

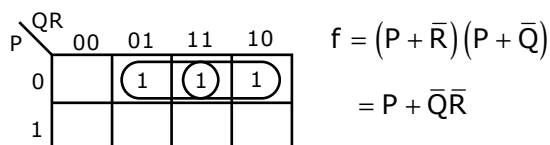
**Q. No. 1 – 25 Carry One Mark Each**

1. The simplified SOP (Sum of Product) form of the Boolean expression  $(P + \bar{Q} + \bar{R}) \cdot (P + \bar{Q} + R) \cdot (P + Q + \bar{R})$  is

- (A)  $(\bar{P}Q + \bar{R})$       (B)  $(P + \bar{Q}\bar{R})$       (C)  $(\bar{P}Q + R)$       (D)  $(PQ + R)$

Answer: - (B)

Exp: -



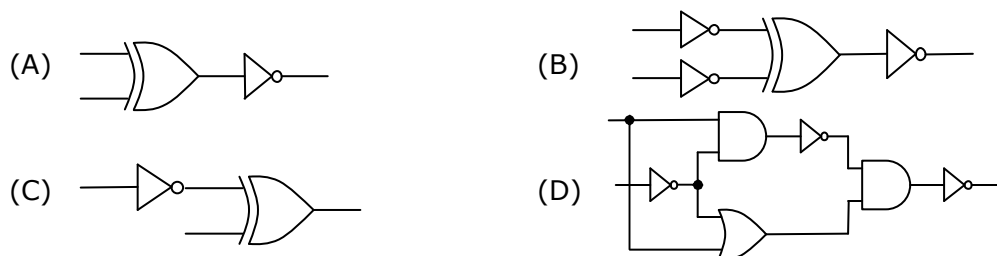
Alternate method

$$(P + \bar{Q} + \bar{R}) \cdot (P + \bar{Q} + R) \cdot (P + Q + \bar{R}) = \overline{\overline{(P + \bar{Q} + \bar{R}) \cdot (P + \bar{Q} + R) \cdot (P + Q + \bar{R})}}$$

$$= \overline{\overline{P}QR + \overline{P}Q\bar{R} + \overline{P}\bar{Q}R} = \overline{\overline{P}Q(R + \bar{R}) + \overline{P}\bar{Q}R} = \overline{\overline{P}Q + \overline{P}\bar{Q}R} = \overline{\overline{P}(Q + \bar{Q}R)}$$

$$= \overline{\overline{P}(Q + R)} = P + \bar{Q}\bar{R}$$

2. Which one of the following circuits is NOT equivalent to a 2-input XNOR (exclusive NOR) gate?



Answer: - (D)

Exp: - All options except option 'D' gives EX-NOR gates

3. The minimum number of D flip-flops needed to design a mod-258 counter is

- (A) 9      (B) 8      (C) 512      (D) 258

Answer: - (A)

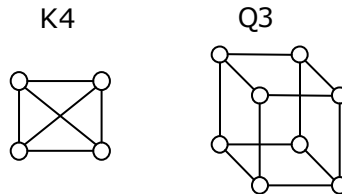
Exp: -  $2^n \geq 258 \Rightarrow n = 9$

4. A thread is usually defined as a 'light weight process' because an operating system (OS) maintains smaller data structures for a thread than for a process. In relation to this, which of the followings is TRUE?

- (A) On per-thread basis, the OS maintains only CPU register state
- (B) The OS does not maintain a separate stack for each thread
- (C) On per-thread basis, the OS does not maintain virtual memory state
- (D) On per thread basis, the OS maintains only scheduling and accounting information

Answer: - (A)

5. K4 and Q3 are graphs with the following structures

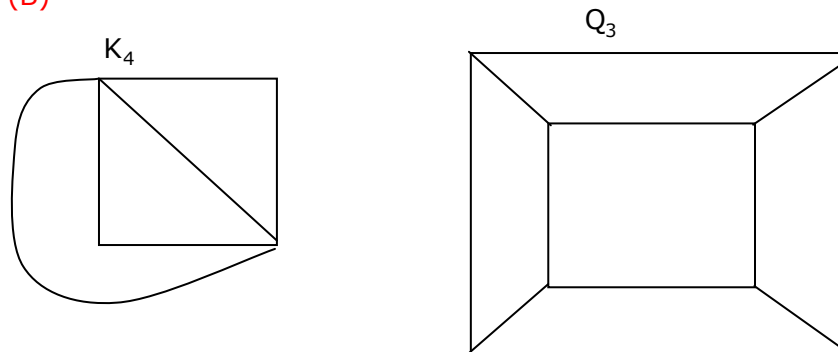


Which one of the following statements is TRUE in relation to these graphs?

