Computer Science and Information Technology

GENERAL APTITUDE

One Mark Questions(Q01–05)

01. The cost of 7 pens, 8 pencils and 3 sharpeners is Rs 20. The cost of 3 pencils, 4 sharpeners and 5 erasers is Rs 21. The cost of 4 pens, 4 sharpeners and 6 erasers is Rs 25. The cost of 1 pen, 1 pencil, 1 sharpener and 1 eraser is ________ (Rs)

Ans: 6

Sol: Let the costs of pens, pencil, eraser and sharpener be p_n, p_p, e and s respectively

Given

$7p_n + 8p_p + 3s = 20$

$3p_p + 4s + 5e = 21$

$4p_n + 4s + 6e = 25$

Adding all three equations

$11p_n + 11p_p + 11s + 11e = 66$

$\therefore\ 1p_n + 1\,p_p + 1s + 1e = 6$

02. **Sentence Completion:**

Although some think the terms "bug" and "insect" are -------, the former term actually refers to ------- group of insects.

(A) parallel - an identical

(B) precise - an exact

(C) interchangeable - particular

(D) exclusive - a separate.

Ans: (C)

Sol: The word "although" indicates that the two parts of the sentence contrast with each other: although most people think about the terms "bug" and "insect" one way, something else is actually true about the terms. Choice (C) logically completes the sentence, indicating that while most people think the terms are "interchangeable," the term "bug" actually refers to a "particular" group of insects.

03. **Sentence improvement:**

<u>Underestimating its value, breakfast is a meal many people skip.</u>

(A) Underestimating its value, breakfast is a meal many people skip

(B) Breakfast is skipped by many people because of their underestimating its value

(C) Many people, underestimating the value of breakfast, and skipping it.

(D) Many people skip breakfast because they underestimate its value.

Ans: (D)

Sol: The problem with this sentence is that the opening phrase "underestimating its value" modifies "breakfast," not "people." The order of the words in the sentence in choice (D) does not have this problem of a misplaced modifying phrase. Choice (D) also clarifies the causal relationship between the two clauses in the sentence. None of the other choices convey the information presented in the sentence as effectively and directly as choice (D).

04. **Spot the error, if any:**

If I were her / I would accept / his offer

(A) If I were her (B) I would accept

(C) his offer (D) No error

Ans: (A)

Sol: Rule we should use Subjective case of pronoun after BE forms…am, is, are was were.,, has been, have been, had been.

Her is an objective case ---

If I were she. is correct

05. Kishenkant walks 10 kilometres towards North. From there, he walks 6 kilometres towards south. Then, he walks 3 kilometres towards east. How far and in which direction is he with reference to his starting point?

(A) 5 kilometres, West Direction

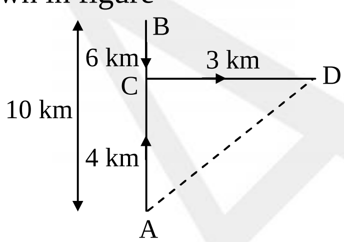
(B) 5 kilometres, North-East Direction

(C) 7 kilometres, East Direction

(D) 7 kilometres, West Direction

Ans: (B)

Sol: The movements of Kishenkant are as shown in figure



A to B, B to C and C to D

AC = (AB – BC) = (10 – 6) km = 4 km

Clearly, D is to the North-East of A

∴ Kishenkant's distance from starting point A

$$AD = \sqrt{AC^2 + CD^2}$$

$$= \sqrt{(4)^2 + (3)^2} = \sqrt{25} = 5 \text{ km}$$

So, Kishenkant is 5 km to the North-East of his starting point

Two Marks Questions(Q06–10)

06. The infinite sum $1+\frac{4}{7}+\frac{9}{7^2}+\frac{16}{7^3}+\frac{25}{7^4}+$ - - - - - equals

Ans: 1.8 to 2

Sol: We have to find the sum of the series $1+\frac{4}{7}+\frac{9}{7^2}+\frac{16}{7^3}+\frac{25}{7^4}+$ - - - - -

Putting $x = \frac{1}{7}$ we get

$1 + 2^2x + 3^2x^2 + 4^2x^3 + 5^2x^4 + \cdots$

$s = 1 + 4x + 9x^2 + 16x^3 + 25x^4$

$s.x = x + 4x^2 + 9x^3 + 16x^4 + \cdots$

$s - sx = 1 + 3x + 5x^2 + 7x^3 + 9x^4 + \cdots$

$x(s - sx) = x + 3x^2 + 5x^3 + 7x^4 + \cdots$

$(s - sx) - x(s - sx) = 1 + 2x + 2x^2 + 2x^3 + \cdots + \text{ to } \infty$

$$(1-x)^2 s = 1+\frac{2x}{1-x}; \text{ since } |x|<1$$

$$s = \frac{1+x}{(1-x)^3}$$

We may use it as direct formula for solving this type of problem

Substituting $x = \frac{1}{7}$ we get

$$s = \frac{1+\frac{1}{7}}{\left(1-\frac{1}{7}\right)^3} = \frac{8\times 343}{7\times 216} = \frac{49}{27}$$

07. If $\frac{x}{3a+2b} = \frac{y}{3b+2c} = \frac{z}{3c+2a} = 5$ and a, b and c are in continued proportion and b, c, a are in continued proportion, then $\frac{x}{a}+\frac{y}{2b}+\frac{z}{3c}$ is ________ (∵ a, b and c are in continued proportion means $b^2 = ac$)

(A) $55\frac{1}{5}$ (B) 25 (C) $4\frac{1}{6}$ (D) $45\frac{5}{6}$

Ans: (D)

Sol: Given that a, b, c are in continued proportion ⇒ $b^2 = ac$ -------- (1)

Also b, c, a are in continued proportion

$\Rightarrow c^2 = ab$ ------- (2)

From (1) and (2)

$b^2c^2 = a^2bc \Rightarrow a^2 = bc$ ------- (3)

Conditions (1), (2) and (3) can only be satisfied when a = b = c = k (say)

$$\therefore \frac{x}{5k} = \frac{y}{5k} = \frac{z}{5k} = 5 \Rightarrow \frac{x}{k} = \frac{y}{k} = \frac{z}{k} = 25$$

$$\therefore \frac{x}{a} + \frac{y}{2b} + \frac{z}{3c} = \frac{x}{k} + \frac{1}{2}\frac{y}{k} + \frac{1}{3}\frac{z}{k}$$

$$= 25 + \frac{25}{2} + \frac{25}{3} = \frac{25\times 11}{6} = \frac{275}{6} = 45\frac{5}{6}$$

08. Rasputin was born in 3233 B.C. The year of birth of Nicholas when successively divided by 25, 21 and 23 leaves remainder of 2, 3 and 6 respectively. If the ages of Nicholas, Vladimir and Rasputin are in arithmetic progression, when was Vladimir born?

