1. Which of the following is true?

(a) $\sqrt{3}+\sqrt{7}=\sqrt{10}$

(b) $\sqrt{3}+\sqrt{7}\leq\sqrt{10}$

(c) $\sqrt{3}+\sqrt{7}<\sqrt{10}$

(d) $\sqrt{3}+\sqrt{7}>\sqrt{10}$

2. What is the sum to infinity of the series,

$3+6x^2+9x^4+12x^6+\dots$ given $|x|<1$?

(a) $\dfrac{3}{(1+x^2)}$

(b) $\dfrac{3}{(1+x^2)^2}$

(c) $\dfrac{3}{(1-x^2)^2}$

(d) $\dfrac{3}{(1-x^2)}$

3. $\displaystyle\lim_{x\to0}\dfrac{\sqrt{1+x}-\sqrt{1-x}}{x}$ is given by

(a) 0

(b) -1

(c) 1

(d) $\dfrac{1}{2}$

4. If $(G,\cdot)$ is a group such that $(ab)^{-1}=a^{-1}b^{-1}$, $\forall\,a,b\in G$, then G is a/an

(a) Commutative semi group

(b) Abelian group

(c) Non-abelian group

(d) None of these

5. A given connected graph G is a Euler Graph if and only if all vertices of G are of

(a) Same degree

(b) Even degree

(c) Odd degree

(d) Different degree

6. Maximum number of edges in a n − node undirected graph without self-loops is

(a) n^2

(b) $\dfrac{n(n-1)}{2}$

(c) $n-1$

(d) $\dfrac{n(n+1)}{2}$

7. The minimum number of NAND gates required to implement the Boolean function $A + A\overline{B} + A\overline{B}C$ is equal to

   (a) 0 (Zero)
   (b) 1
   (c) 4
   (d) 7

8. The minimum Boolean expression for the following circuit is
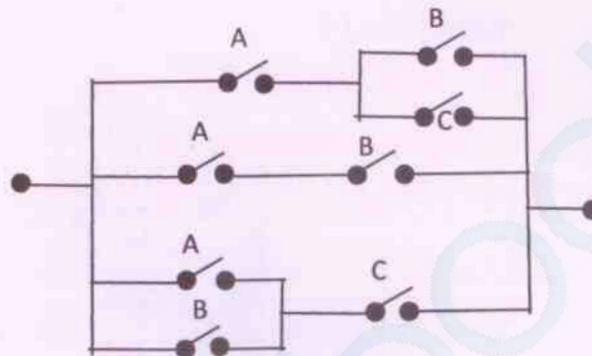
   (a) $AB + AC + BC$
   (b) $A + BC$
   (c) $A + B$
   (d) $A + B + C$

9. For a binary half-subtractor having two inputs A and B, the correct set of logical expression for the outputs D (= A minus B) and X (= borrow) are

   (a) $D = AB + \overline{A}B$, $X = \overline{A}B$
   (b) $D = \overline{A}B + A\overline{B}$, $X = A\overline{B}$
   (c) $D = \overline{A}B + A\overline{B}$, $X = \overline{A}B$
   (d) $D = AB + \overline{A}B$, $X = A\overline{B}$

10. Consider the following gate network
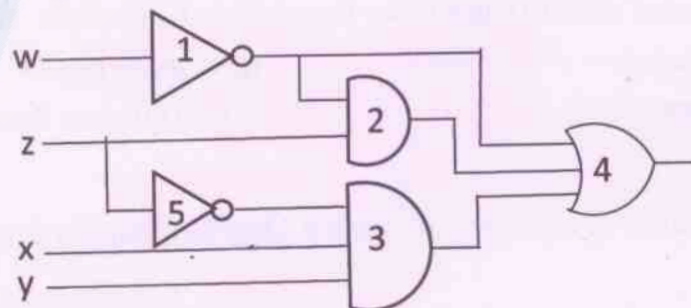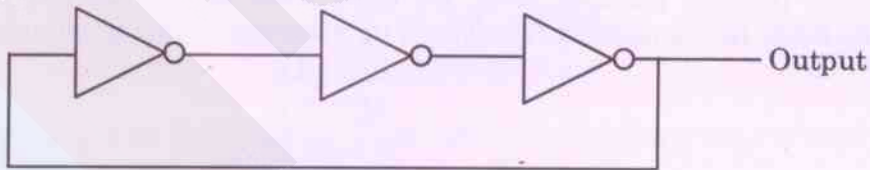
   Which one of the following gates is redundant?

