1.

Consider the following types of languages: L_1: Regular, L_2: Context-free, L_3: Recursive, L_4: Recursively enumerable. Which of the following is/are **TRUE ?**

I. $\overline{L_3} \cup L_4$ is recursively enumerable.
II. $\overline{L_2} \cup L_3$ is recursive.
III. $L_1^* \cap L_2$ is context-free.
IV. $L_1 \cup \overline{L_2}$ is context-free.

A. I only.
B. I and III only.
C. I and IV only.
D. I, II and III only.

I. I. $\overline{L_3} \cup L_4$
L_3 is recursive, so $\overline{L_3}$ is also recursive (closed under complement),
So, $\overline{L_3}$ is recursive enumerable.
L_4 is recursive enumerable,
so, $\overline{L_3} \cup L_4$ is also recursive enumerable (closed under union).

II. $\overline{L_2} \cup L_3$
L_2 is Context-free, so $\overline{L_2}$, may or may not be Context-free (not closed under complement), but definitely $\overline{L_2}$ is Recursive.
L_3 is recursive.
so $\overline{L_2} \cup L_3$ is also recursive (closed under union).

III. $L_1^* \cap L_2$
L_1 is Regular, so L_1^* is also regular (closed under kleene star)
L_2 is Context-free
so, $L_1^* \cap L_2$ is also context-free (closed under intersection with regular).

IV. $L_1 \cup \overline{L_2}$
L_1 is regular.
L_2 is context-free, so $\overline{L_2}$ may or may not be Context-free (not closed under complement).
so, $L_1 \cup \overline{L_2}$ may or may not be Context-free.

Here, answer is **D**.

2. Pumping lemma for regulr language is generally used for proving:

A) Whether two given regular expression are equivalent

B) a given grammar is ambiguous

C) a given grammar is regular

D) a given grammar is not regular

Ans: D

D) a given grammar is not regular

The pumping lemma is often used to prove that a particular language is non-regular. Pumping lemma for regular language is generally used for proving a given grammar is not regular.

3. HTML (HyperText Markup Language) has language elements which permit certain actions other than
describing the structure of the web document. Which one of the following actions is **NOT** supported
by pure HTML (without any server or client side scripting) pages?

(A) Embed web objects from different sites into the same page
(B) Refresh the page automatically after a specified interval
(C) Automatic redirect to another page upon download
(D) Display the client time as the part of the page

Explanation:
<OBJECT>...</OBJECT> tag is used to embed object
<META HTTP-EQUIV="Refresh" CONTENT="5"> is used to refresh page after every 5 seconds
<META HTTP-EQUIV="Refresh" CONTENT="0;URL=another-page.html"> is used to redirect

4. Which of the following is **NOT** desired in a good Software Requirement Specifications (SRS) document?

(A) Functional Requirements (B) Non-Functional Requirements
(C) Goals of Implementation (D) Algorithms for Software Implementation

Explanation:
"An SRS document should clearly document the following aspects of a system: Functional Requirements,
Non-Functional Requirements and Goals of implementation."

5. Let the time taken to switch between user and kernel modes of execution be t_1 while the time taken to
switch between two processes be t_2. Which of the following is **TRUE**?

(A) $t_1 > t_2$
(B) $t_1 = t_2$
(C) $t_1 < t_2$
(D) nothing can be said about the relationship between t_1 and t_2

Explanation:
"Whenever a trap or interrupt occurs, the hardware switches from user mode to monitor mode (this is,
changes the state of the mode bit to 0). Thus whenever the operating system gains control of the
computer, it is in monitor mode. The system always switches to user mode (by setting the mode bit
to 1) before passing the control to a user program."
"When a context switch occurs, the kernal saves the context of old process in its PCB and loads the
saved context of the new process scheduled to run."

Galvin (Operating System Concepts)
As mode switching is a part of context switching, it's definitely less than context switch time.
Alternatively, when ever context switch occurs between two user processes then there are two mode
changes first from user to monitor and after that monitor to user.

