$$\frac{1}{\tau} = \frac{1}{\hbar\omega}\,\frac{1}{1+\frac{u}{\hbar\omega N}} + \frac{1}{\hbar\omega}\log\left(1+\frac{N\hbar\omega}{u}\right) - \frac{N}{u+N\hbar\omega}$$

$$= \cancel{\frac{N}{N\hbar\omega+u}} - \cancel{\frac{N}{u+N\hbar\omega}} + \frac{1}{\hbar\omega}\log\left(1+\frac{N\hbar\omega}{u}\right)$$

$$\Rightarrow \frac{1}{\tau} = \frac{1}{\hbar\omega}\log\left(1+\frac{N\hbar\omega}{u}\right)$$

$$\Rightarrow 1+\frac{N\hbar\omega}{u} = \exp\left(\frac{\hbar\omega}{\tau}\right)$$

$$\Rightarrow \boxed{u = \frac{N\hbar\omega}{\exp\left(\frac{\hbar\omega}{\tau}\right)-1}}$$

Problem 2.6

According to equ. (17)

$$g(s_1)\,g(s_2) = (g_1 g_2)_{max}\exp\left(-\frac{2\delta^2}{N_1} - \frac{2\delta^2}{N_2}\right)$$

$$P(s_2) = \frac{g(s_1)\,g(s_2)}{g_{s_2\,max}}$$

$$\Rightarrow P(s_1) = \exp\left(-\frac{2\delta^2}{N_1} - \frac{2\delta^2}{N_2}\right)$$

$$P(t) = \exp\left(-\frac{4\delta^2}{N_1}\right) \quad \text{with } N_1 = N_2$$