Q.1-20 Carry One Mark Each

1. Suppose there are two coins. The first coin gives heads with probability 5/8 when tossed, while the second coin gives with probability ¼. One of the two coins is picked up at random with equal probability and tossed. What is the probability of obtaining heads?

   (A) 7/8 (B) 1/2 (C) 7/16 (D) 5/32

2. Let A be the matrix $\begin{bmatrix} 3 & 1 \\ 1 & 2 \end{bmatrix}$. What is the maximum value of $x^T Ax$ where the maximum is taken over all x that are the unit eigen vectors of A?

   (A) 5 (B) $\frac{5+\sqrt{5}}{2}$ (C) 3 (D) $\frac{5-\sqrt{5}}{2}$

3. Consider a weighted undirected graph with positive edge weights and let uv be an edge in the graph. It is known that the shortest path from the source vertex s to u has weight 53 and the shortest path from s to v has weight 65. Which one of the following statements is always true?

   (A) $\text{weight}(u,v) < 12$ (B) $\text{weight}(u,v) \le 12$

   (C) $\text{weight}(u,v) > 12$ (D) $\text{weight}(u,v) \ge 12$

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4. In the Spiral model of software developed, the primary determinant is selecting activities in e ach iteration is

   (A) Iteration size

   (B) Cost

   (C) Adopted process such as Rational Unified Process or Extreme Programming
   (D) Risk

5. Which of the following system is a most likely candidate example of a pipe filter architecture?

   (A) Expert system (B) DB repository

   (C) Aircraft flight controller (D) Signal processing

6. A processor takes 12 cycles to complete an instruction1. The corresponding pipelines processor uses 6 stages with the execution times of 3, 2, 5, 4, 6 and 2 cycles respectively. What is the asymptotic speedup assuming that a very large number of instructions are to be executed?

   (A) 1.83 (B) 2 (C) 3 (D) 6

7. Which of the following input sequences for a cross-coupled R-S flip-flop realized with two NAND gates may lead to an oscillation?

   (A) 11, 00 (B) 01, 10 (C) 10, 01 (D) 00, 11

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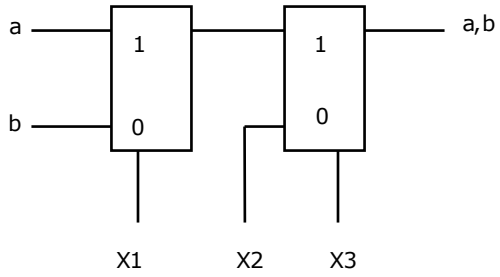
8. The following circuit implements a two-input AND gate using two 2-1 multiplexers
What are the values of X1, X2, X3?
(A) X1=b, X2=0, X3=a
(B) X1=b, X2=1, X3=b
(C) X1=a, X2=b, X3=1
(D) X1=a, X2=0, X3=b



9. Consider an ambiguous grammar G and its disambiguated version D. Let the language recognized by the grammars be denoted by L(G) and L(D) respectively. Which one of the following is true?
(A) $L(D) \subset L(G)$ (B) $L(D) \supset L(G)$
(C) $L(D) = L(G)$ (D) $L(D)$ is empty

10. Process P1 and P2 use critical_flag in the following routine to achieve mutual exclusion. Assume that ctirical_flag is initiated to FALSE in the main program

```
get_exclusive_access( )
{
    if (critical_flag==FALSE{
        critical_flag=TRUE;
        critical_region( );
        critical_flag=FALSE;
    }
}
```

Consider the following statements
(i) It is possible for both P1 and P2 to access critical_region concurrently
(ii) This may lead to a deadlock
Which of the following holds?
(A) (i) is false and (ii) is true (B) Both (i) and (ii) are false
(C) (i) is true and (ii) is false (D) Both (i) and (ii) are true

11. Let a memory have four free blocks of sizes 4k, 8k, 20k, 2k. These blocks are allocated following the best-fit strategy. The allocation requests are stored in a queue as shown below

Request No	J1	J2	J3	J4	J5	J6	J7	J8
Request sizes	2k	14k	3k	6k	6k	10k	7k	20k
Usage Time	4	10	2	8	4	1	8	6

The time at which the request for J7 will be completed will be
(A) 16 (B) 19 (C) 20 (D)37

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12. The address sequence generated by tracing a particular program executing in a pure demand paging system with 100 bytes per page is

0100,0200,0430,0499,0510,0530,0560,0120,0220,0240,0260,0320,0410

Suppose that the memory can store only one page and if x is the address which causes a page fault then from addresses x to x+99 are loaded on to the memory. How many page faults will occur?

(A) 0 (B) 4 (C) 7 (D) 8

13. Consider the following statements about the timeout value used in TCP

(i) The timeout value is set to the RTT (Round Trip Time) measured during TCP connection establishment for the entire duration of the connection

(ii) Appropriate RTT estimation algorithm is used to set the timeout value of a TCP connection

(iii) Timeout value is set to twice the propagation delay from the sender to the receiver

Which of the following choices hold?

(A) (i) is false, but (ii) and (iii) are true

(B) (i) and (ii) are false, but (ii) is true

(C) (i) and (ii) are false, but (iii) is true

(D) (i), (ii) and (iii) are false

14. Consider a TCP connection in a state where there are no outstanding ACKs. The sender sends two segments back to back. The sequence numbers of the first and second segments are 230 and 290 respectively. The first segment was lost, but the second segment was received correctly by the receiver. Let X be the amount of data carried in the first segment (in bytes) and Y be the ACK number sent by the receiver. The values of X and Y (in that order) are

(A) 60 & 290 (B) 230 & 291 (C) 60 & 231 (D) 60 & 230

15. Consider the following two statements:

(i) A hash function (there are often used for computing digital signature) is an injective function

(ii) An encryption technique such as DES performs a permutation on the elements of its input alphabet

Which one of the following options is valid for the above two statements?

(A) Both are false

(B) Statement (i) is true and the other is false

(C) Statement (ii) is true and the other is false

(D) Both are true

16. The minimum position integer p such that 3^p modulo 17 = 1 is

(A) 5 (B) 8 (C) 12 (D) 16

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17. Exponentiation is a heavily used operation in public key cryptography. Which of the following options is the tightest upper bound on the number of multiplications required to compute b^n modulo $m, 0 \le b, n \le m$?