- (A) K4 is planar while Q3 is not
- (B) Both K4 and Q3 are planar
- (C) Q3 is planar while K4 is not
- (D) Neither K4 nor Q3 is planar

Answer: - (B)

Exp: -



∴ Both K<sub>4</sub> and Q<sub>3</sub> are planar

6. If the difference between the expectation of the square of random variable ( $E[X^2]$ ) and the square of the expectation of the random variable ( $(E[X])^2$ ) is denoted by R then

- (A)  $R = 0$
- (B)  $R < 0$
- (C)  $R \geq 0$
- (D)  $R > 0$

Answer: - (C)

7. The lexical analysis for a modern computer language such as Java needs the power of which one of the following machine models in a necessary and sufficient sense?

- (A) Finite state automata
- (B) Deterministic pushdown automata
- (C) Non-Deterministic pushdown automata

(D) Turing machine

Answer: - (A)

Exp: - Lexical Analysis is implemented by finite automata

8. Let the page fault service time be 10ms in a computer with average memory access time being 20ns. If one page fault is generated for every  $10^6$  memory accesses, what is the effective access time for the memory?

(A) 21ns                      (B) 30ns                      (C) 23ns                      (D) 35ns

Answer: - (B)

Exp: -  $P$  = page fault rate

EA =  $p \times$  page fault service time

+  $(1 - p) \times$  Memory access time

$$= \frac{1}{10^6} \times 10 \times 10^6 + \left(1 - \frac{1}{10^6}\right) \times 20 \cong 29.9 \text{ ns}$$

9. Consider a hypothetical processor with an instruction of type LW R1, 20(R2), which during execution reads a 32-bit word from memory and stores it in a 32-bit register R1. The effective address of the memory location is obtained by the addition of constant 20 and the contents of register R2. Which of the following best reflects the addressing mode implemented by this instruction for the operand in memory?

(A) Immediate Addressing                      (B) Register Addressing  
(C) Register Indirect Scaled Addressing (D) Base Indexed Addressing

Answer: - (D)

Exp: - Here 20 will act as base and content of  $R_2$  will be index

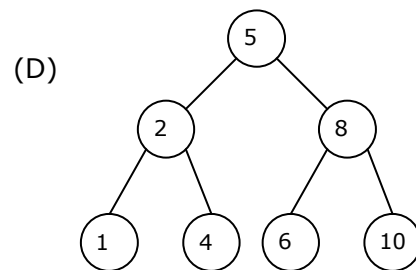
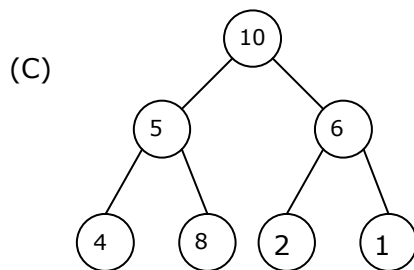
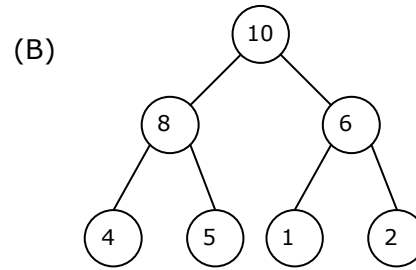
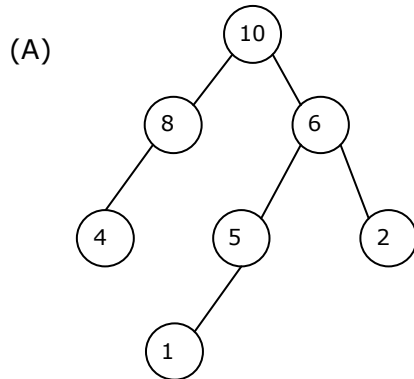
10. What does the following fragment of C-program print?

```
char c[ ] = "GATE2011";  
char *p = c;  
printf("%s", p+p[3]-p[1]);
```

(A) GATE2011                      (B) E2011                      (C) 2011                      (D) 011

Answer: - (C)

11. A max-heap is a heap where the value of each parent is greater than or equal to the value of its children. Which of the following is a max-heap?