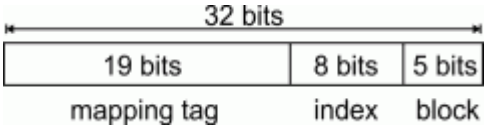
6. An 8KB direct-mapped write-back cache is organized as multiple blocks, each of size 32-bytes. The processor
generates 32-bit addresses. The cache controller maintains the tag information for each cache block
comprising of the following.

1 Valid bit
1 Modified bit
As many bits as the minimum needed to identify the memory block mapped in the cache.

What is the total size of memory needed at the cache controller to store meta-data (tags) for the cache?

(A) 4864 bits (B) 6144 bits (C) 6656 bits (D) 5376 bits

Explanation:
Cache size = 8 KB
Block size = 32 bytes
Number of cache lines = Cache size / Block size = (8 × 1024 bytes)/32 = 256



total bits required to store meta-data of 1 line = 1 + 1 + 19 = 21 bits
total memory required = 21 × 256 = 5376 bits

7. Consider the following activities related to email.
m1: Send an email from mailbox server to a mail client
m2: Download an email from mailbox server to a mail client
m3: Checking email in a web browser
Which application level protocol used in each activity?

(A) m1:HTTP m2:SMTP m3:POP
(B) m1:SMTP m2:FTP m3:HTTP
(C) m1:SMTP m2:POP m3:HTTP
(D) m1:POP m2:SMTP m3:IMAP

Explanation:
"SMTP is a push protocol; it pushes the message from the client to server"
"POP and IMAP supports pull protocol they can pull the message from the server"
"Web-Based mail: Mail transfer from Alice's browser to her mail server is done through HTTP. The message

from the receiving server (the Web server) to Bob's browser is done through HTTP."

-

Forouzan (Data Communications and Networking)

It's now clear that

m1:SMTP m2:POP or IMAP m3:HTTP

8. Database table by name Loan_Records is given below.

Borrower	Bank_Manager	Load_Amount
Ramesh	Sundarajan	10000.00
Suresh	Ramgopal	5000.00
Mahesh	Sundarajan	7000.00

What is the output of the following SQL query?

```
SELECT count(*)
FROM(
    (SELECT Borrower,Bank_Manager FROM Loan_Recordx) AS S
   NATURAL JOIN
    (SELECT Bank_Manager,Loan_Amount FROM Loan_Records) AS T
);
```

(A) 3 (B) 9 (C) 5 (D) 6

Explanation:

Borrower	Bank_Manager
Ramesh	Sundarajan
Suresh	Ramgopal
Mahesh	Sundarajan

S

Bank_Manager	Load_Amount
Sundarajan	10000.00
Ramgopal	5000.00
Sundarajan	7000.00

T

It is evaluated as

$\Pi_{Borrower,Bank\_Manager,Loan\_Amount}(\sigma_{S.Bank\_Manager=T.Bank\_Manager}(S \times T))$

Borrower	S.Bank_manager	T.Bank_manager	Loan_Amount
Ramesh	Sundarajan	Sundarajan	1000
Ramesh	Sundarajan	Ramgopal	5000
Ramesh	Sundarajan	Sundarajan	7000
Suresh	Ramgopal	Sundarajan	1000
Suresh	Ramgopal	Ramgopal	5000
Suresh	Ramgopal	Sundarajan	7000
Mahesh	Sundarajan	Sundarajan	1000
Mahesh	Sundarajan	Ramgopal	5000
Mahesh	Sundarajan	Sundarajan	7000

S×T

Final rows after Project operator has been applied

Borrower	Bank_manager	Loan_Amount
Ramesh	Sundarajan	10000
Ramesh	Sundarajan	7000
Suresh	Ramgopal	5000
Mahesh	Sundarajan	10000
Mahesh	Sundarajan	7000

9. Suppose we have an O(n) time algorithm that finds the median of an unsorted array. Now consider a QuickSort implementation where we first find the median using the above algorithm, then use the median as a pivot. What will be the worst-case time complexity of this modified QuickSort?

