**Question 1**: Design and Analysis of the algorithms

1. **Algorithm** TwoColor(A,n)  
   Input: Array A of n balls with 2 color  
   OutPut: Array A with all the balls sorted accouring to their color.  
   n🡨A.lengh  
   **if n=0 || n=1**  
    return A  
   p🡨A[0]   
   i🡨 1  
   j🡨 n   
   **while i!=j**  
    **if A[i]!=A[j]**  
    **if p=[j]**  
    SWAP(A[i],A[j])  
    i++  
    j--  
    j++  
   return A  
     
   🡪 This Sorting Algorithm is O(n)
2. **Algorithm** 4ColorAnd3Color(A,n)  
   ***Input***: Array A of n balls with 3 or more Different Colors  
   ***Output***: Array A sorted according to their color  
   n🡨 A.length  
   **if n=0 || n=1**  
    return A  
   p🡨A[0]  
   i🡨 1  
   j🡨 n  
   **while i!=n**  
    **if A[i]!=A[j]**  
    **if p = A[j]**  
    SWAP(A[i],A[j])  
    i++  
    j--  
    **if i>=j**  
    p=A[i]  
    j=n  
    i++  
     
   **return A**

**Question 2:**

1. **A= {1, 2, 3, 4, 5, 6, 7, 8, 9}  
   3(8)/4 = 6  
   pivot = A[6] = 7   
   L= {1,2,3,4,5,6}** size which is equal to 6   
   🡪 So we can say this is Bad Call.
2. **A={8, 7, 6, 5, 4, 3, 2, 1, 9}  
   3(8)/4 = 6  
   pivot = A[6]=2  
   G={3,4,5,6,7,8,9}** size which is 7 Greater than 6   
   🡪 so we can determine this is A Bad Call.
3. **A={9, 1, 8, 2, 7, 3, 6, 4, 5}  
   3(8)/4= 6  
   pivot = A[6] = 6  
   G={7,8,9}  
   L={1,2,3,4,5}  
   E={6}  
   🡪**so we can Conclude All G,L and E are less than 6 So it’s a Good Call.
4. **A** = **{5, 1, 4, 2, 3, 9, 7, 6, 8}  
   3(8)/4= 6  
   pivot = A[6] = 7  
   L= {1,2,3,4,5,6}** size which is equal to 6   
   🡪 So we can say this is Bad Call.

**Question 3:**

**N.B🡪 p=pivot**

1. **A=** **{1, 2, 3, 4, 5, 6, 7, 8, 9} k = 5  
   p= 3(8)/4=6 =>7**

**E= {7}  
L={1,2,3,4,5,6}** size is bigger than k so we have our number in here.  
 p=3(5)/4=3 => 4  
E= {4}  
G={5,6} again pic a number for pivot  
 p= 3(1)/4=1=>5  
 E={5}=K=5  
 🡪 we found the number 5th smallest is 5.

1. **A= {8, 7, 6, 5, 4, 3, 2, 1, 9} k = 3  
   p=3(8)/4= 6 => 2  
   E= {2}  
   L= {1}** Size is 1 so definitely our number is in the G Array. **G= {9,3,4,5,6,7,8}** p = 3(6)/4 = 4 => 6  
    E={6}  
    L={3,4,5}  
    p= 3(2)/4 = 1 => 3  
    E={3} = k = 3  
    🡪 so we got the 3th smallest number is 3.