Lancaster and Blundell

$$\phi(x, t_x) = \int G^+(x, t_x, y, t_y)\phi(y, t_y)\, dy$$

Feynman and Hibbs

$$\psi(x_b, t_b) = \int_{-\infty}^{\infty} K(x_b, t_b, x_a, t_a)\psi(x_a, t_a)\, dx_a$$

Harmonic oscillator

$$\psi_n(x) = \frac{1}{\sqrt{2^n n!}} \left(\frac{m\omega}{\pi\hbar}\right)^{\frac{1}{4}} H_n\left(\sqrt{\frac{m\omega}{\hbar}}\, x\right) \exp\left(-\frac{m\omega x^2}{2\hbar}\right)$$

Harmonic oscillator propagator ($T = t_b - t_a$)

$$K(x_b, t_b, x_a, t_a) = \left(\frac{m\omega}{2\pi i\hbar \sin(\omega T)}\right)^{\frac{1}{2}} \exp\left[\frac{im\omega}{2\hbar \sin(\omega T)} \left(x_a^2 \cos(\omega T) - 2x_a x_b + x_b^2 \cos(\omega T)\right)\right]$$

Compute

$$\int_{-\infty}^{\infty} K(x_b, t_b, x_a, t_a)\psi_1(x_a)\, dx_a$$