(A)
O(n^2 Logn)

(B)
O(n^2)

(C)
O(n Logn Logn)

(D)
O(nLogn)

Answer: (D)

Explanation:
If we use the median as a pivot element, then the recurrence for all cases becomes
T(n) = 2T(n/2) + O(n)

The above recurrence can be solved using Master method. It falls in case 2 of the master method.
So, the worst-case time complexity of this modified QuickSort is **O(nLogn).**

10. Reasoning strategies used in expert systems include _____.
(A) Forward chaining, backward chaining and problem reduction
(B) Forward chaining, backward chaining and boundary mutation
(C) Forward chaining, backward chaining and back propagation
(D) Backward chaining, problem reduction and boundary mutation

Answer: (A)

Explanation: Reasoning strategies used in expert systems include forward chaining, backward chaining and problem reduction. In Forward chaining expert system is

driven by antecedent and backward system is driven by consequent.
So, option (A) is correct.

11.
The notation ∃!xp(x) denotes the proposition "there exists a unique x such that P(x) is true".
Give the truth values of the following statements :

I. ∃!xP(x) → ∃xP(x)
II. ∃!x ¬ P(x) → ¬∀xp(x)

a. Both I and II are true

b. Both I and II are false

c. I-false, II-true

d. I-true, II-false

Ans:

a. Both I and II are true

- ∃!xP(x) means that there exists a unique x such that P(x) is true.
- ∃!xP(x)→∃xP(x) means that if there exists a unique x such that P(x) is true, then there exists another x such that P(x) is true.
- ∀xP(x) means that P(x) is true for all x.
- ∀xP(x)→∃!xP(x) means that if P(x) is true for all x, then there exists a unique x such that P(x) is true.

To answer your question, we need to consider the meaning and implications of each statement. Here are some explanations and examples:

- ∃!xP(x): This statement asserts that there exists a single element x in the domain of discourse such that P(x) holds. For example, if P(x) = “x is an even number”, then ∃!xP(x) = “there exists an even number”. This statement can be used to express the existence and uniqueness of a solution to a problem or equation. For example, ∃!x2 + 1 = 0 means “there exists an integer solution to the quadratic equation”. The truth value of this statement depends on whether there is such an element in the domain of discourse or not. If there is, then the statement is true; if not, then it is false.
- ∃!xP(x)→∃xP(x): This statement asserts that if there exists a unique x such that P(x) holds, then there exists another x such that P(x) holds. For example, if P(x) = “x + 1 = 2”, then ∃!xP(x)→∃xP(x) = “if there exists an odd number plus one equal to two, then there exists another odd number plus one equal to two”. This statement can be used to express the existence and uniqueness of a pair of solutions to a problem or equation. For example, ∃!xy + 1 = 0 means “there exist two integers solutions to the quadratic

equation". The truth value of this statement depends on whether both statements are true or not. If both are true, then the statement is true; if either one or both are false, then it is false.

- ∀xP(x): This statement asserts that P(x) holds for all elements in the domain of discourse. For example, if P(x) = "x > 0", then ∀xP(x) = "all numbers greater than zero are positive". This statement can be used to express the general property or characteristic of a set or function. For example, ∀xn > 0 means "all real numbers greater than zero are real numbers". The truth value of this statement depends on whether it holds for every element in the domain of discourse or not. If it does, then the statement is true; if it does not, then it is false.
- ∀xp: This statement asserts that p holds for all elements in the domain of discourse where p denotes some function or relation. For example, if p denotes "the area of a circle", then ∀xp means "the area of any circle in any set or function where circles exist". This statement can be used to express the general property or characteristic of a set or function where functions or relations exist. For example, ∀xn2πr2 means "the area of any circle with radius r in any set where circles exist". The truth value of this statement depends on whether it holds for every element in the domain of discourse where functions or relations exist or not. If it does, then the statement is true; if it does not, then it is false.

12. Which of the following statement(s) is/are false?

a. A connected multigraph has an Euler Circuit if and only if each of its vertices has even degree.
b. A connected multigraph has an Euler Path but not an Euler Circuit if and only if it has exactly two vertices of odd degree.
c. A complete graph ($K_{n)}$ has a Hamilton Circuit whenever $n \geq 3$.
d. A cycle over six vertices ($C_{6)}$ is not a bipartite graph but a complete graph over 3 vertices is bipartite.

