1. Find the Fourier transform of the function \( f(t) = \exp(-|t|) \).

   (a) By applying Fourier’s inversion theorem prove that
   \[
   \frac{\pi}{2} \exp(-|t|) = \int_{0}^{\infty} \frac{\cos \omega t}{1 + \omega^2} d\omega.
   \]
   
   (b) By making the substitution \( \omega = \tan \theta \), demonstrate the validity of Parseval’s theorem for this function.

2. By taking the Fourier transform of the equation
   \[
   \frac{d^2 \phi}{dx^2} - K^2 \phi = f(x)
   \]
   show that its solution \( \phi(x) \) can be written as
   \[
   \phi(x) = -\frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} \frac{e^{ikx} \tilde{f}(k)}{k^2 + K^2} dk,
   \]
   where \( \tilde{f}(k) \) is the Fourier transform of \( f(x) \).