

GATE Exam Question Papers-Computer Science -2001

1.1 Consider the following statements:

S1 : The sum of two singular $n \times n$ matrices may be non-singular

S2 : The sum of two $n \times n$ non-singular matrices may be singular

Which of the following statements is correct?

- Both S1 and S2 are true
- S1 is true, S2 is false
- S1 is false, S2 is true
- S1 and S2 are both false

1.2 Consider the following relations:

R1 (a, b) if $f(a + b)$ is even over the set of integers

R2 (a, b) if $f(a + b)$ is odd over the set of integers

R3 (a, b) if $f a.b > 0$ over the set of non-zero rational numbers

R4 (a, b) iff $|a - b| \leq 2$ over the set of natural numbers

Which of the following statements is correct?

- R1 and R2 are equivalence relations, R3 and R4 are not
- R1 and R3 are equivalence relations, R2 and R4 are not
- R1 and R4 are equivalence relations, R2 and R3 are not
- R1, R2, R3 and R4 are all equivalence relations

1.3 Consider two well-formed formulas in propositional logic

F1 : $P \vee \neg P$ F2 : $(P \vee \neg P) \vee (\neg P \vee P)$

Which of the following statements is correct?

- F1 is satisfiable, F2 is valid
- F1 unsatisfiable, F2 is satisfiable
- F1 is unsatisfiable, F2 is valid
- F1 and F2 are both satisfiable.
- Consider the following two statements:

1.4 S1: $\{0^n 2^n | n \geq 1\}$ is a regular language

S2: $\{0^m 1^n | 0 \leq m \leq n\}$ is a regular language

Which of the following statements is correct?

- Only S1 is correct
- Only S2 is correct
- Both S1 and S2 are correct

- None of S1 and S2 is correct

1.5 Which of the following statements in true?

- (a) If a language is context free it can always be accepted by a deterministic push-down automaton
- (b) The union of two context free languages is context free
- (c) The intersection of two context free languages is context free
- (d) The complement of a context free language is context free

1.6 Given an arbitrary non-deterministic finite automaton (NFA) with N states, the maximum number of states in an equivalent minimized DFA is at least

- (a) N^2 (b) $2N$
- (c) $2N$ (d) $N!$

1.7 More than one word are put in one cache block to

- (a) exploit the temporal locality of reference in a program
- (b) exploit the spatial locality of reference in a program
- (c) reduce the miss penalty
- (d) none of the above

1.8 Which of the following statements is false? .

- Virtual memory implements the translation of a program's address space into physical memory address space
- Virtual memory allows each program to exceed the size of the primary memory
- Virtual memory increases the degree of multiprogramming
- Virtual memory reduces the context switching overhead
- A low memory can be connected to 8085 by using
- INTER
- RESETN
- HOLD
- READY
- Suppose a processor does not have any stack pointer register. Which of the following statements is true?
- It cannot have subroutine call Instruction,
- It can have subroutine call instruction, but no nested subroutine calls

(c) Nested subroutine calls are possible, but interrupts are not

(d) All sequences of subroutine calls and also interrupts are possible

1.11 Given the following Karnaugh map, which one of the following represents the minimal Sum-Of-Products of the map?

wx ® 00 01 11 10

YZ				
00	0	X	0	X
01	X	1	X	1
11	0	X	1	0
10	0	1	X	0

- $xy+y'z$ (b) $wx'y'+xy+xz$

(c) $w'x+y'z+xy$ (d) $xz+y$

1.12 A processor needs software interrupt to

- test the interrupt system of the processor
- implement co-routines

(c) obtain system services which need execution of privileged instructions

(d) return from subroutine

1.13 A CPU has two modes - privileged and non-privileged. In order to change the mode from privileged to non-privileged

- a hardware interrupt is needed
- a software interrupt is needed
- a privileged instruction (which does not generate an interrupt) is needed
- a non-privileged instruction (which does not generate an interrupt) is needed

1.14 Randomized quick sort is an extension of quick sort where the pivot is chosen randomly. What is the worst-case complexity of sorting n numbers using randomized quick sort?

