We are given

$$\psi(x,0) = C\exp\left(\frac{ipx}{\hbar}\right)$$

This is equation (3.3).

$$K_0(b,a) = \left(\frac{m}{2\pi i\hbar(t_b - t_a)}\right)^{1/2} \exp\left(\frac{im(x_b - x_a)^2}{2\hbar(t_b - t_a)}\right) \tag{3.3}$$

Rewrite (3.3) as follows.

$$\begin{aligned} K_0(b,a) = {} & \left(\frac{m}{2\pi i\hbar(t_b - t_a)}\right)^{1/2} \\ & \times \exp\left(\frac{imx_b^2}{2\hbar(t_b - t_a)}\right) \exp\left(\frac{imx_a^2}{2\hbar(t_b - t_a)} - \frac{imx_b x_a}{\hbar(t_b - t_a)}\right) \end{aligned}$$

Then for $t_a = 0$

$$K_0(x_b, t_b, x_a, 0) = \left(\frac{m}{2\pi i\hbar t_b}\right)^{1/2} \exp\left(\frac{imx_b^2}{2\hbar t_b}\right) \exp\left(\frac{imx_a^2}{2\hbar t_b} - \frac{imx_b x_a}{\hbar t_b}\right)$$

By equation (3.42) we have

$$\psi(x_b, t_b) = \int_{-\infty}^{\infty} K_0(x_b, t_b, x_a, 0)\psi(x_a, 0)\, dx_a$$

Hence

$$\begin{aligned} \psi(x_b, t_b) = {} & C\left(\frac{m}{2\pi i\hbar t_b}\right)^{1/2} \\ & \times \exp\left(\frac{imx_b^2}{2\hbar t_b}\right) \int_{-\infty}^{\infty} \exp\left(\frac{imx_a^2}{2\hbar t_b} - \frac{imx_b x_a}{\hbar t_b}\right) \exp\left(\frac{ipx_a}{\hbar}\right) dx_a \end{aligned} \tag{1}$$

Rewrite the integral as

$$\int_{-\infty}^{\infty} \exp(Ax_a^2 + Bx_a)\, dx_a$$

where

$$\begin{aligned} A &= \frac{im}{2\hbar t_b} \\ B &= -\frac{imx_b}{\hbar t_b} + \frac{ip}{\hbar} \end{aligned}$$

Solve the integral.

$$\begin{aligned} & \int_{-\infty}^{\infty} \exp\left(\frac{imx_a^2}{2\hbar t_b} - \frac{imx_b x_a}{\hbar t_b}\right) dx_a \\ & = \left(-\frac{\pi}{A}\right)^{1/2} \exp\left(-\frac{B^2}{4A}\right) \\ & = \left(\frac{2\pi i\hbar t_b}{m}\right)^{1/2} \exp\left(-\frac{imx_b^2}{2\hbar t_b} - \frac{ip^2 t_b}{2m\hbar} + \frac{ipx_b}{\hbar}\right) \end{aligned} \tag{2}$$

Substitute (2) into (1) to obtain

$$\psi(x_b, t_b) = C \exp\left(-\frac{ip^2 t_b}{2m\hbar} + \frac{ipx_b}{\hbar}\right)$$

Substitute x for x_b and t for t_b.

$$\psi(x, t) = C \exp\left(-\frac{ip^2 t}{2m\hbar} + \frac{ipx}{\hbar}\right)$$

Hence the wave function $\psi(x,t)$ depends on x through the function $e^{ipx/\hbar}$ and varies in time as $e^{-ip^2t/2m\hbar}$.