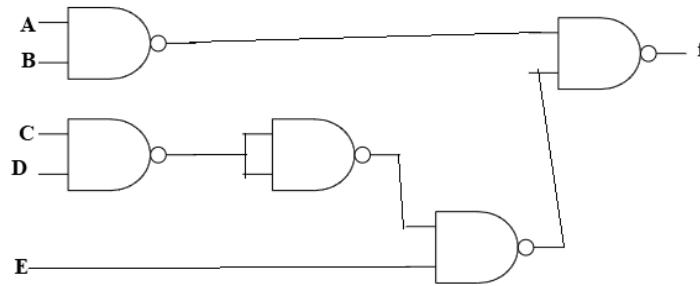


# Numerical Type Questions and Answer

1. The minimum number of two inputs NAND gates required for realizing the expression  $f=AB+CDE$  is

**Solution:**



5 NAND gates are required.

2. Consider a 8-bit serial out shift register which is used to shift the bits left or right. Total number of clock pulse(s) required for the shift register is.....

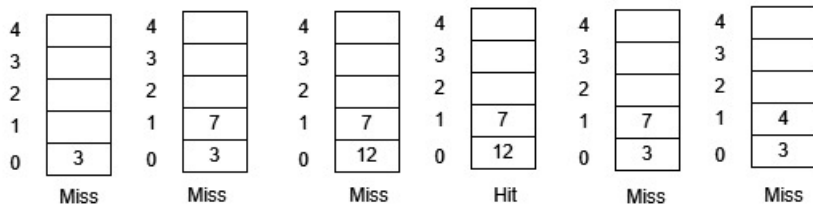
**Solution:** 8 clock pulses are required to input data serially, but only 7 clock pulses are required to output data, because after 7<sup>th</sup> clock pulse, data present in 7 register is directly available. So, for total operation, we required 8+7=15 clock pulses.

3. Consider a small 2-way set associative cache memory, consisting of five blocks. For choosing the block to be replaced, use the Least Recently Used (LRU) scheme.

The number of cache miss for the sequence of block addresses 3, 7, 12, 7, 3, 4 is .....

**Solution:** Sequence 3, 7, 12, 7, 3, 4

Apply the LRU as follows:



Total number of cache misses=5

4. Consider a direct mapped cache of size 64 KB with block size 64 bytes. The CPU generates 64-bit addresses. The number of tags (in bits) are

**Solution:** Size of cache=64k

=64 x 2<sup>10</sup> byte

=2<sup>6</sup> x 2<sup>10</sup> byte

$=2^{16}$  byte = 16 bits  
 Number of tags =  $64 - 16 = 48$  bits.

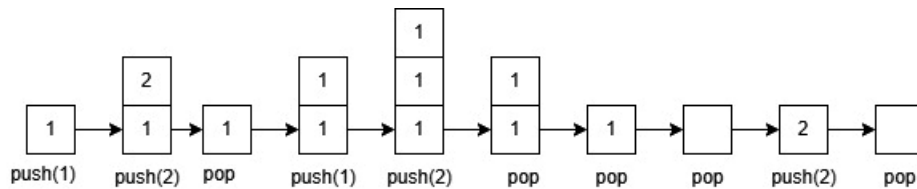
5. ---- chips are needed when RAM is 64 k x 1 and provide memory capacity of 512 k bytes?

**Solution:** Basic RAM = 64 k x 1  
 Design RAM = 512 k x 8  
 Number of RAM =  $(512 \text{ k} \times 8) / (64 \text{ k} \times 1)$   
 $= (2^{19} \times 2^3) / (2^{16} \times 2^0)$   
 $= 2^3 \times 2^3 = 64$

It requires 8 parallel lines and in each parallel line 8 serial RAM chips are required.