- $O(n)$
- $O(n \log n)$
- $O(n^2)$
- $O(n!)$

1.15 Consider an array representation of an n element binary heap where the elements are stored from index 1 to index n of the array. For the element stored at index i of the array ($i \leq n$), the index of the parent is

- $i-1$
- $\lfloor i/2 \rfloor$
- $\lfloor i/2 \rfloor + 1$
- $(i+1)/2$

1.16 Let $f(n) = n^2 + 1$ and $g(n) = n + 10$ be two positive functions of n. Which of the following statements is correct ?

- $f(n) = O(g(n))$ and $g(n) = O(f(n))$
- $g(n) = O(f(n))$ and $f(n) = O(g(n))$
- $f(n) = O(g(n))$ and $g(n) = O(f(n))$

(d) $f(n) = O(g(n))$ and $g(n) = O(f(n))$

1.17 The process of assigning load addresses to the various parts of the program and adjusting the code and data in the program to reflect the assigned addresses is called

- (a) Assembly (b) Parsing
(c) Relocation (d) Symbol resolution

1.18 Which of the following statements is false?

- An unambiguous grammar has same leftmost and rightmost derivation
 - An LL(1) parser is a top-down parser
 - LALR is more powerful than SLR
- (d) An ambiguous grammar can never be LR(k) for any k

1.19 Consider a set of n tasks with known runtimes r_1, r_2, \dots, r_n to be run on a uniprocessor machine. Which of the following processor scheduling algorithms will result in the maximum throughput?

- (a) Round-Robin (b) Shortest-Job-First
(c) Highest-Response-Ratio-Next (d) First-Come-First-Served

1.20 Where does the swap space reside ?

- (a) RAM (b) Disk
(c) ROM (d) On-chip cache

1.21 Consider a virtual memory system with FIFO page replacement policy. For an arbitrary page access pattern, increasing the number of page frames in main memory will

- always decrease the number of page faults
- always increase the number of page faults
- some times increase the number of page faults
- never affect the number of page faults

1.22 Which of the following requires a device driver?

- Register
- Cache
- Main memory
- Disk

1.23 Consider a schema $R(A, B, C, D)$ and functional dependencies $A \twoheadrightarrow B$ and $C \twoheadrightarrow D$. Then the decomposition of R into $R_1(AB)$ and $R_2(CD)$ is

- dependency preserving and loss less join
- loss less join but not dependency preserving
- dependency preserving but not loss less join
- not dependency preserving and not loss less join

1.24 Suppose the adjacency relation of vertices in a graph is represented in a table Adj(X, Y). Which of the following queries cannot be expressed by a relational algebra expression of constant

length?

(a) List all vertices adjacent to a given vertex

- List all vertices which have self loops
- List all vertices which belong to cycles of less than three vertices
- List all vertices reachable from a given vertex

1.25 Let r and s be two relations over the relation schemes R and S respectively, and let A be an attribute in R . Then the relational algebra expression $\sigma_{A=a}(r \bowtie s)$ is always equal to

(a) $\sigma_{A=a}(r)$ (b) r

(c) $\sigma_{A=a}(r) \bowtie s$ (d) none of the above

2.1 How many 4-digit even numbers have all 4 digits distinct?

(a) 2240 (b) 2296

(c) 2620 (d) 4536

2.2 Consider the following statements:

S1 : There exist infinite sets A, B, C such that $A \cap (B \cap C)$ is finite.

S2: There exist two irrational numbers x and y such that $(x+y)$ is rational. Which of the following is true about S1 and S2 ?

- Only S1 is correct
- Only S2 is correct
- Both S1 and S2 are correct
- None of S1 and S2 is correct

2.3 Let $f : A \rightarrow B$ be a function, and let E and F be subsets of A . Consider the following statements about images.

