2003 Paper 10 Question 3

Foundations of Programming

The following Java program has been written by a novice who is attempting to implement a tree-sort algorithm. This test program is intended to set up three nodes. The value fields of these nodes are to be written out in ascending order.

```
public class TreeSort
 { public static void main(String[] args)
    { Node tree = null;
      tree.put(8);   tree.put(16);   tree.put(4);
      System.out.println("Sorted values:  " + tree);
    }
 }

class Node
 { private int val;
   private Node left, right;

   public Node(int n)
    { this.val = n;
      this.left = null;
      this.right = null;
    }

   public void put(int k)
    { if (this == null)
         this = new Node(k);           // Error noted here
      if (k < this.val)
         this.left = new Node(k);
      else
         this.right = new Node(k);
    }
 }
```

(a) The compiler reports a single error, complaining about the statement indicated. What is the problem? Explain why there is more to fixing the program than merely changing this statement. [5 marks]

(b) Making the minimum number of changes (which will include adding a `toString()` method to class `Node`), modify the program so that it works in the way you think the author intended. [10 marks]

(c) Provide for class `Node` a method `sum()` which returns the sum of the elements in the tree. [5 marks]