The grand sum therefore is:

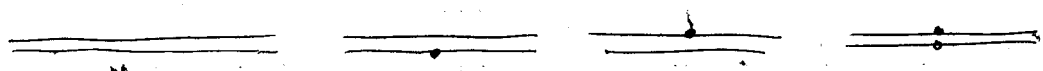
$$\mathcal{Z} = \sum_s \lambda^N e^{-\varepsilon_s/\tau} = 1 + \lambda e^{-\varepsilon/\tau} + \lambda^2 e^{-2\varepsilon/\tau}$$

$$\langle N \rangle = \frac{1}{\mathcal{Z}} \sum_s N \lambda^N e^{-\varepsilon_s/\tau} = \frac{1 + \lambda e^{-\varepsilon/\tau} + 2\lambda^2 e^{-2\varepsilon/\tau}}{1 + \lambda e^{-\varepsilon/\tau} + \lambda^2 e^{-2\varepsilon/\tau}} =$$

$$= 1 + \frac{\lambda^2 e^{-2\varepsilon/\tau}}{1 + \lambda e^{-\varepsilon/\tau} + \lambda^2 e^{-2\varepsilon/\tau}}.$$

I don't see a way to simplify this further. There are, of course, a lot of possible ways to reexpress the same result — any of them should be fine.

(b) Now the allowed of the system made up of 2 orbitals with the same energy are:



$N=0$	$N=1$	$N=1$	$N=1$
$E=0$	$E=\varepsilon$	$E=\varepsilon$	$E=2\varepsilon$

$$\mathcal{Z} = 1 + 2\lambda e^{-\varepsilon/\tau} + \lambda^2 e^{-2\varepsilon/\tau} = \left(1 + \lambda e^{-\varepsilon/\tau}\right)^2$$

$$\langle N \rangle = \frac{1 + 2\lambda e^{-\varepsilon/\tau} + 2\lambda^2 e^{-2\varepsilon/\tau}}{1 + 2\lambda e^{-\varepsilon/\tau} + \lambda^2 e^{-2\varepsilon/\tau}} = 1 + \frac{\lambda^2 e^{-2\varepsilon/\tau}}{\mathcal{Z}} =$$

$$= 1 + \frac{\lambda^2 e^{-2\varepsilon/\tau}}{\left(1 + \lambda e^{-\varepsilon/\tau}\right)^2} = 1 + \frac{1}{\left(\lambda^{-1} e^{\varepsilon/\tau} + 1\right)^2}$$

Again, a number of alternative ways to write $\langle N \rangle$ exist.