CS151B/EE116C – Solutions to Homework #1

1.5

a. instructions / sec = frequency / CPI

P1's instructions/sec = $3 \times 10^9 / 1.5 = 2 \times 10^9$

P2's instructions/sec = $2.5 \times 10^9 / 1.0 = 2.5 \times 10^9$

P3's instructions/sec = $4 \times 10^9 / 2.2 = 1.8 \times 10^9$

b. The number of cycles in 10 seconds = frequency × 10

cycles (P1) = $10 \times 3 \times 10^9 = 3 \times 10^{10}$

cycles (P2) = $10 \times 2.5 \times 10^9 = 2.5 \times 10^{10}$

cycles (P3) = $10 \times 4 \times 10^9 = 4 \times 10^{10}$

The number of instructions in 10 seconds = instructions/second (answer of 1.5.a) × 10

c. From the problem, $CPI_{new} = CPI_{old} \times 1.2$, $T_{new} = T_{old} \times 0.7$, and ($IC_{new} = IC_{old}$)

Thus, $0.7 \times (IC_{old} \times CPI_{old} \times 1 / F_{old}) = IC_{new} \times CPI_{new} \times 1 / F_{new}$

$0.7 \times (IC_{old} \times CPI_{old} \times 1 / F_{old}) = IC_{old} \times CPI_{old} \times 1.2 \times 1 / F_{new}$

$F_{new} = 1.2 / 0.7 \times F_{old} = 1.714 \times F_{old}$

So, F_{new}(P1, P2, P3) = (5.14GHz, 4.29GHz, 6.86GHz)

1.6

a. CPI (P1) = $1 \times 0.1 + 2 \times 0.2 + 3 \times 0.5 + 3 \times 0.2 = 2.6$

CPI (P2) = 2

b. cycles (P1) = CPI × IC = 2.6×10^6

cycles (P2) = 2×10^6

T (P1)= $10^6 \times 2.6 \times 1 / (2.5 \times 10^9) = 1.04 \times 10^{-3}$ s

T (P2)= $10^6 \times 2 \times 1 / (3 \times 10^9) = 0.66 \times 10^{-3}$ s.

Thus, P2 is faster than P1.

1.7

a. CPI = T / IC × cycle time

$CPI_A = 1.1 / 10^9 \times 10^{-9} = 1.1$, $CPI_B = 1.5 / 1.2 \times 10^9 \times 10^{-9} = 1.25$

b. $F_B / F_A = IC_B \times CPI_B / IC_A \times CPI_A = 1.2 \times 10^9 \times 1.25 / 10^9 \times 1.1 = 1.37$

c. $T_A / T_{NEW} = 10^9 \times 1.1 / 6 \times 10^8 \times 1.1 = 1.67$,

$T_B / T_{NEW} = 1.2 \times 10^9 \times 1.25 / 6 \times 10^8 \times 1.1 = 2.27$

1.13

1. The reduction of $T_{FP} = 70 - 70 \times 0.8 = 14$ s. The reduction time is 14 / 250 = 5.6%
2. $T_{NEW} = 250 \times 0.8 = 200 = 70 + 85 + 40 + T_{INT}$. $T_{INT} = 5$

   The reduction time of INT is (55-5)/55 = 90.9%
3. No, since $T_{FP} + T_{INT} + T_{L/S} = 210$s