6. If the sequence of operations Push (1), Push (2), Pop, Push (1), Push (2), Pop, Pop, Pop, Push (2), Pop are performed on a stack, the sequence of popped out values are

**Solution:**



So, the sequence of popped out value are 2 2 1 1 2

7. Let C be a two-dimensional array declared as follows:

C: array [1.....15] [1.....20] of integer; Assuming that each integer takes two bytes memory location. the array is stored in column-major order and the first element of the array is stored at location 200. the address of the element C [10] [20] is-

**Solution:** In column-major order,  
 Address of element,  $C[i][j] = BA + W((i-L_1)) + M(j-L_2)$   
 Where, Base address,  $BA = 200$        $L_2 = 1$   
 Integer size,  $W = 2$        $i = 10$   
 $M = 15$        $j = 20$   
 $L_1 = 1$   
 So,  $C[10][20] = 200 + 2((10-1) + 15(20-1))$   
 $= 200 + 2(9 + 15 \times 19)$   
 $= 200 + 2 \times 294$   
 $= 200 + 588$   
 $= 788$

8. A machine needs a minimum of 100 sec to sort 1000 names by quick sort. The minimum time ( in sec) needed to sort 100 names will be approximately –

**Solution:** For best case in quick short  
 $T(n) \leq C * n \log_2 (n)$

For  $n = 1000$   
 $T(1000) = 100 \text{ sec}$   
 $100 \leq C * 100 \log_2 (1000)$   
 $100 \leq C * 1000 * 9.96578$   
 $C = 0.010034$

Now, for  $n = 100$

$$\begin{aligned}
 T(100) &= 0.010034 \times 100 \log_2(100) \\
 &= 0.010034 \times 100 \times 6.6438 \\
 &= 6.66638 \\
 &= 6.7 \text{ sec}
 \end{aligned}$$

**9. Consider the following program**

```

main()
{
    inc():
    inc():
    inc():
    inc():
}
inc()
{
    static int x ;
    Printf ("%d", ++x);
}

```

---is the output of above code.

**Solution:** By default x will be initialized to 0. Since its storage class is static .it preserves its exit value (and forbids reinitialisation on re-entry)  
So, 1234 will be printed.

**10. The value of a for the following expression is-**

```

int z =5,a=2;
a += (z<15)? 10:15;

```

**Solution:** Initially z=5,a=2

The expression is : a +=(z<15)? 10:15

a=a + (z < 15)? 10:15

In the part 2,

```

z<15? 10:15
5<15 ?10:15

```

= 10

Now, a=2+10=12.

**11.The output of the following C program is-**

```

void main ()
{
    int a=4, *p;
    p=&a
    *p=12
    Printf ("%d",a);
}

```

**Solution:** Initially, a=4, Pointer p contains the address of a and also \*p denotes or pointed to value of a. \*p =12,so value of a is also changed from 4 to 12.

Hence, the output of the given program is 12.

---

**12. We have a file of 105 pages and assume that 5 buffer pages are available to sort that file. The cost of sorting using 4-way merge sort is ---units.**

**Solution:** In the first pass, we can create  $[105/5]=21$  sorted sub files each 5 page long. In the second pass by 4-way merging, one can create  $[21/4]=6$  sorted sub files, each 20 page long (except last).

Again, applying 4-way merging ,we can create  $[6/4]=2$  sorted sub files.

These two can be merged to get the final sorted file.

We require a total of 4-passes. Total cost will be  $2*105*4=840$  units.

**13. Fold the key 123456789 into as hash table of ten spaces (0 through 10).the key 123456789 is inserted into the hash table at address—**

**Solution:** We are given  $x = 123456789$  and the table size  $m=11$

Since, we can break  $x$  into three parts any way we want to, we will break up it evenly.

Thus,  $P_1=123, P_2=456, P_3=789$

$$f(x)=(P_1+P_2+P_3)\text{mod } m$$

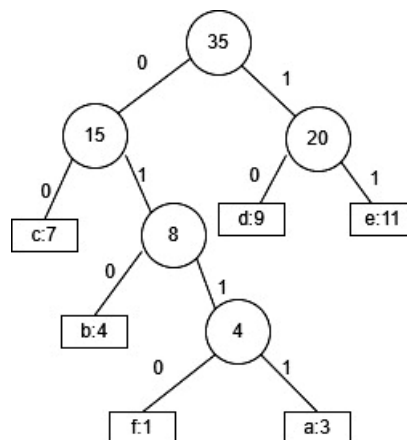
$$f(123456789)=(123+456+789)\text{mod } 11=1368 \text{ mod } 11=4$$

so,123456789 is inserted into the hash table at address 4.

