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1.1

	A	B
IC	2.0×10^9	2.5×10^9
CPU Time	2.8s	3.0s
CCT	1×10^{-9}s	1×10^{-9}s

a) $\text{CPU Time} = IC \times CPI \times CCT$

$$CPI = \frac{\text{CPU Time}}{CCT \times IC}$$

For A

$$CPI = \frac{2.0 \times 10^9}{1 \times 10^{-9} \times 2.8} = \boxed{1.4}$$

For B

$$CPI = \frac{2.5 \times 10^9}{1 \times 10^{-9} \times 3.0} = \boxed{1.2}$$

b) Since CPU Times are equal

$$IC_A \times CPI_A \times CCT_A = IC_B \times CPI_B \times CCT_B$$

$$2.0 \times 10^9 \times 1.4 \times CCT_A = 2.5 \times 10^9 \times 1.2 \times CCT_B$$

$$2.8 \times 10^9 \times CCT_A = 3.0 \times 10^9 \times CCT_B$$

$$CCT_A = \frac{3}{2.8} CCT_B$$

A's clock is faster by a rate of $\frac{3}{2.8} \approx 1.071$ compared to the clock of B.

1.2 a)

$$\text{CPU Time} = \frac{\Sigma(IC \times CPI)}{CR}$$

$$\text{CPU Time} = \frac{(60 \times 10^8 \times 2) + (130 \times 10^8 \times 1) + (90 \times 10^8 \times 4) + (25 \times 10^8 \times 2)}{4GHz}$$

$$\text{CPU Time} = \frac{660 \times 10^8}{4GHz} = \boxed{16.5 \text{ seconds}}$$

b.) New FP CPI = $2 \times .60 = 1.2$

New L/S Instructions = $90 \times 10^8 \times .80 = 72 \times 10^8$

$$\text{CPU Time} = \frac{(60 \times 10^8 \times 1.2) + (130 \times 10^8 \times 1) + (72 \times 10^8 \times 4) + (25 \times 10^8 \times 2)}{4\text{GHz}}$$

$$\text{CPU Time} = \frac{540 \times 10^8}{4\text{GHz}} = 13.5 \text{ seconds}$$

Execution time is improved by 3 seconds

c.) It is not possible because to make two times faster execution time we have to reduce by 50% which for $\Sigma(IC \times CPI) = 660 \times 10^8$ reduced by 50% would be $\Sigma(IC \times CPI) = 330 \times 10^8$ and for FP we only have $IC \times CPI = 120 \times 10^8$ and $120 \times 10^8 < 330 \times 10^8$ where 330×10^8 is the $IC \times CPI$ that we have to remove for the 2 times faster execution time.

1.3 1 processor

(BIT) Branching Instruction Time = $200s \times .20 = 40s$

(NBIT) Non-Branching Instruction Time = $200s - 40s = 160s$

N=2 2 processors

BIT = 40s Overhead = 20s

NBIT = $\frac{1}{N}(160s) = \frac{1}{2}(160s) = 80s$

Total execution time = $40s + 20s + 80s =$ 140s

Speed Up = $\frac{200s}{140s} =$ 1.429

N=8 8 processors

BIT = 40s Overhead = 20s

NBIT = $\frac{1}{N}(160s) = \frac{1}{8}(160s) = 20s$

Total execution time = $40s + 20s + 20s =$ 80s

Speed Up = $\frac{200s}{80s} =$ 2.5