3)

$$\textit{We have that for constant } v_{in}:$$
$$v(t) = v_{in}\left(1 - e^{-\frac{t}{\tau}}\right) \textit{ is a solution of}$$
$$\tau\frac{dv}{dt} = v_{in} - v,\ v(0) = 0$$

The interspike interval are the sum of refractory time and the time it take for v to climb from 0 to 1.

Let the time when v is 0 equals to 0.

Then we have

$$v(t) = 1$$
$$\Longrightarrow v_{in}\left(1 - e^{-\frac{t}{\tau}}\right) = 1$$
$$\Longrightarrow e^{-\frac{t}{\tau}} = 1 - \frac{1}{v_{in}}$$
$$\Longrightarrow -\frac{t}{\tau} = \ln\left(1 - \frac{1}{v_{in}}\right)$$
$$\Longrightarrow t = -\tau \ln\left(1 - \frac{1}{v_{in}}\right)$$

Then we have that:

$$t_{isi} = \tau_{ref} + \left(-\tau \ln\left(1 - \frac{1}{v_{in}}\right) - 0\right)$$
$$= \tau_{ref} - \tau \ln\left(1 - \frac{1}{v_{in}}\right)$$

Then from the interspike interval we can have the firing rate of LIF is:

$$G(v_{in}) = \begin{cases} \dfrac{1}{\tau_{ref} - \tau \ln\left(1 - \frac{1}{v_{in}}\right)} & \textit{for } v_{in} > 1 \\ 0 & \textit{otherwise} \end{cases}$$