Solution

1(a) P1: \(\frac{2000 \times 2 + 3000 \times 1 + 4000 \times 3}{2000 + 3000 + 4000} = \frac{19}{9} = 2.11\)
P2: \(\frac{4000 \times 2 + 2000 \times 1 + 4000 \times 3}{4000 + 2000 + 4000} = 2.20\)

1(b) P1: \((2000 \times 2 + 3000 \times 1 + 4000 \times 3) \times 1\text{ns} = 19\text{us}\)
P2: \((4000 \times 2 + 3000 \times 1 + 4000 \times 3) \times 1\text{ns} = 20\text{us}\)

1(c) It’s true in this case, but not so in general.
Execution time = CPI * #instructions * cycle time
Even if the CPI is faster, there could be differences in the other terms.

1(d) 19us = 2.20 \times 10000 \times T \Rightarrow T = 19/22 \text{ ns}
2(a)

\[ \begin{align*}
I_1: & \quad R_1 \leftarrow R_2 + R_3 \\
I_2: & \quad R_4 \leftarrow \text{Mem}(R_1) \\
I_3: & \quad R_2 \leftarrow \text{Mem}(R_2) \\
I_4: & \quad R_4 \leftarrow R_4 + R_5 \\
I_5: & \quad R_6 \leftarrow \text{Mem}(R_3) \\
I_6: & \quad R_1 \leftarrow R_6 + R_7
\end{align*} \]

RAW conflict from I1 to I2
WAW conflict from I1 to I6 (not critical for this hardware)
WAR conflict from I3 to itself (not critical for this hardware)
RAW conflict from I2 to I4
WAW conflict from I2 to I4
WAR conflict from I4 to itself
RAW conflict from I5 to I6

(b)

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