1.

Mingkuan Pang

M1: $CPU_{exe} = IC \cdot CPI \cdot CCT$

$$20 = 500M \cdot CPI \cdot \frac{1}{900M}$$

$$\frac{20}{CPI} = \frac{500M}{900M}$$

$$\frac{20}{CPI} = \frac{5}{9}$$

$$5CPI = 180$$

$$CPI = 36$$

M2: $CPU_{exe} = IC \cdot CPI \cdot CCT$

$$15 = 400M \cdot CPI \cdot \frac{1}{800M}$$

$$15 = \frac{400M}{800M} \cdot CPI$$

$$\frac{1}{2} CPI = 15$$

$$CPI = 30.$$

2.

$M1$: $CPU_{exe} = IC \cdot CPI \cdot CCT$

$$8 = IC \cdot 36 \cdot \frac{1}{900M}$$

$$8 = \frac{36}{900M} \cdot IC$$

$$8 = \frac{IC}{25M}$$

$$IC = 8 \times 25M = 200M$$

$M2$: $CPU_{exe} = IC \cdot CPI \cdot CCT$

$$10 = IC \cdot 30 \cdot \frac{1}{800M}$$

$$10 = \frac{3}{80M} \cdot IC$$

$$IC = \frac{800M}{3} \approx 267M$$

3. M1:

$$MIPS = \frac{IC}{CPU_{exe} \cdot M} = \frac{IC}{IC \cdot CPI \cdot CCT \cdot M} = \frac{1}{CPI \cdot CCT \cdot M}$$

$$MIPS = \frac{1}{CPI \cdot \frac{1}{CRate} \cdot M} = \frac{CRate}{CPI \cdot M}$$

Therefore $MIPS = \frac{CRate}{CPI \cdot M}$, CRate and M are constant.

Thus $MIPS(max) = \frac{CRate}{CPI(min) \cdot M}$, $CPI(min) = 1$.

$$MIPS(max) = \frac{800M}{1M} = 800$$

M2: same as above,

$$MIPS(max) = \frac{CRate}{CPI(min) \cdot M} \quad CPI(min) = 2$$

$$MIPS(max) = \frac{900M}{2 \cdot M} = 450$$

4.

M1:

$$CPU_{exe} = IC \cdot CPI \cdot CCT$$

$$= [(1\times0.25)+(2\times0.25)+(3\times0.25)+(4\times0.25)] \times \frac{1}{800M}$$

$$= (0.25+0.5+0.75+1) \times \frac{1}{800M}$$

$$= \frac{2.5}{800M}$$

$$= \frac{5}{1600M}$$

M2: $CPU_{exe} = IC \cdot CPI \cdot CCT$

$$= [(3\times0.25)+(2\times0.25)+(4\times0.25)+(2\times0.25)] \times \frac{1}{900M}$$

$$= (0.75+0.5+1+0.5) \times \frac{1}{900M}$$

$$= \frac{2.75}{900M}$$

$$= \frac{11}{3600M}$$

$CPU_{exe}(M_1) = \frac{5}{1600M} = \frac{45}{14400}$; $CPU_{exe}(M_2) = \frac{11}{3600M} = \frac{44}{1440}$

Thus $CPU_{exe}(M_2) < CPU_{exe}(M_1)$

Therefore, M_2 is faster.

$$\frac{CPU_{exe}(M_1)}{CPU_{exe}(M_2)} = \frac{\frac{45}{14400}}{\frac{44}{144000}} = \frac{450}{44} \approx 1.02$$

Therefore M_2 is 1.02 times faster than M_1

5.

$$CPU_{exe}(M_1) = IC \cdot CPI \cdot CCT = IC_{M_2} \cdot CPI_{M_2} \cdot CCT_{M_2}$$

$$CPU_{exe}(M_1) = [(1 \times 0.25) + (2 \times 0.25) + (3 \times 0.25) + (4 \times 0.25)] \times \frac{1}{CRate(M_1)}$$

$$= (0.25 + 0.5 + 0.75 + 1) \times \frac{1}{CRate(M_1)}$$

$$= \frac{2.5}{CRate(M_1)}$$

Therefore

$$\frac{2.5}{CRate(M_1)} = [(3 \times 0.25) + (2 \times 0.25) + (4 \times 0.25) + (2 \times 0.25)] \times \frac{1}{900M}$$

$$\frac{2.5}{CRate(M_1)} = (0.75 + 0.5 + 1 + 0.5) \times \frac{1}{900M}$$

$$\frac{2.5}{CRate(M_1)} = \frac{2.75}{900M}$$

$$CRate(M_1) = \frac{900M \times 2.5}{2.75} = 818MHZ$$

Therefore, For having the same performance as M_2, M_1 should have 818MHZ clock rate.

6.

$$CRate(C_2) = \frac{Clockcycle(C_2)}{CPUexe\ C_2} = \frac{1.5\ Clockcycle\ C_1}{\frac{1}{2} \times CPUexe\ C_1}$$

$$CRate(C_2) = \frac{1.5 \times \frac{CPUexe\ C_1}{CCT_{C_1}}}{\frac{1}{2} \times 15} = \frac{1.5 \times 15 \times CRate\ C_1}{7.5}$$

$$CRate(C_2) = \frac{22.5 \times 2.5GHZ}{7.5} = 7.5\ GHZ.$$

Therefore 7.5 GHZ will be the clock rate of computer C_2.