Given the hash function **h(k) = k mod 12**, answer the following question on hashing *(Note: Read both questions at once before beginning)*.

a) Insert the following keys into the hash table below. Use the **linear probing** collision resolution technique when appropriate. *Note: Implementation of this technique includes wrapping around the array when you run out of slots at the end.*

## **Insert keys \*: 18, 41, 22, 44, 58, 32, 34**

18 – hashes to 6, no collision

41 – hashes to 5, no collision

22 – hashes to 10 – no collision

44 – hashes to 8 – no collision

58 – hashes to 10 – COLLISION, put in 11.

32 – hashes to 8 – COLLISION, put in 9

34 – hashes to 10 – COLLISION, put in 0

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 34 |  |  |  |  | 41 | 18 |  | 44 | 32 | 22 | 58 |
| *0* | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | *11* |

## **Remove keys \*: 22**

Remove 22 – found at hashed location 10.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 34 |  |  |  |  | 41 | 18 |  | 44 | 32 |  | 58 |
| *0* | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | *11* |

## **Insert 73 and 20**

73 - hashed to 1 – no collision

20 – hashes to 8 – COLLISION, put in 10

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **34** | **73** |  |  |  | **41** | **18** |  | **44** | **32** | **20** | **58** |
| *0* | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *9* | *10* | *11* |

b) How many keys (in total) and which ones caused an initial collision when being inserted (list them with commas)?

**ANSWER**: Four keys caused collisions with insertion: 58, 32, 34, 20.