Aim: Generate a large number of elements randomly and sort all the elements in ascending order using Quick Sort. Analyze the time complexity for best, average and worst case.

```c
#include <stdio.h>
#include <stdlib.h>
#include <sys/time.h>

void swap(int* a, int* b){
    int t = *a;
    *a = *b;
    *b = t;
}

int partition (int arr[], int low, int high) {
    int pivot = arr[high];
    int i = (low - 1);

    for (int j = low; j <= high- 1; j++) {
        if (arr[j] < pivot) {
            i++;
            swap(&arr[i], &arr[j]);
        }
    }
    swap(&arr[i + 1], &arr[high]);
    return (i + 1);
}

void quickSort(int arr[], int low, int high) {
    if (low < high) {
        int pi = partition(arr, low, high);

        quickSort(arr, low, pi - 1);
        quickSort(arr, pi + 1, high);
    }
}

void shuffle(int *array, size_t n){
    if (n > 1) {
        size_t i;
        for (i = 0; i < n - 1; i++) {
```

```
            size_t j = i + rand() / (RAND_MAX / (n - i) + 1);
            int t = array[j];
            array[j] = array[i];
            array[i] = t;
          }
      }
}

void main(){
    int n,i;
    int *array;
    int t1,t2;
    float t3,t4;
    int tt1,tt2;
    struct timeval tv;
    struct timezone tz;

    printf("\nHow many values You want to enter:");
    scanf("%d",&n);

    array = (int*)malloc(n*sizeof(int));

    for(i=0 ; i < n ;i++){
        //array[i]=i+1;          //For Best Case
        array[i]=n-i;            //For Worst Case
    }
    //shuffle(array,n);          //For Average Case


    gettimeofday(&tv,&tz);
    tt1 = tv.tv_sec;
    t1 = tv.tv_usec;

    quickSort(array,0,n);

    gettimeofday(&tv,&tz);
    tt2 = tv.tv_sec;
    t2 = tv.tv_usec;

    tt1 = tt1%100;
    t3 = (float)t1*(0.000001);
    t3 = t3 + (float)tt1;
    tt2 = tt2%100;
    t4 = (float)t2*(0.000001);
    t4 = t4 + (float)tt2;
```

```
    printf("\nStart : %d.%d",tt1,t1);
    printf("\nEnd   : %d.%d",tt2,t2);

    if(t4>t3)
        printf("\nDifferenc1 : %f",t4-t3);
    else
        printf("\nDifferenc2 :  %f",t3-t4);

    free(array);
}
```

Time Analysis :

Table :

Total Elements	Best Case	Average Case	Worst Case
5000	0.087929	0.000999	0.070976
10000	0.354797	0.001019	0.263824
15000	0.818532	0.002995	0.569679
25000	2.229725	0.004997	1.540117

Graph :