This quiz has 4 questions, for a total of 10 points.

1. **3 points** Given the following array, which positions of the array will be read from during a binary search for the number 8? (The number 3 is in position 0.)

   \[3, 8, 9, 10, 35, 42, 43\]

   **Solution:** Binary search will read from positions \(\lfloor 7/2 \rfloor = 3\) and \(\lfloor 3/2 \rfloor = 1\).

2. **2 points** Suppose we create an algorithm that detects whether two length \(n\) words are anagrams by counting the occurrences of each letter (English alphabet) in the first word and similarly for the second word, and then checking whether the number of occurrences of each letter are the same for the two words. Which of the following expresses an upper bound on the time complexity of this algorithm?

   a) \(O(n \log n)\)
   
   b) \(\Theta(\log n)\)
   
   c) \(\Omega(n)\)
   
   d) \(O(\log n)\)

   **Solution:** a) \(O(n \log n)\) is the correct answer. \(O(n)\) would be an even better answer but that wasn’t an option.) The answers b) and d) are incorrect because they are too low. The answer c) is incorrect because it expresses a lower bound.

3. **3 points** Prove that \((n + 2)^b \in O(n^b)\).

   **Solution:** We need to show that \(\forall n \geq n_0, \exists c. (n + 2)^b \leq cn^b\) for some \(n_0\). Choose \(n_0 = 2\) (1 point). Let \(n\) be an arbitrary integer greater or equal to 2. Then we have

   \[n + 2 \leq 2n\]  

   so \((n + 2)^b \leq (2n)^b = 2^b n^b\) (1 point)

   We choose \(c = 2^b\), (1 point) and therefore have \((n + 2)^b \leq cn^b\).

4. **2 points** What is the output, if any, of the following Python program?

   ```python
   [3, 8, 9, 10, 35, 42, 43]
   Solution: Binary search will read from positions \(\lfloor 7/2 \rfloor = 3\) and \(\lfloor 3/2 \rfloor = 1\).
   ```
def f1(g, n):
    if n == 0:
        return True
    else:
        return g(f1, n - 1)
def f2(h, n):
    if n == 0:
        return False
    else:
        return h(f2, n - 1)

print(f1(f2, 1))

**Solution:** The output is False.