1) Given a binary tree, write a function that returns the number of nodes in the tree that have exactly one child.

Notes:
The function should have just one argument, a pointer to the root.
No global variables may be used.
No additional functions may be defined.

2) Consider the following insertion sort algorithm.

```c
void insertion_sort(element a[], int n)
// Put a[0]..a[n-1] into ascending order by insertion sort.
{
    for (int k = 1; k < n; k++) {
        // At this point, a[0]..a[k-1] are already in order.
        // Insert a[k] where it belongs among a[0]..a[k].
        // You need to write code for this insertion as the body of the for-k loop.
    } // endfor k
}
```

a) Write the code for the body of the for-k loop to complete the insertion sort routine.
b) Count the precise best case and worst case number of “element comparisons” in your insertion sort routine. Your answers should be functions of n in closed form. Note that “closed form” means that you must resolve all sigmas and …’s. Asymptotic answers (such as ones that use big-oh, big-theta, etc.) are not acceptable.

3) Which of the following five statements correctly describes the relationship between the functions f and g defined in a)-d) below? Note that more than one of the five statements may be correct for each part. You do not need to explain your choices.

\[ f \in o(g) \quad f \in O(g) \quad f \in \Theta(g) \quad g \in o(f) \quad g \in O(f) \]

a) \( f(n) = 3n^2, \quad g(n) = 2n^2 \)
b) \( f(n) = 2^n, \quad g(n) = 3^n \)
c) \( f(n) = 2^{n-1}, \quad g(n) = 2^n \)
d) \( f(n) = \sqrt{n}, \quad g(n) = \log_2(n) \)