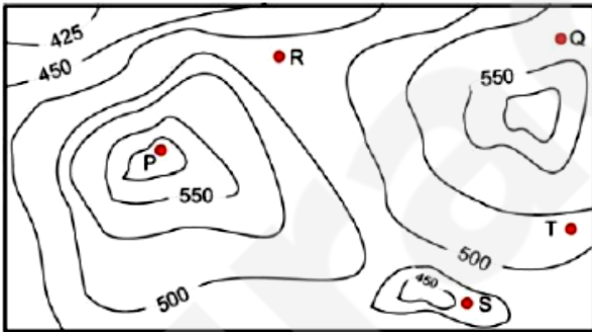


General Aptitude

- Research in the workplace reveals that people work for many reason _____.
A. money beside B. beside money
C. money besides D. besides money
- After Rajendra chola returned from his voyage to Indonesia, he ____ to visit the temple in Thanjavur.
A. was wishing B. is wishing
C. wished D. had wished
- Rahul Murali, Srinivas and Arul are seated around a square table. Rahul is sitting to the left of Murali. Srinivas is sitting to the right of Arul. Which of the following pairs are seated opposite each other?
A. Rahul and Murali B. Srinivas and Arul
C. Srinivas and Murali D. Srinivas and Rahul
- Find the smallest number y such that is a perfect cube.
A. 24 B. 27
C. 32 D. 36
- The probability that a k-digit number does NOT contain the digits 0,5,or 9 is
A. 0.3^k B. 0.6^k
C. 0.7^k D. 0.9^k
- A contour line joins locations having the same height above the mean sea level. The following is a contour plot of a geographical region. Contour lines are shown at 25m intervals in this plot. If in a flood, the water level rises to 525m, which of villages P, Q, R, S, T get submerged?



- P, Q
R, S, T
P, Q, T
Q, R, S
- "The hold of the nationalist imagination on our colonial past is such that anything inadequately or improperly nationalist is just not history"
Which of the following statements best reflects the author's opinion?
A. Nationalists are highly imaginative.
B. History is viewed through the filter of nationalism.
C. Our colonial past never happened.
D. Nationalism has to be both adequately and properly imagined.
 - The expression $\frac{(x+y) - |x-y|}{2}$ is equal to
A. the maximum of x and y
B. the minimum of x and y
C. 1
D. None of the above

- Six people are seated around a circular table. There are at least two men and two women. There are at least three right-handed persons. Every woman has a left-handed person to her immediate right. None of the women are right-handed. The number of women at the table is
A. 2 B. 3
C. 4 D. Cannot be determined
- Arun, Gulab, Neel and Shweta must choose one shirt each from a pile of four shirts coloured red, pink, blue and white respectively. Arun dislikes the colour red and Shweta dislikes the colour white. Gulab and Neel like all the colours. In how many different ways can they choose the shirts so that no one has a shirt with a colour he or she dislikes?
A. 21 B. 18
C. 16 D. 14

Computer Science

- Let X be a Gaussian random variable mean 0 and variance σ^2 . Let $Y = \max(X, 0)$ where $\max(a, b)$ is the maximum of a and b. The median of Y is _____.
A. 0 B. 1
C. 2 D. 3
- Consider the Karnaugh map given below, where x represents "don't care" and blank represents 0.

dc \ ba	00	01	11	10
00		x	x	
01	1			x
11	1			1
10		x	x	

Assume for all inputs (a, b, c, d) the respective complements ($\bar{a}, \bar{b}, \bar{c}, \bar{d}$) are also available. The above logic is implemented 2-input NOR gates only. The minimum number of gates required is _____.

