

4/4. Chapter 3

1. 1) 流水线时钟周期由最长流水级决定。

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

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

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

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

当有无限多流水级时，每个流水级所需时间无限接近。

则流水级处理器的时钟周期由寄存器延迟决定，为 0.1 ns

$$\text{加速比为 } \frac{T_{\text{cycle}}}{T'_{\text{pipe}}} = \frac{7 \text{ns}}{0.1 \text{ns}} = 70.$$