③ $y = \log \sum_{i=1} e^{x_i} = a + \log \sum_{i=1} e^{x_i - a}$

- $a + \log \sum_{i=1} e^{x_i - a} = a + \log \sum_{i=1} \frac{e^{x_i}}{e^a} = a + \log\left(\frac{1}{e^a} \sum_{i=1} e^{x_i}\right) = a + \log(e^{-a}) + \log\left(\sum_{i=1} e^{x_i}\right) = \cancel{a - a} \cdot 1 + \log\left(\sum_{i=1} e^{x_i}\right) = \log\left(\sum_{i=1} e^{x_i}\right)$ //

④ $\frac{e^{x_i}}{\sum_{i=1} e^{x_i}} = \frac{e^{x_i - a}}{\sum_{i=1} e^{x_i - a}}$

- $\frac{e^{x_i - a}}{\sum_{i=1} e^{x_i - a}} = \frac{e^{x_i}}{\cancel{e^a}} \cdot \frac{1}{\cancel{e^a} \sum_{i=1} e^{x_i}} = \frac{e^{x_i}}{\sum_{i=1} e^{x_i}}$ //