
So result is -11
8. Ans. C.
$0->1->0->2->0->3$
$0000->0001->0100->0010->1000->0011$
There are 6 states and 3 of them correspond to same state.
To differentiate between $0,1,2,3$ we need 2 bits.
To differentiate between 30 's we need 2 bits.
So Total 4 bits required $=4 \mathrm{FF}$
9. Ans. C.

Memory size $=4 \mathrm{~GB}=2^{32}$ bytes
Word size $=2$ bytes
$\therefore$ No. of Address bits
$=\frac{\text { Memory size }}{\text { Word size }}=\frac{2^{32} \text { bytes }}{2 \text { bytes }}=2^{3 t} \Rightarrow 31$ bits
10. Ans. A.

Both ENQUEUE and DEQUEUE can be performed in O(1) time using circular array.
11. Ans. D.
abcdef
adebcf
abdcef
adbcef
abdecf
adbecf
12. Ans. D.

Here function f takes two arguments one is int and the other is short and its return type is void. So, in main function ' $P$ ' is a pointer to short and when we call $\mathrm{f}(\mathrm{i}, * \mathrm{p}$ ) there won't be any type checking error.
13. Ans. D.

Merge sort $\theta(\mathrm{n} \log \mathrm{n})$ in all the cases
Quick sort $\theta(\mathrm{n} \log \mathrm{n})$ best case and $\theta\left(\mathrm{n}^{2}\right)$ worst cases Insertion sort $\theta(\mathrm{n})$ best case $\mathrm{R} \theta\left(\mathrm{n}^{2}\right)$ worst case
14. Ans. A.


MST of G does not change but shortest path between some pair may change when every edge weight is increased by same value as shown in above.
15. Ans. B.

Output is not affected by the function mystery () as it is just taking the address of a\&b into ptra \& ptrb and contents of ptra \& ptrb are swapped leaving a\&b as it is.
16. Ans. D.

Given grammar generates all strings of a's and b's including null string
$\therefore \mathrm{L}=(\mathrm{a}+\mathrm{b})$ *
17. Ans. C.

There is no known algorithm to check whether the language accepted by TM is empty. Similarly there is no algorithm to check whether language CFG's are equivalent.
18. Ans. B.
A) contains $00 \& 11$ consecutively which is not the required condition.
C) Doesn't guaranty that both $00 \& 11$ will be present in the string.
D) Says string should start with 11 \& ends with 00 or vice versa.
19. Ans. A.
$\mathrm{x} 1=\mathrm{u}-\mathrm{t}$;
$\mathrm{y} 1=\mathrm{x} 1$ * v ;
$\mathrm{x} 2=\mathrm{y} 1+\mathrm{w}$;
$\mathrm{y} 2=\mathrm{t}-\mathrm{z}$;
$y 3=x * y 2 ;$
So, we require total 10 variables in SSA form of the given code.
20. Ans. A.

SRTF is pre-emptive SJF which produces less average waiting time.
21. Ans. B.

Any superset of VY is a super key.
22. Ans. D.
'D' means durability not deadlock freedom.
23. Ans. A.
candidate key is (volume, number, start page, end page) (Volume number) $\rightarrow$ year is a partial dependency. So original table is in 1NF but not in 2NF
24. Ans. C.

Except DHCP, remaining all the protocols are used to resolve one form of address to another one.
25. Ans. C.

FTP and POP 3are stateful application layer protocols
26. Ans. A.
$\left(x^{3}+x^{4}+x^{5}+x^{6}+\ldots\right)^{3}$
$=x^{9}\left(1+x+x^{2}+\ldots\right)^{3}$
$=x^{9}\left((1-x)^{-1}\right)^{3}$
$=x^{9}(1-x)^{-3}$
$=x^{9} \sum_{n=0}^{\infty} \frac{(n+1)(n+2)}{2} x^{n}$
For coefficient of $\mathrm{x}^{12}$ put $\mathrm{n}=3=\frac{4 \times 5}{2}=10$
27. Ans. B.