(A) 3227 B.C (B) 3229 B.C

(C) 3230 B.C (D) 3231 B.C

Ans: (C)

Solution: The year of birth of Nicholas

25	21	23	
↓	↓	↓	
2	3	6	$\Rightarrow$ 3227

The ages of Nicholas, Vladimir and Rasputin are in A.P

The ages of Nicholas	Vladimir	Rasputin
3227	?	3233

$$\therefore \text{Vladimir age} = \frac{\text{Nicholas} + \text{Rasputin}}{2}$$

$$= \frac{3227 + 3233}{2} = 3230 \text{ B.C}$$

09. Recent studies have highlighted the harmful effects of additives in food (colors, preservatives, flavor enhancers etc.). There are no synthetic substances in the foods we produce at Munchon Foods - we use only natural ingredients. Hence you can be sure you are safeguarding your family's health when you buy our products, says Munchon Foods. Which of the following, if true, would most weaken the contention of Munchon Foods?

(A) Some synthetic substances are not harmful

(B) Some natural substances found in foods can be harmful

(C) Food without additives is unlikely to taste good

(D) Munchon Foods produces only breakfast cereals

Ans: (B)

Sol: Munchon's contention is that buying their products safeguards health. To weaken that argument we can show that, for some reason, their foods might not be healthy.

So think about an alternative cause

10. To open a lock, a key is taken out of a collection of n keys at random. If the lock is not opened with this key, it is put back into the collection and another key is tried. The process is repeated again and again. It is given that with only one key in the collection, the lock can be opened. The probability that the lock will open in 'n^{th}' trail is _____.

(A) $\left(\frac{1}{n}\right)^n$ (B) $\left(\frac{n-1}{n}\right)^n$

(C) $1 - \left(\frac{n-1}{n}\right)^n$ (D) $1 - \left(\frac{1}{n}\right)^n$

Ans: (C)

Sol: Probability that the lock is opened in a trail is $\frac{1}{n}$ (since there is exactly one key, which opens the lock)

$\therefore$ The chance that the lock is not opened in a particular trail = $1 - \frac{1}{n}$

P(lock is opened in n^{th} trial) = 1– P(lock is not opened in n trials)

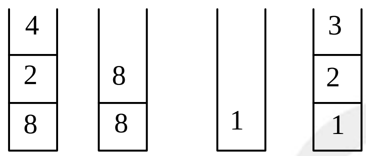
$$= 1 - \left[1 - \frac{1}{n}\right]^n = 1 - \left[\frac{n-1}{n}\right]^n$$

Techinical Questions

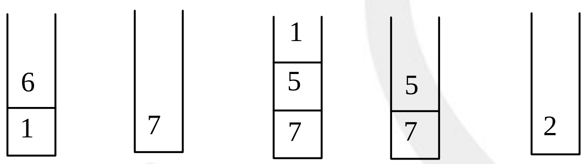
One Mark Questions (Q11–35)

11. The result evaluating the postfix expression 8 2 4 * / 2 3 * + 5 1 * – is __________.

Ans: 2
Sol:



2 * 4 = 8 8 / 8 = 1



2 * 3 = 6 6 +1 = 7 5 * 1 = 5 7– 5 = 2

12. For which value of α the following system of equations is inconsistent?

$$3x + 2y + z = 10$$
$$2x + 3y + 2z = 10$$
$$x + 2y + \alpha z = 10$$

Ans: 1.4

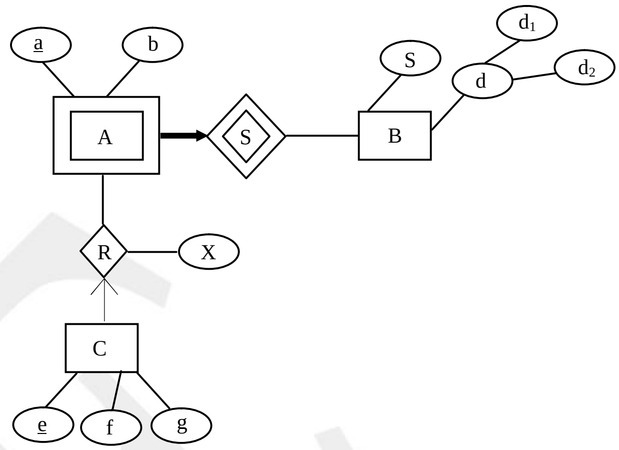
Sol : $\begin{vmatrix} 3 & 2 & 1 \\ 2 & 3 & 2 \\ 1 & 2 & \alpha \end{vmatrix} = 0$

$\Rightarrow 3(3\alpha - 4) - 2(2\alpha - 2) + (4 - 3) = 0$

$\Rightarrow 5\alpha - 7 = 0$

$\therefore \alpha = \dfrac{7}{5} = 1.4$

13. Consider the following E-R diagram



Total number of attributes in each of the relation schemes in relational model is ______

Ans: 13
Sol:
The relation schemes in relational model

AS (a c b) $\rightarrow$ Fk

RC (e f g X a c) $\rightarrow$ T_1 (e , f, X, a c) $\rightarrow$ Fk
RC (e f g X a c) $\rightarrow$ T_2 (e g)

B (c d_1 d_2)

Total number of attributes = 13

14. The Smallest Negative integer that can be represented in signed 2's complement notation with 10 bit is _______.

Ans: –512

Sol: Range for n bit is $-(2^{n-1})$ to $+(2^{n-1}-1)$

Given n = 10,

$\Rightarrow -(2^{10-1})$ to $+ (2^{10-1}-1)$

$\Rightarrow -(2^{9})$ to $+ (2^{9}-1)$

$\Rightarrow -512$ to 511

The smallest negative integer is –512

15. The maximum number of articulation points of any binary tree of 100 nodes is ______.

Ans: 98

Sol:

Maximum number of articulation points are possible if the binary tree is left skewed (or) right skewed.

In left skewed (or) right skewed binary tree with 'n' nodes contains maximum (n–2) articulation points.

Since we have 100 nodes, so we have 98 articulation points.

