**Question 1:**

A = B = 3

|  |  |  |  |
| --- | --- | --- | --- |
| Event | In P1’s cache | In P2’s cache | In P3’s cache |
|  | L = invalid | L = invalid | L = invalid |
| P1 writes A = 4  (write miss) | L <- A = 4 (exclusive) | L = invalid | L = invalid |
| P3 writes B = 2  (write miss) | L <- A = 4 (exclusive) | L = invalid | L <- B = 2 (exclusive) |
| P2 reads A  (read miss) | A is written back  L <- A = 4 (shared) | L <- A = 4 (shared) | L <- B = 2 (exclusive) |
| P3 reads A  (read miss) | L <- A = 4 (shared) | L <- A = 4 (shared) | B is written back  L <- A = 4 (shared) |
| P3 writes A = 12  (write hit) | L = invalid | L = invalid | L <- A = 12 (exclusive) |
| P2 reads A  (read miss) | L = invalid | L <- A = 12 (shared) | A is written back  L <- A = 12 (shared) |
| P1 reads B  (read miss) | L <- B = 2 (shared) | L <- A = 12 (shared) | L <- A = 12 (shared) |
| P1 writes B = 10  (write hit) | L <- B = 10 (exclusive) | L <- A = 12 (shared) | L <- A = 12 (shared) |

**Question 2:**

Block a: Shared by processors Q and R

Block b: Exclusive with Q as the owner

Block c: Shared a located at R

1. **Processor R issues a “write” into block a**

- R sends a request to P to have the block as “exclusive” -  
- P sets the state to “exclusive” -  
- P informs R of the block’s other sharers -  
- R sets the block’s state to “exclusive” -  
- R sends invalidating messages to each sharers (Q) -  
- Q sets block’s state to “invalid”

1. **Processor R issues a “read” into block b**

- R sends request to P –

- P informs R about the block owner, Q –

- R requests the block from Q –

- Q send the block to R –

- R and Q set the state of block to “shared” –

- Q informs P that it should change the state of the block to “shared”