(A) $O(\log n)$ (B) $O\left(\sqrt{n}\right)$ (C) $O(n/\log n)$ (D) $O(n)$

18. A firewall is to be configured to allow hosts in a private network to freely open TCP connections and send packets on open connections. However, it will only allow external hosts to send packets on existing open TCP connections or connections that are being opened (by internal hosts) but not allow them to open TCP connections to hosts in the private network. To achieve this the minimum capability of the firewall should be that of

(A) A combinational circuit

(B) A finite automaton

(C) A pushdown automaton with one stack

(D) A pushdown automaton with two stacks

19. Given below are some HTML lines

```
< img src="pict.jpg" width="256" height="256" border="0"
    usemap="#map"/>
<map name ="map">
<area shape="poly"
   coords="50,50,50,100,100,100,75,75,100,50"
href="fl.html">
<area shape="circle" coords="100.75,5"
   href="../cgi-bin/f2.pl?vl=ask abc's age">
<area shape="default" href="fd.html">
<map>
```

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With reference to the HTML lines given above, consider the following statements

(i) Clicking on the point <80, 75> does not have any effect

(ii) The web browser can identify the area applicable to the mouse-click within the image and the subsequent action to be taken without additional responses from the web server.

(iii) The dots in the cgi-bin URL will be resolved by the web browser before it is sent to the web server

(iv) The "fd.html" request when sent to the web server will result in a FET request

Exactly how many of the statements given above are correct?

(A) 0 (B) 1 (C) 2 (D) 3

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20. Consider the XML document fragment given below

⟨Book⟩

⟨Title⟩GATE 2K7 Example</Title>

⟨Content⟩

One of many lines

⟨/Content⟩

⟨TOC⟩

One of many content entries

⟨/TOC⟩

⟨/Book⟩

Consider the XPath expression: $*\{\text{not}(\text{self} :: \text{TOC})\}$

What would be the result of the given XPath expression when the current node is Book?

(A) The Title and Content elements
(B) The Content and TOC elements
(C) The Title and TOC elements
(D) The Title,Content & TOC element

Q. 21 to 75 Carry Two Marks Each

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21. Which of these first-order logic formulae is valid?

(A) $\forall x\left(P(x) \Rightarrow \left(\left(\forall xP(x)\right) \Rightarrow \left(\forall xQ(x)\right)\right)\right)$
(B) $\exists x\left(P(x) \vee \left(\left(\exists xP(x)\right) \Rightarrow \left(\exists xQ(x)\right)\right)\right)$
(C) $\exists x\left(P(x) \Leftrightarrow \left(\left(\exists xP(x)\right) \wedge \left(\exists xQ(x)\right)\right)\right)$
(D) $\forall x\exists yP(x,y) \Rightarrow \exists y\forall xP(x,y)$

22. The trapezoidal method is used to evaluate the numerical value of

$\int_0^1 e^x dx$ Consider the following values for the step size h

(i) 10^{-2} (ii) 10^{-3} (iii) 10^{-4} (iv) 10^{-5}

For which of these values of the step size h, is the computed value guaranteed to be correct to seven decimal places. Assume that there are no round-off errors in the computation

(A) (iv) only
(B) (iii) and (iv) only
(C) (ii), (iii) and (iv) only
(D)(i), (ii), (iii) and (iv)

23. A partial order P is defined on the set of natural numbers as follows. Here x/y denotes integer division

(i) $(0,0) \in P$

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(ii) $(a,b) \in P$ if and only if $a\%10 \le b\%10$ and $(a/10,b/10) \in P$

Consider the following ordered pairs

(A) (101, 22) (B) (22, 101) (C) (145, 265) (D) (0, 153)

Which of these ordered pairs of natural numbers are contained in P?

(A) (i) & (iii) (B) (ii) & (iv) (C) (i) & (iv) (D) (iii) & (iv)

24. A depth-first search is performed on a directed acyclic graph. Let d[u] denote the time at which vertex u is visited for the first time, and f[u]the time at which the dfs call to the vertex u terminates. Which of the following statements is always true for all edges (u,v) in the graph?

(A) $d[u] < d[v]$ (B) $d[u] < f[v]$ (C) $f[u] < f[v]$ (D) $f[u] > f[v]$

25. What is the Largest integer m such that every simple connected graph with n vertices and n edges contains at least m different spanning trees?

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

26. Consider n jobs J_1, J_2,…,J_n such that job j_1 has execution time and a non-negative integer weight w_i. The weighted mean completion time of the jobs is defined to be $\frac{\sum_{i=1}^{n} w_i T_i}{\sum_{i=1}^{n} w_i}$ where Ti is the completion of job J_i. Assuming that there is only one processor available, in what order must the jobs be executed in order to minimize the weighted mean completion time of the jobs?

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(A) Non-decreasing order of t_i (B) Non-increasing order of w_i

(C) Non-increasing order of $w_i t_i$ (D) Non-increasing order of w_i/t_i

27. The function f is defined as follows:

```
int f(int  n)  {
        if (n<=1) return 1;
        else if (n % 2==0) return f(n/2);
        else return f(3n-1);
   }
```

Assuming that arbitrarily large integers can be passed as a parameter to the function., consider the following statements.

(i) The function f terminates for finitely many different values of $n \ge 1$

(ii) The function f terminates for infinitely many different values of $n \ge 1$

(iii) The function f does not terminate for finitely many different values of $n \ge 1$

(iv) The function f does not terminate for infinitely many different values of $n \ge 1$

Which one of the following options is true of the above?

(A) (i) and (iii) (B) (i) and (iv) (C) (ii) and (iii) (D) (ii) and (iv)

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28. Consider a hash function that distributes keys uniformly. The hash table size is 20. After hashing of how many keys will the probability that any new hashed collides with an existing one exceed 0.5

(A) 5 (B) 6 (C) 7 (D) 10

29. When searching for the key value 60 in a binary search tree, nodes containing the key values 10, 20, 40, 50, 70, 80, 90 are traversed, not necessarily in the order given. How many different orders are possible in which these key values can occur on the search path from the root to node containing the value 60?

(A) 35 (B) 64 (C) 128 (D) 5040

30. Suppose you are given an implementation of a queue of integers. The operations that can be performed on the queue are:

(i) isEmpty(Q) – returns true if the queue is empty, false otherwise.

(ii) delete(Q) – deletes the element at the front of the queue and returns its value

(ii) insert(Q, i) – inserts the integer I at the rear of the queue

Consider the following function:

```
void f (queue Q) {
  int i;
  if (! isEmpty (Q) {
       i=delete (Q);
       f(Q);
       insert(Q,i);
   }
}
```

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What operation is performed by the above function f?

