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Pledge: "I pledge my honor that I have abided by the Stevens Honor System."

Consider the implementation of quickselect below:

```
int lomuto_partition(int array[], int left, int right) {
   int p = array[left], s = left;
   for (int i = left + 1; i <= right; ++i) {
       if (array[i] < p) {
           ++s;
           swap(array[s], array[i]);
       }
   }
   swap(array[left], array[s]);
   return s;
}

int quick_select(int array[], size_t left, size_t right, size_t k) {
    size_t s = lomuto_partition(array, left, right);

    if (s == k - 1) {
        return ____(a)____;
    }
    if (s > k - 1) {
        return quick_select(array, left, ____(b)____, k);
    }
    return quick_select(array, ____(c)____, right, ____(d)____);
}

int quick_select(int array[], const size_t length, size_t k) {
    return quick_select(array, 0, length - 1, k);
}
```

1) Fill in the 4 blanks in the quickselect algorithm. (4 points)
   a) array[s]
   b) s - 1
   c) s + 1
   d) k

2) Show the array [4, 5, 6, 4, 0] after running **lomuto_partition**. (3 points) [4, 0, 4, 6, 5]

3) Suppose we are sorting an array of eight integers using **quicksort** with **lomuto_partition** and have just finished the first call to **lomuto_partition**. The array now looks as follows:

   `11 4 20 45 32 60 98 70`

   Which value or values could have been the pivot? (1 point) 20 or 60

4) Suppose mergesort were to cut the array into 3 evenly sized subarrays (instead of 2) and did a 3-way merge after making the recursive calls.
   a) Write the recurrence relation for this modified version of mergesort. (1 point)

   $T(n) =$ 3T(n/3) + O(n)

   b) Use the Master Theorem to determine its complexity. (1 point, answer depends on correct 4a, indicate base for logarithm)

   $T(n) \in \theta($ $n \log_3 n$ $)$