- 0 B. 1
C. 2 D. 3
- The statement $(\neg p) (\neg q)$ is logically equivalent to which of the statements below?
I. $p \Rightarrow q$ II. $q \Rightarrow p$
III. $(\neg q) \vee p$ IV. $(\neg q) \vee q$
A. I only B. I and IV only
C. II only D. II and III only
 - Consider the following table:

Algorithms	Design Paradigms
P. Kruskal	i. Divide and Conquer
Q. Quicksort	ii. Greedy
R. Floyd-Warshall	iii. Dynamic Programming

Match the algorithms to the design paradigms they are based on.

- P-(ii), Q-(iii), R-(i) B. P-(iii), Q-(i), R-(ii)
C. P-(ii), Q-(i), R-(iii) D. P-(i), Q-(ii), R-(iii)

5. A sender S sends a message m to receiver R, which is digitally signed by S with its private key. In this scenario, one or more of the following security violations can take place.

I. S can launch a birthday attack to replace m with a fraudulent message.

II. A third party attacker can launch a birthday attack to replace m with a fraudulent message.

III. R can launch a birthday attack to replace m with a fraudulent message.

Which of the following are possible security violations?

- A. I and II only B. I only
C. II only D. II and III only

6. Consider the following grammar.

$P \rightarrow xQRS$

$Q \rightarrow yz|z$

$R \rightarrow w| \epsilon$

$S \rightarrow y$

What is FOLLOW (Q)?

- A. {R} B. {w}
C. {w, y} D. {w, \$}

7. Consider the language L given by the regular expression $(a+b)^*b(a+b)$ over the alphabet {a, b}. The smallest number of states needed in a deterministic finite-state automation (DFA) accepting L is _____.

- A. 2 B. 3
C. 4 D. 5

8. Consider a two-level cache hierarchy with L1 and L2 caches. An application incurs 1.4 memory accesses per instruction on average. For this application, the miss rate of L1 cache 0.1, the L2 cache experiences, on average, 7 misses per 1000 instructions. The miss rate of L2 expressed correct to two decimal places is _____.

- A. 0.05 B. 0.07
C. 0.03 D. 0.01

9. Consider the following CPU processes with arrival times (in milliseconds) and length of CPU burst (in milliseconds) as given below:

Process	Arrival time	Burst time
P1	0	7
P2	3	3
P3	5	5
P4	6	2

If the pre-emptive shortest remaining time first scheduling algorithm is used to schedule the processes., then the average waiting time across all processes is _____ milliseconds.

- A. 0 B. 1
C. 2 D. 3

10. Threads of a process share
A. global variable but not heap
B. heap but not global variables
C. neither global variables nor heap
D. Both heap and global variables

11. Let C_1, \dots, C_n be scalars, not all zero, such that $\sum_{i=1}^n C_i a_i = 0$ where a_i are column vectors in R^n .

Consider the set of linear equations $Ax = b$

where $A = [a_1, \dots, a_n]$ and $b = \sum_{i=1}^n a_i$. The set of

equations has

- A. a unique solution at $x = j_n$ where j_n denotes a n-dimensional vector of all 1
B. no solution
C. infinitely many solutions
D. finitely many solutions

12. Consider the C code fragment given below.

```
typedef struct node {
    int data;
    node* next;
} node;
void join (node* m, node* n) {
    node* p=n;
    while (p->next != NULL){
        p = p->next;
    }
    p->next = m;
}
```

Assuming that m and n point to valid NULL-terminated linked lists, invocation of join will

- A. append list m to the end of list n for all inputs
B. either cause a null pointer dereference or append list m to the end of list n
C. cause a null pointer dereference for all inputs
D. append list n to the end of list m for all inputs

13. The n-bit fixed-point representation of an unsigned real number real X uses f bits for the fraction part. Let The range of decimal values for X in this representation is

- A. 2^{-f} to 2^i B. 2^{-f} to $(2^i - 2^{-f})$
C. 0 to 2^i D. 0 to $(2^i - 2^{-f})$

14. Consider the following intermediate program in three address code

$p = a - b$

$q = q * c$

$p = u * v$

$q = p + q$

Which one of the following corresponds to a static single assignment form of the above code?