(A) Leaves the queue Q unchanged

(B) Reverses the order of the elements in the queue Q

(C) Deletes the element at the front of the queue Q and inserts it at the rear keeping the other elements in the same order

(D) Empties the queue Q

31. Consider the C program given below:

```
#include ⟨stdio.h⟩
 int main ( ) {
     int sum = 0, maxsum=0,i,n=6;
     int a[ ]={2,–2,–1,3,4,2};
```

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```
    for (i=0;i<n;i++) {
        if (i==0 || a[i] < 0 || a[i] < a[i-1])
            if (sum>maxsum) max sum = sum;
            sum=(a[i] > 0) ? a[i] : 0;
        }
        else sum+=a[i];
    }
    if (sum>maxsum) max sum = sum;
    printf("%d\n",maxsum);
}
```

What is the value printed out when this program is executed?

(A) 9 (B) 8 (C) 7 (D)6

32. Consider the following C program:

```
#include <stdio.h>
#define EOF-1
void push(int);/* push the argument on the stack*/
int pop(void); /* pop the top of the stack*/
void flagError( );

int main( )
{  int C, m, n, r;
   while ((C=getchar( )!= EFE))
   {     if {isdigit(C)}}
            push(C);

         else if ((C=='+') || (C == '*'))
          {   m=pop( );
              n=pop( );
               r=(C=='+') ? n + m : n * m;
               push(r);

           }
           else if (C!=' ')
                flagError( );
    }
    printf ("%C",pop( ));
}
```

What is the output of the program for the following input?

5 2 * 3 3 2 + * +

(A) 15 (B) 25 (C) 30 (D)150

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33. Consider the program below in a hypothetical language which allows global variables and a choice of call by reference or call by value methods of parameter passing.

```
int i;
program main( )
{       int j=60;
        i=50;
        call f(i,j);
        print i,j;
}
procedure f(x,y)
{       i=100;
        x=10;
        y=y+i;
}
```

Which one of the following options represents the correct output of the program for the two parameter passing mechanisms?

(A) Call by value: i=70,j=10; Call by reference: i=60, j=70

(B) Call by value: i=50,j=60; Call by reference: i=50, j=70

(C) Call by value: i=10,j=70; Call by reference: i=100, j=60

(D) Call by value: i=100,j=60; Call by reference: i=10, j=70

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34. Consider the program below in a hypothetical programming language which allows global variables and a choice of static or dynamic scoping.