**14. In the symbols and frequencies, the occurrence given below, the number of bits(s) required for the message *abdee*, if Huffman coding is used to compress the data is.....**

| Symbol | Frequency |
|--------|-----------|
| a      | 3         |
| b      | 4         |
| c      | 7         |
| d      | 9         |
| e      | 11        |
| f      | 1         |

**Solution:**



$$a = 0111, b=010, c=00, d=10, e=11, f=0110$$

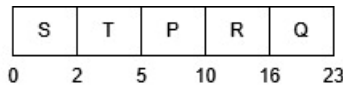
abdee = 4 + 3 + 2 + 2 + 2 = 13 bits.

15. Consider the following table of arrival time and burst time for five processes P, Q, R, S, T.

| Process | Arrival Time | Burst Time |
|---------|--------------|------------|
| P       | 0 ms         | 5          |
| Q       | 2 ms         | 7          |
| R       | 4 ms         | 6          |
| S       | 6 ms         | 2          |
| T       | 3 ms         | 3          |

The preemptive shortest job first scheduling algorithm is used. Scheduling is carried out only at arrival or completion of processes. The average waiting time (in ms) for the five processes is....

**Solution:**



Waiting time: P=5, Q= 16, R= 10, S= 0, T=2

Average Waiting Time = (5+16+10+0+2)/5 = 6.6 ms

16. Which one of the following regular expressions represents the set of all binary strings with an odd number of 1's?

- a)  $((0 + 1)^* 1(0 + 1)^* 1)^* 10^*$
- b)  $(0^* 10^* 10^*)^* 0^* 1$
- c)  $10^*(0^* 10^* 10^*)^*$
- d)  $(0^* 10^* 10^*)^* 10^*$

**Solution:**

Try to find counter example to show expression

- a) is incorrect because it force to end "10".
- b) is incorrect because it forces the string to start with "1" and hence cannot generate a string like "01", which has odd number of ones.
- c) is same as  $(0 + 1)^* 10^*$  which will generate some wrong string like "110" which has even number of 1's. It is a superset and hence not correct.
- d) is same as  $(0^* 1 0^* 1 0^*)^* 1 0^*$  which is most suitable answer for the given problem according to given options.

17. If there are m input lines and n output lines for a decoder that is used to uniquely address a byte addressable 1 KB RAM, then the minimum value of m + n is

**Solution:**

We need 10 input lines and 1024 outputs lines to map 1 KB RAM.

For this we need  $10 \times 2^{10}$  decoder.

Here, M = 10 and N =  $2^{10} = 1024$

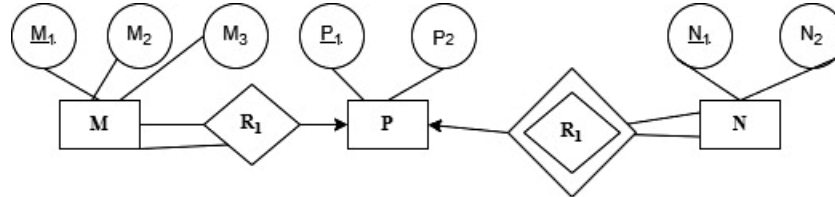
Therefore, M + N = 1034

18. Number of cross point needed for 10 lines in a cross point switch which is full duplex in nature and there are no self-connection is.....

**Solution:**

As all lines are full duplex and there are no self-connections, only the cross points above the diagonal are needed. So, the cross point needed is =  $n(n-1)/2$

19. Consider the following E-R diagram.



The minimum number of table(s) needed to represent M, N, P, R<sub>1</sub>, R<sub>2</sub> is (are)....

**Solution:** The minimum number of tables needed for the given ER diagram to represent M, N, P, R<sub>1</sub>, R<sub>2</sub> are 2. First table have the relation between M and P and second table have the relation between P and N.

20. What will be the output:

```

SELECT A.id FROM A
WHERE A.age > All (SELECT B.age FROM B
WHERE B.name = "Arun")
    
```

**Solution:**

The meaning of "All" is the A. Age should be greater than all the values returned by the subquery. There is no entry with name "arun" in table B. So, the subquery will return Null. If a subquery returns Null, then the condition becomes true for all rows of A (see this for details). So, all rows of table A are selected.

21. Consider the table employee(empId, name, department, salary) and the two queries Q<sub>1</sub>, Q<sub>2</sub> below. Assuming that department 5 has more than one employee, and we want to find the employees who get higher salary than anyone in the department 5, which is true?

