1. Consider an array containing the following 40 integers: (10 points)

   5 2 4 4 0 1 6 7 3 1 1 0 5 1 5 4 4 5 7 0 6 1 0 7 5 2 7 6 5 3 7 0 5 5 7 1 1 2 6 5

   Apply counting sort to sort this array and show all the steps of your work.

2. Consider an array containing the following hexadecimal numbers: (10 points)

   4EC1EEA9

   520B6E78

   1E90D74E

   52DB6E42

   5F05EF13

   74284442

   794E8117

   55526E42

   Consider you are using a version of RadixSort that sorts on one byte at a time (two hexadecimal digits at a time). Under the stated circumstances, show all the steps when you apply radix sort on this array.

3. (a) Construct a Huffman tree (variable-length encoding) for the following: (3 points)

Symbol	A	B	C	D	E
Frequency	40	10	20	15	15

(b) Encode ABACABAD using the tree you generated for (a). [1 point]

(c) Decode 100010111001010 using the tree you generated for (a). [1 point]

(d) What compression gain (percent of improvement) do we get by using Huffman encoding (variable-length encoding) instead of a fixed-length encoding scheme. Draw the tree for the fixed-length encoding. (2+3=5 points)

4. Consider the following binary tree.
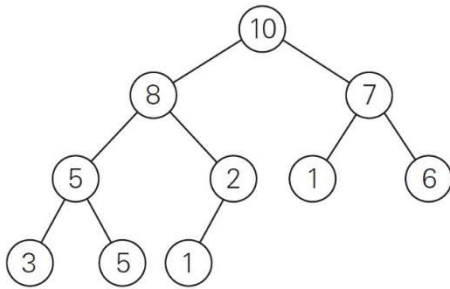
a) Traverse the tree preorder. (2 points)

b) Traverse the tree inorder. (2 points)

c) Traverse the tree postorder. (2 points)

d) How many internal nodes are there? (1 point)

e) What is the maximum width of the tree? (1 point)

f) What is the height of the tree? (1 point)

g) What is the diameter of the tree? (1 point)

5. Draw the 2-3 tree after inserting each of the following keys. Redraw the whole tree for each part.

a)   50 (1 point)

b)   76 (1 point)

c)   23 (2 points)

d)   21 (2 points)

e)   20 (2 points)

f)   19 (2 points)