```
int i;
program main( )
{       i=10;
        call f( );
}
procedure f( )
{       int i=20;
        call g( );
}
procedure g( )
{       print i;
}
```

Let x be the value printed under static scoping and y be the value printed under dynamic scoping. Then x and y are

(A) x= 10, y= 20 (B) x= 20, y= 10 (C) x= 10, y= 10 (D) x= 20, y= 20

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35. Early binding refers to a binding performed at compile time late binding refers to a binding performed at execution time. Consider the following statements

(i) Static scope facilitates w1 bindings

(ii) Dynamic scope requires w2 bindings

(iii) Early bindings w3 execution efficiency

(iv) Late bindings w4 execution efficiency

The right choices of w1, w2, w3 and w4 (in that order) are

(A) Early, late, decrease, increase (B) Late, early, increase, decrease

(C) Late, early, decrease, increase (D) Early, late, increase, decrease

36. The floating point unit of a processor using a design D takes 2t cycles compared to t cycles taken by the fixed [point unit. There are two more design suggestions D1 and D2. D1 uses 30% more cycles for fixed point unit but 30% less cycles for floating point unit as compared to design D. D2 uses 40% less cycles for fixed point unit but 10% more cycles for floating point unit as compared to design D. For a given program which has 80% fixed point operations and 20% floating point operations, which of the following ordering reflects the relative performances of three designs? ($D_i > D_j$ denotes that D_i is faster than D_j)

(A) D1>D>D2 (B) D2>D>D1 (C) D>D2>D1 (D) D>D1>D2

37. Consider a Direct Mapped Cache with 8 cache blocks (numbered 0-7). If the memory block requests are in the following order

3,5,2,8,0,63,9,16,20,17,25,18,30,24,2,63,5,82,17,24

which of the following memory blocks will not be in the cache at the end of the sequence?

(A) 3 (B) 18 (C) 20 (D) 30

38. The following expression was to be realized using 2-input AND and OR gates were substituted by 2-input NAND gates.

$(a.b)c + (\bar{a}.c)d + (b.c)d + ad$

What is the function finally realized?

(A) 1 (B) $\bar{a} + \bar{b} + \bar{c} + \bar{d}$ (C) $\bar{a} + b + \bar{c} + \bar{d}$ (D) $\bar{a} + \bar{b} + c + \bar{d}$

39. Data forwarding techniques can be used to speed up the operation in presence of data dependencies. Consider the following replacements of LHS with RHS

(i) $R1 \rightarrow Loc, Loc \rightarrow R2 \equiv R1 \rightarrow R2, R1 \rightarrow Loc$

(ii) $R1 \rightarrow Loc, Loc \rightarrow R2 \equiv R1 \rightarrow R2$

(iii) $R1 \rightarrow Loc, R2 \rightarrow Loc \equiv R1 \rightarrow Loc$

(iv) $R1 \rightarrow Loc, R2 \rightarrow Loc \equiv R2 \rightarrow Loc$

In which of the following options, will the result of executing the RHS be the same as executing the LHS irrespective of the instructions that follow?

(A) (i) & (iii) (B) (i) & (iv) (C) (ii) & (iii) (D)(ii) & (iv)

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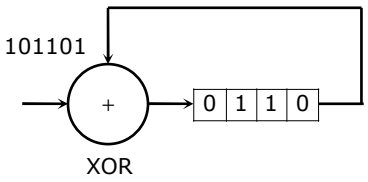
40. What is the final value stored in the linear feedback shift register if the input is 101101?



(A) 0110 (B) 1011 (C) 1101 (D) 1111

41. Following table indicates the latencies of operations between the instruction producing the result and instruction using the result

Instruction producing the result	Instruction using the result	Latency
ALU Operation	ALU Operation	2
ALU Operation	Store	2
Load	ALU Operation	1
load	store	0

Consider the following code segment

Load R1, Loc1;	Load R1 from memory location Loc1
Load R2, Loc2;	Load R2 from memory location Loc2
Add R1, R2, R1;	Add R1 and R2 and save result in R1
Dec R2;	Decrement R2
Dec R1;	Decrement R1
Mpy R1, R2, R3;	Multiply R1 and R2 and save result in R3
Store R3, Loc3;	Store R3 in memory location Loc3

What is the number of cycles needed to execute the above code segment assuming each instruction takes one cycles to execute?

(A) 7 (B) 10 (C) 13 (D) 14

42. $(C012.25)_H - (10111001110.101)_B =$

(A) $(135103.412)_O$ (B) $(564411.412)_O$