Answer: - (B)

Exp: - Heap is a complete binary tree

12. An algorithm to find the length of the longest monotonically increasing sequence of numbers in an array  $A[0 : n - 1]$  is given below.

Let  $L_i$  denote the length of the longest monotonically increasing sequence starting at index  $i$  in the array

Initialize  $L_{n-1} = 1$

For all  $i$  such that  $0 \leq i \leq n - 2$

$$L_i = \begin{cases} 1 + L_{i+1} & \text{if } A[i] < A[i + 1] \\ 1 & \text{Otherwise} \end{cases}$$

Finally the length of the longest monotonically increasing sequence is  $\text{Max}(L_0, L_1, \dots, L_{n-1})$ . Which of the following statements is TRUE?

- (A) The algorithm uses dynamic programming paradigm  
 (B) The algorithm has a linear complexity and uses branch and bound paradigm  
 (C) The algorithm has a non-linear polynomial complexity and uses branch and bound paradigm  
 (D) The algorithm uses divide and conquer paradigm.

Answer: - (A)

13. Let  $P$  be a regular language and  $Q$  be a context free language such that  $Q \subseteq P$ . (For example, let  $P$  be the language represented by the regular expression  $p^*q^*$  and  $Q$  be  $\{p^nq^n \mid n \in \mathbb{N}\}$ ). Then which of the following is ALWAYS regular?

- (A)  $P \cap Q$                       (B)  $P - Q$                       (C)  $\Sigma^* - P$                       (D)  $\Sigma^* - Q$

Answer: - (C)

Exp: -  $\Sigma^* - P$  is the complement of P so it is always regular,

since regular languages are closed under complementation

14. In a compiler, keywords of a language are recognized during  
(A) parsing of the program (B) the code generation  
(C) the lexical analysis of the program (D) dataflow analysis

Answer: - (C)

Exp: - Any identifier is also a token so it is recognized in lexical Analysis

15. A layer-4 firewall (a device that can look at all protocol headers up to the transport layer) CANNOT  
(A) block entire HTTP traffic during 9:00PM and 5:00AM  
(B) block all ICMP traffic  
(C) stop incoming traffic from a specific IP address but allow outgoing traffic to the same IP address  
(D) block TCP traffic from a specific user on a multi-user system during 9:00PM and 5:00AM

Answer: - (A)

Exp: - Since it is a layer 4 firewall it cannot block application layer protocol like HTTP.

16. If two fair coins are flipped and at least one of the outcomes is known to be a head, what is the probability that both outcomes are heads?  
(A) 1/3 (B) 1/4 (C) 1/2 (D) 2/3

Answer: - (A)

Exp: - Sample space = {HH, HT, TH}

$$\text{Required probability} = \frac{1}{3}$$

17. Consider different activities related to email.  
m1: Send an email from a mail client to a mail server  
m2: Download an email from mailbox server to a mail client  
m3: Checking email in a web browser  
Which is the application level protocol used in each activity?  
(A) m1:HTTP m2:SMTP m3:POP (B) m1:SMTP m2:FTP m3:HTTP  
(C) m1: SMTP m2: POP m3: HTTP (D) m1: POP m2: SMTP m3:IMAP

Answer: - (C)

Exp: - Sending an email will be done through user agent and message transfer agent by SMTP, downloading an email from mail box is done through POP, checking email in a web browser is done through HTTP

18. A company needs to develop a strategy for software product development for which it has a choice of two programming languages L1 and L2. The number of lines of code (LOC) developed using L2 is estimated to be twice the LOC developed with L1. the product will have to be maintained for five years. Various parameters for the company are given in the table below.

Parameter	Language L1	Language L2
Man years needed for development	LOC / 10000	LOC / 10000
Development Cost per year	Rs. 10,00,000	Rs. 7,50,000
Maintenance time	5 years	5 years
Cost of maintenance per year	Rs. 1,00,000	Rs. 50,000

Total cost of the project includes cost of development and maintenance. What is the LOC for L1 for which the cost of the project using L1 is equal to the cost of the project using L2?

