#1. A.

	workload C (IC = 1000)	workload D (IC = 2000)
processor A	$\frac{1000 \times 1.}{2\times10^9} = \frac{1}{2}\times10^{-6} = 5\times10^{-7}$ s	$\frac{2000 \times 2.}{2\times10^9} = 2\times10^{-6}$ s
processor B	$\frac{1000 \times 2.}{3\times10^9} = \frac{2}{3}\times10^{-6}$ s	$\frac{2000 \times 2.5}{3\times10^9} = \frac{5}{3}\times10^{-6}$ s

B.

workload C and D for 80% and 20%

processor A

↓

workload. C → 5×10^{-7} s

workload. D → 2×10^{-6} s

$\frac{4}{5}\times5\times10^{-7} + \frac{1}{5}\times2\times10^{-6}$

$= 4\times10^{-7} + \frac{2}{5}\times10^{-6}$

$= 0.4\times10^{-6} + 0.4\times10^{-6}$

$= 0.8\times10^{-6}$ s

processor B

↓

C $\frac{2}{3}\times10^{-6}$ s

D. $\frac{5}{3}\times10^{-6}$ s.

$\frac{4}{5}\times\frac{2}{3}\times10^{-6} + \frac{1}{5}\times\frac{5}{3}\times10^{-6}$

$= \frac{8}{15}\times10^{-6} + \frac{5}{15}\times10^{-6}$

$= \frac{13}{15}\times10^{-6}$

$\frac{\text{Exec. A.}}{\text{Exec. B}} = \frac{\text{performance B}}{\text{performance A}}$

$= \frac{\frac{13}{15}\times10^{-6}\ s}{0.8\times10^{-6}\ s} = \frac{13}{15}\times\frac{5}{4} = \frac{13}{12}$

B. is more faster than A $\left(\frac{13}{12}\right)$.

#2.

What is potential problem when using MIPS instead of execution time as a performance metric.

↳ Response time.

cpu time = IC × CPI × clock cycle time.

= execution time.

MIPS → 초당 명령 수. = 단위 시간당 처리한 수 많은 명령어.

20×350 = 7000개

execution time. | 20s | 350 MIPS

" | 30s | 400 MIPS → 30×400 = 12000개 instruction

↓

이와같이 인스트럭션은 많이 실행한다해서

성능이 좋아지는게 아니기 때문이다

#3.

processor has CPI of 1, 12, 5

→ 2GHz clock frequency

a program.

execution for
- 2.56×10^9 arithmetic.
- 1.28×10^9 load/store.
- 2.56×10^8 branch

parallelized on multiple cores.

core 많다
branch. instruction의 수는 같음.

load/store, arithmetic instruction의 수는 $0.7 \times p$ 개가 된다.
(p is the number of processors)

1.28 / 2

12.8
2.56
15.36

$CPI \times IC \times \frac{1}{\text{clock rate}}$

A. processor 가 1, 2, 4, 8 일 때. execution time.

$2.56 \times 10^9 \times 1 + 1.28 \times 10^9 \times 12 + 2.56 \times 10^8 \times 5$

$= 10^9 (2.56 + 15.36 + 12.80)$

$\frac{19.2 \times 10^8}{1.92 \times 10^9}$

2.56
1.28
15.36

15.36
3.84
19.2

CPU clock cycles

$\frac{7.94 \times 10^{10}}{2 \times 10^9}$

I phasor -

$(1 \times 2.56 \times 10^9) + (12 \times 1.28 \times 10^9) + (5 \times 2.56 \times 10^8) / 2GHz.$

$= 2.56 \times 10^9 + 15.36 \times 10^9 + 1.28 \times 10^9$

12.80
15.36
3.84
19.20

$= 10^9 (19.2)$

$= 10^{10} \times 1.92$

2×10^9

$1.92 \times 5 = 9.60$

9.6 s.

45

$\frac{(1 \times 2.56 \times 10^9) + (12 \times 1.28 \times 10^9)}{0.7} + 5 \times 2.56 \times 10^8$

15.36
2.56
17.92

$10^9 \left(\frac{15.36 + 2.56}{0.7} + 1.28 \right)$

25.6

$\frac{17.92}{0.7 \times 2}$

$\frac{1.28}{100} \times \frac{10}{14}$

10

39.