S1 : $f(E \cap F) = f(E) \cap f(F)$

S2 : $f(E \cup F) = f(E) \cup f(F)$

Which of the following is true about S1 and S2 ?

- Only S1 is correct
- Only S2 is correct
- Both S1 and S2 are correct
- None of S1 and S2 is correct

2.4 Seven (distinct) car accidents occurred in a week. What is the probability that they all occurred on the same day?

- $\frac{1}{7^7}$
- $\frac{1}{7^6}$

- 1/2 7
- 7/2 7

2.5 Consider a DFA over $S = \{a, b\}$ accepting all strings which have number of a's divisible by 6 and number of b's divisible by 8. What is the minimum number of states that the DFA will have?

- 8
- 14
- 15
- 48
- Consider the following languages:

2.6 $L1 = \{w w^R \mid w \in \{a,b\}^*\}$

$L2 = \{ww^R \mid w \in \{a, b\}^*, w^R \text{ is the reverse of } w\}$

$L3 = \{0^i 2^i \mid i \text{ is an integer}\}$

$L4 = \{0^i 2^i \mid i \text{ is an integer}\}$

Which of the languages are regular?

- Only L1 and L2
- Only L2, L3, and L4
- Only L3 and L4
- Only L3

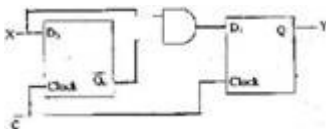
2.7 Consider the following problem X .

Given a Turing machine M over the input alphabet Σ , any state q of M and a word $w \in \Sigma^*$, does the computation of M on w visit the state q ?

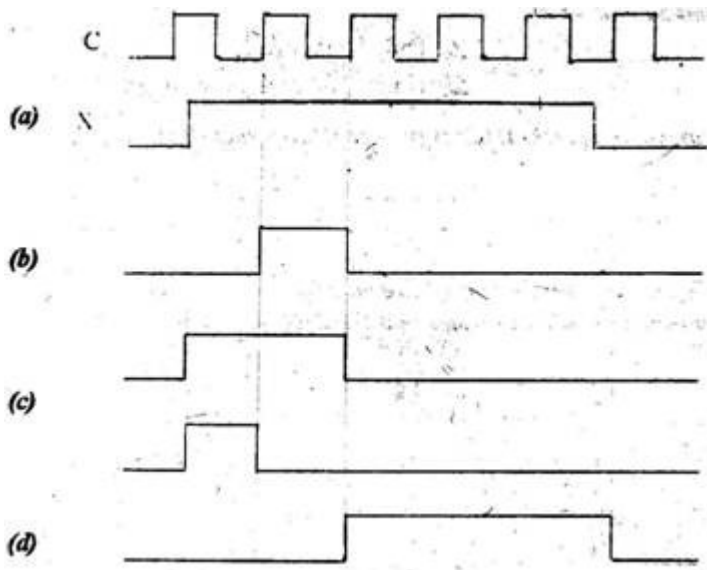
Which of the following statements about X is correct?

- X is decidable
- X is undecidable but partially decidable
- X is undecidable and not even partially decidable.
- X is not a decision problem

2.8 Consider the following circuit with initial state $Q_0 = Q_1 = 0$. The D Flip-Flops are positive edge triggered and have set up times 20 nanosecond and hold times 0.



Consider the following timing diagrams of X and C; the clock period of C is 40 nanosecond. Which one is the correct plot of Y?



