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Question 1)

a) Insert D, I, J, K, S, T, R, A to an empty
2-3 tree, and then delete S and I in
given order.

D/ [D]   I/ [D I]   J/ [D I J] → [I]
                                                 / \
                                               [D] [J]

K/   [I]   S/   [I]   [I K]
     /   \   /   \   →   / | \
   [D] [J K]   [D] [J K S]   [D][J][S]
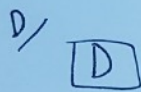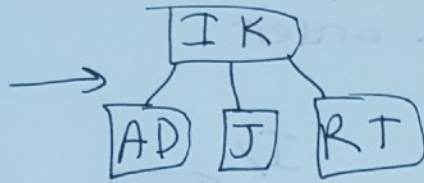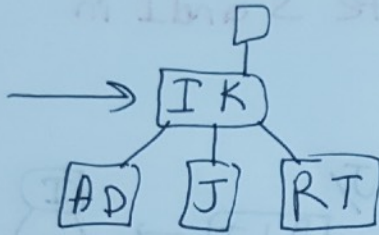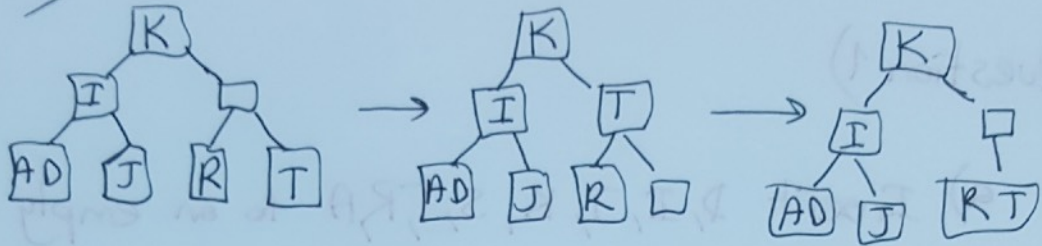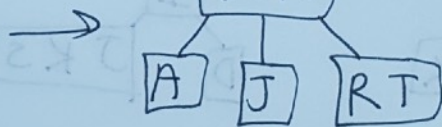
T/   [I K]   R/   [I K]   [I K S]
       / | \   / | \   →   / | \
    [D][J][S T]   [D][J][R S T]   [D][J][R T]

→   [K]   A/   [K]
        /   \   /   \
      [I]   [S]   [I]   [S]
     / | | \   / | | \
  [D][J] [R][T]   [A D][J] [R][T]
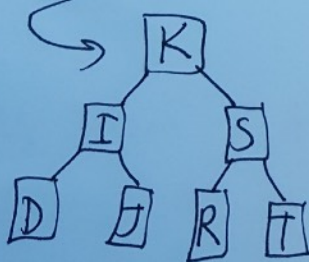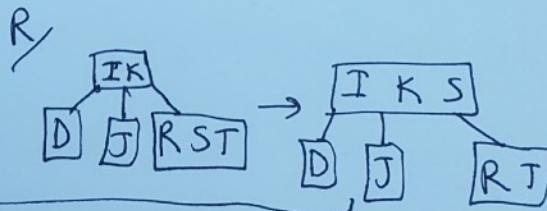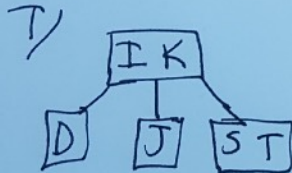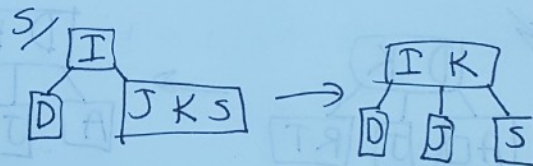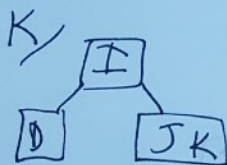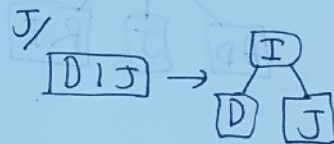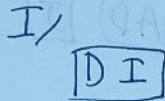
delete

S:

I:

b) Insert   V, I, N, T, C, E, R, F   to an empty   2-3-4 tree   and then delete T and N.

Y/ [V]   I/ [I V]   N/ [I N V]

T/ [N]
    / \
  [I] [T V]

C/ [N]
    / \
 [C I] [T V]

E/ [N]
     / \
  [C E I] [T V]

R/ [N]
     / \
  [C E I] [R T V]

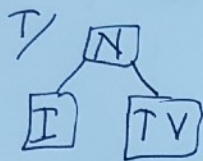F/ [E N]
     /|\
  [C] [I] [R T V]   →   [E N]
                            /|\
                         [C] [F I] [R T V]

delete

T/ [E N]
     /|\
   [C] [F I] [R V]

N/ [E]
    / \
  [C] [F I] [R V]

  [E R]
   /|\
 [C] [F I] [V]
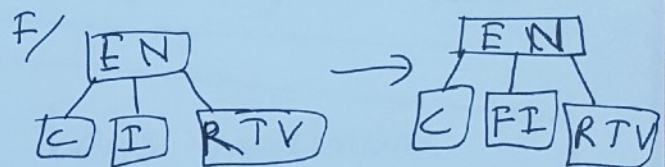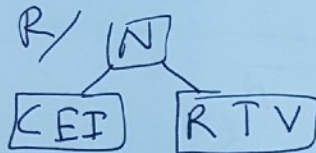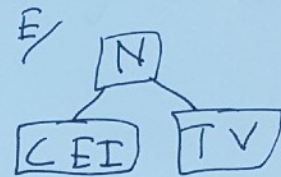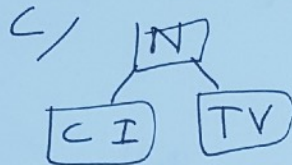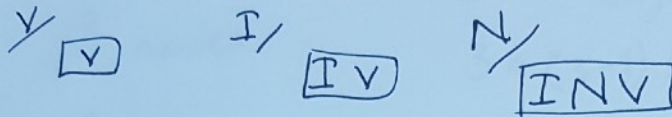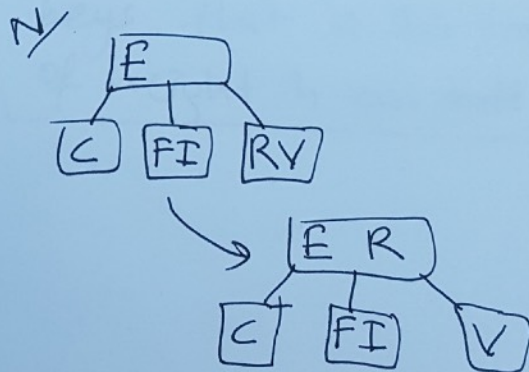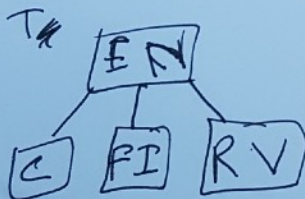
c) what is the maximum number of keys
that a 2-3 tree of height h kan hold?

1 node	$3-1$ keys at level 1
3 nodes	$3*(3-1)$ keys at level 2
9 nodes	$3*3*(3-1)$ keys at level 3
$\vdots$	
$3^{(h-1)}$	$3^{(h-1)}*(3-1)$ keys at level h

$$\boxed{3^{h}-1}$$ keys maximum
total number of
keys that a 2-3 tree
of height h can hold.