$p_1 = a - b$ $p_3 = a - b$

A. $q_1 = p_1 * c$ B. $q_4 = p_3 * c$

$p_1 = u * v$ $p_4 = u * v$

$q_1 = p_1 + q_1$ $q_5 = p_4 + q_4$

$p_1 = a - b$ $p_1 = a - b$

C. $q_1 = p_2 * c$ D. $q_1 = p_2 * c$

$p_3 = u * v$ $p_2 = u * v$

$q_2 = p_4 + q_3$ $q_2 = p + q$

15. Consider the C struct defined below:
- ```
struct data {
 int marks [100];
 char grade;
 int cnumber;
};
struct data student;
```
- The base address of student is available in register R1. The field student.grade can be accessed efficiently using
- Post-increment addressing mode, (R1)+
  - Pre-decrement addressing mode, -(R1)
  - Register direct addressing mode, R1
  - Index addressing mode, X(R1), where X is an offset represented in 2's complement 16-bit representation.
16. Consider a TCP client and a TCP server running on two different machines. After completing data transfer, the TCP client calls close to terminate the connection and a FIN segment is sent to the TCP server. Server-side TCP responds by sending an ACK which is received by the client-side TCP. As per the TCP connections state diagram (RFC 793), in which state does the client-side TCP connection wait for the FIN from the sever-side TCP?
- LAST-ACK
  - TIME-WAIT
  - FIN-WAIT-1
  - FIN-WAIT-2
17. Consider the following context-free grammar over the alphabet  $\Sigma = \{a, b, c\} = \{a, b, c\}$  with S as the start symbol.
- $$S \rightarrow abScT \mid abcT$$
- $$T \rightarrow bT \mid b$$
- Which one of the following represents the language generated by the above grammar?
- $\{(ab)^n (cb)^n \mid n \geq 1\}$
  - $\{(ab)^n cb^{m_1} cb^{m_2} \dots cb^{m_n} \mid n, m_1, m_2, \dots, m_n \geq 1\}$
  - $\{(ab)^n (cb^m)^n \mid m, n \geq 1\}$
  - $\{(ab)^n (cb^n)^m \mid m, n \geq 1\}$
18. Consider the first-order logic sentence  $f: \forall z (\exists y R(x, y))$ . Assuming non-empty logical domains, which of the sentences below are implied by F?
- $\exists y (\exists x R(x, y))$
  - $\exists y (\forall x R(x, y))$
  - $\forall y (\exists x R(x, y))$
  - $\neg \exists x (\forall y \neg R(x, y))$
- IV only
  - I and IV only
  - II only
  - II and III only
19. When two 8-bit numbers  $A_7 \dots A_0$  and  $B_7 \dots B_0$  in 2's complement representation (with  $A_0$  and  $B_0$  as the least significant bits) are added using a ripple-carry adder, the sum bits obtained are  $S_7 \dots S_0$  and the

carry bits are  $C_7 \dots C_0$ . An overflow is said to have occurred if

- the carry bit  $C_7$  is 1
  - all the carry bits  $C_7 \dots C_0$  are 1
  - $(A_7 B_7 \overline{S_7} + \overline{A_7} \overline{B_7} S_7)$  is 1
  - $(A_0 B_0 \overline{S_0} + \overline{A_0} \overline{B_0} S_0)$  is 1
20. Consider a database that has the relation schema EMP (EmpId, EmpName, and DeptName). An instance of the schema EMP and a SQL query on it are given below.

| EMP   |          |           |
|-------|----------|-----------|
| EmpId | Emp Name | Dept Name |
| 1.    | XYA      | AA        |
| 2.    | XYB      | AA        |
| 3.    | XYC      | AA        |
| 4.    | XYD      | AA        |
| 5.    | XYE      | AB        |
| 6.    | XYF      | AB        |
| 7.    | XYG      | AB        |
| 8.    | XYH      | AC        |
| 9.    | XYI      | AC        |
| 10.   | XYJ      | AC        |
| 11.   | XYK      | AD        |
| 12.   | XYL      | AD        |
| 13.   | XYM      | AE        |

```
SELECT AVG(EC.Num)
FROM EC
WHERE (DeptName, Num) IN
 (SELECT DeptName, COUNT(EmpId) AS
 EC(DeptName, Num)
 FROM EMP
 GROUP BY DeptName)
```

The output of executing the SQL query is \_\_\_\_\_.