16. A group of N stations share a 64 Kbps pure ALOHA channel. Each station outputs a 2000 bits frame on an average of once every 100 sec, even if the previous one has not yet been send. What is the maximum value of N ?

Ans: 576

Sol:

Pure ALOHA throughput = 18 %

Utilization bandwidth = 0.18 × 64 Kbps
= 11.52 Kbps

This has to be shared by N station.

Transmission rate = 2000/100 = 20 bps

N = 11520/20 = 576

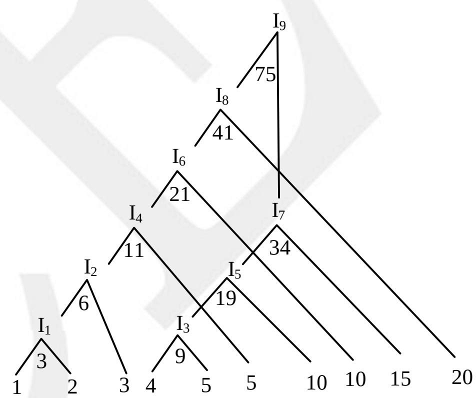
17. Let F_1, F_2, ... F_n be files with length L_1, L_2....... L_n we would like to merge all of the files together to make a single file. The cost of merging files is m+n if the files have length m and n. Find the minimum cost of merging ten files whose length are 5, 3, 10, 20, 15, 10, 5, 1, 2, 4 is _______.

Ans : 219

Sol:

First arrange all files in the increasing order of length and then in each iteration, select two files which are having least number of records and merge them into single file.

Continue this process until all files are completed.



Minimum cost of merging all files
= 3 + 6 + 9 + 11 + 19 + 21 + 34 + 41 + 75
= 219

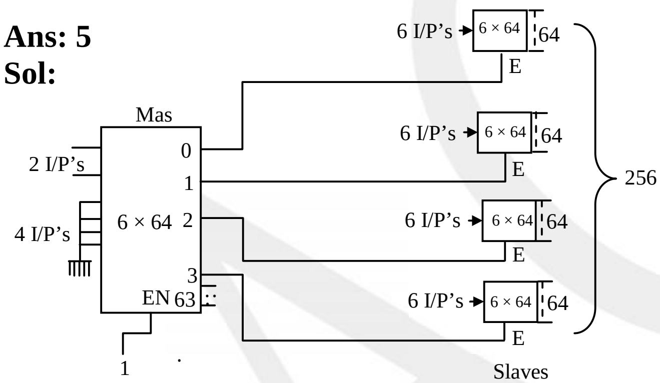
18.
```
int f(long int n)
{
int sum;
if (n = = 9)
return 1;
if (n < 9 )
  return 0;
  sum = 0;
  while (n > 0)
   {
    sum + = n%10;
     n / = 10;
   }
  return f(sum);
}
```

What is the return value of f(49698589) is ________.

Ans: 0
Sol:
A number is divisible by 9 iff the sum of the digits of the number is divisible by 9.
f(49698589) $\rightarrow$ 4 + 9 +6 + 9 + 8 + 5 + 8 +9 = 58
f(58) $\rightarrow$ 5 + 8 = 13
f(13) $\rightarrow$ 1 + 3 = 4
f(4) $\rightarrow$ return '0'

19. Minimum number of 6 × 64 Decoder needed to implement 8× 256 Decoder with enable inputs (without using extra Hardware) is ______.

Ans: 5
Sol:



1 master + 4 slaves
Total 5 decoders are minimum needed.

20. In which of the modes of operation the transmission error does not affect the future bits.
(A) Cipher block chaining
(B) Cipher feedback
(C) Output feedback
(D) B and C

Ans: (C)
Sol: Output is not linked to input of next block but sub key is linked to next block.

21. Assume intermediate router received a IP_V6 datagram. If the datagram is too large to be forwarded over the outgoing link, the router is _______.
(A) Drops
(B) Fragments
(C) Forward without fragmenting
(D) None

Ans: (A)
Sol: Drops and sends "Packet Too Big" ICMP error message

22. Consider the following enumerations & choose the false answer:
$\Sigma 1$: Effective enumeration of all cfls that is countably infinite.
$\Sigma 2$: A countably infinite effective enumeration of all pairs of real numbers.
$\Sigma 3$: A countably infinite effective enumeration of all TMs
$\Sigma 4$: An effective enumeration of all recursive sets that is countably infinite
(A) $\Sigma 1 \times \Sigma 2$ does not exist
(B) $\Sigma 2 \times \Sigma 3$ does not exist
(C) $\Sigma 3 \times \Sigma 4$ does not exist
(D) $\Sigma 1 \times \Sigma 3$ does not exist

Ans: (D)
Sol: Since the descriptions of TMs are finite & all cfls are finite we can enumerate effectively all the descriptions in increasing order of size. So $\Sigma 1 \times \Sigma 3$ is countably infinite by dovetailing.

23. What is the Time Complexity of the following piece of code?

```
void A( )
{
    int n = 2^(2^K) ;
    for(i = 1; i < n; i++)
    {
        j = 2;
        while(j < = n)
        {
            j = j^2;
            printf("ACE");
        }
    }
}
```

(A) O(n log n) (B) $O(n \log_2 \log_2^n)$
(C) O(n) (D) O(log n)

Ans: (B)

Sol: For each value of i, the while loop will be executed K + 1 Times.

So, the Total number of Times while loop executed = n (K + 1)

but $n = 2^{2^K}$

$\Rightarrow 2^k = \log_2^n$

$\Rightarrow k = \log_2 \log_2^n$

$\therefore$ Total Time complexity

$= n(\log_2 \log_2^n + 1)$

$= O(n \log_2 \log_2^n)$

24. Consider the following relation R(A, B, C, D, E) with the following FD's: $A \to BC$, $CD \to E$, $\$ \to D$.

We don't know what \$ is, it could be any non empty subset of R's attributes. Which of the following must be *true* regardless of what is inside \$? (Here key refer to candidate key)

(A) Every key of R contains A
(B) No key of R contains A
(C) Some key of R contains A while some other key does not
(D) None of the above

Ans: (A)

Sol: Based on given dependencies candidate key is AD (or) A \$.

If \$ is A or B or C then candidate key is A.

If \$ is E then candidate key is AD and AE.

