1. (a) CPU Time = $\frac{IC \times CPI}{\text{Clock Rate}}$ (IC × CPI → # clock cycle), $CPI = \frac{\text{CPU Time} \times \text{Clock Rate}}{IC}$

- A: 10^5 inst. B: 2×10^5 inst.
  C: 5×10^5 inst. D: 2×10^5 inst.
- P1 CPU Time = $(10^5 \times 1 + 2 \times 10^5 \times 2 + 5 \times 10^5 \times 3 + 2 \times 10^5 \times 3) / (2.5 \times 10^9)$
  $= (26 \times 10^5) / (2.5 \times 10^9) = 10.4 \times 10^{-4}$ s
  P2 CPU Time = $(10^5 \times 2 + 2 \times 10^5 \times 2 + 5 \times 10^5 \times 2 + 2 \times 10^5 \times 2) / (3 \times 10^9)$
  $= (20 \times 10^5) / (3 \times 10^9) = 6.667 \times 10^{-4}$ s
- P1 CPI = $(10.4 \times 10^{-4}) \times (2.5 \times 10^9) / 10^6$
  $= 26 \times 10^{-1} = 2.6$
  P2 CPI = $(6.667 \times 10^{-4}) \times (3 \times 10^9) / 10^6$
  $= 20 \times 10^{-1} = 2.0$

1. (b). P1 Clock Cycles = 26×10^5
P2 Clock Cycles = 20×10^5

∴ P2 is 1.56 times faster than P1.

2. (a) $CPI = \frac{\text{CPU Time}}{IC \times CCT}$

- Compiler A $CPI = 1.1 / (10^9 \times 10^{-9})$
  $= 1.1$

  Compiler B $CPI = 1.5 / (1.2 \times 10^9 \times 10^{-9})$
  $= 1.25$

2. (b) $CCT = \frac{\text{CPU Time}}{IC \times CPI}$

- Two CPU Times are the same.
- A CCT : B CCT $= \frac{1}{10^9 \times 1.1} : \frac{1}{1.2 \times 10^9 \times 1.25}$
  $= 1.2 \times 1.25 : 1.1$
  $= 1.5 : 1.1$
  $\fallingdotseq 1.364 : 1$

∴ B is about 1.364 times faster than A.

2. (c) CPU Time = IC × CPI × CCT

- New Compiler CPU Time : A CPU Time $= (6 \times 10^8) \times 1.1 \times CCT : 10^9 \times 1.1 \times CCT$
  $= 0.6 : 1 \fallingdotseq 1 : 1.667$
- New Compiler CPU Time : B CPU Time $= (6 \times 10^8) \times 1.1 \times CCT : 1.2 \times 10^9 \times 1.25 \times CCT$
  $= 6.6 : 15$
  $= 0.44 : 1 \fallingdotseq 1 : 2.273$

∴ New one is about 1.667 times faster than A, and
new one is about 2.273 times faster than B.

3.(a) $CPI = \frac{\text{CPU Time}}{IC \times CCT}$

$= \frac{750}{(2.389 \times 10^{12}) \times (0.333 \times 10^{-9})}$

$= \frac{750}{0.795537 \times 10^{3}} \fallingdotseq 0.943$

3.(b) SPEC ratio = 9650 / 750

$\fallingdotseq 12.867$

3.(c) CPU Time = CPI × IC × CCT

- ✓ CPI 와 CCT는 그대로.
- ✓ IC는 10% 증가.

∴ CPU Time도 10% 증가.

3.(d) CPU Time = CPI × IC × CCT

- ✓ CCT는 그대로.
- ✓ IC는 10% 증가, CPI는 5% 증가

∴ CPU Time은 15.5% 증가.

3.(e) SPEC Ratio = reference time / CPU Time

$= 9650 / (750 \times 1.155)$

$\fallingdotseq 11.140$

3.(f) $CPI = \frac{\text{CPU Time} \times \text{Clock Rate}}{IC}$

$= \frac{700 \times 4 \times 10^{9}}{2.389 \times 10^{12} \times 0.85}$

$\fallingdotseq 1.379$

4. (a) FP Time = 70 x 0.8 = 56s

New Time = 56 + 85 + 40 + 55 = 236s

∴ 14 / 250 = 0.056

⇒ Reduction: 5.6%

(b) 전체적으로 20%의 시간이 감소했기 때문에

FP, L/S, branch instruction과 INT operation 또한

20% 만큼 시간이 줄어든다.

∴ Reduction : 20%

(c) New Total Time = 250 x 0.8 = 200s

$T_{FP} + T_{LIS} + T_{branch\_new} + T_{int} = T_{branch\_new} + 210s$

T_{branch_new} cannot be -10s.

∴ NO.