

$$KL(q // \pi_2) + \mathcal{L}(q, \theta)$$

$$= - \int q(z) \log \left(\frac{\pi_2(z | x, \theta)}{q(z)} \right) dz + \int q(z) \log \left(\frac{\pi(x, z | \theta)}{q(z)} \right) dz$$

$$= - \int q(z) \log(\pi_2(z | x, \theta)) dz + \int q(z) \log(\pi(x, z | \theta)) dz$$

$$= - \int q(z) \log \frac{\pi_2(z | x, \theta)}{\pi(x, z | \theta)} dz = - \int q(z) \log \frac{1}{\pi(x | \theta)} dz = \underbrace{\log \pi(x | \theta)}$$