25. Consider the minimum state dfa M for the set denoted by the complement of the intersection of the sets denoted by $(rs + r)^*s$ & $r(sr + r)^*$

Choose the correct answer:

(A) M has one state
(B) M has two states
(C) M is not unique because of $\in$
(D) M has more than two but a finite number of states

Ans: (A)

Sol: The given regular expressions have nothing in common. The complement of the intersection is the set $(r + s)^*$. This needs one state.

26. Consider the following

(S_1) $((\sim p \to q) \wedge \sim q) \to p$
(S_2) $\{(p \to q) \wedge (q \to r) \wedge (\sim q \wedge r)\} \to p$
(S_3) $((p \to q) \wedge \sim p) \to \sim q$
(S_4) $(\sim(p \to q) \wedge p) \to \sim q$

Which of the following is true?

(A) S_1 and S_2 are valid
(B) S_2 and S_3 are valid
(C) S_3 and S_4 are valid
(D) S_1 and S_4 are valid

Ans: (D)

Sol: $S_1 \Leftrightarrow (p \vee q) \wedge \sim q$

$\Leftrightarrow$ T (disjunctive syllogism)

$\therefore S_1$ is valid

S_2: when p has truth value false, q has truth value false and r has truth value true, we have S_2 is false.

$\therefore$ S_2 is not valid

S_3 : when p is false and q is true; we have, S_3 is false.

$\therefore$ S_3 is not valid

S_4: $(\sim(p \to q) \wedge p) \to \sim q$

$\Leftrightarrow ((p \wedge \sim q) \wedge p) \to \sim q$

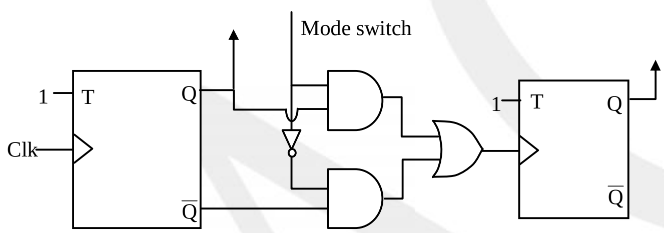
$\Leftrightarrow ((\sim q \wedge p) \wedge p) \to \sim q$ By commutativity

$\Leftrightarrow (\sim q \wedge (p \wedge p)) \to \sim q$ By associativity

$\Leftrightarrow (\sim q \wedge p) \to \sim q$ By idempotent law

$\Leftrightarrow T$ (Simplification)

27. The below diagram acts as 2 bit ________ when mode switch is connected to '1'.



(A) 2 bit up counter
(B) 2 bit Down counter
(C) Mod 3 up counter
(D) Mod 3 Down counter

Ans: (B)

Sol: When mode switch is '1', only upper AND gate gives '1' output so, it acts as positive trigger, so it is 2 bit down counter with sequence of 00, 11, 10, 01,00, 11.....

28. We have 2 designs D_1 and D_2 for a synchronous pipelined processor. D_1 has 6 stages with execution times of 2 ns, 6 ns, 5 ns, 4 ns, 2 ns and 5 ns. While the design D_2 has 8 stages each with 3 ns execution time. How much time can be saved using design D_2 over D_1, for executing '100' instructions?

(A) 99 ns (B) 2091 ns
(C) '0' ns (D) 309 ns

Ans: (D)

Sol: $\underline{D_1}$

K = 6

t_p = 6 ns, n = 100

$(K+n-1)\times t_p = 105 \times 6$

= 630 ns

$\underline{D_2}$

K = 8 ns

t_p = 3 ns;

n = 100

$\therefore$ $t_p = 107 \times 3$

= 321

Time

$\therefore$ saved = 630 – 321 = 309

29. The Concatenation of two linked lists is to be performed on O(1) time. Which of the following implementation should be used?

(A) Circular Linked List
(B) Singly Linked List
(C) Doubly Linked List
(D) Circular doubly linked list

Ans: (D)

Sol: The starting node holds the address of the last node

30. An organization has a Class C network and want to form subnets for four departments with hosts as follows.

A–35, B – 20, C– 54, D–40

What is the possible arrangements of subnet masks?

(A) 255.255.255.192 (B) 255.255.255.224
(C) 255.255.255.128 (D) 255.255.255.240

Ans: (A)

Sol: class C has 24 bits – NID

8 bits – HID

2 bits SID 6 bits HID

255.255.255.11000000

31. Consider a system with n – CPU's (n > 1) and 'z' processes. (z < n). The maximum number of processes that can be in the running & block states are respectively.

(A) n & z – n
(B) z & z
(C) n & z
(D) n & n - z

Ans: (B)

Sol: Since the number of processes are less than the number of CPU's hence all can be running state. In a situation sometimes all can be blocked.

32. Consider a System with n–processes arriving at time zero. Scheduling overhead is 's' seconds. Using Round Robin CPU Scheduling what must be the value of time quantum 'q' such that each process is guaranteed to gets its turn on the CPU in its subsequent run exactly twice within 't' sec (inclusive)?

(A) $\frac{t}{2n}$ (B) $\frac{t-ns}{n}$

(C) $\frac{t-ns}{n-1}$ (D) $\frac{t-ns}{2n-2}$

Ans: (D)

Sol: Within duration 't' , if each process gets exactly once, then the total C.S overhead is ns.

t – ns time is shared between (n – 1) processes; hence $\frac{1}{2}$ of $\left(\frac{t-ns}{n-1}\right)$ allow each process to get the same.

33. If the determinant of n × n matrix is zero, then

(A) rank(A) ≤ n – 2
(B) trace of A is zero
(C) zero is an eigen value of A
(D) X = 0 is the only Solution of AX = 0

Ans: (C)

Sol: If $\det(A_{n\times n}) = 0$ then zero is an eigen value of A. Since det(A) = product of eigen values.

34. Let B = {2, 3, 6, 9, 12, 18, 24} and let A = B × B. Define the following relation on A: (a, b) R(c, d) if and only if {a | c and b ≤ d} Then R is ______.

S_1) reflexive and symmetric
S_2) antisymmetric and transitive
S_3) an equivalence relation
S_4) a partial order relation

Which of the following is true?

