4.12

	I1	I2	I3	I4	I5	I6
I1	/					
I2	/	/				
I3	WAW	RAW	/			
I4	/	WAW	WAR	/		
I5	/	RAW	RAW	RAW	/	
I6	/	/	/	/	WAW	/

$4/(1)$ $S = \dfrac{ab \cdot 1 \times \frac{6}{5}}{\dfrac{}{} \cdot 0.6 \times \frac{11}{8}} = \dfrac{16}{11}$

(2) $CPI_A = 80\% \times \dfrac{6}{5} + 20\% \times 95\% \times \dfrac{6}{5} + 20\% \times 5\% \times \dfrac{8}{5} = 1.204$

$CPI_B = 99\% \times \dfrac{11}{8} + 1\% \times \dfrac{16}{8} = 1.38125$

$6/(1)$ 将指令编号为①~⑥

①② RAW　①③ RAW　②③ RAW

①④ WAR　③④ WAR　④⑤ RAW　⑤⑥ RAW

(2) ① IF ID EXE MEM WB
②   IF ID S   S EX MEM WB
③   IF S S ID S EX MEM WB WB
④   S S IF S S ID 8 8 EX MEM WB
⑤   S S S S IF 8 8 ID S S EX MEM WB
⑥   S S S 8 8 IF S S ID S S EX MEM WB

共 18×25＝450 个时钟周期

7/6 (1)① IF ID EX MEM WB
②   IF ID S EX MEM WB
③   IF S ID EX MEM WB
④   S IF ID EX MEM WB
⑤   S IF ID EX MEM WB
⑥   S IF ID EX MEM WB

共 25×11＝ 275 个时钟周期
(2) 25×7+4＝179 个周期

8/(1)

① IF1 IF2 ID1 ID2 EX1 EX2 M1 M2 WB1 WB2
②   IF1 IF2 ID1 ID2 S S S EX1 EX2 M1 M2 WB1 WB2
③   IF1 IF2 ID1 S S S ID2 S EX1 EX2 M1 M2 WB1 WB2
④   IF1 IF2 S S S ID1 S ID2 S S S EX1 EX2 M1 M2 WB1 WB2
⑤   IF1 S S S IF2 S ID1 S S S ID2 S EX1 EX2 M1 M2 WB1 WB2
⑥   S S S IF1 S IF2 S S S ID1 S ID2 S EX1 EX2 M1 M2 WB1 WB2

共 25×11+13＝288 个周期

8(2) 6: $CPI = \frac{25 \times 18}{25 \times 6} = 3$ 7(1) $CPI = \frac{25 \times 11}{25 \times 6} = \frac{11}{6}$ 7(2) $CPI = \frac{179}{25 \times 6} = 1.193$

7研印 8 $CPI = \frac{288}{25 \times 6} = 1.92$

19(1) add √ addi X ld X sd √ bne √ jal X jalr √

(2) 将指令依次编号为①~⑤

① IF ID EX MEM WB

② IF ID ID S EX MEM WB

③ IF S S ID EX MEM WB

④ S S IF ID EX MEM WB

⑤ S S IF ID EX MEM WB

12周期

(2) ① IF ID EX MEM WB

② IF ID S EX MEM WB

③ IF S ID EX MEM WB

④ S IF ID EX MEM WB

⑤ S IF ID EX MEM WB

10周期