(C) $(564411.205)_O$ (D) $(135103.205)_O$

43. An error correcting code has the following code words:

00000000 00001111 01010101 10101010 11110000

What is the maximum number of bit errors that can be corrected?

(A) 0 (B) 1 (C) 2 (D) 3

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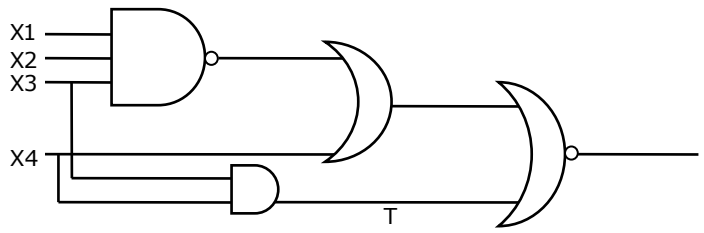
44. A hard disk system has the following parameters:
Number of tracks = 500
Number of sectors/track=100
Number of bytes/sector=500
Time taken by the head to move from one track to adjacent track = 1ms
Rotation speed = 600 rpm
What is the average time taken for transferring 250 bytes from the disk?
(A) 300.5ms (B) 255.5ms (C) 255ms (D) 300ms

45. The line T in the following figure is permanently connected to the ground



Which of the following inputs (X1 X2 X3 X4) will detect the fault?
(A) 0000 (B) 0111
(C) 1111 (D) None of above

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46. The two grammars given below generate a language over the alphabet $\{x, y, z\}$

$G1: S \rightarrow x|z|xS|zS|yB$
$B \rightarrow y|z|yB|zS|zB$
$G2: S \rightarrow y|z|yS|zS|xB$
$B \rightarrow y|yS$

Which one of the following choices describes the properties satisfied by the strings in these languages?
(A) G1: No y appears before any x
G2: Every x is followed by at least one y

(B) G1: No y appears before any x
G2: No x is followed by at least one y

(C) G1: No y appears before any x
G2: Every x is followed by at least one y

(D) G1: No y appears before any x
G2: Every x is followed by at least one x

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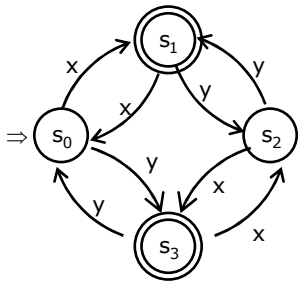
47. Consider the following DFA in which s_0 is the start state and s_1, s_3 are the final states



What language does this DFA recognize?

(A) All strings of x and y

(B) All strings of x and y which have either even number of x and even number of y or odd number of x and odd number of y

(C) All strings of x and y which have equal number of x and y

(D) all strings of x and y with either even number of x and odd number of y or odd number of x and even number of y

48. Consider the grammar give below

$S \rightarrow xB|yA$

$A \rightarrow x|xS|yAA$

$B \rightarrow y|yS|yBB$

Consider the following strings

(i) xxyyx (ii) xxyyxy (iii) xyxy (iv)yxxy

(v) yxx (vi) xyx

Which of the above strings are generated by the grammar?

(A) (i), (ii) and (iii) (B) (ii), (v) and (vi)

(C) (ii), (iii) and (iv) (D) (i), (iii) and (iv)

49. Consider the following grammars. Names representing terminals have been specified in capital letters.

G_1 : stmnt $\rightarrow$ WHILE(expr)stmnt
stmnt $\rightarrow$ OTHER
expr $\rightarrow$ ID

G_2 : stmnt $\rightarrow$ WHILE(expr)stmnt
stmnt $\rightarrow$ OTHER
expr $\rightarrow$ expr + expr
expr $\rightarrow$ expr * expr
expr $\rightarrow$ ID

Which one of the following statements is true?

(A) G_1 is context-free but not regular and G_2 is regular

(B) G_2 is context-free but not regular and G_1 is regular

(C) Both G_1 and G_2 are regular

(D) Both G_1 and G_2 are context-free but neither of them is regular

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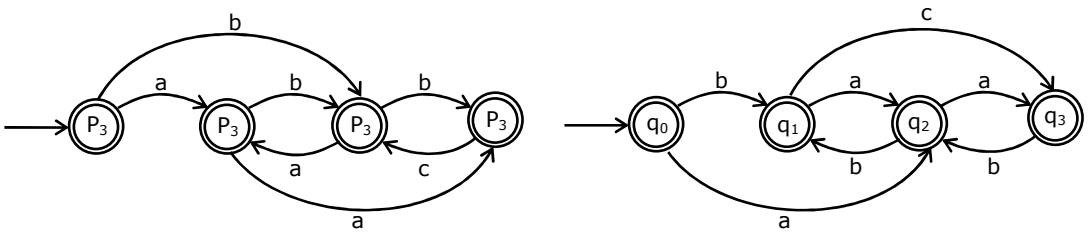
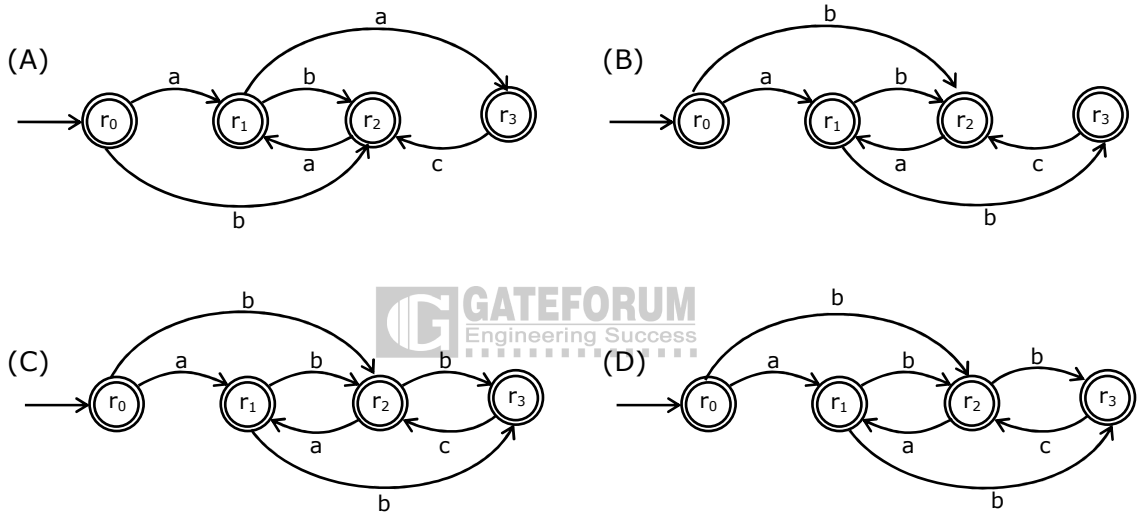
50. Consider the following finite automata P and Q over the alphabet {a, b, c}. The start states are indicated by a double arrow and final states are indicated by a double circle. Let the languages recognized by them be denoted by L(P) and L(P) respectively.



The automaton which recognizes the language $L(P) \cap L(Q)$ is



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51. The following table shows the time between failures for a software system.

Error Number	1	2	3	4	5
Time since Last failure House	6	4	8	5	6

The reliability of the system for one hour of operation assuming an exponential model is

(A) 0.45 (B) 0.63 (C) 0.84 (D) 0.95

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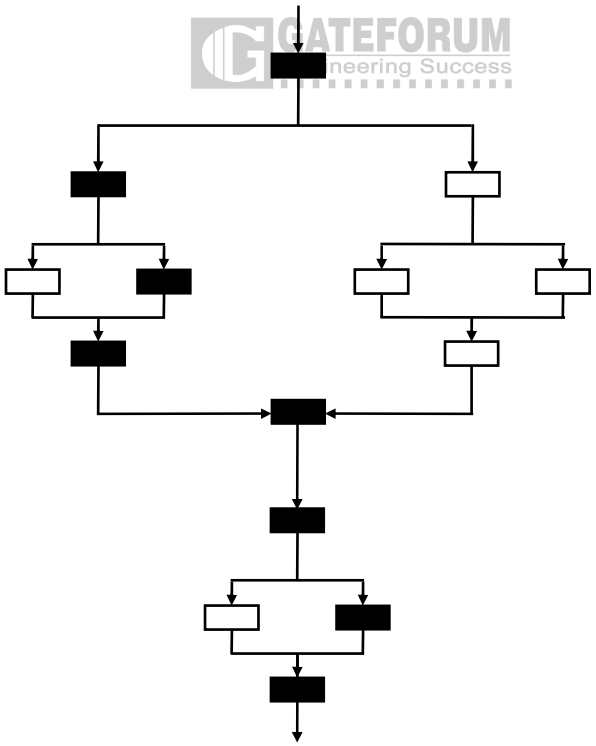
52. Given the following algorithm for sorting an array X of N numbers:

