Instructions: You have 80 minutes to complete this test. The test is closed book and closed notes. No calculators are allowed. Make sure to show your work on all problems. No credit will be given for answers without sufficient work.

Problem 1

Problem 2

Problem 3

Problem 4

Problem 5

TOTAL
a) Construct a Huffman code for these symbols. Show the tree you use to construct your code.

b) What is the expected number of bits per symbol in your code?
2) 20 points

Prove by induction that, in any tree $T$, the number of leaves is 1 more than the number of nodes that have right siblings.
3) 20 points
Consider the AVL tree shown below:

a) For each node in the tree, write the node’s balance next to it.

b) Assuming 26 is inserted into the tree, draw the rebalanced AVL tree that would result after an AVL tree insert operation.
4) 20 points

Prove by induction that, in any undirected graph G, the number of vertices having odd degree is even.
5) 20 points
Use the Ford-Fulkerson Algorithm to find a flow function that maximizes the flow in the following network and calculate the total flow that results. List the augmenting paths that you use to get your solution in order to get full credit.