(1) (5 Points) Simplify the following integral using a trig substitution. You do not evaluate the integral, but you should make any obvious algebraic simplifications. (i.e. stop just before integrating)

\[
\int \frac{\sqrt{1+x^2}}{x} \, dx = \int \frac{\sqrt{1+k^2}}{k} \, \sec \theta \, d\theta
\]

\[
x = \tan \theta \quad \frac{dx}{d\theta} = \sec^2 \theta \quad d\theta
\]

\[
= \int \frac{\sec \theta}{\tan \theta} \, \sec^2 \theta \, d\theta
\]

\[
= \int \frac{\sec^3 \theta}{\tan \theta} \, d\theta
\]

(2) (5 Points) Find a partial fraction decomposition of

\[
\frac{x}{x^2+1} = \frac{A}{x-1} + \frac{B}{x+2}
\]

(this includes finding values of the constants)

\[
= \frac{A}{x-1} + \frac{B}{x+2}
\]

\[
A(x+2) + B(x-1) = x
\]

\[
A + 2A + Bx - B = x
\]

\[
A + B = 1 \quad 2A - B = 0 \quad \Rightarrow B = 2A
\]

\[
3A = 1
\]

\[
A = \frac{1}{3}, \quad B = \frac{2}{3}
\]