1. A priority queue has the same operations as a regular queue, except the items are NOT returned in the FIFO (first-in, first-out) order. Instead, each item has a priority that determines the order they are removed. A hospital emergence room operates like a priority queue -- the person with the most serious injury has highest priority even if they just arrived.

a) Suppose that we have a priority queue with integer priorities such that the smallest integer corresponds to the highest priority. For the following priority queue, which item would be dequeued next?

priority queue:

```
40  10  79
  30  13
```

b) To implement a priority queue, we could use an unordered Python list. If we did, what would be the worst-case theta (Θ( )) notation for each of the following methods: (justify your answer)

- enqueue:
- dequeue:

(c) To implement a priority queue, we could use a linked list ordered by priorities, e.g., the OrderedList class of chapter 7. If we did, what would be the worst-case theta (Θ( )) notation for each of the following methods: (justify your answer)

- enqueue:
- dequeue

2. A common implementation of a priority queue is to use a binary heap. A binary heap is a special type of binary tree that is efficient at finding and deleting the smallest (min heap) item (similarly, there is also a max heap). Binary heaps have the following properties:

- items are stored conceptually in a complete tree (a full tree with any additional leaves as far left as possible)
- the heap order property: for every node x with parent p, the key in p is smaller than or equal to the key in x

a) Where would the smallest node in the heap be located?
3) For the above heap, the list/array indexes are indicated in [ ]'s. For a node at index \( i \), what is the index of:

a) its left child if it exists:

b) its right child if it exists:

c) its parent if it exists:

4) Why aren’t arrays used to store general BST’s?

5) What would the heap look like after inserting 80?

6) What would be the height of a heap containing \( n \) nodes?