

#### 4/4. Chapter 3.

1. 1) 流水线时钟周期由最长流水级决定.

$$T_{\text{pipe}} = T_{\text{mem}} + T_{\text{reg}} = 2\text{ns} + 0.1\text{ns} = 2.1\text{ns}$$

$$2) \text{ 执行时间比 } S = \frac{T_{\text{pipe}} \times \text{CPI}_{\text{pipe}} \times N_{\text{instruction}}}{T_{\text{cycle}} \times \text{CPI}_{\text{cycle}} \times N_{\text{instruction}}} = \frac{T_{\text{pipe}} \times \text{CPI}_{\text{pipe}}}{T_{\text{cycle}} \times \text{CPI}_{\text{cycle}}}$$

$$\text{加速比} = \frac{1}{S} = \frac{T_{\text{cycle}} \times \text{CPI}_{\text{cycle}}}{T_{\text{pipe}} \times \text{CPI}_{\text{pipe}}} = \frac{7 \times 5}{2.1 \times (5+5-1)} = \frac{5}{2.7} = 1.85$$

$$3) \frac{\text{CPI}_{\text{pipe}}}{\text{CPI}_{\text{cycle}}} = \frac{N+K-1}{N} \quad \text{总认为 } N \gg K.$$

当有无限多流水级时, 每个流水级所需时间无限接近0.

则流水线处理器的时钟周期由寄存器延迟决定, 为0.1ns

$$\text{加速比} = \frac{T_{\text{cycle}}}{T_{\text{pipe}}} = \frac{7\text{ns}}{0.1\text{ns}} = 70.$$