- 0.3
  - 1.4
  - 2.6
  - 3.1
21. The following functional dependencies hold true for the relational schema  $R\{V, W, X, Y, Z\}$ :

$V \rightarrow W$

$VW \rightarrow X$

$Y \rightarrow VX$

$Y \rightarrow Z$

Which of the following is irreducible equivalent for this set of functional dependencies?

$V \rightarrow W$

$V \rightarrow W$

A.  $V \rightarrow W$

B.  $W \rightarrow X$

$Y \rightarrow V$

$Y \rightarrow V$

$Y \rightarrow Z$

$Y \rightarrow Z$

$V \rightarrow W$

$V \rightarrow W$

$V \rightarrow X$

$W \rightarrow X$

C.  $Y \rightarrow V$

D.  $Y \rightarrow V$

$Y \rightarrow X$

$Y \rightarrow X$

$Y \rightarrow Z$

$Y \rightarrow Z$

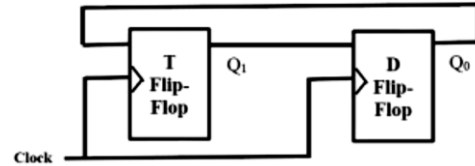
22. Consider the following functions from positive integers to real numbers:

$$10, \sqrt{n}, n, \log_2 n, \frac{100}{n}$$

The CORRECT arrangement of the above functions in increasing order of asymptotic complexity is:

- A.  $\log_2 n, \frac{100}{n}, 10, \sqrt{n}, n$
- B.  $\frac{100}{n}, 10, \log_2 n, \sqrt{n}, n$
- C.  $10, \frac{100}{n}, \sqrt{n}, \log_2 n, n$
- D.  $\frac{100}{n}, \log_2 n, 10, \sqrt{n}, n$
23. Let T be a tree with 10 vertices. The sum of the degrees of all the vertices in T is \_\_\_\_\_.  
A. 0                                      B. 10  
C. 18                                      D. 20
24. Let T be a binary search tree with 15 nodes. The minimum and maximum possible heights of T are:  
**Note:** The height of a tree with a single node is 0.  
A. 4 and 15 respectively  
B. 3 and 14 respectively  
C. 4 and 14 respectively  
D. 3 and 15 respectively
25. Consider the following C code:  
# include <stdio.h>  
int \* assignval (int \*x, int val) {  
  \*x = val;  
  return x;  
}  
void main ( ) {  
  int \* x= malloc (sizeof (int));  
  if (NULL == x) return;  
  x = assignval (x,0);  
  if(x) {  
    x=(int \*) malloc (sizeof (int));  
    if (NULL == x) return;  
    x = assignval (x, 10);  
  }  
  printf("%d\n", \*x);  
  free (x);  
}  
The code suffers from which one of the following problems:  
A. compiler error as the return of malloc is not typecast appropriately.  
B. compiler error because the comparison should be made as x==NULL and not as shown.  
C. compiles successfully but execution may result in dangling pointer.  
D. compiles successfully but execution may result in memory leak.