   (a) Gate No. 1
   (b) Gate No. 2
   (c) Gate No. 3
   (d) Gate No. 4

11. The dynamic hazard problem occurs in

    (a) Combinational circuit alone

    (b) Sequential Circuit only

    (c) Both (a) and (b)

    (d) None of the above

12. The logic circuit given below converts a binary code y_1, y_2, y_3 into
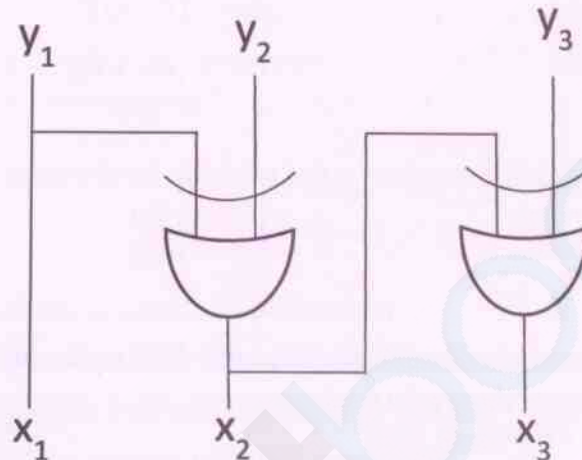
    (a) Excess-3 code

    (b) Gray code

    (c) BCD code

    (d) Hamming Code

13. The circuit shown in the figure below is

    (a) An oscillating circuit and its output is square wave

    (b) The one whose output remains stable in '1' state

    (c) The one having output remains stable in '0' state

    (d) Has a single pulse of three times propagation delay

14. If $12A7C_{16} = X_8$, then the value of X is

    (a) 224174

    (b) 425174

    (c) 6173

    (d) 225174

15. The Excess-3 Code is also called
   (a) Cyclic Redundancy Code
   (b) Weighted Code
   (c) Self-Complementing Code
   (d) Algebraic Code

16. The simplified Sum of Product form of the following Boolean expression
   $$(P+\overline{Q}+\overline{R})(P+Q+R)(P+Q+\overline{R})$$
   (a) $(\overline{P}Q+R)$
   (b) $(P+Q\overline{R})$
   (c) $(P\overline{Q}+R)$
   (d) $(PQ+R)$

17. Which of the following binary number is the same as its 2's complement?
   (a) 1010
   (b) 0101
   (c) 1000
   (d) 1001

18. The functional difference between SR flip-flop and JK flip-flop is that
   (a) JK flip-flop is faster than SR flip-flop
   (b) JK flip-flop has a feedback path
   (c) JK flip-flop accepts both inputs 1
   (d) None of the above

19. Consider a non-pipelined processor with a clock rate of 2.5 GHz and average cycles per instruction of four. The same processor is upgraded to a pipelined processor with five stages; but due to the internal pipeline delay, the clock speed is reduced to 2 GHz. Assume that there are no stalls in the pipeline. The speed up achieved in this pipelined processor is
   (a) 3.2
   (b) 3.0
   (c) 2.2
   (d) 2.0

20. What is the output of this C code?
```
#include <stdio.h>
void main()
{
    int k = 5;
    int *p = &k;
    int **m = &p;
    printf("%d %d %d\n", k, *p, **m);
}
```
   (a) 5 5 5
   (b) 5 5 junk
   (c) 5 junk junk
   (d) Compile time error

21. Consider a disk pack with 16 surfaces, 128 tracks per surface and 256 sectors per track. 512 bytes of data are stored in a bit serial fashion in a sector. The capacity of the disk pack and the number of bits required to specify a particular sector in the disk respectively

(a)   256 MB, 19 bits   (b)   256 MB, 28 bits

(c)   512 MB, 20 bits   (d)   64 GB, 28 bits

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

(a)   21.4 ns   (b)   29.9 ns

(c)   23.5 ns   (d)   35.1 ns

23. Register renaming is done in pipelined processors

(a)   As an alternative to register allocation at compile time

(b)   For efficient access to function parameters and local variables

(c)   To eliminate certain kind of hazards

(d)   As part of address translations

24. In which class of Flynn's taxonomy, Von Neumann architecture belongs to?

(a)   SISD   (b)   SIMD

(c)   MIMD   (d)   MISD

25. What will be output of following program? Assume that you are running this program in little-endian processor.

```
#include<stdio.h>
int main( ) {
short a = 320;
char *ptr;
    ptr = (char *)&a;
    printf("%d",*ptr);
return 0;
}
```

(a)   1   (b)   320

(c)   64   (d)   Compilation Error

26. · Consider the following segment of C code

```
int j, n;

j = 1;

while (j<= n)
        j = j*2;
```

