Ques 1

Analysis of time complexity of any list in insertion sort.

for best case ~~sort~~ list should be in ascending order as we know Algorithm of Insertion sort.

```
for( int x=1;  x<n; x++)
  {
     temp= arr[x]
    for (int y=x-1; y>=0 ; y--)
     {
        if (temp < arr[y])
          {
            temp[y+1] = temp[y];
            temp[y] = temp;
          }
        else
          break;
     }
  }
```

consider List is {7, 9, 11, 13, 16}

Loop-1 →

temp = 9

Loop 2 → (9 < 7) false

else break;

means at x=1 Loop-2 has been called 1 time

Similarly

(ii) for x=2

temp = 11

Loop 2 [y=1] ✓ y>0 true

i/s (11 < arr[1]) than break

false

means at x=2 Loop 2 has been called once again -

So we can say - [In Ascending order

Loop-1	Loop-2	No. of call
x=1	y=0	1
x=2	y=1	1
x=3	y=2	1
x=4	y=3	1
x=5	y=4	1
x=n-1	y=n-2	1
	Total loop call	n-1

Time complexity = $O(n-1) \approx O(n)$ Ans

Qus=>2 ~~Merge Sort~~:-

✳ Bubble sort:-

Algorithm:-

```
for(int a=0; a<n-1; a++)
{
  for(int b=0; b<n-1; a++)
  {
    if(a[b]>a[b+1])
    {
      temp = a[b];
      a[b] = a[b+1];
      a[b+1] = temp;
    }
  }
}
```