```
SUBROUTINE SORT (X, N)
    IF N(N < 2)
        RETURN
    FOR (i = 2 TO N INCREMENT BY 1)
        IF (X[i] > X([J])
            CONTINUE
        TEMP = X[ i ]
        X[ i ] = X[ j ]
        X[j] = TEMP
    END FOR
END FOR
END SUBROUTING
```

A good approximation of Halstead's estimated program length is

(A) 20 (B) 50 (C) 80 (D) 110

53. In the simplified flowchart given below, the shaded boxes represent code that is executed during a test case.



(A) 3/4 (B) 2/3 (C) 1/2 (D) 3/8

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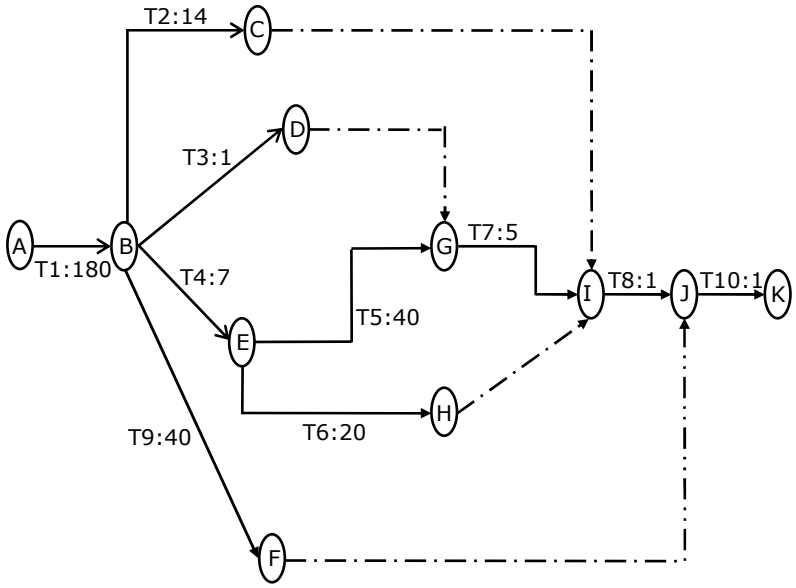
54. Consider the CPM activity chart where an arc connecting two milestones is labeled with a task identifier and the time taken in days. For example in order to go from A to B, task TI takes 180 days. A dashed line depicts an additional dependency that is equivalent to a zero time task



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The set of activities that lie on the critical path are

(A) T1, T2, T8, T10 (B) T1, T3, T8, T10

(C) T1, T2, T3, T4, T5, T6, T7, T8, T10 (D) T1, T4, T5, T6, T7, T8, T10

55. Consider the following pseudo-code:

IF $((A > B)$ AND $(C > D))$ THEN

$A = A + 1$

$B = B + 1$

ENDIF

The cyclomatic complexity of the pseudo-code is

(A) 2 (B) 3 (C) 4 (D) 5

56. Synchronization in the classical readers and writers problem can be achieved through use of semaphores. In the following incomplete code for readers-writers problem, two binary semaphores mutex and wrt are used to obtained synchronization.

wait (wrt)

writing is performed

signal (wrt)

wait (mutex)

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readcount = readcount + 1

if readcount = 1 then **S1**

S2

reading is performed

S3

readcount = readcount – 1

If readcount = 0 then **S4**

signal (mutex)

The values of **S1, S2, S3, S4** (in that order) are

(A) signal (mutex), wait (wrt), signal (wrt), wait (mutex)

(B) signal (wrt), signal (mutex), wait (mutex), wait (wrt)

(C) wait (wrt), signal (mutex), wait (mutex), signal (wrt)

(D) signal (mutex), wait (mutex), signal (mutex), wait (mutex)

57. In a multi-user operating system, on an average, 20 requests are made to use a particular resource per hour. The arrival of requests follows a Poisson distribution. The probability that either one, three or five requests are made in 45 minutes is given by

(A) $6.9\times10^{6}\times e^{-20}$ (B) $10.2\times10^{6}\times e^{-20}$

(C) $6.9\times10^{3}\times e^{-20}$ (D) $1.02\times10^{3}\times e^{-20}$

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58. A demand paging system takes 100 time units to service a page fault and 300 time units to replace a dirty page. Memory access time is 1 time unit. The probability of a page fault is p. In case of a page fault, the probability of page being dirty is also p. It is observed that the average access time is 3 time units. Then the value of p is

(A) 0.194 (B) 0.233 (C) 0.514 (D) 0.981

59. The contents of the text file t1.txt containing four lines are as follows:

a1 b1

a2 b2

a3 b3

a4 b4

The contents of the text file t2.txt containing five lines are as follows:

a1 c1

a2 c2

a3 c3

a4 c3

a5 c4

Consider the following Bourne shell script:

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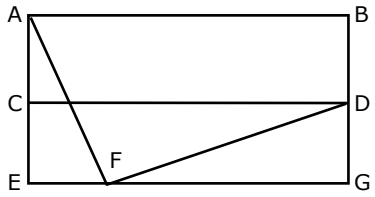
```
awk -F ' ' '{print $1, $2}'t1.txt
while read a b ; do
awk -vaV=$a -vbV=$b -F ' '
aV=$1{print aV, bV, $2 }' t2.txt
done
```

Which one of the following strings will NOT be present in the output generated when the above script is run? (Note that the given strings may be substrings of a printed line.)

(A) "b1 c1" (B) "b2 c3" (C) "b1 c2" (D)"b1 c3"

60. For the network given in the figure below, the routing tables of the four nodes A, E, D and G are shown. Suppose that F has estimated its delay to its neighbors, A, E D and G as 8, 10, 12 and 6msecs respectively and updates its routing table using distance vector routing technique.



Routing Table of A	
A	0
B	40
C	14
D	17
E	21
F	9
G	24

Routing Table of E	
A	24
B	27
C	7
D	20
E	0
F	11
G	22

Routing Table of D	
A	20
B	8
C	30
D	0
E	14
F	7
G	22

Routing Table of G	
A	21
B	24
C	22
D	19
E	22
F	10
G	0

Which one of the following options represents the updated routing table of F?

(A)

A	8
B	20
C	17
D	12
E	10
F	0
G	6

(B)

A	21
B	8
C	7
D	19
E	14
F	0
G	22

(C)

A	8
B	20
C	17
D	12
E	10
F	16
G	6

(D)

A	8
B	8
C	7
D	12
E	10
F	16
G	6

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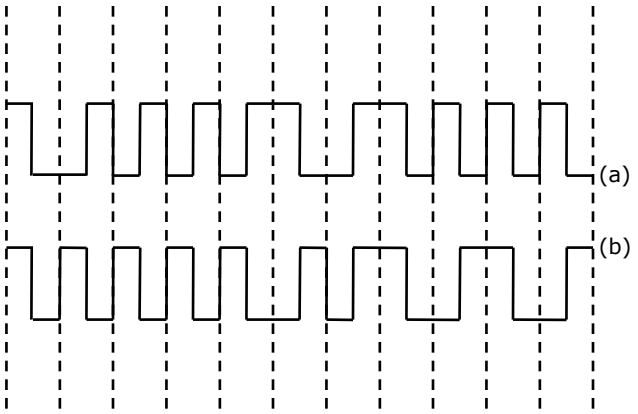
61. In the waveform (a) given below, a bit stream is encoded by Manchester encoding scheme. The same bit stream is encoded in a different coding scheme in waveform (b). The bit stream and the coding scheme are



(A) 1000010111 and Differential Manchester respectively
(B) 0111101000 and Differential Manchester respectively
(C) 1000010111 and Integral Manchester respectively
(D) 0111101000 and Integral Manchester respectively

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62. Let us consider a statistical time division multiplexing of packets. The number of sources is 10. In a time unit, a source transmits a packet of 1000 bits. The number of sources sending data for the first 20 time units is 6, 9, 3, 7, 2, 2, 2, 3, 4, 6, 1, 10, 7, 5, 8, 3, 6, 2, 9, 5 respectively. Then the average number of backlogged packets per time unit during the given period is

(A) 5 (B) 4.45 (C) 3.45 (D) 0