The number of comparisons made in the execution of the loop for any n > 0 is

(a) $\lfloor \log_2 n \rfloor * n$

(b) n

(c) $\lfloor \log_2 n \rfloor$

(d) $\lfloor \log_2 n \rfloor + 1$

27. The following postfix expression with single digit operands is evaluated using a stack

8 2 3 ^ / 2 3 * + 5 1 * −

(Note that ^ is the exponential operator)

The top two elements of the stack after the first * operator is evaluated are

(a) 6, 1

(b) 5, 7

(c) 3, 2

(d) 1, 5

28. Average number of comparison required for a successful search for sequential search on 'n' items is

(a) $\dfrac{n}{2}$

(b) $\dfrac{(n-1)}{2}$

(c) $\dfrac{(n+1)}{2}$

(d) None of the above

29. A Hash Function f is defined as f(key) = key mod 7. With linear probing, while inserting the keys 37, 38, 72, 48, 98, 11, 56 into a table indexed from 0, in which location the key 11 will be stored (count table Index 0 as 0th location)?

(a) 3

(b) 4

(c) 5

(d) 6

30. A complete binary tree with n non-leaf nodes contains

   (a) $\log_2 n$ nodes

   (b) $n+1$ nodes

   (c) $2n$ nodes

   (d) $2n+1$ nodes

31. Algorithm design technique used in quick sort algorithm is

   (a)   Dynamic programming

   (b)   Backtracking

   (c)   Divide and Conquer

   (d)   Greedy Method

32. An FSM (Finite State Machine) can be considered to be a Turning Machine of finite tape length

   (a)   Without rewinding capability and unidirectional tape movement

   (b)   Rewinding capability and unidirectional tape movement

   (c)   Without rewinding capability and bidirectional tape movement

   (d)   Rewinding capability and bidirectional tape movement

33. Let $L = \{w \in (0+1)^* \mid w$ has even number of 1s$\}$, i.e. L is the set of all bit strings with even number of 1s. Which one of the regular expression below represents L?

   (a)   (0*10*1)*

   (b)   0*(10*10*)*

   (c)   0*(10*1*)*0*

   (d)   0*1(10*1)*10*

34. Consider the following recurrence

$$T(n) = 2T(\sqrt{n}) + 1$$

$$T(1) = 1$$

   Which of the following is true?

   (a) $T(n) = O(\log \log n)$

   (b) $T(n) = O(\log n)$

   (c) $T(n) = O(\sqrt{n})$

   (d) $T(n) = O(n)$

35. Consider the following statements about the context-free grammar :

$$G = \{S \rightarrow SS, S \rightarrow ab, S \rightarrow ba, S \rightarrow {}^\wedge\}$$

I.   G is ambiguous

II.   G produces all strings with equal number of a's and b's

III.   G can be accepted by a deterministic PDA

Which combinations below expresses all the true statements about G?

(a)   I only

(b)   I and III only

(c)   II and III only

(d)   I, II and III

36. If L and $\overline{L}$ are recursively enumerable, then L is

(a)   Regular

(b)   Context-free

(c)   Context-sensitive

(d)   Recursive

37. $S \rightarrow aSa \mid bSb \mid a \mid b$

The language generated by the above grammar over the alphabets $\{a, b\}$ is the set of

(a)   All palindromes

(b)   All odd length palindromes

(c)   Strings that begin and end with same symbol

(d)   All even length palindromes

38. What is the highest type number that can be assigned to this following grammar :

$$S \rightarrow Aa, A \rightarrow Ba, B \rightarrow abc$$

(a)   Type 0

(b)   Type 1

(c)   Type 2

(d)   Type 3

39. Access time of the symbol table will be logarithmic, if it is implemented by

(a)   Linear list

(b)   Search Tree

(c)   Hash Table

(d)   Self-organization list

40. Recursive descent parsing is an example of
    - (a) Top-down parsers
    - (b) Bottom-up parsers
    - (c) Predictive parsers
    - (d) None of these

41. A top-down parser generates
    - (a) Rightmost derivation
    - (b) Rightmost derivation in reverse
    - (c) Leftmost derivation
    - (d) Leftmost derivation in reverse

42. Relative mode of addressing is most relevant to writing
    - (a) Co-routines
    - (b) Position-independent code
    - (c) Sharable code
    - (d) Interrupt Handlers

43. A simple two-pass assembler does which of the following in the first pass?
    - (a) Checks to see if the instructions are legal in the current assembly mode
    - (b) It allocates space for the literals
    - (c) It builds the symbol table for the symbols and their values
    - (d) All of these