26. Consider a combination of T and D flip flop is connected to the input of the connected to the input of the D flip-flop is connected to the input of the T flip-flop and the output of the T Flip-flop is connected to the input of the D Flip-flop,



Initially, both  $Q_0$  and  $Q_1$  are set to 1 (before the 1 clock cycle). The outputs

- A.  $Q_1Q_0$  after the 3<sup>rd</sup> cycle are 11 and after the 4  
B.  $Q_1Q_0$  after the 3<sup>rd</sup> cycle are 11 and after the 4  
C.  $Q_1Q_0$  after the 3<sup>rd</sup> cycle are 00 and after the 4  
D.  $Q_1Q_0$  after the 3<sup>rd</sup> cycle are 01 and after the 4
27. The number of integers between 1 and 500 (both inclusive) that are divisible by 3 or 5 or 7 is \_\_\_\_\_.  
A. 212                                      B. 271  
C. 311                                      D. 354
28. Consider a RISC machine where each instruction is exactly 4 bytes long. Conditional and unconditional branch instructions use PC- relative addressing mode with Offset specified in bytes to the target location of the branch instruction. Further the Offset is always with respect to the address of the next instruction in the program sequence. Consider the following instruction sequence.
- | Instr. No. | Instruction     |
|------------|-----------------|
| i:         | add R2, R3, R4  |
| i + 1:     | sub R5, R6, R7  |
| i + 2:     | cmp R1, R9, R10 |
| i + 3      | beq R1, Offset  |
- If the target of the branch instruction is i, then the decimal value of the Offset is \_\_\_\_\_.  
A. -10                                      B. -16  
C. -22                                      D. -25
29. Consider the C functions foo and bar given below:  
int foo (int val ) {  
  int x = 0;  
  while (val > 0) {  
    x = x + foo ( val --);  
  }  
  return val ;  
}  
int bar (int val ) {  
  int x = 0;  
  while (val > 0) {  
    x = x + bar (val - 1) ;  
  }  
  return val ;  
}  
Invocations of foo (3) and bar (3) will result in:  
A. Return of 6 and 6 respectively.  
B. Infinite loop and abnormal termination respectively.  
C. Abnormal termination and infinite loop respectively.  
D. Both terminating abnormally