63. A group of 15 routers are interconnected in a centralized complete binary tree with a router at each tree node. Router I communicates with router j by sending a message to the root of the tree. The root then sends the message back down to router j. The mean number of hops per message, assuming all possible router pairs are equally likely is

(A) 3 (B) 4.26 (C) 4.53 (D) 5.26

64. A broadcast channel has 10 nodes and total capacity of 10Mbps. It uses polling for medium access. Once a node finishes transmission, there is a polling delay of 80μs to poll the next node. Whenever a node is polled, it is allowed to transmit a maximum of 1000 bytes. The maximum throughput of the broadcast channel is

(A) 1 Mpbs (B) 100/11 Mpbs (C) 10 Mpbs (D) 100 Mpbs

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65. Consider a selection of the form $\sigma_{A \le 100}(r)$, where r is a relation with 1000 tuples. Assume that the attribute values for A among the tuples are uniformly distributed in the interval [0, 500]. Which one of the following options is the best estimate of the number of tuples returned by the given selection query?

(A) 50 (B) 100 (C) 150 (D) 200

66. Consider the following two transactions : T_1 and T_2

T_1 :	T_1 :
read(A);	read(B);
read(B);	read(A);
if A = 0 then B ← B + 1;	if B ≠ 0 then A ← A + 1;
write(B);	write(A);

Which of the following schemes, using shared and exclusive locks, satisfy the requirements for strict two phase locking for the above transactions?

(A)

S1 :	S2 :
lockS(A);	lockS(B);
read(A);	read(B);
lockS(B);	lockS(A);
read(B);	read(B);
if A = 0	if B ≠ 0
thenB ← B + 1;	thenA ← A + 1;
write(B);	write(A);
commit;	commit;
unlock(A);	unlock(B);
unclock(B);	unclock(A);
unclock(B);	unclock(B);

(B)

S1 :	S2 :
lockX(A);	lockx(B);
read(A);	read(B);
lockX(B);	lockx(A);
read(B);	read(A);
if A = 0	if B ≠ 0
thenB ← B + 1;	thenA ← A − 1;
write(B);	write(A);
commit;	unlock(A)
unlock(A);	commit;
commit;	commit;
unclock(B);	unclock(B);

(C)

S1 :	S2 :
lockS(A);	lockS(B);
read(A);	read(B);
lockX(B);	lockX(A);
read(B);	read(A);
if A = 0	if B ≠ 0
thenB ← B + 1;	thenA ← A − 1;
write(B);	write(A);
unlock(A);	unlock(A);
commit;	commit;
unclock(B);	unclock(B);

(D)

S1 :	S2 :
lockS(A);	lockS(B);
read(A);	read(B);
lockX(B);	lockX(A);
read(B);	read(A);
if A = 0	if B ≠ 0
thenB ← B + 1;	thenA ← A − 1;
write(B);	write(A);
unlock(A);	unclock(A);
unclock(B);	unclock(B);
commit;	commit;

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67. Consider the following implications relating to functional and multivalued dependencies given below, which may or may not be correct.

(i) If $A \twoheadrightarrow B$ and $A \twoheadrightarrow C$ then $A \rightarrow BC$
(ii) If $A \rightarrow B$ and $A \rightarrow C$ then $A \twoheadrightarrow BC$
(iii) If $A \twoheadrightarrow BC$ then $A \rightarrow B$ and $A \rightarrow C$
(iv) If $A \rightarrow BC$ then $A \twoheadrightarrow B$ and $A \twoheadrightarrow C$

Exactly how many of the above implications are valid?

(A) 0 (B) 1 (C) 2 (D) 3

68. Consider the following relation schemas:

b=Schema=(b-name, b-city, assets)

a=Schema=(a-num, b-name, bal)

d=Schema=(c-name, a-number)

Let branch, account and depositor be respective instances of the above schemas. Assume that account and depositor relation are much bigger than the branch relations.

Consider the following query:

$\Pi_{\text{c-name}}\left(\sigma_{\text{b-city="Agra"}\wedge\text{bal}<0}\left(\text{branch} \bowtie\right)\text{account} \bowtie \text{depositor}\right)$

Which one of the following queries is the most efficient version of the above query?

(A) $\Pi_{\text{c-name}}\left(\sigma_{\text{bal}<0}\left(\sigma_{\text{b-city="Agra"}}\text{branch} \bowtie \text{account}\right)\text{account} \bowtie \text{depositor}\right)$

(B) $\Pi_{\text{c-name}}\left(\sigma_{\text{b-city="Agra"}}\text{branch} \bowtie \left(\sigma_{\text{bal}<0}\text{account} \bowtie \text{depositor}\right)\right)$

(C) $\Pi_{\text{c-name}}\left(\left(\sigma_{\text{b-city="Agra"}}\text{branch} \bowtie \sigma_{\text{b-city="Agra"}\wedge\text{bal}<0}\ \text{account}\right)\right)$

(D) $\Pi_{\text{c-name}}\left(\sigma_{\text{b-city="Agra"}}\text{branch} \bowtie \left(\sigma_{\text{b-city="Agra"}\wedge\text{bal}<0}\text{account} \bowtie \text{depositor}\right)\right)$

69. Consider the following clauses:

(i) Not inherently suitable for client authentication.
(ii) Not a state sensitive protocol.
(iii) Must be operated with more than one server.
(iv) Suitable for structured message organization.
(v) May need two ports on the server side for proper operation

The option that has the maximum number of correct matches is

(A) $\text{IMAP}-(\text{i}), \text{FTP}-(\text{ii}), \text{HTTP}-(\text{iii}), \text{DNS}-(\text{iv}), \text{POP3}-(\text{v})$

(B) $\text{FTP}-(\text{i}), \text{POP3}-(\text{ii}), \text{SMTP}-(\text{iii}), \text{HTTP}-(\text{iv}), \text{IMAP}-(\text{v})$

(C) $\text{POP3}-(\text{i}), \text{SMTP}-(\text{ii}), \text{DNS}-(\text{iii}), \text{IMAP}-(\text{iv}), \text{HTTP}-(\text{v})$

(D) $\text{SMTP}-(\text{i}), \text{HTTP}-(\text{ii}), \text{IMP}-(\text{iii}), \text{DNS}-(\text{iv}), \text{FTP}-(\text{v})$

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70. You are given the following four bytes:

10100011	00110111	11101001	10101011

Which of the following are substrings of the base 64 encoding of the above four bytes?

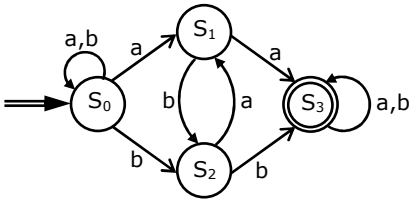
