$\int x^2 e^{-2\lambda x}\,dx$, $\frac{d}{dx}(fg) = \frac{df}{dx}g + f\frac{dg}{dx}$

or $\int_a^b \frac{df}{dx}\cdot g\,dx = -\int_a^b \frac{dg}{dx} f\,dx + fg\Big|_a^b$

or $\int_0^\infty \frac{d}{dx}\left(\frac{e^{-2\lambda x}}{-2\lambda}\right) x^2\,dx = -\int_0^\infty \frac{d}{dx}(x^2)\frac{e^{-2\lambda x}}{-2\lambda}\,dx + \cancel{\left(\frac{x^2 e^{-2\lambda x}}{-2\lambda}\right)_0^\infty}^{\,0}$

$= +\int_0^\infty \frac{2x}{2\lambda}e^{-2\lambda x}\,dx = \frac{-2}{2\lambda}\int_0^\infty \frac{dx}{dx}\frac{e^{-2\lambda x}}{-2\lambda}\,dx + \cancel{\left(\frac{2}{2\lambda}\frac{e^{-2\lambda x}}{-2\lambda}x\right)_0^\infty}^{\,0}$

$= \frac{2}{(2\lambda)^2}\int_0^\infty e^{-2\lambda x}\,dx = \frac{2}{(2\lambda)^3}$.

as $\int_0^\infty e^{-2\lambda x}\,dx = \frac{1}{2\lambda}$

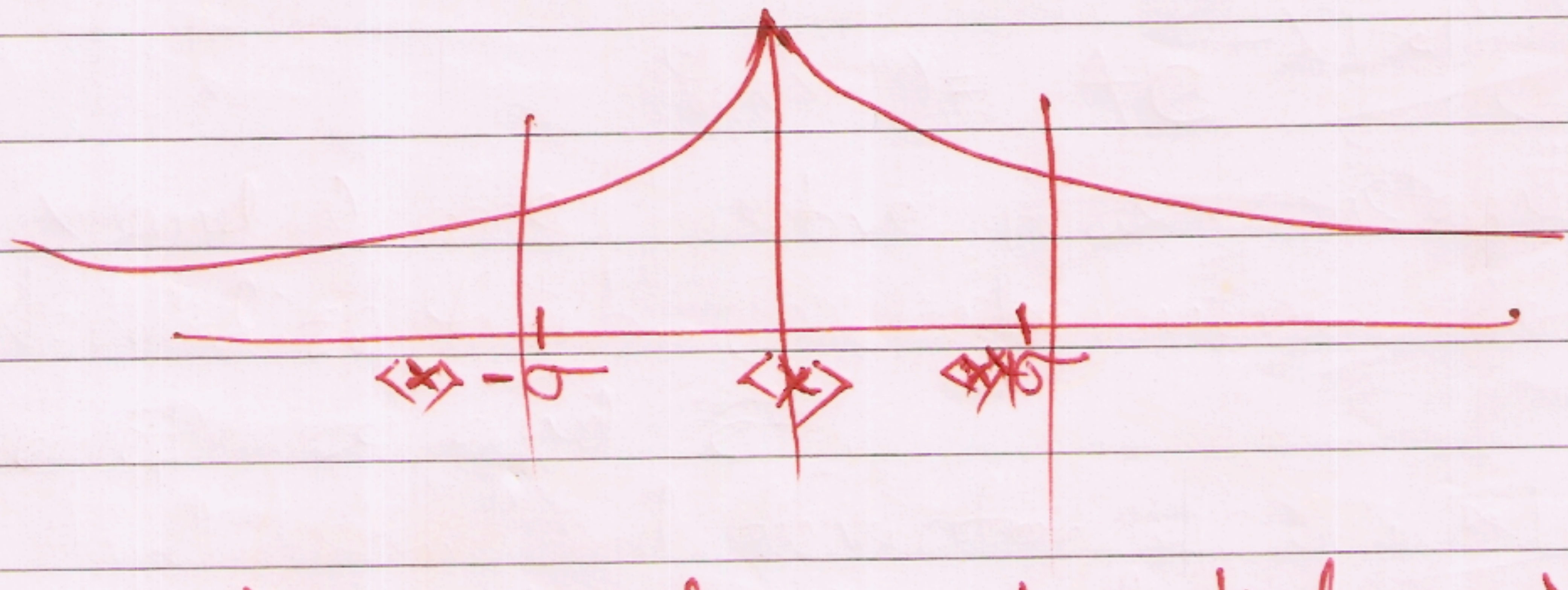
$\Rightarrow \langle x^2\rangle = 2(\sqrt{\lambda})^2\cancel{e^{-i\omega t}} \cdot \frac{2}{(2\lambda)^3} = \frac{4}{8\lambda^3} = \frac{1}{2\lambda^2}$

(c) $\sigma^2 = \langle x^2\rangle - \langle x\rangle^2 = \cancel{4e^{-i\omega t}}\cdot\lambda^{-5/2} = 4\lambda^{-5/2}$

$\sigma = \frac{1}{\sqrt{2}\,\lambda}$

$\cancel{\text{or } \sigma = }\ \ \cancel{2e^{-i\frac{\omega}{2}t}}\ \cancel{\lambda\sqrt{\lambda^2}} = \cancel{\frac{2}{\lambda\sqrt{\lambda^{1/2}}}}$

$|\Psi|^2 = A^2 e^{-2\lambda|x|} = \lambda e^{-2\lambda|x|}$



Probability that a particle will be found outside of this range