1. . Algorithm works correctly.

**before quick sort**

**[70, 54, 56, 91, 25, 90, 53, 39, 43, 47]**

**after quick sort**

**[25, 39, 43, 47, 53, 54, 56, 70, 90, 91]**

1. .

|  |  |  |  |
| --- | --- | --- | --- |
| Input size | Quick sort running time | Heap sort running time | Merge sort running time |
| 4 | 3700 | 184600 | 5900 |
| 16 | 10400 | 8100 | 11400 |
| 64 | 48200 | 46400 | 40800 |
| 256 | 204300 | 42000 | 204100 |
| 1024 | 1174000 | 211900 | 573800 |
| 4096 | 1223800 | 814900 | 757300 |
| 16384 | 4154100 | 2803000 | 3221800 |
| 65536 | 25527400 | 8274500 | 7754500 |
| 262144 | 302792400 | 26576800 | 27531500 |
| 1048576 | 4118227100 | 87824200 | 104084200 |
| 4194304 | Stack overflow | Stack overflow | Stack overflow |
| 16777216 | Stack overflow | Stack overflow | Stack overflow |
| 67108864 | Stack overflow | Stack overflow | Stack overflow |

After array size is 4194304, I got stack overflow error. (Tried to change the memory configuration, didn’t work.)

1. .

|  |  |  |  |
| --- | --- | --- | --- |
| Input size | Quick sort RAM | Heap sort RAM | Merge sort RAM |
| 67108864 | 315 | 328 | 1757 |

Merge sort uses more Ram compared to other sorts since it needs extra arrays to able complete its job. On the other hand, quick sort and heap sort have similar memory usage which means they do not need additional space.