2.9 Which is the most appropriate match for the items in the first column with the items in the second column ?

X Indirect Addressing I. Array implementation

Y Indexed Addressing II. Writing relocatable code

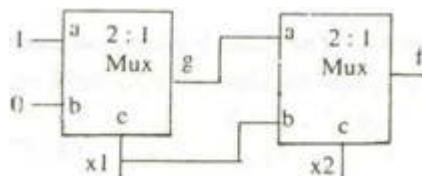
Z. Base Register Addressing III. Passing array as parameter

- (X, III), (Y, I), (Z, II)
- (X, II), (Y, III), (Z, I)
- (X, III), (Y, II), (Z, I)
- (x, I), (Y, III), (Z, II)

2.10 The 2's complement representation of (-539) 10 in hexadecimal is

- ABE
- DBC
- DE5
- 9E7

2.11 Consider the circuit shown below. The output of a 2:1 Mux is given by the function $(ac' + bc)$.

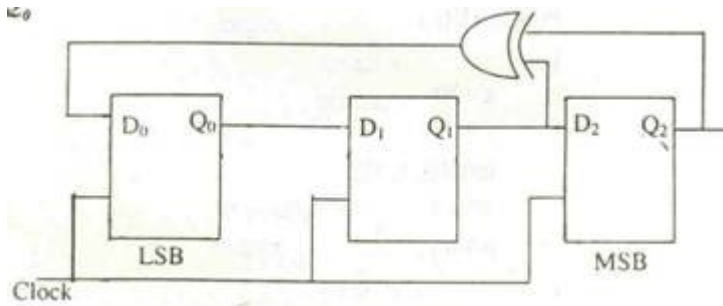


Which of the following is true?

- $f = x1' + x2$
- $f = x1 \cdot x2 + x1x2'$
- $f = x1x2 + x1 \cdot x2'$

- $f = x^1 + x^2$

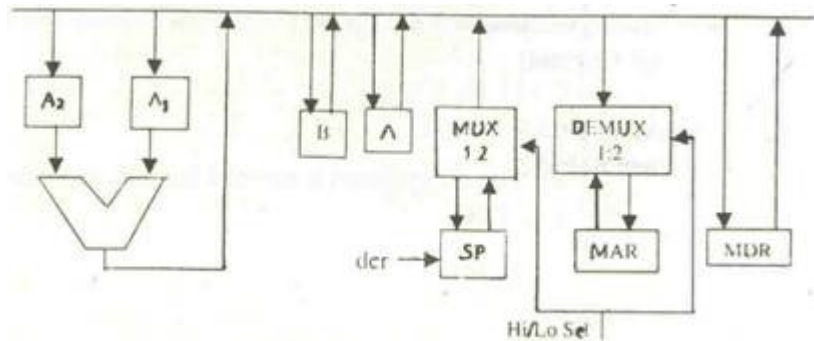
2.12 Consider the circuit given below with initial state $Q_0 = 1, Q_1 = Q_2 = 0$. The state of the circuit is given by the value $4Q_2 + 2Q_1 + Q_0$



Which one of the following is the correct state sequence of the circuit?

- (a) 1,3,4,6,7,5,2
- (b) 1,2,5,3,7,6,4
- (c) 1,2,7,3,5,6,4
- (d) 1,6,5,7,2,3,4.

2.13 Consider the following data path of a simple non-pipelined CPU. The registers A, B, A1, A2, MDR, the bus and the ALU are 8-bit wide. SP and MAR are 16-bit registers. The MUX is of size $8 \times (2:1)$ and the DEMUX is of size $8 \times (1:2)$. Each memory operation takes 2 CPU clock cycles and uses MAR (Memory Address Register) and MDR (Memory Date Register). SP can be decremented locally.



The CPU instruction "push r". where $r = A$ or B , has the specification

$$M[SP] \leftarrow r$$

$$SP \leftarrow SP - 1$$

How many CPU clock cycles are needed to execute the "push r" instruction?

- 2
- 3
- 4
- 5

2.14 Consider an undirected unweighted graph G. Let a breadth-first traversal of G be done starting from a node r. Let $d(r, u)$ and $d(r, v)$ be the lengths of the shortest paths from r to u and v respectively, in G. If u is visited before v during the breadth-first traversal, which of the following statements is correct?

