③ Instruction Count : 2×10^6
Clock Rate : 200×10^6 Hz

$$\text{Avg. CPI} = \sum_{i=0}^{n} (CPI_i \times C_i)$$

↳ Instruction count

$$= \left(\frac{38}{100} \times 1\right) + \left(\frac{15}{100} \times 3\right) + \left(\frac{42}{100} \times 4\right) + \left(\frac{5}{100} \times 2\right)$$
$$= 0.38 + 0.45 + 1.68 + 0.10$$

CPI = 2.61

$$\text{MIPS} = \frac{\text{Inst. count}}{\text{Exec. time} \times 10^6} =$$

$$\text{Exec time} : \frac{\text{Inst. count} \times CPI}{\text{Clock rate}} = \frac{(2 \times 10^6) \times 2.61}{200 \times 10^6} = 0.02618$$

$$\text{MIPS} = \frac{2 \times 10^6}{0.0261 \times 10^6} = 76.62$$

④ $$\text{Avg CPI}_A = 4 \times \frac{9}{60} + 1 \times \frac{15}{60} + 5 \times \frac{12}{60} + 2 \times \frac{24}{60}$$
$$= 2.65$$

$$\text{MIPS}_A = \frac{\text{Clock Rate}}{CPI \times 10^6} = \frac{2 \times 10^9}{2.65 \times 10^6} = 754.71$$

$$\text{Exec. time} = \frac{60 \times 2.65 \times 10^9}{2 \times 10^{11}} = 79.5$$

$$\text{Avg CPI}_B = 1 \times \frac{16}{80} + 3 \times \frac{24}{80} + 1 \times \frac{12}{80} + 5 \times \frac{28}{80} = 3.00$$

$$\text{MIPS}_B = \frac{2.5 \times 10^9}{3.00 \times 10^6} = 833.33$$

$$\text{Exec. time} = \frac{80 \times 10^9 \times 3}{2.5 \times 10^9} = 96$$

Machine B is better in terms of MIPS
" A " " " " exec time

(5)

a. Prog A $\frac{T_{M1}}{T_{M2}} = \frac{30}{20} = 1.5$ times

$\therefore M_2$ is faster

Prog B $\frac{T_{M1}}{T_{M2}} = \frac{40}{80} = 0.5$ times

$\therefore M1$ is faster

b. $MIPS_{M_1A} = \frac{7000 \times 10^6}{30 \times 10^6} = 233.33$

$MIPS_{M_2A} = \frac{3000 \times 10^6}{20 \times 10^6} = 150$

c. $CPI_{M_1A} = \frac{30 \times 3 \times 10^9}{7000 \times 10^6} = 12.857$

$CPI_{M_2A} = \frac{20 \times 5 \times 10^9}{3000 \times 10^6} = 33.33$

d. Total time = 3600 sec.

A: 100 times B: Remaining

M1	M2
A: 30 x 100	A: 20 x 100
Rem time: 600	Rem time: 1600
B: $\frac{600}{40} = 15$	B: $\frac{1600}{80} = 20$
$\therefore$ 115 op.	120 op.

M2 is faster

(6)

a. $f = 0.8$ $n = 15$

speedup $= \frac{1}{\frac{0.8}{15} + 0.2} = 3.947$

b. $f = 0.7$ $n = 0.85$

speedup $= \frac{1}{0.3 + \frac{0.7}{0.85}} = 0.89$

c. $f = 0.5 \quad n = 20$

$$= \frac{1}{0.5 + \frac{0.5}{20}} = 1.907$$

⑦ a. ~~Exec time after imp = Exec time affected + Exec time unaffected / Amount imp.~~

⑦ a. $\frac{100}{3} = \frac{85}{n} + (100 - 85)$

$$\boxed{n = 4.637}$$

b. $\frac{25}{4}\frac{100}{} = \frac{85}{n} + 15$

$$\boxed{n = 8.5}$$

⑧ $CPI = (0.45 \times 1) + (0.38 \times 1.4) + (0.15(0.6 \times 2 + 0.4 \times 1.5)) + 0.02 \times 1.2$

$= 0.45 + 0.532 + 0.27 + 0.024$

$= 1.276$

⑨ $4 = \frac{1}{(1-f) + \frac{f}{10}} \rightarrow f = 0.83$

$\therefore 83\%$.

⑩ a. $f = 0.6, \quad n = 1.4$

$$\text{Speedup} = \frac{1}{0.4 + \frac{0.6}{1.4}} = 1.206$$

b. ① → $f = 0.7, \quad n = 1.4$

speedup = 1.25 & cost/speedup $= \frac{50}{1.25} = 40$

② → $f = 0.5, \quad n = 2$

Speedup = 1.33 & cost / speedup $= \frac{60}{1.33} = 45.1$

Option 1 is better as it has lesser cost / speedup.