28

112

12.8

12.8 + 1.28

1.28

7.04

$\frac{14.08 \times 10^9}{2 \times 10^9}$

7.68

3.84 s

$\frac{(6.4 + 1.28) \times 10^9}{2 \times 10^9}$

64

$\frac{1.792}{500} \times \frac{10}{28}$

10

6

168

112.

$$\frac{1792}{1000} \times \frac{56}{56}$$

$$\frac{168}{112}$$

$$\frac{(3.2 + 1.28) \times 10^9}{2 \times 10^9}$$

8.24s

processor	time	speed-up
1	9.60s	1
2	7.04s	1.36
4	3.84s	2.5
8	2.24s	4.29

3. arithmetic instruction 의 CPI → instruction 당 clock cycle 수 ↑

∴ CPU time ↑ → for each 1, 2, 4, 8

(그래프 그리기)

processor 1 만 계산.

$$10^9(5.12 + 5.36 + 1.28)$$

$$\frac{1 \times 2.56 \times 10^9 \times 2 + 1.28 \times 10^9 \times 12 + 2.56 \times 10^8 \times 5}{2 \times 10^9}$$

$2 \overline{)21.96}$ = 10.98

= **10.98s**

좋다.

C.

구하고 싶은 "load/store 의 N

(3.84s)가 되어야 함

$$\frac{2.56\times10^{9}\times1 + N\times1.28\times10^{9} + 1.28\times10^{9}}{2\times10^{9}} = 3.84$$

$$\frac{2.56 + 1.28N + 1.28}{2} = 3.84$$

$1.28 + 0.64N + 0.64 = 3.84$

$1.92 + 0.64N = 3.84$

$0.64N = 1.92$

$N = 3$

#4.

A.

FP ← 얘를 빼다 (3진)

$$(50\times10^6\times1 + 110\times10^6\times1 + 80\times10^6\times4 + 16\times10^6\times2) =$$

execution time 을 2배 ↓

$\frac{1}{2}$배

B.

" $\frac{1}{2}$배

C.

$$50\times10^6\times1\times\frac{3}{5} + 110\times10^6\times1\times\frac{3}{5} + 80\times10^6\times\frac{7}{10}\times4 + 16\times10^6\times\frac{7}{10}\times2$$

$$10^6(30 + 66 + 22.4 + 22.4)$$

$$96 + 246.4$$

$$=$$

$$\frac{16.7}{5} \quad \frac{112}{100}$$

$$246.4 + 96$$

$$\frac{342.4\times10^6}{} \qquad \frac{3.424\times10^6\times10^2}{} = 3.424\times10^8$$

$$\frac{3.424\times10^8}{2\times10^9}$$

$$\frac{1.712}{3.424} \cdot \frac{10}{20} = 0.1712 s$$

#5

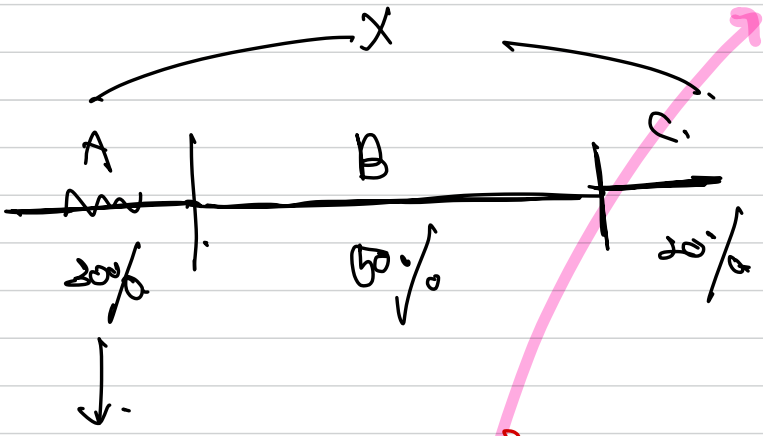
How much each part affects system performance

A 30 %.

B 50 %

C. 20 %.

I'll improve B



3/10

$0.1X + \frac{0.3X}{2}$ ... ①

$= 0.1X + \frac{3}{20}X = \frac{11}{20}X = 11.6 =$ 102

$0.5X + \frac{0.5X}{5}$ ... ②

$= \frac{1}{2}X + \frac{1}{3}X = \frac{5+10}{30}X = \frac{25}{30}X = \frac{5}{6}X$

100

$0.8X + \frac{0.2X}{4}$ ... ③

$\Rightarrow \frac{4}{5}X + \frac{1}{20}X = \frac{17}{20}X$ 102