(A) S_1 and S_3 are true
(B) S_2 and S_4 are true
(C) S_1, S_3 and S_4 are true
(D) Only S_4 is true

Ans: (B)

Sol:

We have a | a and b ≤ b
y (a, b) R(a, b)
Let (a, b) R(c, d) ⇒ (c, d)$\not R$(a, b)
∴ R is not symmetric
Let (a, b) R(c, d) and (c, d)R(a, b)
⇒ a = c and b = d
⇒ (a, b) = (c, d)
∴ R is antisymmetric
Let (a, b) R(c, d) and (c, d) R(e,f)
⇒ {a | c and b ≤ d} and {c | e and d≤f}
⇒ {a | e and b ≤ f}

$\Rightarrow$ (a, b) R (e, f)
$\therefore$ R is transitive
Hence R is a partial order

35. Messages are transmitted over a communication channel using two signals. The transmission of one signal requires 1 microsecond and the transmission of the other signal requires two microseconds. The recurrence relation for the number of different messages consisting of sequences of these two signals (where each signal is immediate followed by the next signal) that can be send in *n* microseconds ($n \geq 2$) is _____.

(A) $a_n = a_{n-1} + a_{n-2}$
(B) $a_n = a_{n-1} + 2a_{n-2}$
(C) $a_n = 2a_{n-1} + a_{n-2}$
(D) $a_n = a_{n-1} + a_{n-3}$

Ans: (A)
Sol:

Let a_n = number of different messages that can be sent in n microseconds.

Case(i): If the first signal required one microsecond, then the remaining part of the message can be sent in a_{n-1} ways.

Case(ii): If the first signal require 2 microseconds, then the remaining part of the message can be sent in a_{n-2} ways.

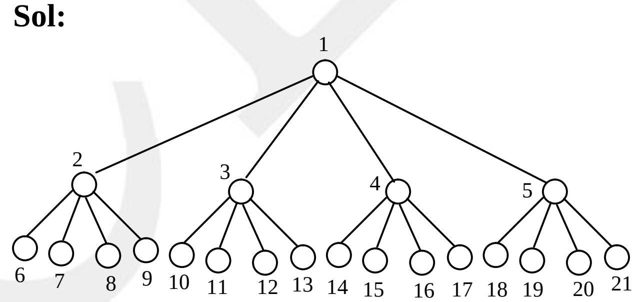
These two cases are mutually exclusive and exhaustive.

$\therefore$ By sum rule, the recurrence relation is $a_n = a_{n-1} + a_{n-2}$.

Two Marks Question (Q36 – 65)

36. A *k-array* heap is like a binary heap, but instead of two children, nodes have k-children. A *k-array* heap can be represented in a one-dimensional array as follows. The root is kept in A[1], its 'k' children are kept inorder in A[2] through A[k+1], their children are kept inorder in A[k+2] through A[k^2+k+1] and so on.
In *4-array* heap, to what index does the 2^{nd} child of 3^{rd} index node map _______.

Ans: 11
Sol:



From the above 4-array tree, we can see index of 2^{nd} child of 3^{rd} index node is 11.

37. Consider the following two transactions

T_1: R(A) W(A) R(B) W(B)
T_2: R(A) W(A) R(B) W(B)

How many interleavings of these transactions are conflict serializable?

Ans: 12
Sol: For serial schedule $T_1 \rightarrow T_2$
$R_1(A)\ W_1(A)\ \underline{R_1(B)\ W_1(B)\ R_2(A)\ W_2(A)}$
$R_2(B)\ W_2(B)$

The operation which are underlined (which are not conflict operations) can be interleaved in

$$\frac{(2+2)!}{2!\times 2!} = 6$$

For serial schedule $T_2 \rightarrow T_1$

R_2 (A) W_2 (A) <u>R_2 (B) W_2 (B) R_1 (A) W_1 (A)</u> R_1 (B) W_1 (B)

The operations which are underlined (which are not conflict operations) can be interleaved in

$$\frac{(2+2)!}{2!\times 2!} = 6$$

Total 6 + 6 = 12

38. Consider a system using demand paging with a page size of 1000 words. Disk access time for a page is 100 ms. Memory cycle time is 10 μs. It requires 1 μs to access current page and an additional 3 μs to access other than the current one of the instructions accessed, 10% accessed other than the current one of the instructions accessed other than the current one 20% were not in memory.The effective memory access time (approximately) is ____________μs.

Ans: 2000

Sol: E.M.A.T= 0.9 × 1 μs + 0.1 (0.8 × 4 μs + 0.2 × 100 ms)
~ 2 ms = 2000 μs

39.
```
# include<stdio.h>
int main( )
{
    int a[3][3], i, j, n, num;
    printf("Enter value of n(odd value):");
    scanf("%d", &n);
    i = n –1;
    j = (n – 1)/2;
    for(num = 1; num < = n * n ; num++)
    {
        a[i][j] = num;
        i++;
        j– –;
        if (num%n = = 0)
        {
            i – = 2;
            j++;
        }
        else if (i = = n)
            i = 0;
        else if (j = = – 1)
            j = n – 1;
    }
}
```

If the above program if we give input value n = 3, then what is sum of elements of every row of matrix is _______.

Ans: 15

Sol: If we give input n = 3 then we can fill the matrix as follows

2	9	4
7	5	3
6	1	8

Sum of elements of every row = 15

40. $\int_{-2}^{2} |1 - x^4|\,dx =$ __________.

Ans: 12

Sol: $\int_{-2}^{2} |1 - x^4|\,dx = 2\int_{0}^{2} |1 - x^4|\,dx$

($\because |1 - x^4|$ is even function)

$= 2\{\int_0^1 (1 - x^4)dx - \int_1^2 (1 - x^4)dx\}$

$= 12$

41. An 8 way set Associative cache memory unit with a capacity of 32 kB is built using a block size of 8 words. The word length is 16 bits. The size of the physical Address space is 16 GB. The number of bits in tag field is _________.

Ans: 22

Sol: Associativity = 8

Size of cache memory = 2^{15} B

Size of a Block = 8 × 2 B = 16 Bytes

= 2^4 Bytes

Number of blocks in cache memory = 2^{11}

Size of main memory = 2^{34} B

Number of blocks in main memory = 2^{30}

Number of sets in cache memory = $2^{11}/8$

= 2^8

$$\text{Number of Tag bits} = \log_2 \frac{2^{30}}{2^8} = \log_2 2^{22} = 22$$

42. If a simple graph G has 2 connected components with 6 vertices and 8 vertices respectively, then maximum number of edges possible in G is _______.

Ans: 43

Sol: Maximum number of edges possible in a connected component with 6 vertices

= C(6, 2) = 15.

