1 Question 1

1.1 a

For sublist of length of \( k \), the sorting complexity will be \( O(k^2) \) using insertion sort. In total there are \( \frac{n}{k} \) lists, thus the total sorting complexity will be \( O(k^2 \cdot \frac{n}{k}) \), namely \( O(nk) \).

Merging two array of total length \( m \) has a complexity of \( O(m) \). Thus for sublists of total length \( n \), each merging step (from 8 sublists to 4 sublists) has a complexity of \( O(n) \). There will be \( \log \left( \frac{n}{k} \right) \) steps needed. So the total complexity for merging is \( O(n \log(n)) \).

If \( O(nk) + O(n \log(n)) = O(n \log(n)) \), \( k \) should satisfy \( k = \log k \).

2 Question 2

2.1 a

First as pivot:
\[
85, 24, 63, 45, 17, 31, 96, 50 \text{ (pivot 85)}
\]
\[
50, 24, 63, 45, 17, 31, 85, 96 \text{ (pivot 50)}
\]
\[
17, 24, 31, 45, 50, 63, 85, 96
\]

Last as pivot:
\[
85, 24, 63, 45, 17, 31, 96, 50 \text{ (pivot 50)}
\]
\[
31, 24, 17, 45, 50, 85, 96, 63 \text{ (pivot 45)}
\]
\[
31, 24, 17, 45, 50, 85, 96, 63 \text{ (pivot 17)}
\]
\[
17, 24, 31, 50, 45, 63, 85, 96 \text{ (pivot 31)}
\]
\[
17, 24, 31, 45, 50, 63, 85, 96 \text{ (pivot 50)}
\]

2.2 b

First as pivot:
\[
96, 85, 63, 50, 45, 31, 24, 17 \text{ (pivot 96)}
\]
\[
17, 85, 63, 50, 45, 31, 24, 96 \text{ (pivot 17)}
\]
\[
17, 85, 63, 50, 45, 31, 24, 96 \text{ (pivot 85)}
\]
\[
17, 24, 63, 50, 45, 31, 85, 96 \text{ (pivot 24)}
\]
\[
17, 24, 63, 50, 45, 31, 85, 96 \text{ (pivot 63)}
\]
\[
17, 24, 31, 50, 45, 63, 85, 96 \text{ (pivot 31)}
\]
\[
17, 24, 31, 50, 45, 63, 85, 96 \text{ (pivot 50)}
\]

Last as pivot:
\[
96, 85, 63, 50, 45, 31, 24, 17 \text{ (pivot 17)}
\]
\[
17, 85, 63, 50, 45, 31, 24, 96 \text{ (pivot 17)}
\]
\[
17, 85, 63, 50, 45, 31, 24, 96 \text{ (pivot 96)}
\]
\[
17, 24, 63, 50, 45, 31, 85, 96 \text{ (pivot 24)}
\]
\[
17, 24, 63, 50, 45, 31, 85, 96 \text{ (pivot 85)}
\]
\[
17, 24, 63, 50, 45, 31, 85, 96 \text{ (pivot 31)}
\]
3 Question 3

3.1 a

3.2 b
Post-order:
5 2 / 3 7 X + 4 - 9 3 / +
Pre-order:
+ - + / 5 2 X 3 7 4 1 9 3