

Now all that's left to do is the 2 integrals. This can be done, but a trick is simpler. Write cos kt in exponential form \Rightarrow

$$q(x, t) = \frac{A}{2\pi} \int_{-\infty}^{\infty} dx' \int_{-\infty}^{\infty} dk \frac{e^{ik(x-x'+vt)} + e^{-ik(x-x'-vt)}}{2} e^{-x'^2/B}$$

Doing the k integration \Rightarrow 2 δ functions \Rightarrow

$$q(x, t) = \frac{A}{2} \int_{-\infty}^{\infty} dx' [\delta(x-x'+vt) + \delta(x-x'-vt)] e^{-x'^2/B}$$

or

$$q(x, t) = \frac{A}{2} \left[e^{-\frac{(x+vt)^2}{B}} + e^{-\frac{(x-vt)^2}{B}} \right]$$