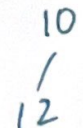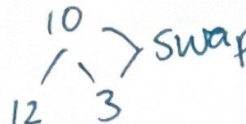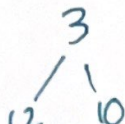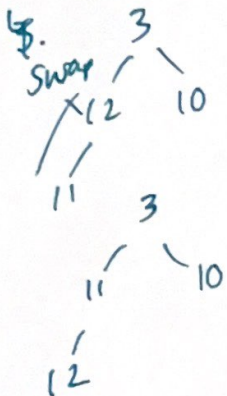4a. heapify!   10, 12, 3, 11, 6, 8, 9

1.   10

2.   10   ✓OK
     /
    12

3.   10   ⟩ swap
     / \
    12 3

     3
     / \
    12 10

4.   3
  swap / \
    ✗12 10
    /
   11   3
         / \
        11   10
        /
       12

5.   3
      / \
     11 ⟶swap 10
     / \
    12 6

       3
      / \
     6   10
    / \
   12 11

6.   3
       / \
      6   10 ⟩ swap
     / \ /
    12 11 8

        3
       / \
      6   8
     / \   /
    12 11 10

7.   3
      / \
     6   8   ✓OK
    / \ / \
   12 11 10 9
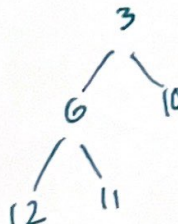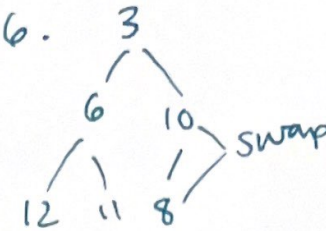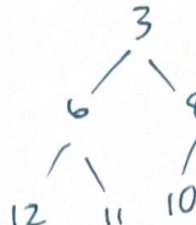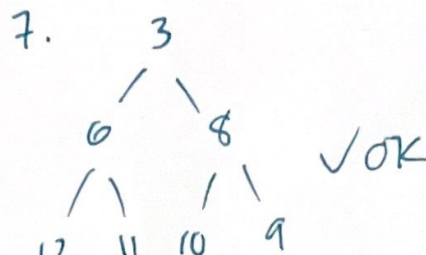
Part 4b:

1. Initial configuration: 2, 4, 6, 8, 10, 12, 14, 16

```
        2
       / \
      4   6
     /\  /\
    8 10 12 14
    /
   16
```

3. pop top (2)
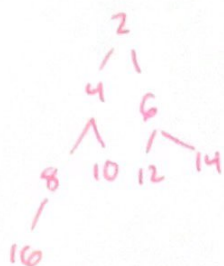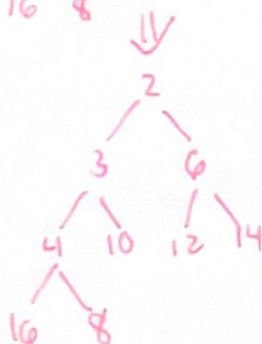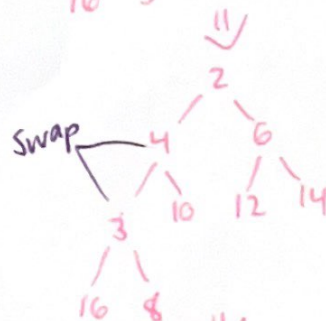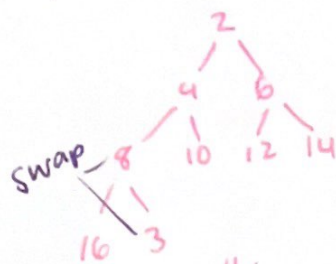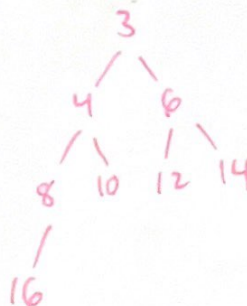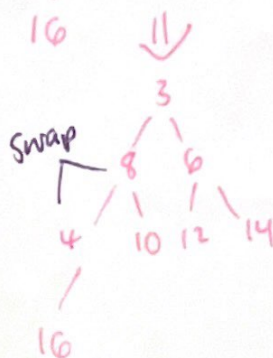   replace 2 with 8 (last leaf)

```
swap ┌  8
      / \
     3   6
    /\   /\
   4 10 12 14
   /
  16
```

⇓

```
        3
       / \
swap ┌ 8   6
      /\   /\
     4 10 12 14
     /
    16
```

```
        3
       / \
      4   6
     /\   /\
    8 10 12 14
    /
   16
```

2. insert 3 - trickle up

```
        2
       / \
      4   6
     /\   /\
    8 10 12 14
```
```
swap  8
     /\
    16  3
```

⇓

```
        2
       / \
swap ┌ 4   6
      /\   /\
     3 10 12 14
    /\
   16 8
```

⇓

```
        2
       / \
      3   6
     /\   /\
    4 10 12 14
   /\
  16 8
```
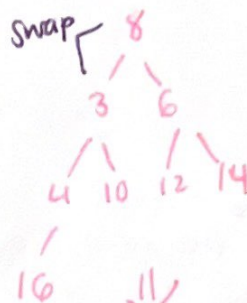
Part 4b cont'd

4. pop top (3)
   replace 3 with 16

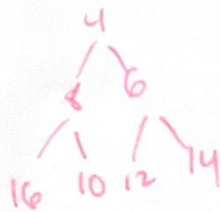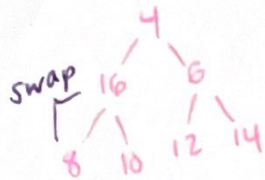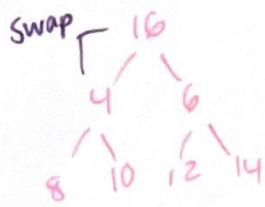swap ⌐ 16
       / \
      4   6
     /\ /\
    8 10 12 14

        4
       / \
swap 16   6
   ⌐ /\ /\
    8 10 12 14

        4
       / \
      8   6
     /\ /\
   16 10 12 14

5. insert 5

        4
       / \
      8   6
     /\ /\
swap 16 10 12 14
   ⌐ /
    5

        4
       / \
swap 8   6
   ⌐ /\ /\
    5 10 12 14
   /
  16

        4
       / \
      5   6
     /\ /\
    8 10 12 14
   /
  16