Codes :

A. a only
B. b and c
C. c only
D. d only

An Euler circuit of a graph G is a simple circuit that contains every edge of G.
A connected multigraph has an Euler circuit if and only if each of its vertices has even degree.

A connected multigraph has an Euler path but not an Euler circuit if and only if it has exactly two vertices of odd degree.

A complete graph K_n has a Hamilton circuit for n≥3.

Cycle graphs with an even number of vertices are bipartite.

Thus C 8 also can be birpatite.

D is false

Answer D

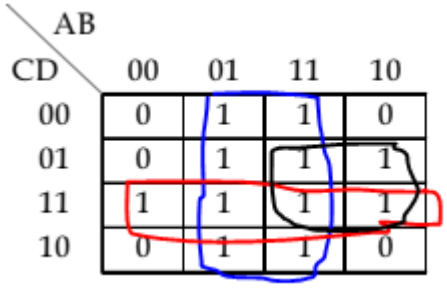
13. The Boolean function with the Karnaugh map

CD \ AB	00	01	11	10
00	0	1	1	0
01	0	1	1	1
11	1	1	1	1
10	0	1	1	0

is:
(A) (A+C).D+B
(B) (A+B).C+D
(C) (A+D).C+B
(D) (A+C).B+D

Answer: (A)

Explanation: To find the boolean function here we will use K-map
Select neighbouring Minterms as max as possible in powers of 2 ie 2 ,4,8 and so on.



Here we have selected group of minterms:
First we will take 8 minterms group which will give us B.
Now take 4 minterms group it will give us CD.
Another 4 minterms group will give us AD.
We have the expression B + CD + AD.
which can be reduced as B + D (A + C)
So, option (A) is correct.

14. Match the following port numbers with their uses :
List-I List-II
(a) 23 (i) World wide web
(b) 25 (ii) Remote Login
(c) 80 (iii) USENET news
(d) 119 (iv) E-mail
Codes :
(a) (b) (c) (d)
(1) (iv) (i) (ii) (iii)
(2) (ii) (i) (iv) (iii)
(3) (ii) (iv) (iii) (i)
(4) (ii) (iv) (i) (iii)

15. An analog signal carries 4 bits in each signal unit. If 1000 signal units are sent per second, then baud rate and bit rate of the signal are _____ and _____

A. 4000 bauds/sec & 1000 bps
B. 2000 bauds/sec & 1000 bps
C. 1000 bauds/sec & 500 bps
D. 1000 bauds/sec & 4000 bps

Ans: baud rate (signal rate)=bit rate/no of bits per signal or bit rate=baud rate x no of bits per signal

so here baud rate is given ***1000 bauds(signals)per sec and no of bits per signal =4***

so bit rate =4000 bits per sec

hence ans is D

16. Consider a non-pipelined processor with a clock rate of 2.5 gigahertz and average cycles per instruction of four. The same processor is upgraded to a pipelined processor with five stages; but due to the internal pipeline delay, the clock speed is reduced to 2 gigahertz. Assume that there are no stalls in the pipeline. The speedup achieved in this pipelined processor is_____.

A) **3.0**
B) **3.2**
C) **2**
D) **4**

Answer: ⇒

Explanation: ⇒

For Non-Pipelined System: ⇒

Given frequency $= \mathbf{2.5GHz}$

$\therefore$ 1 Cycle time $= \dfrac{\mathbf{1}}{\mathbf{2.5Gs}} = \dfrac{1}{2.5}$ nano seconds

$\therefore$ Total Time $= 4 \times \frac{1}{2.5}$ nano seconds $= \dfrac{4}{2.5}$ nano seconds

For Pipelined System: ⇒

Average CPI $= 1$ [$\because$ It is given that pipeline has no stalls.]

This also proves the fact that pipeline is also independent of the number of phases, [so there would be no change if the question was asked for **6** stages also.]