(A) zdp (B) fpq (C) qwA (D) oze

Common Data for Questions 71, 72, 73

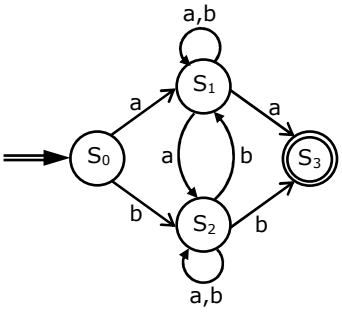
Consider the regular expression $R = (a+b)^*(aa+bb)(a+b)^*$.

71. Which of the following non-deterministic finite automata recognizes the language defined by the regular expression R? Edges labeled λ denote transitions on the empty string.

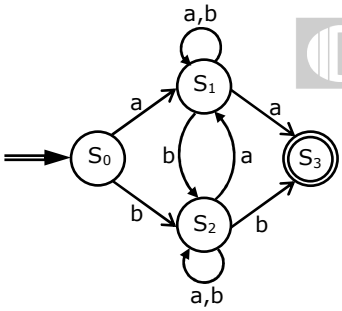
(A)



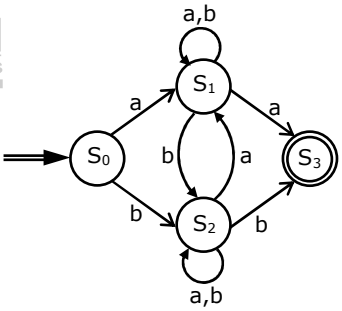
(B)



(C)

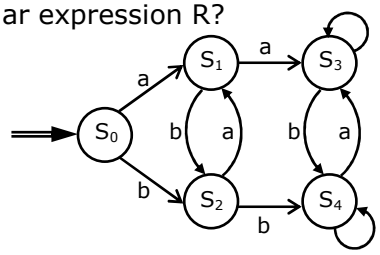


(D)

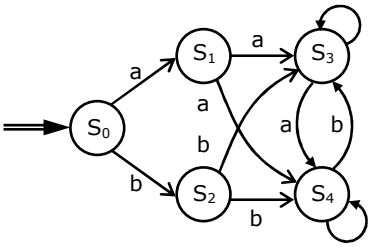


72. Which deterministic finite automaton accepts the language represented by the regular expression R?

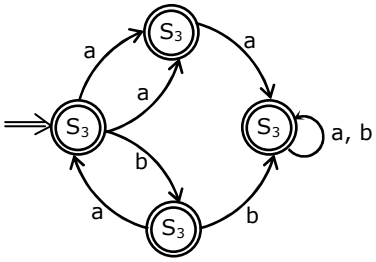
(A)



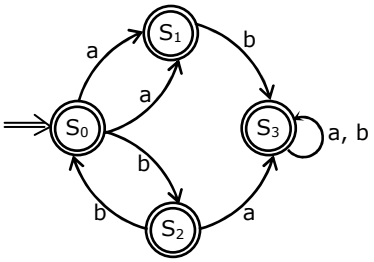
(B)



(C)



(D)



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73. Which one of the regular expressions given below defines the same language as defined by the regular expression R?

(A) $(a(ba)^* + b(ab)^*)(a+b)^+$

(B) $(a(ba)^* + b(ab)^*)^*(a+b)^*$

(C) $(a(ba)^*(a+bb) + b(ab)^*(b+aa))(a+b)^*$

(D) $(a(ba)^*(a+bb) + b(ab)^*(b+aa))(a+b)^+$

Common Data for Questions 74 and 75

Consider a token ring topology with N stations (numbered 1 to N) running token ring protocol where the stations are equally spaced. When a station gets the token it is allowed to send one frame of fixed size. Ring latency is t_p, while the transmission time of a frame is t_t. All other latencies can be neglected.

74. The maximum utilization of the token ring when $t_t = 3ms, t_p = 5ms, N = 10$ is

(A) 0.545 (B) 0.6 (C) 0.857 (D) 0.961

75. The maximum utilization of the token ring when $t_t = 5ms, t_p = 3ms, N = 10$ is

(A) 0.545 (B) 0.655 (C) 0.9375 (D) 0.961

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Linked Answer Questions: Q.76 to Q.85 carry two marks each.

Statement for Linked Answer Questions 76 and 77

Consider the sequence $\{x_n\}_{n\geq 0}$ defined by the recurrence relation $x_{n+1} = cx_n^2 - 2$, where $c > 0$.

76. Suppose there exists a non-empty open interval (a, b) such that for all x_0 satisfying $a < x_{0,} < b$ the sequence converges to a limit. The sequence converges to the value

(A) $\frac{1+\sqrt{1+8c}}{2c}$ (B) $\frac{1-\sqrt{1+8c}}{2c}$ (C) 2 (D) $\frac{2}{2c-1}$

77. For which of the following values of c, does there exist a non-empty open interval (a, b) such that the sequence x_n converges to a limit. The sequence converges to the value

(i) 0.25 (ii) 0.35 (iii) 0.45 (iv) 0.5

(A) (i) only (B) (i) and (ii) only

(C) (i), (ii) and (iii) only (D) (i), (ii), (iii) and (iv)

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Statement for Linked Answer Questions 78 and 79

Consider the following expression

$a\bar{d} + \bar{a}\,\bar{c} + b\bar{c}\,d$

78. Which of the following Karnaugh Maps correctly represents the expression?

(A)

	$\bar{c}\bar{d}$	$\bar{c}d$	cd	$c\bar{d}$
$\bar{a}\bar{b}$	×	×		
$\bar{a}b$	×	×		
ab	×	×		×
$a\bar{b}$	×			×

(B)

	$\bar{c}\bar{d}$	$\bar{c}d$	cd	$c\bar{d}$
$\bar{a}\bar{b}$	×	×		
$\bar{a}b$	×			
ab	×	×		×
$a\bar{b}$	×	×		×

(C)

	$\bar{c}\bar{d}$	$\bar{c}d$	cd	$c\bar{d}$
$\bar{a}\bar{b}$	×	×		
$\bar{a}b$	×	×		×
ab	×	×		×
$a\bar{b}$	×			×

(D)

	$\bar{c}\bar{d}$	$\bar{c}d$	cd	$c\bar{d}$
$\bar{a}\bar{b}$	×	×		
$\bar{a}b$	×	×		
ab	×	×		×
$a\bar{b}$	×		×	×

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79. Which of the following expressions does not correspond to the Karnaugh Map obtained in Q 78?

(A) $\bar{c}\bar{d} + a\bar{d} + ab\bar{c} + \bar{a}\bar{c}d$

(B) $\bar{a}\bar{c} + \bar{c}\bar{d} + a\bar{d} + ab\bar{c}d$

(C) $\bar{a}\bar{c} + \bar{a}\bar{d} + ab\bar{c} + \bar{c}\,d$

(D) $\bar{b}\bar{c}\bar{d} + ac\bar{d} + \bar{a}\bar{c} + ab\bar{c}$

Statement for Linked Answer Questions 80 and 81

Let $P_1, P_2, \ldots, P_n$ be n points in the xy-plane such that no three of them are collinear. For every pair of points P_i and P_j, let L_{ij} be the line passing through them. Let L_{ab} be the line with the steepest gradient amongst all n(n-1)/2 lines.

80. Which one of the following properties should necessarily be satisfied?

(A) P_a and P_b are adjacent to each other with respect to their x-coordinate

(B) Either P_a or P_b has the largest or the smallest y-coordinate among all the points

(C) The difference between x-coordinates of P_a and P_b is minimum

(D) None of the above

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81. The time complexity of the best algorithm for finding P_a and P_b is

(A) $\theta(n)$ (B) $\theta(n\log n)$ (C) $\theta(n\log^2 n)$ (D) $\theta(n^2)$

Statement for Linked Answer Questions 82 and 83

The head of a hard disk serves requests following the shortest seek time first (SSTF) policy.

The head is initially positioned at track number 180.

82. Which of the request sets will cause the head to change its direction after servicing every request assuming that the head does not change direction if there is a tie is SSTF and all the requests arrive b3efore the servicing starts?

(A) 11,139,170,178,181,184,201,265

(B) 10,138,170,178,181,185,201,265

(C) 10,139,169,178,181,184,201,265

(D) 10,138,170,178,181,185,200,265

83. What is the maximum cardinality of the request set, so that the head changes its direction after servicing every request if the total number of tracks are 2048 and the head can start from any track?

(A) 9 (B) 10 (C) 11 (D) 12

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