44. Peephole optimization is a form of
    - (a) Loop optimization
    - (b) Local optimization
    - (c) Constant folding
    - (d) Data flow analysis

45. At a particular time of computation, the value of a counting semaphore is 7. Then 20 P operation and x V operations were completed on this semaphore. If the final value of the semaphore is 5, x will be
    - (a) 18
    - (b) 22
    - (c) 15
    - (d) 13

46. With single resource, deadlock occurs
    - (a) If there are more than two processor competing for that resource
    - (b) If there are only two processes competing for that resource
    - (c) If there is a single process competing for that resource
    - (d) None of these

47. A system has 3 processes sharing 4 resources. If each process needs a maximum of 2 units, then

   (a)   Deadlock can never occur   (b)   Deadlock may occur

   (c)   Deadlock has to occur   (d)   None of these

48. Determine the number of page faults when references to pages occur in the following order : 1, 2, 4, 5, 2, 1, 2, 4. Assume that the main memory can accommodate 3 pages and the main memory already has the pages 1 and 2, with page one having brought earlier than page 2. (LRU page replacement algorithm is used)

   (a)   3   (b)   5

   (c)   4   (d)   None of these

49. Working Set (t,k) at an instant of time t is

   (a)   The set of k future references that the Operating System (OS) will make

   (b)   The set of future references that the OS will make in next t unit of time

   (c)   The set of k references with high frequency

   (d)   The k set of pages that have been referenced in the last t time units

50. A CPU generates 32-bit virtual addresses. The page size is 4 KB. The processor has a translation look-aside buffer (TLB) which can hold a total of 128 page table entries and is 4-way set associative. The minimum size of the TLB tag is

   (a)   11 bits   (b)   13 bits

   (c)   15 bits   (d)   20 bits

51. The real-time operating system, which of the following is the most suitable scheduling scheme?

   (a)   Round robin   (b)   First come first serve

   (c)   Pre-emptive   (d)   Random scheduling

52. In which one of the following page replacement policies, Balady's anomaly may occur?

    (a) FIFO

    (b) Optimal

    (c) LRU

    (d) MRU

53. Consider Join of a relation R with a relation S. If R has m tuples and S has n tuples, then maximum and minimum sizes of the Join respectively are

    (a) $m + n$ and 0

    (b) mn and 0

    (c) $m + n$ and $|m - n|$

    (d) mn and $m + n$

54. Let $R(a, b, c)$ and $S(d, e, f)$ be two relations in which d is the foreign key of S that refers to the primary key of R

    Consider the following four operations in R and S

    I. Insert into R

    II. Insert into S

    III. Deletion from R

    IV. Deletion from S

    Which of the following can cause violation of the relational integrity constraint above?

    (a) Both I and IV

    (b) Both II and III

    (c) All of these

    (d) None of these

55. The relation **book** (<u>title</u>, <u>price</u>) contains the titles and prices of different books. Assuming that no two books have the same price, what does the following SQL query list?

[select title from book as B where (select count(*) from book as T where T.price > B.price) < 5]

   (a)   Titles of the four most expensive books

   (b)   Title of the fifth most inexpensive book

   (c)   Title of the fifth most expensive book

   (d)   Titles of the five most expensive books

56. Goals for the design of the logical schema include

   (a)   Avoiding data inconsistency

   (b)   Being able to construct queries easily

   (c)   Being able to access data efficiently

   (d)   All of these

57. Given the relations

   employee (name, salary, deptno) and

   department (deptno, deptname, address)

   Which of the following queries cannot be expressed using the basic relational algebra operations $(U, -, x, \pi, \sigma, p)$?

   (a)   Department address of every employee

   (b)   Employees whose name is the same as their department name

   (c)   The sum of all employees' salaries

   (d)   All employees of a given department

58. Trigger is

(a) Statement that enables to start any DBMS

(b) Statement that is executed by the user when debugging an application program

(c) The condition that the system tests for the validity of the database user

(d) Statement that is executed automatically by the system as a side effect of a modification to the database

59. The order of a leaf node in a B+ tree is the maximum number of (value, data record pointer) pairs it can hold. Given that the block size is 1K bytes, data record pointer is 7 bytes long, the value field is 9 bytes long and a block pointer is 6 bytes long, what is the order of the leaf node?