The recurrence relation can be written as
$a_{n}-a_{n-1}=6 n^{2}+2 n$
Characteristic equation is $\mathrm{m}-1=0, \mathrm{~m}=1$
Complementary solution $=a_{n}^{(1)}=C_{1}(1)^{n}=C_{1}$
Let the particular solution be $a_{n}^{(b)}=\left(A n^{2}+B n+C\right) n$
( $\because$ RHS is second deg ree polynomial and 1 is root)
By substuting $a_{n}=\left(A n^{2}+B n+C\right) n$ in (1) and solving
$A=2, B=4, C=2$
General solution is $a_{n}=a_{n}^{(c)}+a_{n}^{(b)}=C_{1}+\left(2 n^{2}+4 n+2\right) n$
given $a_{1}=B \Rightarrow B=c_{1}+B \Rightarrow c_{1}=0$
Given $\mathrm{a}_{99}=\mathrm{k} \times 10^{4}$
$\Rightarrow\left[2(99)^{2}+4(99)+2\right] 99=2$
$\left[(100-1)^{2}+2(100-1)+(100-1)\right]=10^{4}$
$(198)=K \times 10^{4}$
$K=198$

## 28. Ans. A.

Given $f(n)=f\left(\frac{n}{2}\right)$ is $n$ is even
$=f(n+5)$ if $n$ is odd
We can observe that
$f(1)=f(2)=f(3)=f(4)=f(6)=f(7) \ldots$. and
$f(5)=f(10)=f(15)=$ $\qquad$
Clearly, the range of $f(x)$ will contain two distinct elements only.

## 29. Ans. A.

From the given steps we can observe that probabilities of $y$ are
$\frac{1}{4},\left(\frac{1}{4}\right)\left(\frac{1}{4}\right),\left(\frac{1}{4}\right)^{2} \frac{1}{4}, \ldots \ldots$.
Required probability
$=\frac{1}{4}+\left(\frac{1}{4} \times \frac{1}{4}\right)+\left(\left(\frac{1}{4}\right)^{2} \times \frac{1}{4}\right)+\ldots$.
$=\frac{1}{4}+\left(\frac{1}{4}\right)^{2}+\left(\frac{1}{4}\right)^{3}+\ldots$
$=\frac{1}{4}\left(1+\frac{1}{4}+\left(\frac{1}{4}\right)^{2}+\ldots\right)$
$=\frac{1}{4}\left(\frac{1}{1-\frac{1}{4}}\right)=\frac{1}{4} \times \frac{4}{3}=\frac{1}{3}=0.33$
30. Ans. D.

Output of first multiplexer is $\mathrm{Y}_{1}=\overline{\mathrm{P}} 0+\mathrm{PR}=\mathrm{PR}$
Output of second multiplexer is
$\mathrm{X}=\overline{\mathrm{Q}} \overline{\mathrm{R}}+\mathrm{QY}_{1}=\overline{\mathrm{Q}} \overline{\mathrm{R}}+\mathrm{QPR} \Rightarrow \overline{\mathrm{Q}} \overline{\mathrm{R}}+\mathrm{PQR}$
31. Ans. B.

DMA controller needs
$\Rightarrow \frac{29154 \mathrm{kB}}{2^{16} \text { byte }} \Rightarrow 455.53125=456$
32. Ans. B.

Old design $t_{p}=800$
New design $t_{p}=600$
Throughput $=\frac{800-600}{600} \times 100 \%=33.33 \%$

## 33. Ans. B.

Look ahead carry generator gives output in constant time if fan in = number of inputs.
If we have 8 inputs, and OR gate with 2 inputs, to build an OR gate with 8 inputs, we will need 4 gates in level-1, 2 in level-2 and 1 in level-3. Hence 3 gate delays, for each level.
Similarly an n-input gate constructed with 2 -input gates, total delay will be $\mathrm{O}(\log \mathrm{n})$.
34. Ans. D.

When $\mathrm{a}=\mathrm{b}$ then $\mathrm{P}[\mathrm{a}]$ will have the maximum value of the array.
35. Ans. A.


Output is 312213444
36. Ans. D.

Dynamic scoping looks for the definition of free variable in the reverse order of calling sequence.
37. Ans. B.

Time complexity of heapification is O (height) $=\mathrm{O}(\mathrm{d})$
38. Ans. A.


If $x=12$ then the shortest path between $d \& c$ will contain edge with lable ' $x$ '.
39. Ans. D.

40. Ans. B.

Statement II is correct. If e is the heaviest edge in cycle every mst excludes it.
Statement 1 is incorrect. Complete graph with 4 vertices and edge weights $1,2,5,6$ in non diagonal and diagonal edges 3 and 4. 4,5,6 will create a cycle and we can exclude the lighest edge e (4) from it, in a MST. So every MST of G need not include e.
41. Ans. B.

Exp. Maximum number of iterations will be
$n^{2}=256[\because \quad i]$
42. Ans. D.

Lagrange's generated by $G_{1}=a * b^{+}$
Lagrange's generated by $G_{2}=a^{+} b^{*}+b^{+}$

## 43. Ans. D.

Given PDA can accept any number of a's by staying at initial state. This PDA can also accept the strings a's followed by b's but equal number of a's and b's by reaching other final state. So
$L=\left\{a^{n} \mid n \geq 0\right\} \cup\left\{a^{n} b^{n} \mid n \geq 0\right\}$ and is deterministic contextfree.
44. Ans. C.

