

第八周.

2. I1: IF ID EX MEM WB

I2: IF ID EX MEM WB

I3: (RAW) IF ID S S EX MEM WB

I4: IF ID EX MEM WB

I5: IF ID S S S EX MEM WB

I6: IF ID S S S S EX MEM WB

$$4. 1) T_A = 1ns + \frac{1ns}{5} = 1.2ns$$

$$T_B = 0.6ns + \frac{3 \times 0.6ns}{8} = 0.825ns$$

$$S = \frac{T_A}{T_B} = 1.455$$

$$2) CPI_A = \frac{5 \times 1ns + 1ns + 5 \times 20\% \times 5\% \times 2 \times 1ns}{5 \times 1ns} = 1.22$$

$$CPI_B = \frac{12 \times 0.6ns + \frac{12}{8} \times 3 \times 0.6ns + 12 \times 20\% \times 5\% \times 5 \times 0.6ns}{12 \times 0.6ns}$$

$$= 1.38$$

6. 1) ld 与 addi 写后读.

addi 与 sd 写后读.

sd 与 addi 存储后读.

addi 与 sub 写后读.

bnez 与 sub 写后读.

2) ld: IF ID EX MEM WB

addi: IF ID S S EX MEM WB

sd: IF ID S S S S EX MEM WB

addi: IF ID S S S S S EX MEM WB

sub: IF ID S S S S S S EX MEM WB

bnez: IF ID S S S S S S S S EX MEM WB

$$N = 19 \times 20 = 380$$

7. 1) ld: IF ID EX MEM WB

addi: IF ID S EX MEM WB

sd: IF ID S EX MEM WB

addi: IF ID S EX MEM WB

sub: IF ID S EX MEM WB

bnez: IF ID S EX MEM WB

$$N = 11 \times 20 = 220$$

$$2) N = (11 - 5) \times 20 + 5 = 125$$

8. 1) ld: IF₁ IF₂ ID₁ ID₂ EX₁ EX₂ M₁ M₂ WB₁ WB₂

addi: IF₁ IF₂ ID₁ ID₂ S S S EX₁ EX₂ M₁ M₂ WB₁ WB₂

sd: IF₁ IF₂ ID₁ ID₂ S S S S EX₁ EX₂ M₁ M₂ WB₁ WB₂

addi: IF₁ IF₂ ID₁ ID₂ S S S S EX₁ EX₂ M₁ M₂ WB₁ WB₂

sub: IF₁ IF₂ ID₁ ID₂ S S S S S EX₁ EX₂ M₁ M₂ WB₁ WB₂

bnez: IF₁ IF₂ ID₁ ID₂ S S S S S S EX₁ EX₂ M₁ M₂ WB₁ WB₂

$$N = (21 - 14) \times 20 + 14 = 154$$

$$2) \textcircled{6} CPI = \frac{17}{6}$$

$$\textcircled{7} CPI = \frac{11}{11}$$

$$CPI_2 = \frac{125}{6 \times 20} = \frac{25}{24}$$

$$\textcircled{8} CPI = \frac{154}{6 \times 20} = \frac{77}{60}$$

19. 1) add addi ld sd bne jal jalr
 是 否 是 是 是 否 否

2) IF ID ID EX MEM WB

IF S ID ID S EX MEM WB

IF S S ID S S EX MEM WB

IF S S ID S S S EX MEM WB

IF S S ID ID S S S EX MEM WB

$n = 15$

3) IF ID EX MEM WB

IF ID S S EX MEM WB

IF ID S S S EX MEM WB

IF ID S S S S EX MEM WB

IF ID S S S S S EX MEM WB

$n = 14$