30. In a RSA cryptosystem a participant A uses two prime numbers  $p = 13$  and  $q = 17$  to generate her public and private keys. If the public key of A is 35. Then the private key of A is \_\_\_\_\_.  
A. 09 B. 11  
C. 21 D. 31
31. Let A be an array of 31 numbers consisting of sequence of 0's followed by a sequence of 1's. The problem is to find the smallest index  $i$  that  $A[i]$  is 1 by probing the minimum numbers of locations in A. The worst case number of probes performed by an optimal algorithm is \_\_\_\_\_.  
A. 2 B. 3  
C. 4 D. 5
32. If G is grammar with productions  
 $S \rightarrow SaS \mid aSb \mid bSa \mid SS \mid \epsilon$   
where S is the start variable,  
then which one of the following is not generated by G?  
A. abab B. aaab  
C. abbaa D. babba
33. The value of  $\lim_{x \rightarrow 1} \frac{x^7 - 2x^5 + 1}{x^3 - 3x^2 + 2}$   
A. is 0 B. is -1  
C. is 1 D. does not exist
34. Instructions execution in a processor is divided into 5 stages. Instruction Fetch (IF), Instruction Decode (ID), Operand Fetch (OF), Execute (EX), and Write Back (WB). These stages take 5, 4, 20, 10 and 3 nanoseconds (ns) respectively. A pipelined implementation of the processor requires buffering between each pair of consecutive stages with a delay of 2ns. Two pipelined implementations of the processor are contemplated.  
(i) a naïve pipeline implementation (NP) with 5 stages and  
(ii) an efficient pipeline (EP) where the OF stage is divided into stages OF1 and OF2 with execution times of 12 ns and 8 ns respectively.  
The speedup (correct to two decimal places) achieved by EP over NP in executing 20 independent instructions with no hazards is \_\_\_\_\_.  
A. 0.43 B. 1.50  
C. 2.31 D. 3.23
35. Consider a database that has the relation schemas EMP(EmpId, EmpName, DepId). And DEPT(DeptName, DeptId). Note that the DeptId can be permitted to be NULL in the relation EMP. Consider the following queries on the database expressed in tuple relational calculus.  
I.  $\{t \mid \exists u \in EMP(t[EmpName] = u[EmpName] \wedge \forall v \in DEPT(t[DeptId] \neq v[DeptId]))\}$   
II.  $\{t \mid \exists u \in EMP(t[EmpName] = u[EmpName] \wedge \exists v \in DEPT(t[DeptId] \neq v[DeptId]))\}$   
III.  $\{t \mid \exists u \in EMP(t[EmpName] = u[EmpName] \wedge \exists v \in DEPT(t[DeptId] \neq v[DeptId]))\}$   
Which of the above queries are safe?  
A. (I) and (II) only B. (I) and (III) only  
C. (II) and (III) only D. (I), (II) and (III)
36. Recall that Belady's anomaly is that the pages-fault rate may increase as the number of allocated frames increases. Now consider the following statements:  
S1: Random page replacement algorithm (where a page chosen at random is replaced) suffers from Belady's anomaly  
S2: LRU page replacement algorithm suffers from Belady's anomaly  
Which of the following is CORRECT?  
A. S1 is true, S2 is true B. S1 is true, S2 is false  
C. S1 is false, S2 is true D. S1 is false, S2 is false
37. The output of executing the following C program is \_\_\_\_\_.  
#include <stdio.h>  
int total (int v) {  
while (v) {  
count += v & 1;  
v >> = 1;  
}  
return count;  
}  
void main ( ) {  
static int x = 0;  
int i = 5;  
for (; i > 0; i--) {  
x = x + total (i) ;  
}  
printf ("%d\n", x) ;  
}  
A. 12 B. 23  
C. 31 D. 44
38. Consider the following C program.  
#include <stdio.h>  
#include <string.h>  
void printlength (char \*s, char \*t) {  
unsigned int c = 0;  
int len = ((strlen(s) - strlen (t)) > c) ? strlen(s) : strlen(t);  
printf ("%d\n", len);  
}  
void main ( ) {  
char \*x = "abc";  
char \*y = "defgh";  
printlength (x,y);  
Recall that strlen is defined in string.h as returning a value of type size\_t, which is an unsigned int. The output of the program is \_\_\_\_\_.  
A. 1 B. 2  
C. 3 D. 4
39. Consider the following languages over the alphabet  $\Sigma = \{a, b, c\}$   
Let  $L_1 = \{a^n b^n c^m \mid m, n \geq 0\}$  and  $L_2 = \{a^m b^n c^n \mid m, n \geq 0\}$   
Which of the following are context-free languages?  
I.  $L_1 \cup L_2$  II.  $L_1 \cap L_2$   
A. I only B. II only  
C. I and II D. Neither I nor II