(a)   63   (b)   64

(c)   67   (d)   68

60. A clustering index is defined on the fields which are of type ——————.

(a)   Non-key and ordering   (b)   Non-key and non-ordering

(c)   Key and ordering   (d)   Key and non-ordering

61. The Extent to which the software can continue to operate correctly despite the introduction of invalid inputs is called as

(a)   Reliability   (b)   Robustness

(c)   Fault tolerance   (d)   Portability

62. Which one of the following is a functional requirement?

(a)   Maintainability   (b)   Portability

(c)   Robustness   (d)   None of the mentioned

63. Configuration management is not concerned with

(a) Controlling changes to the source code

(b) Choice of hardware configuration for an application

(c) Controlling documentation changes

(d) Maintaining versions of software

64. 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 man 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) 10,000

(b) 5,000

(c) 7,500

(d) 75,000

65. A company needs to develop digital signal processing software for one of its newest inventions. The software is expected to have 20000 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 2.2 for the software development on embedded systems, while the exponentiation factor is given as 1.5. What is the estimated effort in person-months?

(a) 196.77

(b) 206.56

(c) 199.56

(d) 210.68

66. In the spiral model of software development, the primary determinant in selecting activities in each iteration is

(a) Iteration size

(b) Cost

(c) Adopted process such as Rational Unified Process or Extreme Programming

(d) Risk

67. Bit stuffing refers to

(a) Inserting a '0' in user stream to differentiate it with a flag

(b) Inserting a '0' in flag stream to avoid ambiguity

(c) Appending a nibble to the flag sequence

(d) Appending a nibble to the user data stream

68. Dynamic routing protocol enable routers to:

(a) Dynamically discover and maintain routes

(b) Distribute routing updates to other routers

(c) Reach agreement with other routers about the network topology

(d) All of the above

69. In Ethernet CSMA/CD, the special bit sequence is transmitted by media access management to handle collision is called

(a) Preamble (b) Postamble

(c) Jam (d) None of these

70. Which network protocol Allows hosts to dynamically get a unique IP number on each bootup?

(a) DHCP (b) BOOTP

(c) RARP (d) ARP

71. In a token ring network, the transmission speed is 10^7 bps and the propagation speed is $200\,m/\mu s$. Then 1 bit delay in this network is equivalent to

   (a)   500 m of cable

   (b)   200 m of cable

   (c)   20 m of cable

   (d)   50 m of cable

72. The address of a class B host is to be split into subnets with a 6-bit subnet number. What is the maximum number of subnets and the maximum number of hosts in each subnet?

   (a)   62 subnets and 262142 hosts

   (b)   64 subnets and 262142 hosts

   (c)   62 subnets and 1022 hosts

   (d)   64 subnets and 1024 hosts

73. The message 11001001 is to be transmitted using the CRC polynomial $x^3 + 1$ to protect it from errors. The message that should be transmitted is

   (a)   11001001000

   (b)   11001001011

   (c)   11001010

   (d)   110010010011

74. What is the maximum size of data that application layer can pass on to the TCP layer below?

   (a)   Any size

   (b)   (2^{16} bytes – the size of TCP header)

   (c) 2^{16} bytes

   (d)   1500 bytes

75. Frames of 1000 bits are sent over a 10^6 bps duplex link between two hosts. The propagation time is 25 ms. Frames are to be transmitted into this link to maximally pack them in transit (within the link).

   What is the minimum number of bits (i) that will be required to represent the sequence numbers distinctly? Assume that no time gap needs to be given between transmission of two frames.

   (a) $i = 2$

   (b) $i = 3$

   (c) $i = 4$

   (d) $i = 5$

76. Which of the following is TRUE only for XML, but not for HTML?

    (a) It is derived from SGML

    (b) It describes content and layout

    (c) It allows user defined tags

    (d) It is restricted only to be used with web browsers

77. Consider a system with 2 level caches. Access times of Level 1 cache, Level 2 cache and main memory are 1 ns, 10 ns, and 500 ns, respectively. The hit rates of Level 1 and Level 2 caches are 0.8 and 0.9, respectively. What is the average access time of the system ignoring the search time within the cache?

    (a) 13.0 ns   (b) 12.8 ns

    (c) 12.6 ns   (d) 12.4 ns

78. If a class C is derived from class B, which is derived from class A, all through public inheritance, then a class C member function can access

    (a) Only protected and public data of C and B

    (b) Only protected and public data of C

    (c) All data of C and private data of A and B

    (d) Public and protected data of A and B and all data of C

79. Which one of the following is correct about the statements given below?

    I.   All function calls are resolved at compile-time in C language.

    II. All function calls are resolved at compile-time in C++.

    (a) Only II is correct   (b) Both I and II are correct

    (c) Only I is correct   (d) Both I and II are incorrect

80. When a DNS server accepts and uses incorrect information from a host that has no authority giving that information, then it is called

    (a) DNS lookup   (b) DNS hijacking

    (c) DNS spoofing   (d) None of the mentioned

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