$$\pi(x_1, x_2, x_3 \mid \tilde{x}_4)$$

$$\propto \pi(\tilde{x}_1, x_2, x_3, x_4)$$

$$\propto \pi(x_4 \mid x_2) \cdot \pi(x_3 \mid x_2) \cdot \pi(x_2 \mid \tilde{x}_1) \cdot \pi(\tilde{x}_1)$$

$$= \pi(x_4 \mid x_2) \cdot \pi(x_3 \mid x_2) \cdot \pi(x_2 \mid \tilde{x}_1)$$