Q<sub>1</sub>: Select e.empId From employee e  
where not exists (Select \* From employee s where s.department = "5" and s. salary >= e.salary)

Q<sub>2</sub>: Select e.empId From employee e  
where e.salary > Any  
(Select distinct salary from employee s where  
s.department = "5")

**Solution:**

As per given

employee(empId, name, department, salary)

This suggests that an employees is to be denoted using the employee id, name, department, salary  
Query 1 It selects an employee but does not compute the result as after the 'where not exists', it does not have statement to produce the result.

Query 2 It selects an employee who get higher salary than anyone in the department 5.

Therefore the query 2 is correct

22. Disk request come to a disk driver cylinder 10, 22, 20, 2, 40, 6 and 38 in that order at a time when the disk drive is reading from cylinder 20. The seek time is 6 ms per cylinder. The total seek time, if disk arm scheduling algo is FCFS If the scheduling algo is closest cylinder next, then total seek time will be

**Solution:**

Total Disk move = (20-10) + (21-10) +(22-2)+(40-2)+(40-6)+(38-6)

$$= 10 + 12 + 20 + 38 + 34 + 32$$

Total Seek time =  $146 \times 6 = 876$  ms.

$$\begin{aligned} \text{Total disk move} &= (22 - 20) + (22 - 2) + (40 - 2) \\ &= 2 + 20 + 38 = 60 \end{aligned}$$

Total seek time =  $60 \times 6 = 360$

**23. Suppose that the following processes arrive for execution at the times indicated. Each process will run the listed amount of time. In answering the questions, use non-preemptive scheduling and base all decisions on the information you have at the time the decision must be made.**

Process Arrival Time Burst Time

P<sub>1</sub> 0.08

P<sub>2</sub> 0.44

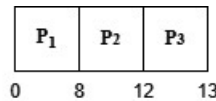
P<sub>3</sub> 1.01

- a) What is the average waiting time for these processes with the FCFS scheduling algorithm?
- b) What is the average waiting time for these processes with the SJF scheduling algorithm?

**Solution: (a)**

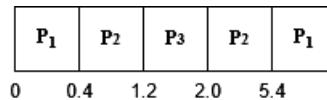
| Process        | Arrival | Burst time |
|----------------|---------|------------|
| P <sub>1</sub> | 0.0     | 8          |
| P <sub>2</sub> | 0.4     | 4          |
| P <sub>3</sub> | 1.0     | 2          |

In FCFS the processes will execute as



$$\begin{aligned} \text{Average waiting time} &= (0 + (8 - 0.4) + (12 - 1)) / 3 \\ &= (7.6 + 11) / 3 = 6.2 \text{ ms} \end{aligned}$$

b) In SJF processes will execute as



$$\begin{aligned} \text{Average waiting time} &= ((5.4 - 0.4) + (2.0 - 0.6 - 0.4) + (1 - 1)) / 3 \\ &= (5 + 1 + 0) / 3 = 6 / 3 = 2 \end{aligned}$$

**24. The second kind of question is that you have to convert the value given in base x to the value is base y. For example, what will be the value of (43)<sub>5</sub>, in base-3 number system?**

**Solution:** First convert the (43)<sub>5</sub>, into decimal number and then convert the result in base-3 number as explained below.

$$\begin{aligned} (43)_5 &= 4 \times 5^1 + 3 \times 5^0 \\ &= (23)_{10} \end{aligned}$$

Then convert (23)<sub>10</sub> into base 3 as below

|            | Remainder | Coefficient |
|------------|-----------|-------------|
| $23/3 = 7$ | 2         | 2           |
| $7/3 = 2$  | 1         | 1           |
| $2/3 = 0$  | 2         | 2           |

Thus,  $(43)_5 = (212)_3$

**25. Convert the decimal number  $(148)_{10}$  to BCD**

**Solution:** 4-bit binary representation of 1 is 0001, 4 will be represented in binary as 0100 and 8 will be represented as 1000. Thus  $(148)_{10}$  will be represented in BCD as 0001 0100 1000.

