

## 4141 HW 2

Duncan Wilkie

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### 1

The probability amplitude is

$$P = \int_{\mathbb{R}} \psi \psi^* = \int_{\mathbb{R}} |\psi|^2 = C^2 \int_{-\infty}^{\infty} \frac{1}{(a^2 + x^2)^2} dx$$

Using the substitution  $x = a \tan u$ ,  $dx = a \sec^2 u du$  this is

$$\begin{aligned} &= C^2 \int \frac{a \sec^2 u}{a^2 + a^2 \tan^2 u} du = C^2 \int \frac{a \sec^2 u}{a^2 (\sec^2 u)} du \\ &= \frac{C^2}{a} \int du = \frac{C^2}{a} u = \frac{C^2}{a} \tan^{-1} \left( \frac{x}{a} \right) \Big|_{-\infty}^{\infty} = \frac{\pi C^2}{a} \end{aligned}$$