40. Consider a 2-way set associative cache with 256 blocks and uses LRU replacement, Initially the cache is empty. Conflict misses are those misses which occur due the contention of multiple blocks for the same cache set. Compulsory misses occur due to first time access to the block. The following sequence of accesses to memory blocks. (0,128,256,128,0,128,256,128,1,129,257,129,1,129,257,129) is repeated 10 times. The number of conflict misses experienced by the cache is \_\_\_\_\_.
- A. 43                                      B. 56  
C. 63                                      D. 76
41. Let  $u$  and  $v$  be two vectors in whose Euclidean norms satisfy What is the value of such that bisects the angle between  $u$  and  $v$ ?
- A. 2                                      B.  $\frac{1}{2}$   
C. 1                                      D.  $-\frac{1}{2}$
42. Consider the following grammar:  
 $\text{stmt} \rightarrow \text{if exp r then else exp r ; stmt } 0$   
 $\text{exp r} \rightarrow \text{term rel op term term}$   
 $\text{term} \rightarrow \text{id} \mid \text{number}$   
 $\text{if} \rightarrow \text{a} \mid \text{b} \mid \text{c}$   
 $\text{number} \rightarrow [0 \dots 9]$   
 where rel op is a relational operate (e.g  $<$ ,  $>$ ,  $\dots$ ) ---  
 $0$  refers to the empty statement, and if, then, else are terminals.  
 Consider a program  $P$  following the above grammar containing ten if terminals. The number of control flows paths in  $P$  is \_\_\_\_\_. For example the program  
 if  $e_1$  then  $e_2$  else  $e_3$   
 has 2 controls flow paths  $e_1 \rightarrow e_2$  and  $e_1 \rightarrow e_3$
- A. 128                                      B. 512  
C. 1024                                      D. 2048
43. In a database system, unique time stamps are assigned to each transaction using Lamport's logical clock. Let  $TS(T_1)$  and  $TS(T_2)$  be the timestamps of transactions  $T_1$  and  $T_2$  respectively. Besides,  $T_1$  holds a lock on the resource  $R$ , and  $T_2$  has requested a conflicting lock on the same resource  $R$ . The following algorithm is used to prevent deadlocks in the database system assuming that a killed transaction is restarted with the same timestamp.  
 if  $TS(T_2) < TS(T_1)$  then  
 $T_1$  is killed  
 else  $T_2$  waits.  
 Assume any transactions that is not killed terminates eventually. Which of the following is TRUE about the database system that uses the above algorithm to prevent deadlocks?
- A. The database system is both deadlock-free and starvation- free.  
 B. The database system is deadlock-free, but not starvation-free.  
 C. The database system is starvation-free but not deadlock-free.  
 D. The database system is neither deadlock-free nor starvation-free.
44. Let  $A$  and  $B$  be infinite alphabets and let  $\#$  be a symbol outside both  $A$  and  $B$ . Let  $f$  be a total functional from  $A^*$  to  $B^*$ . We say  $f$  is computable if there exists a Turing machine  $M$  which given an input  $x$  in  $A^*$ , always halts with  $f(x)$  on its tape. Let  $L_f$  denote the language  $\{x\#f(x) \mid x \in A^*\}$ . Which of the following statements is true:  
 A.  $f$  is computable if and only if  $L_f$  is recursive.  
 B.  $f$  is computable if and only  $L_f$  recursively enumerable.  
 C. If  $f$  is computable then  $L_f$  is recursive, but not conversely.  
 D. If  $f$  is computable then  $L_f$  is recursively enumerable, but not conversely.
45. Consider the expression  $(a-1)^*(((b+c)/3)+d)$ . Let  $X$  be the minimum number of registers required by an optimal code generation (without any register spill) algorithm for a load/store architecture in which (i) only loads and store instructions can have memory operands and (ii) arithmetic instructions can have only register or immediate operands. The value of  $X$  is \_\_\_\_\_.
- A. 0                                      B. 1  
C. 2                                      D. 3
46. Let  $G = (V, E)$  be any connected undirected edge-weighted graph. The weights of the edges in  $E$  are positive and distinct. Consider the following statements:  
 (I) Minimum spanning tree of  $G$  is always unique.  
 (II) Shortest path between any two vertices of  $G$  is always unique.  
 Which of the above statements is/are necessarily true?
- A. (I) only                                      B. (II) only  
C. Both (I) and (II)                                      D. Neither (I) nor (II)
47. A multithreaded program  $P$  executes with  $x$  number of threads and uses  $y$  number of locks for ensuring mutual exclusion while operating on shared memory locations. All locks in the program are non-re-entrant, i.e., if a thread holds a lock  $l$ , then it cannot re-acquire lock  $l$  without releasing it. If a thread is unable to acquire a lock, it blocks until the lock becomes available. The minimum value of  $x$  and the minimum value of  $y$  together for which execution of  $P$  can result in a deadlock are:
- A.  $x = 1, y = 2$                                       B.  $x = 2, y = 1$   
C.  $x = 2, y = 2$                                       D.  $x = 1, y = 1$
48. The values of parameters for the Stop-and - Wait ARQ protocol are as given below:  
 Bit rate of the transmission channel = 1 Mbps  
 Propagation delay from sender to receiver = 0.75 ms  
 Time to process a frame = 0.25 ms  
 Number of bytes in the information frame = 1980  
 Number of bytes in the acknowledge frame = 20  
 Number of overhead bytes in the information frame = 20  
 Assume that there are no transmission errors. Then the transmission efficiency (expressed in percentage) of the Stop-and - Wait ARQ protocol for the above parameters is \_\_\_\_\_.
- A. 75.33                                      B. 89.33  
C. 92.33                                      D. 99.33