Maximum number of edges possible in a connected component with 8 vertices

= C(8, 2) = 28

∴Maximum number of edges possible in G = 15 +28 = 43

43. Suppose host A is sending a large file to host B over a TCP connection. The two end hosts are 20 msec apart connected by a 512 Mbps link. Assume that they are using a packet size of 1200 bytes to transmit the file. Assume Ack packets are small and ignored.

How big would the window size (in packets) have to be for the channel utilization to be greater than 80% is _______.

Ans: 1706 – 1707

Sol: Bandwidth-delay product

$= 512 \times 10^6 \times 40 \times 10^{-3} = 2048 \times 10^4$ bits.

80% utilization,

it is $2048 \times 10^4 \times 0.8 = 16384 \times 10^3$.

$$\text{Number of packets} = \frac{16384 \times 10^3}{1200 \times 8} \approx 1707$$

44. Certain CPU uses expanding Opcode. It has 32 bit instructions with 8 bit Addresses. It supports One Address and Two Address instructions only. If there are 'n' Two Address instructions; The maximum number of one Address instruction is:

(A) $(2^8 - n) \times 2^8$
(B) $(2^{16} - n) \times 2^{16}$
(C) $(2^{16} - n) \times 2^8$
(D) $(2^{24} - n) \times 2^8$

Ans: (C)

Sol: Max number of 2 Address instructions is 2^{16}.

Opcode	A_1	A_2
16	8	8

32

But is uses 'n' only; so, remaining free combinations $(2^{16} - n)$ are left for one Address instructions.

∴ Max number of Address instructions to be formulated: $(2^{16} - n) \times 2^8$

45.
```
# include<stdio.h>
int main( )
{
        char arr[15];
        arr = "ACEHYDERABAD";
        printf("%d", arr);
        return 0;
}
```
What will be output of above program?

(A) ACEHYDERABAD
(B) A
(C) NULL
(D) Compilation ERROR.

Ans: (D)
Sol: Compilation Error: L value Required
Array name is constant pointer and we can not assign any value in constant datatype after declaration.

46. It is at present not known if a polynomial time complexity algorithm exists for integer factorization. Let p represent this statement being true if no algorithm exists.
Consider the language

$$L = \begin{cases} (a+b)^* \text{ if } p \text{ is true} \\ \{ww^R \mid w \in (a+b)^*\} \text{ if } p \text{ is false} \\ \{w \not\subset w^R \mid w \in (a+b)^*\} \text{ if } p \text{ is undecidable} \end{cases}$$

Choose the correct answer:
(A) L is recursive but not a cfl
(B) L is r.e. but not recursive
(C) L is undecidable
(D) L is always a cfl

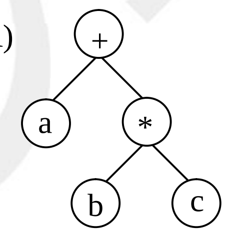
Ans: (D)
Sol: Regardless of p, L is always a cfl.

47. A fair coin is tossed until one of the two sides occurs twice in a row. The probability that the number of tosses required is even is ________.

(A) $\frac{2}{3}$ (B) $\frac{1}{3}$
(C) $\frac{1}{2}$ (D) None

Ans: (A)
Sol: A = {HH, HTHH, HTHTHH, ...}
B = {TT, THTT, THTHTT, ...}
P(A) = $\frac{1}{3}$ & P(B) = $\frac{1}{3}$
P(A or B) = $\frac{2}{3}$

48. The intermediate form of a + b * c is given below in triples, quadruples, postfix, trees & DAGs choose the correct answer.

(A)


(B) ab +c *

(C) 1. (*, b, c)
2. (+, a, (1))

(D) 1. (+, b, c, T1)
2.(*, a, T1, T2)

(A) is a DAG & not a tree
(B) is an erroneous representation as * has a higher precedence than +
(C) The triple representation (C) is useful so for optimization of expressions
(D) This quadruple representation is not optimized

Ans: (C)
Sol: The triples representation makes it easy to detect common sub expression.

49. Consider two formal languages L & $L_1 = L \cup \{\in\}$. It is given that L is $\in$ -free. Let $L_2 = L_1 \cup L_2$. Which of the following statements is true?

(A) If L is regular then L_2 is always recursive
(B) If L is a cfl then L_2 is always recursive
(C) L_1, L_2 can never be recursive but L may be recursive
(D) L, L_1 & L_2 can possibly be all r.e. & recursive

Ans: (C)

Sol: A recursive set cannot contain $\in$.

50. Consider the following concurrent processes 'i', 'k' and 'l'.
S,T and Z are Binary Semaphores initialized as follows :
B Sem S = 1, T = 0, Z = 0

```
Process i :
{
   while (1)
   {
       P(S);
       print ('*');
       V(T);
   }
}

Process k:
{
   P (T);
   V(Z);
}

Process l :
{
   P (Z);
   V(S);
}
```

The Maximum & Minimum number of times '*' gets printed is ____ & ______;

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

Ans: (C)

Sol: Process i Can get blocked ;
Process k & Process l are completable;
Process k gets woken up by Process i ;
Process l by Process k .

51. The area bounded by the curve $y = x^4 - 2x^3 + x^2 + 3$, the x-axis and two ordinates corresponding to the points of minimum of this function is;

(A) $\frac{1}{30}$
(B) $\frac{91}{30}$
(C) $\frac{-758}{480}$
(D) $\frac{728}{480}$

Ans: (B)

Sol: $y' = 0 \Rightarrow 4x^3 - 6x^2 + 2x = 0$

$\Rightarrow x = 0, \frac{1}{2}, 1$ are stationary points

$y'' = 12x^2 - 12x + 2$

$\Rightarrow y(x)$ has min at $x = 0$ & $x = 1$

$\therefore$ Required Area

$$= \int_0^1 \left(x^4 - 2x^3 + x^2 + 3\right)dx = \frac{91}{30}$$

52. The Chained matrix product problem is defined as follows:

Given 'n' matrices $M_1, M_2, \ldots\ldots\ M_n$, the dimensions of the matrices are given by a vector d[0....n] such that the matrix M_i, $1 \le i \le n$ is of dimension $d_{i-1} \times d_i$. We build the table m_{ij} diagonal by diagonal: diagonal 's' contains the elements m_{ij} such that $j-i = s$. Where m_{ij} represents the minimum number of scalar multiplications required to compute matrix product $M_1, M_2, \ldots\ldots M_j$.

