Задача 2

$$f(x^\mu + a^\mu) = \frac{1}{[k_\mu (x^\mu + a^\mu)]^2}, \quad a = const$$

$$f(x+a) = f(x) + \partial_i f(x)\, a_i + \frac{1}{2} \partial_i \partial_j f(x)\, a_i a_j$$

- $$\partial_i f(x) = \frac{\partial f(x)}{\partial x^i} = \frac{\partial}{\partial x^i}\left(\frac{1}{k_\mu x^\mu k_\gamma x^\gamma}\right) =$$

$$= -\frac{1}{(k_\mu x^\mu k_\gamma x^\gamma)^2} \frac{\partial}{\partial x_i}(k_\mu x^\mu k_\gamma x^\gamma) =$$

$$= -\frac{1}{(k\cdot x)^4}\left(k_\mu \delta_i{}^\mu (k\cdot x) + (k\cdot x) k_\gamma \delta_i{}^\gamma\right) =$$

$$= -\frac{2k_i}{(k\cdot x)^3}$$

- $$\partial_i \partial_j f(x) = \partial_i \left(\frac{-2k_j}{(k_\mu x^\mu k_\gamma x^\gamma k_\beta x^\beta)}\right) =$$

$$= \frac{2k_j \left((k\cdot x)^2 k_\mu \delta_i{}^\mu + (k\cdot x)^2 k_\gamma \delta_i{}^\gamma + (k\cdot x)^2 k_\beta \delta_i{}^\beta\right)}{(k\cdot x)^6}$$

$$= \frac{6 k_i k_j}{(k \cdot x)^4}$$

$$\cdot \; f(x+a) = f(x) - \frac{2k_i}{(k\cdot x)^3} a_i + \frac{3 k_i k_j a_i a_j}{(k\cdot x)^4}$$

$$\partial_i \left(\frac{-2\delta_i^{\mu}}{k_\mu^2 (x^\eta)^3} \right) =$$

$$= \frac{-2\delta_i^{\mu}}{k_\mu^2} \; \partial_i \frac{1}{(x^\eta)^3} = \frac{-6\delta_i^{\mu}}{k_\mu^2 (x^\eta)^4} \delta_i^{\mu} = \frac{6\delta_i^{\mu}\delta_i^{\mu}}{k_\mu^2 (x^\eta)^4}$$

$$f(x^\mu + a^\mu) = f(x^\eta) - \frac{2\delta_i^{\mu}}{k_\mu^2 (x^\eta)^3} a_i + \frac{3\delta_i^{\mu}\delta_j^{\mu}}{k_\mu^2 (x^\eta)^4} a_i a_j$$