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.

```java
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
        } else {
            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]