Y reduces to W and we know Y is Recursively enumerable but not recursive, so W is not recursively enumerable. $Z$ reduces to $X$ and we know $X$ is recursive language, then $Z$ is also recursive language.
45. Ans. C.
$2-5+1-7 * 3$
$2-(5+1)-7 * 3$
$2-6-7 * 3$
$2-(6-7) * 3$
$2-(-1) * 3$
$(2+1) * 3$
$3 * 3=9$
46. Ans. C.
print (2)

47. Ans. A.

Given $L A=40$ bit $=L A S=2^{40}$
Page size $=16 \mathrm{~KB}$
Page table Entry size (e) $=48$ bits (or) 6 bytes
Page table size $=$ ?
Size of the page table $=\mathrm{n} \times \mathrm{e}$
$\therefore$ No. of pages $(n)=\frac{L A S}{P S}=\frac{2^{40}}{2^{14}}=2^{26}=64 M$
$\therefore$ Page table size $=64 \times 6 B=384 M B$
48. Ans. A.

C-Look disc Scheduling
010113847638792121191199

$\therefore$ Total Head movements
$=24+5+29+70+181+1+27+9=346$
49. Ans. B.
$a_{1}, a_{2}, \ldots . a_{20}, a_{1}, a_{2}, \ldots . . a_{20}$


For first $a_{1}$ to $a_{20} 20$ page fault
Now $a_{1}$ to $a_{9}$ Hit
again $a_{10}$ to $a_{20}$ replace only 9th position, so 11 page fault.
So total 31 page fault

Optimal


$$
z_{1}
$$

For first $a_{1}$ to $a_{20} 20$ fault
Next $a_{1}$ to $a_{9}$ Hit
again $a_{10}$ to $a_{19}$ replace any location from 0 to 9 for $a_{20}$
Hit.
So total 30 page fault
Difference $=31-30=1$
50. Ans. A.

It can guarantee that at most one process can be in critical section at any time. But other conditions will fail in some cases.
51. Ans. A.

2PL ensures serializability and here as we are following linear order in acquiring the locks there will not be any deadlock.
52. Ans. B.

53. Ans. B.


So, no. of fragments that are transferred in this scenario is 13 .
54. Ans. B.

Given
$\mathrm{C}=1 \mathrm{Mb}$
Max Output rate $=20 \mathrm{Mbps}$
Arrival rate $=10 \mathrm{Mbps}$
$\therefore$ The minimum time required to transmit the data is
$S=\frac{c}{m-p}$
$S=\frac{1 \mathrm{Mb}}{20-10 \mathrm{Mpbs}}=\frac{1}{10}=0.1 \mathrm{sec}$
For 12 Mb of data, S value becomes 1.2 seconds
55. Ans. B.

Frame size (L) =1000bytes
Sender side bandwidth ( $\mathrm{B}_{\mathrm{s}}$ ) $=80 \mathrm{kbps}$
Acknowledgement ( $L_{A}$ ) =100bytes
Receiver side bandwidth $\left(B_{R}\right)=8 \mathrm{kbps}$
$\mathrm{T}_{\mathrm{p}}=100 \mathrm{~ms}$
$\mathrm{n}=\frac{\mathrm{T}_{\mathrm{x}}}{\mathrm{T}_{\mathrm{x}}+\mathrm{T}_{\mathrm{ack}}+2 \mathrm{~T}_{\mathrm{p}}}$
$(\mathrm{msg}) \mathrm{T}_{\mathrm{x}}=\frac{\mathrm{L}}{\mathrm{B}_{\mathrm{s}}}=\frac{1000 \text { Bytes }}{10 \times 10^{3} \mathrm{BPS}}=100 \mathrm{~ms}$
$($ Ack $) T_{A}=\frac{L_{A}}{B_{R}}=\frac{100 \text { Bytes }}{1 \times 10^{3} \mathrm{BPS}}=100 \mathrm{~ms}$
$T_{p}=100 \mathrm{~ms}$
$\therefore$ Channel Utilization
$=\frac{T_{n}}{T_{n}+T_{\text {ack }}+2 T_{p}}=\frac{100 m s}{100 m s+100 m s+200 m s}$
$=\frac{1}{4}$
$\therefore$ Throughput
$=\eta \times \mathrm{B}=\frac{1}{4} \times 10 \times 10^{3}=2.5 \mathrm{Kbps}$
(or 2500 Bps )