**26. BCD Addition  $27 + 19$ .**

BCD representation of 27 is 0010 0111

BCD representation of 19 is 0001 1001

Addition

$$\begin{array}{r}
 0010\ 0111 \\
 0001\ 1001 \\
 \hline
 0011\ 1000 \\
 \\
 0011\ 0000 \\
 \quad 1\ 0110 \\
 \hline
 0100\ 0110 \\
 \quad \quad 4\quad 6
 \end{array}$$

**27. Suppose DATA array contains 1000000 elements, Using the binary search algorithm, one requires only about n comparisons to find the location of an item in the DATA array, then n is....**

**Solution:**  $\text{ceil}(\log_2(10^6))=20$

**28. The number of nodes in a complete binary tree of level 5 is...**

**Solution:** The binary tree is the complete binary tree  $2^{n+1} - 1$ . Here  $n=5$  so the answer is= 63

**29. The number of binary trees with 3 nodes which when traversed in post-order gives the sequence A, B, C is...**

**Solution:** 5

**30. The weight of the minimal spanning tree for the graph in problem 234 is....**

**Solution:** Minimal spanning tree for the graph in problem 234 is the 21.

**31. A complete binary tree of level 5 has .....number of nodes**

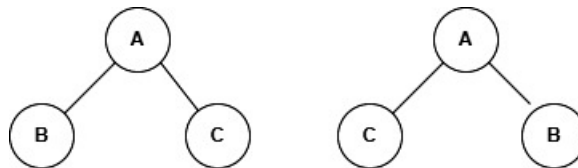
**Solution:** 63

**32. The smallest number of key that will force a B-tree of order 3 to have a height 3 is...**

**Solution:** 7

**33. Number of possible ordered trees with 3 nodes A, B, C is\_**

**Solution:** The tree may be of depth 2 or 1. If 2, we have 6 possible trees. Because one of the three nodes A, B, C may be the root. The next level may be one of the remaining two. So, 6. If the depth is 2, the root may be one of the 3 nodes A, B, C corresponding to a root say A, two trees are possible as this.



**34. Minimum number of.....comparison operations required to find the smallest and largest element in an unsorted array of 10 elements.**

**Solution:** Compare all the elements pair wise, total 5 comparisons. We got two set has all greater elements and second set has all smaller elements. Find the largest in the first in 5 comparisons and smallest in the second set with 5 comparisons. Total 15 comparisons.

**35. Consider the following relation schema pertaining to a students database:**

student (roll no, name, address)

enroll (roll no, course no, course name)

Where the primary keys are shown underlined. The number of tuples in the student and enroll tables are 120 and 8 respectively.....are the maximum and minimum number of tuples that can be present in (student \* enroll), where \* denotes natural join?

**Solution:** The minimum and maximum number of tuples in given natural join operation is minimum of these  $\min(120,8) = 8$

**36. Fiber optics have maximum segment of .....m Solution: 2000m**

**37. Twisted pair have maximum segment of .....m Solution: 100 m**

**38. Thick coax have maximum segment of .....m Solution: 500 m**

**39. ....character per second (7 bits and 1 parity) can be transmitted over a 2400 line in case of synchronous transfer (1 stop and 1 start bit)?**

**Solution:** For synchronous transfer, start bit and stop bit are ignored.

So, for synchronous transfer =  $2400/8 = 300$

**40. A client uses TCP to send data to server. The data are 32 bytes. Calculated efficiency of this transmission at the TCP level. Assume the padding field is 10 bytes.**

**Solution:** Data field – 32 bytes.

TCP header size-  $(20 + 8 + 10) = 38$  bytes

Efficiency =  $32 / (32 + 38) = 32 / 70 = 0.46$

**41. Period of a signal is 100 ms. Then the frequency of this signal in kilohertz is.....**

**Solution:**

Period =  $T = 100$  ms

Frequency  $f = 1/T$

$f = 1/100 = 1/(100 \times 10^{-3}) = 10 \text{ s}^{-1} = 10$  Hertz

$f = 10 \times 10^{-3}$  kilohertz =  $10^{-2}$  kilohertz

**42. If there are 32 segments, each of size 1 K byte, then the logical address should have ----- bits.**

**Solution:**

To specify a particular segment, 5 bits are required (since  $2^5 = 32$ )

Having selected a page, to select a particular byte one needs 10 bits (since  $2^{10} = 1$  K byte)

So, totally  $5 + 10 = 15$  bits are needed.