An incomplete recursive definition for the function m_{ij} is given below:

$m_{i,j} = 0$, if $s = 0$ and $i = 1, 2, 3, \ldots\ldots n$

$m_{i,\,i+1} = d_{i-1} \times d_i \times d_{i+1}$, if $s = 1$ and

$i = 1, 2, 3, ...n-1$

$m_{i,\ i+s}$ = expr , if $1 < s < n$ and

$i = 1, 2, 3, ...n-s$;

Which one of the following options is ***correct*** for expr?

(A) $\min\limits_{i \le k < i+s} (m_{ik} + m_{k+1,\ i+s} + d_{i-1} \times d_k \times d_{i+s})$

(B) $\min\limits_{i \le k < i+s} \left(m_{ik} + m_{k+1, i+s} + d_{i-1} \times d_{k+1} \times d_{i+s}\right)$

(C) $\min\limits_{i < k \le i+s} \left(m_{ik} + m_{k, i+s} + d_{i-1} \times d_k \times d_{i+s}\right)$

(D) $\min\limits_{i \le k \le i+s} \left(m_{ik} + m_{k, i+s} + d_{i-1} \times d_k \times d_{i+s}\right)$

Ans : (A)

Sol:

When $s > 1$, the diagonal 's' contains the elements $m_{i,i+s}$ corresponding to the products of the form M_i , M_{i+1}....... M_{i+s}. We can make the first cut in the product after any of the matrices M_i, M_{i+1}, ... M_{i+s-1}. If we make the cut after M_k $i \le k < i + s$. We need m_{ik} scalar multiplications to calculate left hand term $m_{k+1,\ i+s}$ to calculate the right hand term and then $d_{i-1} \times d_k \times d_{i+s}$ to multiply the two resulting matrices to obtain final result.

$\therefore \min\limits_{i \le k < i+s} \left(m_{ik} + m_{k+1, i+s} + d_{i-1} \times d_k \times d_{i+s}\right)$

53. Let A be a 3 × 3 matrix with real entries such that det(A) = 6 and tr(A) = 0. If det(A+I) = 0, where I denotes the 3 × 3 matrix. The eigen values of A are______.

(A) –1, 2, 3 (B) –1, 2, –3

(C) 1, 2, –3 (D) –1, –2, 3

Ans: (D)

Sol: only option(D) satisfies all conditions.

tr(A) = –1 – 2 + 3 = 0,

det(A) = (–1) (–2) (3) = 6

The eigen values of (A+I) are 4, –1, 0

det(A + I) = 0

54. If the probability of hitting a target is $\frac{1}{5}$ and if 10 shots are fired, what is the conditional probability that the target being hit atleast twice assuming that atleast one hit is already scored?

(A) 0.6999 (B) 0.624

(C) 0.892 (D) 0.268

Ans: (A)

Sol: $P(x \ge 2 | x \ge 1) = \dfrac{P(x \ge 2)}{P(x \ge 1)}$

$= \dfrac{1 - q^n - npq^{n-1}}{1 - q^n}$

$= \dfrac{1 - \left(\frac{4}{5}\right)^{10} - 10\left(\frac{1}{5}\right)\left(\frac{4}{5}\right)^9}{1 - \left(\frac{4}{5}\right)^{10}}$

$= 0.6999$

55. Let S be a non empty set and P(S) is power set of S.

A binary operation * on P(S) is defined by

A * B = A ⊕ B

= Symmetric difference of A and B

Now, P(S) with respect to * is ______.

(A) a semi group but not a monoid

(B) a monoid but not a group

(C) a group

(D) not a semi group

Ans: (C)

Sol: $A \oplus B = (A-B) \cup (B-A)$

we have $A \oplus B \in P(S)$ $\forall$ A, B $\in$ P(S)

$\therefore$ * is a closed operation

We have $(A \oplus B) \oplus C = A \oplus (B \oplus C)$

$\therefore$ * is associative on P(S)

we have, $A \oplus \phi = A \;\; \forall A \in P(S)$

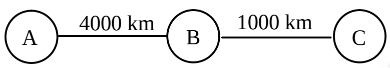
$\therefore$ ϕ is identity element in P(S) w.r.t. *.

We have, $A \oplus A = \phi \; \forall A \in P(S)$

$\therefore$ For each element of P(S), inverse exists, because inverse of $A=A \; \forall A\in P(S)$.

$\therefore$ (P(S), *) is a group.

56. In the following figure



Frames are generated at node A and sent to node C through node B. Determine the minimum transmission rate required between nodes B and C. So that buffers at node B are not flooded based on the following.

The data rate between A and B is 100 kbps and propagation delay is 5 μsec/km for both lines. All frames are 1000 bits long, Ack's negligible size. Between A and B, a Sliding window protocol is used with window size of 3 frames and between B and C a stop-and wait is used.

(A) 200 kbps
(B) 50kbps
(C) 100 kbps
(D) 120 kbps

Ans: (B)

Sol: A → B: propagation time = 4000×5 μsec = 20 msec

Transmission time = $1000/100 \times 10^3$ = 10 msec

B → C: Propagation Time = 1000×5 μsec = 5 msec

Transmission Time (x) = 1000/R

A → B: 3 frames transmission takes 50 msec,

B → C one frame takes 10 + x msec

$\Rightarrow 30 + 3x = 50 \Rightarrow 3x = 20$

$\Rightarrow x = 6.66$ msec

R = 1000/6.66 = 150 kbps

57. In a new number system; x and y are successive digits such that $(xy)_r = 25_{10}$ and $(yx)_r = 31_{10}$; x, y and r values respectively are.

(A) 4, 3, 7
(B) 3, 4, 7
(C) 7, 4, 3
(D) 7, 3, 4

Ans: (B)

Sol: $xr + y = 25$, $yr + x = 31$ and $y = x + 1$ from these expressions; $x = 3$, $y = 4$ and $r = 7$.

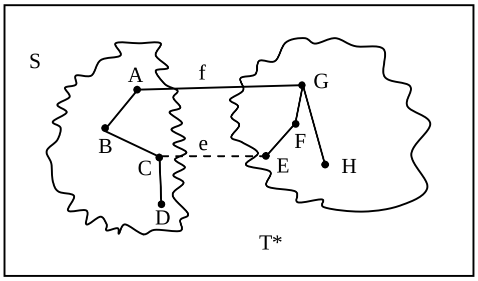
58. Let 'G' be an undirected connected graph with distinct edge weight. Let 'C' be any cycle and let 'f' be the max cost edge belonging to 'C'. Let 'S' be any subset of vertices and let 'e' be the min cost edge with exactly one end point in 'S'. Then which of the following statements is/are ***TRUE*** : -

I. MST of 'G' does not contain 'f '.
II. MST of 'G' contains 'e'.

(A) Only I
(B) Only II
(C) Both I and II
(D) Neither I nor II

Ans: (C)

Sol:



I. ***TRUE***

- Suppose 'f' belongs to T*
- Deleting 'f' from T* disconnects T* and let 's' be one side of cut.
- Some other edge in cycle 'C' say 'e' has exactly one end point in S
- $T = T^* \cup \{e\} - \{f\}$ is also a spanning Tree.

