**1.7**

ICA = 1E9

ETA = 1.1 s

ICB = 1.2E9

ETB = 1.5 s

A)

Clock cycle = 1ns = 1E-9 s

CPI = CPU time/(IC \* CC time)

CPIA = 1.1 s /(1.0E9 \* 1.0E-9 s) = 1.1

CPIB = 1.5 s / (1.2E9 \* 1.0E-9 s) = 1.25

B)

Clock rateA = (ICA \* CPIA) / ~~CPUtime~~~~A~~ = 1.0E9 \* 1.1 = 1.1E9 hz

Clock rateB = (ICB \* CPIB) / ~~CPUtime~~~~B~~ = 1.2E9 \* 1.25 = 1.5E9 hz

Clock rateB / Clock rateA = 1.5E9 hz / 1.1E9 hz = 1.36364

B is 1.37 times faster than A

C)

 ICc = 6E8

CPIc = 1.1

CPU time = IC \* CPI \* CC time

CPU timec = 6E8 \* 1.1 \* 1 ns = 6.6E8 ns

CPU timeA = 1.0E9 \* 1.1 \* 1ns = 1.1E9 ns

CPU timeB = 1.2E9 \* 1.25 \* 1ns = 1.5E9 ns

**1.9.1**

Total execution time = (arithmetic + load/store + branch) / Clock frequency

1 Processor

Total Execution time = (2.56E9(1) + 1.28E9(12) + 2.56E8(5)) / 2E9 == 9.6 s

2 Processors

IC = (2.56E9(1) / (0.7 \* 2)) + (1.28E9(12) / (0.7 \* 2)) + 2.56E8(5) == 1.408E10

Total Execution time = 1.408E10 / 2E9 == 7.04 s

Speed up = 9.6 s / 7.04 s == 1.36

4 Processors

IC = (2.56E9(1) / (0.7 \* 4)) + (1.28E9(12) / (0.7 \* 4)) + 2.56E8(5) == 7.68E9

Total Execution time = 7.68E9 / 2E9 == 3.84 s

Speed up =  9.6 s / 3.84 s == 2.5

8 Processors

IC = (2.56E9(1) / (0.7 \* 8)) + (1.28E9(12) / (0.7 \* 8)) + 2.56E8(5) == 4.48E9

Total Execution time = 4.48E9 / 2E9 == 2.24 s

Speed up = 9.6 s / 2.24 s == 4.29

|  |  |  |
| --- | --- | --- |
| Processor | Total execution Time | Speed up |
| 1 | 9.6 s | none |
| 2 | 7.04 s | 1.36 |
| 4 | 3.84 s | 2.5 |
| 8 | 2.24 s | 4.29 |