49. A computer network uses polynomials over GF(2) for error checking with 8 bits as information bits and uses  $x^3 + x + 1$  as the generator polynomial to generate the check bits. In this network, the message 01011011 is transmitted as  
 A. 01011011010 B. 01011011011  
 C. 01011011101 D. 01011011100
50. Let p, q, and r be propositions and the expression  $(p \rightarrow q) \rightarrow r$  be a contradiction. Then, the expression  $(r \rightarrow p) \rightarrow q$  is  
 A. a tautology  
 B. a contradiction  
 C. always TRUE when p is FALSE  
 D. always TRUE when q is TRUE
51. A cache memory unit with capacity of N words and block size of B words is to be designed. If it is designed as a direct mapped cache, the length of the TAG field is 10 bits. If the cache unit is now designed as a 16-way set-associative cache, the length of the TAG field is \_\_\_\_\_ bits.  
 A. 12 B. 14  
 C. 16 D. 18
52. Consider the following two functions.
- ```
void fun1 (int n) {
  if (n == 0 ) return;
  printf ("%d" , n);
  fun2 (n - 2);
  printf ("%d" , n);
}

void fun2 (int n) {
  if (n == 0) return ;
  printf ("%d" , n);
  fun1(++n) ;
  printf ("%d" , n);
}
```
- The output printed when fun1(5) is called is
 A. 53423122233445 B. 53423120112233
 C. 53423122132435 D. 53423120213243
53. Consider a database that has the relation schema CR (StudentName, CourseName). An instance of the schema CR is as given below.

CR	
Student Name	Course Name
SA	CA
SA	CB
SA	CC
SB	CB
SB	CC
SC	CA
SC	CB
SC	CC
SD	CA
SD	CB
SD	CC
SD	CD
SE	CD
SE	CA
SE	CB
SF	CA
SF	CB
SF	CC

The following query is made on the database.

$$T1 \leftarrow \pi_{Course\ Name}(\sigma_{Student\ Name='SA'}(CR))$$

$$T2 \leftarrow CR \div T1$$

The number of rows in T2 is _____.

- A. 2 B. 3
 C. 4 D. 5

54. Let A be real valued square symmetric matrix of rank

2 with $\sum_{i=1}^n \sum_{j=1}^n A_{ij}^2 = 50$. Consider the following

statements.

(I) One eigen value must be in $[-5, 5]$

(II) The eigen value with the largest magnitude must be strictly greater than 5.

Which of the above statements about eigen values of A is/are necessarily CORRECT?

- A. Both (I) and (II) B. (I) only
 C. (II) only D. Neither (I) nor (II)

55. Consider the context-free grammars over the alphabet $\{a,b,c\}$ given below. S and T are non-terminals

$$G_1 : S \rightarrow aSb \mid T, T \rightarrow cT \mid \epsilon$$

$$G_2 : S \rightarrow bSa \mid T, T \rightarrow cT \mid \epsilon$$

The language $L(G_1) \cap L(G_2)$ is

- A. Finite
 B. Not finite but regular
 C. Context-free but not regular
 D. Recursive but not context-free