Similarly, as above:

Frequency $= 2$ GHz

$\therefore$ 1 cycle time $= \dfrac{1}{2}$ nano seconds

$\therefore$ **Speed-up** $= \dfrac{\text{Time without pipelining}}{\text{Time with pipelining}} = \dfrac{\frac{4}{2.5}}{\frac{1}{2}} = 3.2$

$\therefore$ 3.2 is the correct answer.

sAnother way:

```
Speedup = ExecutionTime_Old / ExecutionTime_New

ExecutionTime_Old = CPI_Old * CycleTime_Old
                    [Here CPI is Cycles Per Instruction]
                  = CPI_Old * CycleTime_Old
                  = 4 * 1/2.5 Nanoseconds
                  = 1.6 ns

Since there are no stalls, CPI_new can be assumed 1 on average.
ExecutionTime_New = CPI_new * CycleTime_new
                  = 1 * 1/2
                  = 0.5

Speedup = 1.6 / 0.5 = 3.2
```

17.

Which raster locations would be chosen by Bresenham's algorithm when scan converting a line from $(1,1)$ to $(8,5)$?

A.

x	y
1	1
2	2
3	3
4	3
5	4
6	4
7	5
8	6

B.

x	y
1	1
2	2
3	2
4	3
5	4
6	5
7	6
8	7

C.

x	y
1	1
2	2
3	2
4	3
5	3
6	4
7	4
8	5

D.

x	y
1	1
2	2
3	2
4	3
5	5
6	4
7	5
8	5

Ans must be C

short cut method since line has to be drawn from (1,1) to (8,5) choice A,B are out as they are ending up with 8,6 and 8,7

now in choice D after point 4,3 it is 5,5 i.e increment of 2 in y which is not as per rule of line drawing

so we can safely say ans is C (because such unusual pattern is not seen in this)

for proper method bresenham's algo is

Step 1 − Input the two end-points of line, storing the left end-point in (x0,y0).

Step 2 − Plot the point (x0,y0).

Step 3 − Calculate the constants dx, dy, 2dy, and (2dy – 2dx) and get the first value for the decision parameter as p0=2dy−dx

Step 4 − At each Xk along the line, starting at k = 0, perform the following test

If pk < 0, the next point to plot is (xk +1,yk) and update value of parameter p as

pk+1=pk+2dy

Otherwise,

next point to plot is (xk+1 ,yk+1) and update value of parameter p as

pk+1=pk+2dy−2dx

Step 5 − Repeat step 4 (dx – 1) times.

For m > 1, find out whether you need to increment x while incrementing y each time.

After solving, the equation for decision parameter Pk will be very similar, just the x and y in the equation gets interchanged.

18. In a two-pass assembler, symbol table is
(A) Generated in first pass
(B) Generated in second pass
(C) Not generated at all
(D) Generated and used only in second pass

Answer: (A)

Explanation: In a two-pass assembler, symbol table is generated in first pass but it need two pass to scan whole source file. While one pass assembler scan whole file in a go.
So, option (A) is correct.

19.

Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R):
Assertion (A): $\bar{p}$
Reason (R): $(r \rightarrow \bar{q}, r \vee s, s \rightarrow \bar{q}, p \rightarrow q)$
In the light of the above statements, choose the correct answer from the options given below:

A) Both (A) and (R) are true and (R)is the correct explanation of (A)

B) Both (A) and (R) are true but (R) is (NOT)the correct explanation of (A)

C) (A)is true but (R)is false

D) (A)is false but (R)is true

Correct answer is Option 2**Explanation:**

Assertion (A): $\bar{p}$ -

Reason (R): $(r \rightarrow \bar{q}, r \vee s, s \rightarrow \bar{q}, p \rightarrow q)$

$r' \vee q'$

$r \vee s$

$s' \vee \bar{q}$

$p' \vee q$

here complement of element is cancel by its original element like r' and r cancel

after solving like that answer is

p'

20. Consider the following assembly language instructions :
mov al, 15
mov ah, 15
xor al, al
mov cl, 3
shr ax, cl
add al, 90H
adc ah, 0
What is the value in ax register after execution of above instructions ?
(A) 0270H
(B) 0170H
(C) 01E0H
(D) 0370H

Answer: (A)

it is 8086 question AX(16 bit) =AH(8 bit) +AL (8 bit)

MOV AL ,15 // 00001111 in AL

mov ah, 15 // 00001111 in AH and AX =0000 1111 0000 1111

xor al, al // AL is 0000 0000 now and so AX =0000 1111 0000 0000

mov cl, 3 // CL is 0000 0011

shr ax, cl //AX = 000 0000 1111 0000 0 or (01E0) h

add al, 90H // AL= 1001 0000 add this to(AX=AH+AL) , now AX =0170 h with carry 1

adc ah, 0 // add 0 to ah with carry which is one so final ans 0270 h

so ans is A

21.

