**1**

**ANS**

a) P0.B0 (S, 120, 00 20)

b) P0.B0 ( M, 120, 00 80)

P3.B0 (I, 120, 00 20)

c) P3.B0 (M, 120, 00 80)

d) M: 110 ← 30

P1.B2 (S, 110, 00 30)

P0.B2 (S, 110, 00 30)

e) P0.B1 (M, 105, 00 48)

P3.B1 (I, 105, 00 08)

f) M: 110 ← 30

P0.B2 (M, 130, 00 78)

g) P3.B2 (M, 130, 00 78)

**2**

**ANS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Processor Request** | **Activity** | **A’s Cache & Status** | **B’s Cache & Status** | **Memory x** |
| Core B reads x | Cache read miss |  | 7 (E) | 7 |
| Core A reads x | Cache read miss | 7(S) | 7 (S) | 7 |
| Core B writes 2 to x | Write hit, Invalidation for x | 7(I) | 2 (E) | 2 |
| Core A reads x | Cache read miss | 2(S) | 2 (S) | 2 |
| Core B writes 5 to x | Write hit, Invalidation for x | 2(I) | 5 (E) | 5 |

**3**

**ANS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Processor Request** | **Activity** | **A’s Cache & Status** | **B’s Cache & Status** | **Memory x** |
| Core A reads x | Cache read miss | 8(E) |  | 8 |
| Core B reads x | Cache read miss | 8(S) | 8 (S) | 8 |
| Core A writes 3 to x | Write hit, Write update for x | 3(S) | 3 (S) | 8 |
| Core A writes 4 to x | Write hit, Write update for x | 4(S) | 4 (S) | 8 |
| Core B reads x | Read hit | 4(S) | 4 (S) | 8 |

**4**

**ANS**

**a)**

**i.**

64 processor arranged a as a ring: largest number of communication hops

= 32 🡪 Communication cost

= 100 + 10 x 32

=420 ns.

**ii.**

64 processor arranged as 8x8 processor grid: largest number of communication hops

=14 🡪 communication cost

=100 + 10 x 14

=240 ns

**iii.**

64 processor arranged as a hypercube: largest number of hops

= 6 (log264) 🡪 Communication cost

= 100 + 10 x 6

= 160 ns

**b)**

**i.**

64 processor arranged a as a ring: Worst case CPI

=0.75 + (0.2/100) x 420

=1.34 cycles/inst

**ii.**

64 processor arranged as 8x8 processor grid: Worst Case CPI

=0.75 + (0.2/100) x 240

= 0.98 cycles/inst

**iii.**

64 processor arranged as a hypercube: Worst case CPI

=0.75 + (0.2/100) x 160

= 0.82 cycles/inst

The average CPI can be obtained by replacing the largest number of communication hops in the above calculation by ĥ , the average numbers of communications hops. That latter number depends on both the topology and the application.