- (A) 4000                      (B) 5000                      (C) 4333                      (D) 4667

Answer: - (B)

Exp: - LOC  $L_1 = x$   
 $L_2 = 2x$

Total cost of project

$$\frac{x}{10000} \times 1000000 + 5 \times 100000 = \frac{2x}{10000} \times 750000 + 50000 \times 5$$

$$100x + 500000 = 150x + 250000$$

$$\Rightarrow 50x = 500000 - 250000$$

$$\therefore x = \frac{250000}{50} \Rightarrow x = 5000$$

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

- (A)  $t_1 > t_2$   
 (B)  $t_1 = t_2$   
 (C)  $t_1 < t_2$   
 (D) Nothing can be said about the relation between  $t_1$  and  $t_2$

Answer: - (C)

Exp: - Process switching also involves mode changing.

20. A company needs to develop digital signal processing software for one of its newest inventions. The software is expected to have 40000 lines of code. The company needs to determine the effort in person-months needed to develop this software using the basic COCOMO model. The multiplicative factor for this model is given as 2.8 for the software development on embedded systems, while the exponentiation factor is given as 1.20. What is the estimated effort in person-months?

---

(A) 234.25

(B) 932.50

(C) 287.80

(D) 122.40

**Answer: - (A)**

**Exp: -** Effort person per month

$$= \alpha \cdot (\text{kDSI})^B$$

KDSI = Kilo LOC

$$= 2.8 \times (40)^{1.20}$$

$$= 2.8 \times 83.6511$$

$$= 234.22 \text{ person per month}$$

21. Which of the following pairs have DIFFERENT expressive power?

(A) Deterministic finite automata (DFA) and Non-deterministic finite automata (NFA)

(B) Deterministic push down automata (DPDA) and Non-deterministic push down automata (NPDA)

(C) Deterministic single-tape Turing machine and Non-deterministic single tape Turing machine

(D) Single-tape Turing machine and multi-tape Turing machine

**Answer: - (B)**

**Exp: -** NPDA is more powerful than DPDA.

Hence answer is (B)

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

(A) Embed web objects from different sites into the same page

(B) Refresh the page automatically after a specified interval

(C) Automatically redirect to another page upon download

(D) Display the client time as part of the page

**Answer: - (D)**

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

(A) Functional Requirements

(B) Non Functional Requirements

(C) Goals of Implementation

(D) Algorithms for Software Implementation

**Answer: - (D)**

24. A computer handles several interrupt sources of which the following are relevant for this question.

Interrupt from CPU temperature sensor

Interrupt from Mouse

Interrupt from Keyboard

Interrupt from Hard Disk

(A) Interrupt from Hard Disk

(B) Interrupt from Mouse

(C) Interrupt from Keyboard

(D) Interrupt from CPU temp sensor

Answer: - (D)

25. Consider a relational table with a single record for each registered student with the following attributes.

1. Registration\_Number: Unique registration number for each registered student
2. UID: Unique Identity number, unique at the national level for each citizen
3. BankAccount\_Number: Unique account number at the bank. A student can have multiple accounts or joint accounts. This attributes stores the primary account number
4. Name: Name of the Student
5. Hostel\_Room: Room number of the hostel

Which of the following options is INCORRECT?

(A) BankAccount\_Number is a candidate key

(B) Registration\_Number can be a primary key

(C) UID is a candidate key if all students are from the same country

(D) If S is a superkey such that  $S \cap \text{UID}$  is NULL then  $S \cup \text{UID}$  is also a superkey

Answer: - (A)

Exp: - In case two students hold joint account then BankAccount\_Num will not uniquely determine other attributes.

### Q. No. 26 – 51 Carry Two Marks Each

26. Which of the given options provides the increasing order of asymptotic complexity of functions  $f_1, f_2, f_3$  and  $f_4$ ?

$$f_1(n) = 2^n; f_2(n) = n^{3/2}; f_3(n) = n \log_2 n; f_4(n) = n^{\log_2 n}$$

(A)  $f_3, f_2, f_4, f_1$

(B)  $f_3, f_2, f_1, f_4$

(C)  $f_2, f_3, f_1, f_4$

(D)  $f_2, f_3, f_4, f_1$

Answer: - (A)