**43. Merge sort time complexity calculation:  $T(n) = 2 * T(n/2) + n/2$**

$$T(n) = 2 * T(n/2) + n/2$$

$$T(n) = 2 * (2 * T(n/4) + n/4) + n/2 = 4 * T(n/4) + 2 * (n/4) + n/2 = 4 * T(n/4) + 2 * (n/2)$$

$$T(n) = 4 * (2 * T(n/8) + n/8) + 2 * (n/2) = 8 * T(n/8) + (n/2) + 2 * (n/2) = 8 * T(n/8) + 3 * (n/2)$$

.....

$$T(n) = 2^k * T(n / 2^k) + k * (n/2), \quad 2^k = n \implies k = \log(n)$$

$$T(n) = \log(n) * T(1) + \log(n) * (n/2)$$

$$T(n) = \log n + n * \log(n)/2$$

$$\text{Time complexity } O(n \log n)$$

44. Write code in C/C++ or any other language to find the maximum between N numbers, where N varies from 10, 100, 1000, and 10000.

**Solution:**

We know that,

- ✓ For N = 10: you may get 0.5 ms time,
- ✓ For N = 10,000: you may get 0.2 ms time.
- ✓ Also, you will get different timings on different machines. Even if you will not get the same timings on the same machine for the same code, the reason behind that is the current network load.

So, we can say that the **actual time required to execute code is machine-dependent** (whether you are using Pentium 1 or Pentium 5) and also it considers network load if your machine is in LAN/WAN.

45. Suppose we have a machine of following specifications:

- ✓ Single processor
- ✓ 32 bit
- ✓ Sequential execution
- ✓ 1 unit time for arithmetic and logical operations
- ✓ 1 unit time for assignment and return statements

**Find the Sum of 2 numbers on the above machine?**

**Solution:**

See the following C programming

```
Sum(a, b)
{
    return a + b;
}
```

The above code will take 2 units of time(constant):

- ✓ one for arithmetic operations and
- ✓ one for return. (as per the above conventions).

Therefore total cost to perform sum operation ( $T_{sum}$ ) = 1 + 1 = 2

**Time Complexity =  $O(2)$  =  $O(1)$** , since 2 is constant.

46. Find the sum of all elements of a matrix

For this one, the complexity is a polynomial equation (quadratic equation for a square matrix)

- ✓ Matrix of size  $n*n \Rightarrow T_{sum} = a.n^2 + b.n + c$
- ✓ Since  $T_{sum}$  is in order of  $n^2$ , therefore **Time Complexity =  $O(n^2)$**
- ✓

47. Consider following employee- salary relation:

| Employee- Salary |      |        |            |
|------------------|------|--------|------------|
| Emp. Code        | Name | Salary | Department |
| E0001            | Ram  | 10000  | CSE        |
| E0002            | Sam  | 7000   | IT         |
| E0003            | Jodu | 8000   | CSE        |
| E0004            | Modu | 5000   | IT         |

$G_{avg}(\text{salary})(\text{employee-salary})$ ----- is the average salary of employees through aggregate function.

**Solution:** The given aggregation function then

$$\begin{aligned}\text{Average salary} &= 10000 + 7000 + 8000 + 5000 \\ &= 30000/4 = 7500.\end{aligned}$$

**48. Consider the following statement when you subnet the IP block 201.222.5.0/24 into 20 subnets. Then what is the Network ID of first subnet, IP address of second host of first subnet?**

**Solution:**

For 20 subnets we borrow 5 bits from host ID part.

I subnet will be = 201.222.5.00000000 (1<sup>st</sup> net)

II<sup>nd</sup> host of I<sup>st</sup> subnet is

$$\begin{aligned}201.222.5.0000\ 0000 \\ \quad \quad \quad \quad \quad \quad 001 \\ \quad \quad \quad \quad \quad \quad 010\ \text{II}^{\text{nd}}\ \text{host}.\end{aligned}$$

**49. The minimum number of inter change needed to convert the array 89, 19, 40, 17, 12, 10, 2, 5, 7, 11, 6, 9, 70 into a heap with maximum element at the root is.....**

**Solution:**

Interchange 1 : 10 and 70

Interchange 2 : 40 and 70

Answer is 2.

**50. The C declaration**

Int b[100];

Reserves-----successive memory locations, each large enough to contain single integer.

**Solution:**

100 successive memories is needed.

---