- $d(r, u) < d(r, v)$

- $d(r, u) > d(r, v)$
- $d(r, u) \neq d(r, v)$
- None of the above

2.15 How many undirected graphs (not necessarily connected) can be constructed out of a given set $V = \{V_1, V_2, \dots, V_n\}$ of n vertices?

- $n(n-1)/2$
- 2^n
- $n!$
- $2^{n(n-1)/2}$

2.16 What is the minimum number of stacks of size n required to implement a queue of size n ?

- (0) One (b) Two
(c) Three (d) Four

- **2.17 What is printed by the print statements in the program P1 assuming call by reference parameter passing?**

Program P1 ()

```
{
x=10;
y=3;
func1(y, x, x);
print x;
print y;
,
func1 (x, y, z)
{
y=y+4;
z=x+y+z;
}
```

- 10,3
- 31,3
- 27,7
- None of the above

2.18 Consider the following three C functions :

```
[PI] int * g (void)
{
int x= 10;
```

```

return (& x);
}
[P2] int * g (void)
{
int * px;
*px= 10;
return px;
}
[P3] int * g (void)
{
int * px;
px = (int *) malloc (sizeof(int));
*px= 10;.
return px;
}

```

Which of the above three functions are likely to cause problems with pointers?

- (a) Only P3 (b) Only P1 and P3
(c) Only P1 and P2 (d) P1,P2,andP3

2.19 Consider the following program

Program P2

Var n: int:

procedure W (var x: int)

begin

x=x+1;

print x;

end

procedure D

begin

var n: int;

n=3;

W(n); .

end

begin \\beginP2

n=10;

D;

end

If the language has dynamic scoping and parameters are passed by reference, what will be printed by the program?

- 10
- 11
- 3
- None of the above

2.20 Which of the following does not interrupt a running process? .

- (a) A device (b) Timer
(c) Scheduler process (d) Power failure

2.21 Consider a machine with 64 M B physical memory and a 32-bit virtual address space. If the page size is 4KB, what is the approximate size of the page table?

- (a) 16 MB (b) 8 MB
(c) 2 MB (d) 24 MB

2.22 Consider Peterson's algorithm for mutual exclusion between two concurrent processes i and j. The program executed by process i is shown below.

repeat

flag = true;

turn = j;

while (P) do no-op;

Enter critical section, perform actions, then exit critical section

flag [i] = false;

Perform other non-critical section actions.

until false;

For the program to guarantee mutual exclusion, the predicate P in the while loop should be

- flag [j] = true and turn = i
- flag [j] = true and turn = j
- flag = true and turn = j
- flag = true and turn = i

2.23 R (A, B, C, D) is a relation. Which of the following does not have a loss less join, dependency preserving BCNF decomposition?

- A \bowtie B, B \bowtie CD
- A \bowtie B, B \bowtie C, C \bowtie D
- AB \bowtie C, C \bowtie AD

- $A \bowtie BCD$

2.24 Which of the following relational calculus expressions is not safe?

- $\{t \mid \exists u \in R_1 (t[A] = u[A]) \wedge \exists s \in R_2 (t[A] = s[A])\}$
- $\{t \mid \exists u \in R_1 (u[A] = "x" \wedge \exists s \in R_2 (t[A] = s[A] \wedge s[A] = u[A]))\}$
- $\{t \mid \exists (t \in R_1)\}$
- $\{t \mid \exists u \in R_1 (t[A] = u[A]) \wedge \exists s \in R_2 (t[A] = s[A])\}$

2.25 Consider a relation `geq` which represents "greater than or equal to", that is, $(x, y) \in \text{geq}$ only if $y \geq x$.

create table `geq`

(`lb` integer not null

`ub` integer not null

primary key `lb`

foreign key (`ub`) references `geq` on delete cascade)

Which of the following is possible if a tuple (x, y) is deleted?

- A tuple (z, w) with $z > y$ is deleted
- A tuple (z, w) with $z > x$ is deleted
- A tuple (z, w) with $w < x$ is deleted
- The deletion of (x, y) is prohibited