  Since $C_e < C_f$ so cost(T) < cost(T*)

  Which is contradictory to minimality of T*

II. ***TRUE***

Suppose 'e' does not belong to T*

Adding 'e' to T* creates a(unique) cycle 'C' in T*

Some other edge in cycle 'C', say 'f' has exactly one end point in 's'

$T = T^* \cup \{e\} - f$ is also spanning Tree and since $C_e < C_f$

So,cost(T) < cost(T*)

Which is contridicts minimality of T*.

59. Consider following table of data

Customers

C_{id}	C_{name}
1	Kumar
2	Rahul
3	Sita

Purchase

C_{id}	P_{id}
1	98
2	99
1	100
3	100
1	99
3	98

Product

P_{id}	P_{name}
98	Detol
99	Lux
100	Colgate

Which of the following queries not returns the customer names, who purchase all products?

(A) Select C_{name}
From customer
Where C_{id} = all (select C_{id} from purchase
Where P_{id} = all (select P_{id} from product));

(B) Select C_{name}
From customer
Where not exists (select P_{id} from product)
minus
(select P_{id} from product
where customer.C_{id} = Purchase.P_{id})

(C) Select C_{name}
From customer
Where (select P_{id} from purchase where customer.C_{id} = purchase.C_{id}) contains (select P_{id} from product)

(D) None

Ans: (A)

Sol: Each inner query in option (A) returns more than one value and = all (many values) returns false. The query results in error.

60. Which of the following statements is/are true?

S_1) In a lattice L, if each element has atmost one complement, then L is a distributive lattice

S_2) A sub lattice of a complemented lattice is also complemented.

Which of the following is true?

(A) S_1 is true and S_2 is false
(B) S_1 is false and S_2 is true
(C) Both S_1 and S_2 are true
(D) Both S_1 and S_2 are false

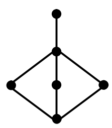
Ans: (D)

Sol:

S_1 is false

Proof by counter example:

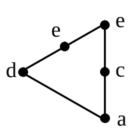
For the lattice shown below



Each element has atmost one complement, but the lattice is not distributive.

$\therefore$ S_1 is false.

For the lattice shown below.



The lattice is complemented. But the sub lattice {a, c, e} is not complemented.

$\therefore$ S_2 is false

61. Which of the following is the probability density function of a random variable X?

(A) $f(x) = \begin{cases} x(2-x), & 0 < x < 2 \\ 0 \quad , & \text{else where} \end{cases}$

(B) $f(x) = \begin{cases} 2xe^{-x^2}, & -1 < x < 1 \\ 0 \quad , & \text{else where} \end{cases}$

(C) $f(x) = \begin{cases} x(1-x), & 0 < x < 1 \\ 0 \quad , & \text{else where} \end{cases}$

(D) $f(x) = \begin{cases} 2x\,e^{-x^2} \quad , & x > 0 \\ 0 \quad , & \text{else where} \end{cases}$

Ans: (D)

Sol: If f(x) is probability density function, then

$\int_{-\infty}^{\infty} f(x)dx = 1$

$\int_{-\infty}^{\infty} f(x)dx \;=\; \int_{0}^{\infty} 2x\,e^{-x^2}\,dx = 1$

$\therefore$ f(x) is a probability density function

62. A binary min heap consisting of integers is implemented using array A[1....n] in which root node is stored at A[1] and locations A[1] through A[n] store the 'n' integer values in the heap. The minimum number of comparisons required to find maximum element in a min heap of 99 elements .

(A) 98 (B) 49
(C) 48 (D) 99

Ans : (B)

Sol: It requires $\left\lceil \frac{n}{2} \right\rceil - 1$ comparisons to find maximum element of 'n' elements in binary heap.

So, it will take $\left\lceil \frac{99}{2} \right\rceil - 1$ = 49 comparisons.

63. A binary search tree contains the values 11, 12, 13, 14, 15, 16, 17, 18. The tree is traversed in pre-order and the values are printed out. Which of the following sequence is valid out?

(A) 15 13 11 12 14 17 18 16
(B) 15 13 11 12 16 14 18 17
(C) 15 13 12 14 11 16 17 18
(D) 15 13 11 12 14 17 16 18

Ans: (D)

Sol: In the given list of outputs 15 is appearing as first one. It will be root. 11, 12, 13, 14 should be left side of 15 and 16, 17 and 18 should be right side of 15.

64. Consider a system with n–processes and a single resource 'R' each process P_i is assigned 'x_i' copies of 'R' and further requests 'y_i' copies of 'R' at time t, there are two processes a & b whose requests is zero. Further, 'K' copies of 'R' are free available at time 't'. System is said to be not approaching deadlock if the minimum need of process request is satisfiable. Which condition indicates that system is not approaching deadlock?

(A) $x_a + y_b > \max_{j \neq a, b} (y_j)$

(B) $x_a + y_b + K > \max_{j \neq a, b} (y_j)$

(C) $x_a + y_b + K \geq \min_{i \neq a, b} (y_i)$

(D) $x_a + y_b + K > \min_{i \neq a, b} (y_i)$

Ans: (C)

Sol: Completing a & b releases their resources and hence total becomes (z + ya + yb) with which we can satisfy the need of the process having least request.

65. Consider the following sets over a finite alphabet

S1: Descriptions of all LR(0) grammars

S2: Descriptions of all LR(1) grammars

S3: Descriptions of all SLR(1) grammars

S4: Description of all LL(1) grammars

S5: Description of all operator grammars

S6: Description of all LALR(1) grammars

Choose the correct answers:

(A) S2 is properly included in S1
(B) S3 and S2 are incomparable
(C) S6 is included in S3
(D) S1, S4 & S5 are incomparable

Ans: (D)

Sol: The operator grammar can be ambiguous where as LL & LR grammars are incomparable. The LR(0) & LL(1) grammars are incomparable.