Series 2

I. Propagators of the free real scalar field

1. Calculate the causal retarded Green's function via residues:

$$D_{ret}(x-y) = \int \frac{\mathrm{d}\vec{x}}{(2\pi)^3} e^{i(\vec{x}-\vec{y})\vec{k}} \times \int \frac{\mathrm{d}k_0}{2\pi} \frac{e^{-i(x^0-y^0)k_0}}{(k_0-\omega_k+i\epsilon)(k_0+\omega_k+i\epsilon)}, \quad (1)$$

   treating $t > 0$ and $t < 0$ separately. What do we see?

2. Calculate the causal advanced Green's function via residues:

$$D_{adv}(x-y) = \int \frac{\mathrm{d}\vec{x}}{(2\pi)^3} e^{i(\vec{x}-\vec{y})\vec{k}} \times \int \frac{\mathrm{d}k_0}{2\pi} \frac{e^{-i(x^0-y^0)k_0}}{(k_0-\omega_k-i\epsilon)(k_0+\omega_k-i\epsilon)}, \quad (2)$$

   treating $t > 0$ and $t < 0$ separately. What do we see?