$$\boxed{\nabla_\phi \mathcal{L}(\phi)} = \nabla_\phi E_{q_\phi}[\log p(x,z) - \log q_\phi]$$

$$= \nabla_\phi \left[\int q_\phi (\log p(x,z) - \log q_\phi)\, dz\right]$$

$$= \int \nabla_\phi q_\phi (\log p(x,z) - \log q_\phi)\, dz + \int q_\phi \nabla_\phi [\underbrace{\log p(x,z)}_{与\phi无关} - \log q_\phi]\, dz$$

$$= ① + ②$$

$$② = \int q_\phi \nabla_\phi (-\log q_\phi)\, dz$$

$$= -\int q_\phi \cdot \frac{1}{q_\phi} \cdot \nabla_\phi q_\phi\, dz$$

$$= -\int \nabla_\phi q_\phi\, dz$$

$$= -\nabla_\phi \underbrace{\int q_\phi\, dz}_{1}$$

$$= -\nabla_\phi 1$$

$$= 0$$

$$= ① = \int (\nabla_\phi q_\phi)(\log p(x,z) - \log q_\phi)\, dz$$

$$= \int q_\phi \cdot \nabla_\phi \log q_\phi \cdot (\log p(x,z) - \log q_\phi)\, dz$$

$$= E_{q_\phi}[\nabla_\phi \log q_\phi \cdot (\log p(x,z) - \log q_\phi)\, dz]$$

The gradient could be represented by an expectation, so we could use sampling methods to estimate the gradient (Monte Carlo).