Let  $n = 1024$

$$f_1(n) = 2^{1024}$$

$$f_2(n) = 2^{15}$$

$$f_3(n) = 10 \times 2^{10}$$

$$f_4(n) = 1024^{10} = 2^{100}$$

$\therefore f_3, f_2, f_4, f_1$  is the required increasing order



27. Four matrices  $M_1$ ,  $M_2$ ,  $M_3$  and  $M_4$  are dimensions  $p \times q$ ,  $q \times r$ ,  $r \times s$  and  $s \times t$  respectively can be multiplied in several ways with different number of total scalar multiplications. For example When multiplied as  $((M_1 \times M_2) \times (M_3 \times M_4))$  the total number of scalar multiplications is  $pqr + rst + prt$ . When multiplied as  $((M_1 \times M_2) \times M_3) \times M_4$ , the total number of scalar multiplications is  $pqr + prs + pst$ .
- If  $p=10$ ,  $q=100$ ,  $r=20$ ,  $s=5$  and  $t=80$ , then the minimum number of scalar multiplications needed is
- (A) 248000            (B) 44000            (C) 19000            (D) 25000

Answer: - (C)

Exp: - Multiply as  $(M_1 \times (M_2 \times M_3)) \times M_4$

The total number of scalar multiplication is

$$= qrs + pqs + pst$$

$$= 10000 + 5000 + 4000 = 19000$$

28. Consider a relational table  $r$  with sufficient number of records, having attributes  $A_1, A_2, \dots, A_n$  and let  $1 \leq p \leq n$ . Two queries  $Q_1$  and  $Q_2$  are given below.

$Q_1: \pi_{A_1 \dots A_n} (\sigma_{A_p=c} (r))$  where  $c$  is a const

$Q_2: \pi_{A_1 \dots A_n} (\sigma_{c_1 \leq A_p \leq c_2} (r))$  where  $c_1$  and  $c_2$  are constants

The database can be configured to do ordered indexing on  $A_p$  or hashing on  $A_p$ . Which of the following statements is TRUE?

- (A) Ordered indexing will always outperform hashing for both queries  
 (B) Hashing will always outperform ordered indexing for both queries  
 (C) Hashing will outperform ordered indexing on  $Q_1$ , but not on  $Q_2$   
 (D) Hashing will outperform ordered indexing on  $Q_2$ , but not on  $Q_1$ .

Answer: - (C)

29. Consider the matrix as given below.

$$\begin{bmatrix} 1 & 2 & 3 \\ 0 & 4 & 7 \\ 0 & 0 & 3 \end{bmatrix}$$

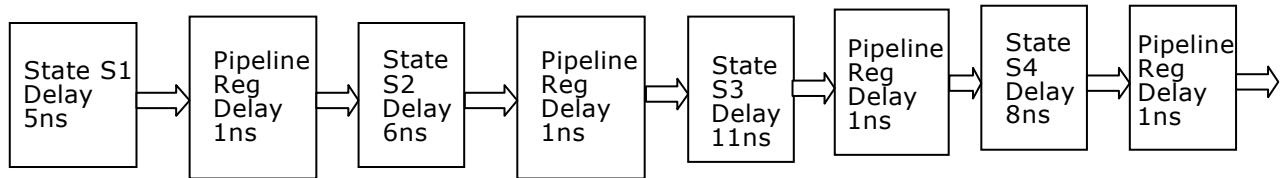
Which one of the following provides the CORRECT values of eigenvalues of the matrix?

- (A) 1,4,3            (B) 3,7,3            (C) 7,3,2            (D) 1,2,3

Answer: - (A)

Exp: - Given matrix is upper triangular matrix and its diagonal elements are its eigen values = 1, 4, 3

30. Consider an instruction pipeline with four stages (S1, S2, S3 and S4) each with combinational circuit only. The pipeline registers are required between each stage and at the end of the last stage. Delays for the stages and for the pipeline registers are as given in the figure.



What is the approximate speed up of the pipeline in steady state under ideal conditions when compared to the corresponding non-pipeline implementation?

- (A) 4.0                      (B) 2.5                      (C) 1.1                      (D) 3.0

Answer: - (B)

Exp: -  $\frac{(5 + 6 + 11 + 8)}{(11 + 1)} = \frac{30}{12} = 2.5$

31. Definition of a language L with alphabet {a} is given as following

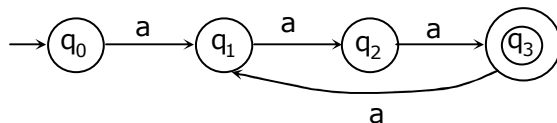
$$L = \{a^{nk} \mid k > 0, \text{ and } n \text{ is a positive integer constant}\}$$

What is the minimum number of states needed in a DFA to recognize L?

