Question1

a) My Algorithm is
    a. Set two indexes i and j
    b. Place i at the first item of the array
    c. Place j at the last item of the array
    d. So long as i less than or equal to j do the following:
        i. Move i so that i is pointing to a red toy
        ii. Move j so that j is pointing to a blue toy
        iii. Then swap toys by i and j
        iv. Move i one step
        v. Move j one step
    e. After the crossover, end the loop

    My Algorithm is in place. The time complexity is O(n)

b) My Algorithm is
    a. Set two indexes i, j
    b. Place i at the first item of the array
    c. Place j at the last item of the array
    d. Divide toys with colors, green and red would be put at the left end of the array, blue would be put at the right end of the array.
    e. So long as i less than or equal to j do the following:
        i. Move i so that i is pointing to a blue toy
        ii. Move j so that j is pointing to a non-blue toy
        iii. Then swap toys by i and j
        iv. Move i one step
        v. Move j one step
    f. After the crossover, end the loop

g. Now you divided array into two, L , R
h. Now recursively call L and recursively R.

c) Algorithm for 4 colors is same as 3 colors, pick two colors in left end, the other two colors in right end.

Question 2:

a. {1, 2, 3, 4, 5, 6, 7, 8, 9}
   i. Pick 9 as pivot
   ii. Divide to {1-8},{9}
   iii. Bad self call
   iv. Pick 5 as pivot
   v. Divide to {1,2,3,4},{5},{6,7,8,9}
   vi. Good self call

b. {8, 7, 6, 5, 4, 3, 2, 1, 9}
   i. Pick 9 as pivot
   ii. Divide to {8-1},{9}
   iii. Bad self call
   iv. Pick 5 as pivot
   v. {1,2,3,4},{5},{6,7,8,9}
   vi. Good self call

c. {9, 1, 8, 2, 7, 3, 6, 4, 5}
   i. Pick 5 as pivot
   ii. Divide to {4,1,2,3},{5},{7,8,6,9}
   iii. Good self call
   iv. Pick 9 as pivot

v. {5,1,8,2,7,3,6,4},{9}
vi. Bad self call

d. {5, 1, 4, 2, 3, 9, 7, 6, 8}
i. Pick 5 as pivot
ii. Divide to {1,4,2,3},{5},{9,7,6,8}
iii. Good self call
iv. Pick 1 as pivot
v. {5,8,4,2,3,9,7,8},{1}
vi. Bad self call

Question 3:

a. {1, 2, 3, 4, 5, 6, 7, 8, 9} k = 5
a. {1,2,3,4,9,6,7,8}, {5}
b. {1,2,3,4},{5},{6,7,8, 9}
c. Good self call

b. {8, 7, 6, 5, 4, 3, 2, 1, 9} k = 3
a. {8,7,6,5,4,9,2,1},{3}
b. {1,2},{3},{5,4,9,7,8,6}
c. Bad self call

c. {9, 1, 8, 2, 7, 3, 6, 4, 5} k = 8
a. {9,1,5,2,7,3,6,4},{8}
b. {4,1,5,2,7,3,6},{8},{9}
c. Bad self call

d. {5, 1, 4, 2, 3, 9, 7, 6, 8} k = 5
a. {8,1,4,2,3,9,7,6},{5}
b. {3,1,4,2},{5},{9,7,6,8}
c. Good self call