Exercise 1: Consider the database with the below parameters:

      block size is 4096 bytes
      header size is 100 bytes
      record size is 100 bytes

Consider a file storing variable length records. What is the block factor?

Answer. Block factor (number of records per block) can be calculated as
BF = (Block Size - Header Size) / Record Size = (4096-100)/100 = 39 records per block

Exercise 2: Consider the database with the below parameters:

      Block Size = 1000 bytes
      Record Size = 100 bytes
      Key Size = 12 Bytes
      Pointer Size = 8 bytes

Given 10000 records, determine the number of dense and sparse index blocks?

Answer. Database file block factor = Block size/ record size = 1000/100 = 10 records per block
Index file block factor = block size / (key+pointer) size = 1000/(12+8) = 50 entries per block

To find out dense index blocks:
No. of entries = No. of records = 10000
No. of dense index blocks = No. of entries / Index file block factor = 10000/50 = 200 blocks

To find out sparse index blocks:
No. of entries = No. of database blocks
No. of database blocks = No. of records/ database file block factor = 10000/10 = 1000 blocks
No. of blocks = 1000/50 = 20 blocks

Exercise 3: Construct a B+-tree for the following set of key values:
(2, 3, 5, 7, 11, 17, 19, 23, 29, 31)
Assume that the tree is initially empty and values are added in ascending order. Construct B+-trees for the cases where the number of pointers that will fit in one node is as follows:
a. Four
b. Six
c. Eight

Answer 3(a): The following were generated by inserting values into the B+- tree in ascending order. A node (other than the root) was never allowed to have fewer than ⌈n/2⌉ values/pointers.

```
                        [19||  ||  ]
              ┌──────────────┘      └──────────┐
         [5|11|  |  ]                      [29|  |  ]
      ┌────┼────┐                        ┌────┘
[2|3|  |]→[5|7|  |]→[11|17|  |]→[19|23|  |]→[29|31|  |]
```

3(b)

```
                [7|19|  |  |  ]
          ┌────────┼────────┐
  [2|3|5|  |]→[7|11|17|  |]→[19|23|29|31|  ]
```

3(c)

```
            [11|  |  |  |  |  ]
      ┌──────────┘        └──────────┐
[2|3|5|7|  |]→[11|17|19|23|29|31|  ]
```
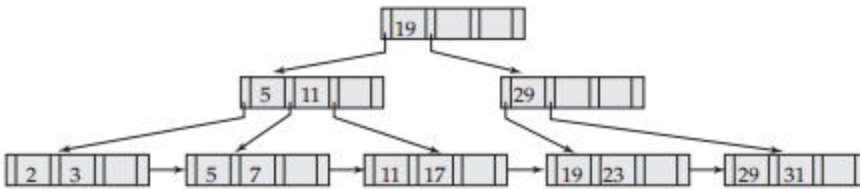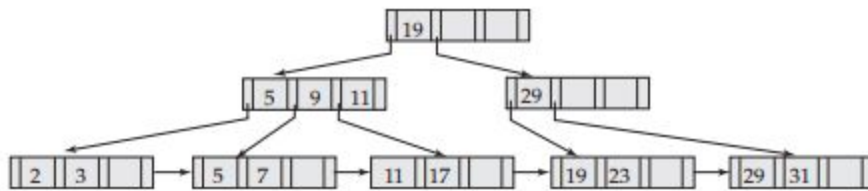
Exercise 4: For the B+ tree of exercise 3(a), show the form of the tree after the following series of operations:
a. Insert 9.
b. Insert 10.
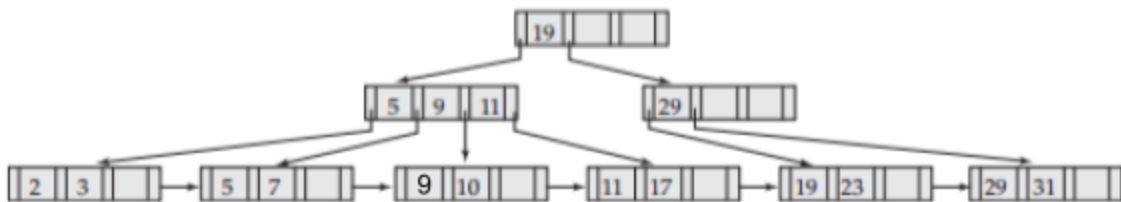c. Insert 8.
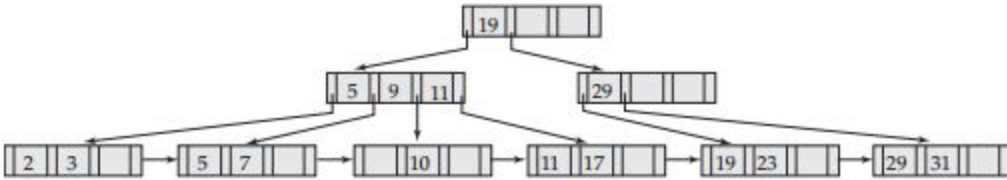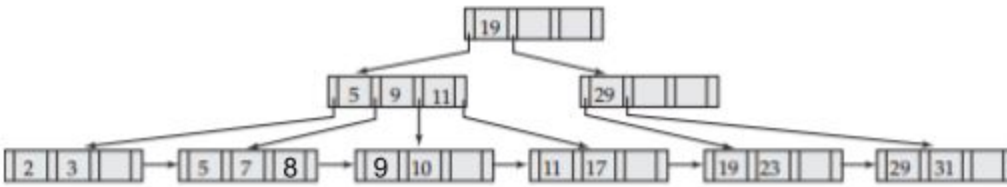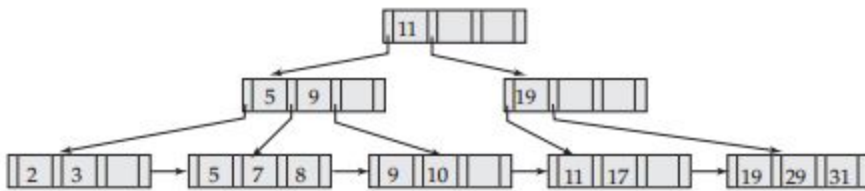d. Delete 23.
e. Delete 19.

Answer.

Insert 9:

Insert 10:

Insert 8

Delete 23:

Delete 19: