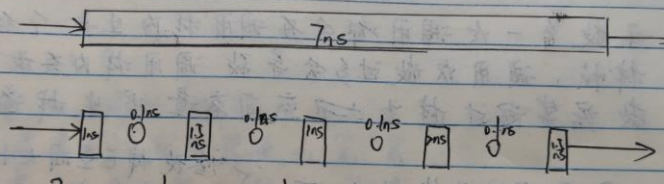
4.4

1.



$T = 2ns + 0.1ns = 2.1ns$

$$S = \frac{T_{old}}{T_{new}} = \frac{(T_{cycle} \cdot CPI \cdot N_I)_{old}}{(T_{cycle} \cdot CPI \cdot N_I)_{new}} = \frac{7ns \cdot 1}{2.1ns \cdot \frac{N_I + 4}{N_I}}$$

$$\approx \frac{7}{2.1} \approx 3.33 \quad (N_I \gg 4)$$

(3)

$$S = \frac{T_{old}}{T_{new}} = \frac{T_{cycle\,old} \cdot CPI_{old}}{T_{cycle\,new} \cdot CPI_{new}} \xrightarrow{\text{无限多级}} \frac{7}{(\frac{7}{N}\times 0.1)\frac{N_I + (N-1)}{N_I}}$$

$$= \frac{7}{\left[\frac{7}{10}(1-\frac{1}{N_I}) + \frac{7}{N_I}\right] + \left[\frac{1(1-\alpha_I)}{N} + \frac{\alpha_I}{10N_I}\right]}$$

$$\leq \frac{7}{\frac{1}{10}(1-\frac{1}{N_I}) + \frac{7}{N_I} + 2\sqrt{\frac{1(1-\alpha_I)}{10N_I}}}$$

N_I 为指令总数，N是级数

如果无限分割的同时保持 $N_I \gg N-1$ ：

$S_{max} = 70$

(如果 $N \gg N_I$，则级数过多，指令停不下来)