In hierarchical routing with 4800 routers, what region and cluster sizes should be chosen to minimize the size of the routing table for the three-layer hierarchy?

A. 10 clusters, 24 regions and 20 routers
B. 12 clusters, 20 regions and 20 routers
C. 16 clusters, 12 regions and 25 routers
D. 15 clusters, 16 regions and 20 routers

$Clusters \times regions \times routers = 4800$ for all options

so we use following

$(clusters - 1) + (regions - 1) + routers$, which option gives minimum is the ans...

Option 1 gives us 52.

Option 2 gives us 50

Option 3 gives us 51

Option 4 gives us 49

So the answer is D

22.

A Hash table has space for 100 records. Then the probability of collision before the table is 10% full is?

A 0.45
B 0.5
C 0.3
D 0.34 (approximately)

For the first time there will be no collision because all the slot is empty.
Now, once the first slot is filled, after then to fill the next key in the slot there is chances of collision by 1/100.
For the next key, 2/100.
So 1/100 + 2/100+.....+9/100.
= .01+.02+.03+.....+.08+.09= .45

23. Match the following:

List – I	List – II	
(a) The 8-Queen's problem	(i)Dynamic programming	
(b) Single-Source shortest paths	(ii) Divide and conquer	
(c)STRASSEN's Matrix multiplication	(iii)Greedy approach	
(d)Optimal binary search trees	(iv)Backtracking	

	(a)	(b)	(c)	(d)
(1)	(iv)	(i)	(iii)	(ii)
(2)	(iv)	(iii)	(i)	(ii)
(3)	(iii)	(iv)	(i)	(ii)
(4)	(iv)	(iii)	(ii)	(i)

(A) (1)
(B) (2)
(C) (3)
(D) (4)

Answer: (D)

Explanation:

- The 8-Queen's problem is a Backtracking algorithm.
- Single-Source shortest paths is a Greedy approach
- STRASSEN's Matrix multiplication is a Divide and conquer
- Optimal binary search trees is a Dynamic programming.

So, option (D) is correct.

24. Let the representation of a number in base 3 be 210. What is the hexadecimal representation of the number?

A) 15

B) 21

C) D2

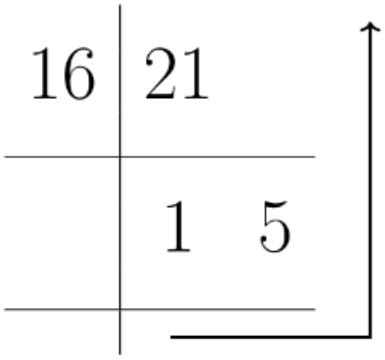
D) 528

Firstly convert base 3 into a decimal number system(Base 10):

$(210)_3 = (x)_{10} \implies 0 * 3^0 + 1 * 3^1 + 2 * 3^2 = (21)_{10}$

Now convert $(21)_{10}$ into a hexadecimal system. dividing by 16 that is:

$(21)_{10} = (z)_{16}$



$\therefore z = (15)_{16}$

Option A is correct.

25. Which of the following is NOT true with respect to a transparent bridge and a router?
(A) Both bridge and router selectively forward data packets
(B) A bridge uses IP addresses while a router uses MAC addresses
(C) A bridge builds up its routing table by inspecting incoming packets
(D) A router can connect between a LAN and a WAN

Answer: (B)

Explanation: Network Devices
Bridges are used to connect two or more networks and create a bigger network. A bridge works up upto the second layer only, i.e. it only implements the Physical and Data Link layers. Therefore it does not use IP addresses for its routing.
Therefore option (B) is correct.