- (A) k+1                      (B) n+1                      (C)  $2^{n+1}$                       (D)  $2^{k+1}$

Answer: - (B)

Exp: - Let n = 3 and k=1



(n + 1) states

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

1 Valid bit

1 Modified bit

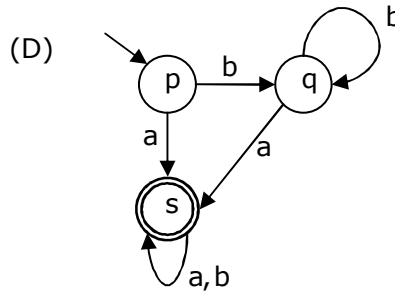
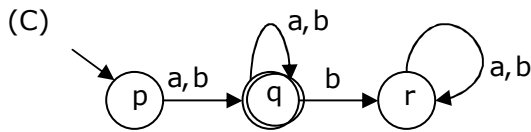
As many bits as the minimum needed to identify the memory block mapped in the cache.

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

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

Answer: - (D)





Answer: - (A)

Exp: - Options B and C will accept the string b

Option - D will accept the string "bba"

Both are invalid strings.

So the minimized DFA is option A

35. The following is comment written for a C function

```
/* This function computes the roots of a quadratic equation
a.x^2+b.x+c=0. The function stores two real roots
in *root1 and *root2 and returns the status of validity of
roots. It handles four different kinds of cases.
```

- (i) When coefficient a is zero irrespective of discriminant
- (ii) When discriminant is positive
- (iii) When discriminant is zero
- (iv) When discriminant is negative

Only in cases (ii) and (iii), the stored roots are valid.

Otherwise 0 is stored in the roots. the function returns 0 when the roots are valid and -1 otherwise.

The function also ensures root1 >= root2.

```
int get_QuadRoots(float a, float b, float c, float *root1, float *root2);
*/
```

A software test engineer is assigned the job of doing black box testing. He comes up with the following test cases, many of which are redundant.

Test Case	Input set			Expected Output set		
	a	b	C	Root1	Root2	Return Value
T1	0.0	0.0	7.0	0.0	0.0	-1
T2	0.0	1.0	3.0	0.0	0.0	-1
T3	1.0	2.0	1.0	-1.0	-1.0	0
T4	4.0	-12.0	9.0	1.5	1.5	0
T5	1.0	-2.0	-3.0	3.0	-1.0	0
T6	1.0	1.0	4.0	0.0	0.0	-1

Which one of the following options provide the set of non-redundant tests using equivalence class partitioning approach from input perspective for black box testing?

- (A) T1,T2,T3,T6
- (B) T1,T3,T4,T5
- (C) T2,T4,T5,T6
- (D) T2,T3,T4,T5

Answer: - (C)

Exp: -  $T_1$  and  $T_2$  checking same condition  $a = 0$  hence, any one of  $T_1$  and  $T_2$  is redundant.

$T_3, T_4$ : in both case discriminant  $(D)=b^2 - 4ac = 0$ . Hence any one of it is redundant.

$T_5$  :  $D > 0$

$T_6$  :  $D < 0$

36. Database table by name Loan\_Records is given below.

Borrower	Bank_Manager	Loan_Amount
Ramesh	Sunderajan	10000.00
Suresh	Ramgopal	5000.00
Mahesh	Sunderajan	7000.00

What is the output of the following SQL query?

```
SELECT count(*)
FROM(
(SELECT Borrower, Bank_Manager FROM Loan_Records) AS S
NATURAL JOIN
(SELECT Bank_Manager, Loan_Amount FROM Loan_Records) AS T
);
(A) 3          (B) 9          (C) 5          (D) 6
```

Answer: - (C)

Exp: - S

Borrower	Bank_Manager
Ramesh	Sunderajan
Suresh	Ramgopal
Mahesh	Sunderjan

Bank_Manager	Loan_Amount
Sunderajan	10000.00
Ramgopal	5000.00
Sunderjan	7000.00

After executing the given query, the output would be

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





