Time Complexity :-

$T(n) = O(n-1) \times O(n-1)$

$= [O(n-1)]^2 \approx O(n^2)$

Loop-1

Loop-2 operates $(n-1)$ times

Loop-2

Loop-2 operates $(n-1)$ tims

means that Loop-1 operates $(n-1)$

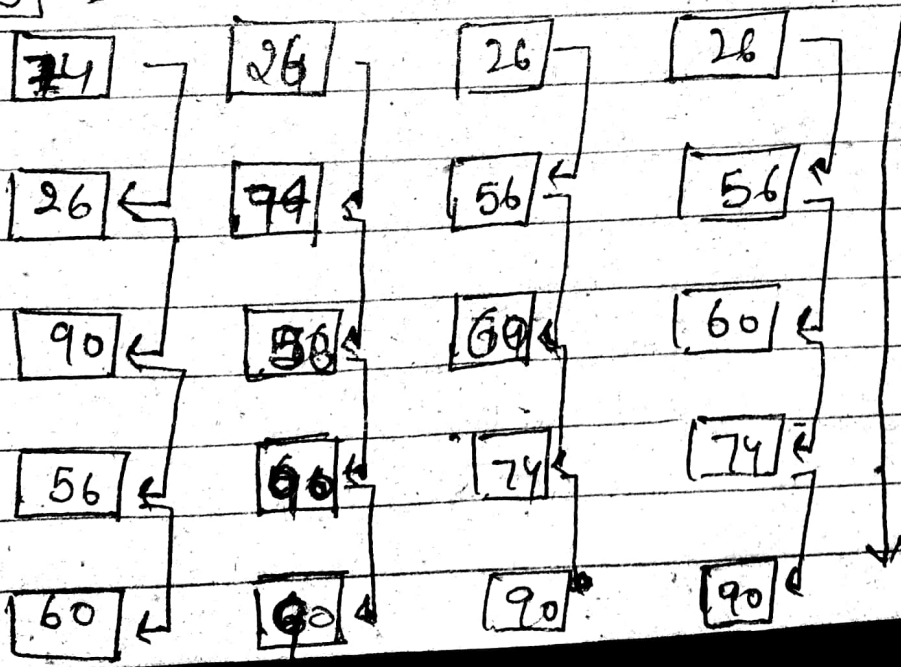
—— Loop-2 —— $(n-1)$

Net $T(n) = O(n-1)^2$

$\approx O(n^2)$

For $n=5$ → $(n-1)$

$\Rightarrow$



$(n-1) \times (n-1) = O(n-1)^2$

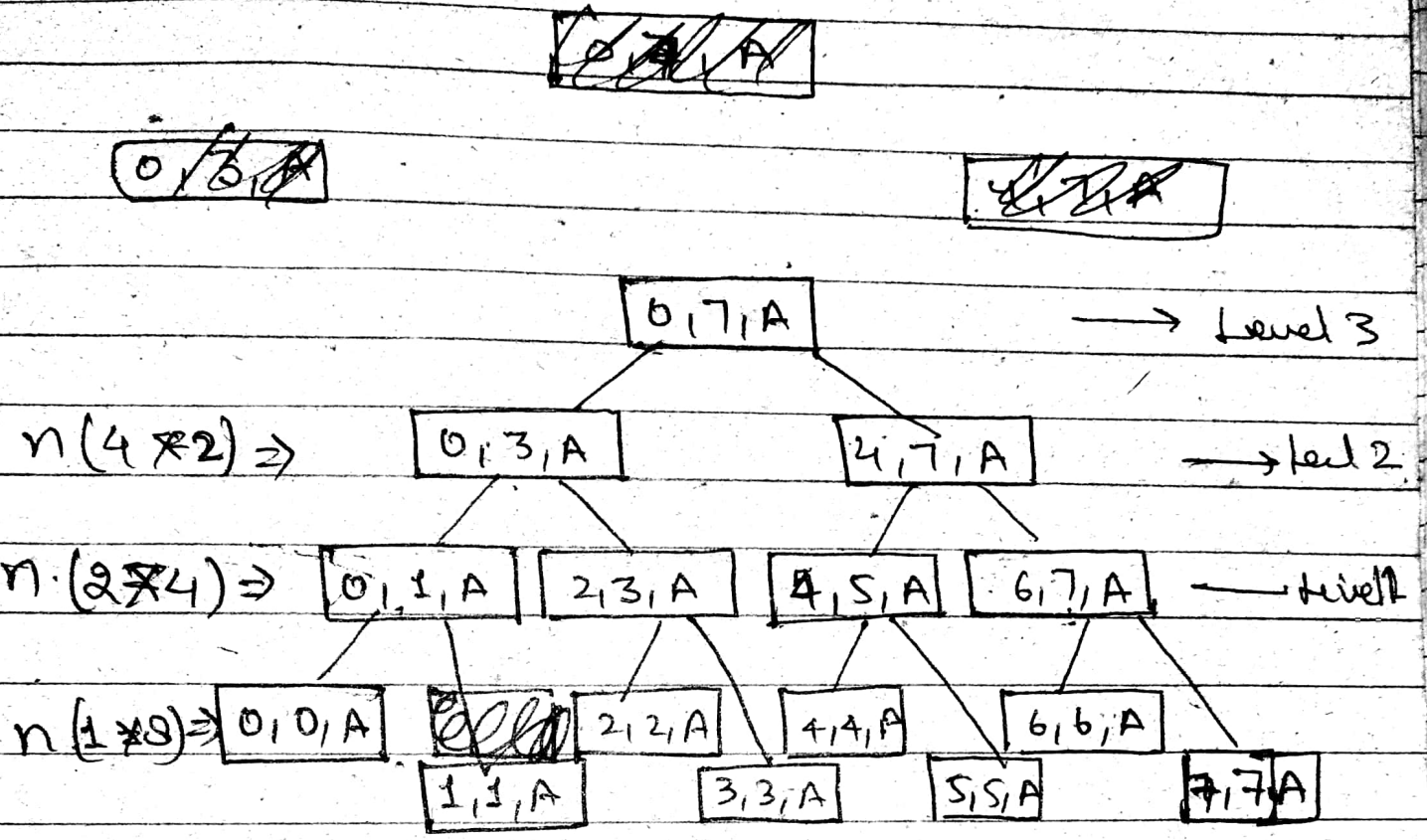
Space Complexity:- O(1) = Constant

Merge sort Algorithm:-

```
void merge_sort(int l, int r, int *a)
{
  if (l<r)
  {
    int m = (l+r)/2;
    mergesort(l, m, a);
    mergesort(m+1, r, a);
    merge(l, m, r, a);
  }
}

void merge(int l, int m, int r  int *p)
{
  int n1 = m-l+1;
  int n2 = r-m;
# array[n1]; stores initial data
# array2[n2]; stores final part of data
  than p will store in array1 &
  array2 to sort by sorting
  with O(n)
```

Lets consider 8 element



Number of Level(n) = $\log_2(n) = \log_2(8) = 3$

Time Complexity [T(n)] → n log n

Merge sort space Complexity = O(n)

* Insertion sort Algorithms:-

```
For (int a=1 ; a<n ; a++)
{
    For (int b=a-1; b>=0; b++)
    {
```

```
if( array[b] > array[b+1])
  {
   temp = array[b];
   array[b] = array[b+1];
   array[b+1] = temp;
  }
 else
  break;
 }
```

time complexity at worst case = $O(n^2)$
best case = $O(n)$

Space complexity = $O(1)$

* Quick Sort:-

Pivot declaration important
Pivot may be any variable from its original array.

it is used to by part array into two array which are in which first sub array contains all values less than pivot &

other sub array will contain all values greater than pivot

```
partition ( l, m, array)   // l=0 ; m=n-1 initially
{
    int start = l
    int end = m
    pivot = a[l]
    while ( start < end )
    {
        while (a[start] <= pivot) && (start <= m)
        {
            start++ ;
        }
        while ( a[end] > pivot) && (end >= l)
        {
            end-- ;
        }
        if ( start < end)
        {
            swaping (array[start], array[end])
        }
    }
    swaping (array[l], array[end])
    return end;
}
```